

the interstellar gas, and the depletion of some of these elements onto interstellar dust grains was established. The achievements of Copernicus were many; Spitzer records several of them and carefully notes their ramifications.

The book is written for those familiar with physical principles who seek an overview of an important field of research. The presentation is clear and may be read without reference to mathematical representations (which are included, where appropriate, in parenthetical statements). The most delightful aspect of the book is that it communicates the excitement of scientific research: questions posed, estimates and theories suggested, and finally answers sought. The book ends, as it must, not with a compendium of "answers" but with a new, more sophisticated way of asking the questions.

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## Colonial Invertebrates

**Recent and Fossil Bryozoa.** Papers from a conference, Durham, England, Sept. 1980. GILBERT P. LARWOOD and CLAUS NIELSEN, Eds. Olsen and Olsen, Fredensborg, Denmark, 1981. viii, 334 pp., illus. Paper, \$55.

Bryozoologists have been getting together for mutual stimulation and enlightenment triennially since 1968. This volume is the fifth report of their meetings. Although the original intent of the gatherings was to share ideas and talk about current research, the proceedings volumes have contained along with papers that do this a preponderance of completed research reports that normally would be published in journals. The happy result is that biologists, including invertebrate zoologists, paleontologists, and other bryozoologists, can obtain in this volume a cross-section of the ideas, research trends, and the types of information found in the study of Bryozoa today.

Among the 35 papers presented I found the ecological studies of competition between encrusting colonies of particular interest. The "war games" school of J. Jackson and L. Buss and their associates is providing broadly applicable insights into competition for space and food in sessile communities. Factors such as angle of encounter (frontal, oblique, and flanking attacks), ability to scale defenses (frontal budding), to lay

siege (starve out the opponent), and to detect and retreat, sacrifice of rear guard but gain in recruits (colony fission), and David and Goliath (zooid size) strategies are some of those shown to be important by Buss, Jackson and J. Winston, and S. Lidgard. As if the sessile combatants did not have enough problems, predators such as dorid nudibranchs apparently have highly specialized feeding requirements and pick out a small number of bryozoan prey species (S. Chadwick and J. Thorpe).

Two patterns of polypide (tentacle and gut) generation-degeneration examined by P. Dyrinda are considered in relation to colony growth and sexual reproduction. Cyclic regeneration of these parts allows reutilization of zooids, extending zooid active life and increasing larval productivity, in contrast to inefficient nonregenerative patterns. Dyrinda also describes androgynoid and gynozoid seasonal development and for the first time the presence of a nurse cell associated with oogenesis.

Of general interest is an essay on growth and reproduction in colonial animals by J. Ryland. Ryland observes that colonial invertebrates tend to have short-lived larvae, implying that their prime role is site selection and not dispersal and that, like the colonial habit itself, this is adaptive to adult life in stable ecosystems.

Several evolutionary themes deserve special note. S. Mundy *et al.* suggest that the horseshoe-shaped lophophore and epistome of phylactolaemate bryozoans are adaptive features correlated with large zooid size. This interpretation and the lack of pre-Tertiary statoblasts lead them to propose a late origin of the phylactolaemates from a phoronid ancestor, an independent earlier derivation of marine bryozoans (also from phoronids), and thus a polyphyletic origin for the phylum. This is supported by comparative ultrastructural studies of spermatids and spermatozoa by A. Franzén. P. Taylor presents a well-considered hypothesis that the spectacular phases of bryozoan diversification during the Ordovician and Cretaceous were related to the evolution of new modes of tentacle eversion. J. Thorpe and J. Beardmore find an unusually low level of genetic variation at 393 enzyme loci; only 53 of the loci are polymorphic. Thorpe and Beardmore relate this to a high selective pressure to optimize metabolic efficiency and growth rate, important features in organisms whose fecundity is dependent on colony size.

Other themes of investigation with Recent Bryozoa are development of rooted

colony forms (P. Cook and P. Chimonides), early colony growth (R. Wass *et al.*), regional faunas (A. Occhipinti Ambrogi and J.-L. d'Hondt on that of Italy; V. Gontar on that of the Kurile Islands), heavy metal uptake (S. Mundy and J. Soule and D. Soule), and body wall innervation (G. Lutaud).

Paleontological studies also show a diversity of interests. The first known fossil bryozoan-seagrass association is reported by E. Voigt from his remarkable specimens from the Upper Cretaceous Maastrichtian localities in the Netherlands. Other topics include intraspecific competition in Devonian fistuliporid and trepostome bryozoans (F. Bigey), colony growth forms (F. McKinney with R. Wass and T. Stedman, G. Brown and E. Daly, G. Illies), global Paleozoic biogeography (C. Ross and J. Ross), stratigraphic, paleofacies, and paleogeographical studies from England (P. Balson, P. Taylor *et al.*), Baltoscandia (K. Brood), eastern Europe (V. Ghiurca, N. Mongereau, N. Varva), Japan (T. Hayami), China (J. Yang and L. Lu), and California (R. Cuffey *et al.*). Cretaceous cribrimorphs receive taxonomic treatment by G. Larwood.

Twenty-one abstracts of other papers presented at the conference are also included in the volume. A number of these papers are now published in full elsewhere.

Finally, I nominate Dyrinda's figure 3, on growth and reproduction relationships, and Taylor's figure 4, of stylized, tentacle eversion diagrams, for inclusion in invertebrate zoology textbooks.

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## Books Received

**Advances in Agronomy.** Vol. 34. N. C. Brady, Ed. Academic Press, New York, 1981. xiv, 486 pp., illus. \$49.50.

**Advances in Catalysis.** Vol. 30. D. D. Eley, Herman Pines, and Paul B. Weisz, Eds. Academic Press, New York, 1981. xiv, 420 pp., illus. \$58.50.

**Advances in Clinical Chemistry.** Vol. 22. A. L. Latner and Morton K. Schwartz, Eds. Academic Press, New York, 1981. x, 306 pp. \$38.

**Advances in Neurochemistry.** Vol. 4. B. W. Agranoff and M. H. Aprison, Eds. Plenum, New York, 1982. xii, 232 pp., illus. \$32.50.

**Advances in Substance Abuse.** Behavioral and Biological Research. A Research Annual. Vol. 2. Nancy K. Mello, Ed. Jai Press, Greenwich, Conn., 1981. x, 352 pp. \$45.

**Advances in Thyroid Neoplasia 1981.** Papers from a colloquium, Rome, Sept. 1981. Mario Andreoli, Fabrizio Monaco, and Jacob Robbins, Eds. Field Educational Italia, Rome, 1981. xxiv, 364 pp., illus. Lit 10,000.

**Agricultural Plants.** R. H. M. Langer and G. D. Hill. Illustrations by Karen Mason. Cambridge University Press, New York, 1982. viii, 344 pp. \$39.95.

**Allosteric Effects in Haemoglobin.** Kiyohiro Imai.

(Continued on page 272)