Book Reviews

Marmosets and Tamarins

The Biology and Conservation of the Callitrichidae. Papers from a symposium, Front Royal, Va., Aug. 1975. DEVRA G. KLEIMAN, Ed. Smithsonian Institution Press, Washington, D.C., 1977. vi, 354 pp., illus. Cloth, $15; paper, $8.95. Symposia of the National Zoological Park.

Marmosets and tamarins have been widely used for over a decade in medical research on virology, oncology, toxicology, and periodontal disease, yet their behavior and reproduction are still poorly known. This is surprising, especially in view of their chorionic fusion and resulting twin chimerism, a distinctive feature for genetic and immunologic studies. The present volume, reflecting a recent surge of interest in these small Neotropical primates, goes a long way toward alleviating this deficiency. The book contains 30 papers presented at a conference representing both the "users" and the "conservers" of callitrichids, together with lively panel discussions held among the 60 participants. Topics include evolution, conservation, field surveys and ecological studies, laboratory studies of social behavior and reproduction, and the management of breeding colonies. Most of the papers are short, but in two of the three long ones G. Dawson and P. Neyman present the first published results from field studies of more than a year's duration on any callitrichid. In many respects the Callitrichidae, as J. Eisenberg suggests, represent an ecological parallel to the Paleotropical squirrels and, because of their small size, rapid movement, and forested habitat, have long been thought to be too difficult to study in the wild. But even the smallest monkey, the pygmy marmoset, was the object of a successful five-month field study by M. Ramirez, reported here for the first time in English.

There is a considerable quantity of new data in this book: habitat preferences of different species; relationship of territorial behavior to degree of proximity of unrelated conspecifics; presence of postpartum estrus; limited maternal care of newborn; role of juveniles in parental care; and tendency of animals to carry members of their own sex. Particularly noteworthy is the finding, by both Dawson and Neyman, that the long-cherished model of nuclear extended-family social structure in callitrichids, based on excellent and replicated laboratory studies, does not hold in the wild, at least not for the two forms studied. Neyman finds fluctuations in group size among cotton-top tamarins in Colombia and suggests that the pair-bond may not be permanent. Dawson, presenting part of his Ph.D. thesis on the closely related Panamanian Geoffroy's tamarin, notes groups consisting of a breeding pair, their dependent offspring, and transient nonbreeding subordinate animals of both sexes. To describe this situation he suggests a new category of social organization: the "age-related dual dominance social system." Dawson's radiotagging studies demonstrate that individual juveniles move into both adjacent and distant groups with a minimum of interference by alpha animals. The degree to which this behavior is found among other species of tamarins and marmosets needs to be determined.

On the subject of reproduction H. Rothe describes in detail behavior accompanying parturition in *Callithrix jacchus*, reporting the first such study on a callitrichid. Papers by J. P. Hearn and by S. H. and J. K. Hampton report the first studies on basic reproductive cycles of callitrichids. With the use of immunoassay of blood steroids and leucocytic alkaline phosphatase activity, estrous cycles of 14 to 16 days have been established for *Saguinus oedipus*, *S. fuscicollis*, and *C. jacchus*. These studies help provide a basis for timed breeding studies since there is no menstrual cycle, no behavioral or morphological index of estrus, or any cyclic vaginal cytology in the Callitrichidae.

Although only a few species of marmosets and tamarins are heavily used in biomedical research, some are unique research models, as in the case of *S. mystax* for human hepatitis A virus. The need for callitrichids in research is real. The threat of extinction of several species is no less real. With the disruption and deforestation of habitats throughout South and Central America, it is essential, as is urged in the joint resolution by participants of the conference, to develop successful breeding programs, either in captivity or in seminatural environments, so that the needs of research can be fulfilled without making excessive demands on wild populations.

In summary, this book is a set of papers of high quality dealing primarily with the reproductive and behavioral biology of one of the less well-known families of primates. Despite the delay between presentation and publication of the papers, much of the information is still very new, and the book will remain a major source of data and theoretical perspective for many years to come.

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Bryozoology

Biology of Bryozoans. ROBERT M. WOOLLACOTT and RUSSEL L. ZIMMER, Eds. Academic Press, New York, 1977. xviii, 566 pp., illus. $35.

During the first half of this century, the bryozoologists of the world could have assembled in a telephone booth. Concomitant with the formation of the International Bryozoology Association in 1968, a critical mass of investigators was achieved and has produced what the editors of this volume call a renaissance of interest and a wealth of research activity. The purpose of the book is to provide a "current review and synthesis" of active areas of research and to expound "aspects of bryozoan biology which should be brought to the attention of a broad audience but have not received sufficient emphasis by bryozoologists." The editors and authors have accomplished this purpose in an outstanding fashion and have produced a very significant work. All the authors provide comprehensive reviews and most have been able to provide new insights.

Two focal points appear from the topics reviewed: evolution and basic biology. Though these are not mutually exclusive, for convenience of discussion I have regrouped the papers according to them. The themes and implications of the evolutionary papers are as follows.

The details of an event so basic as fertilization are unknown for most Bryozoa. Å. Franzén describes the macro-

and ultrastructure of bryozoan sperm and interprets what he finds in the light of his conclusion that there is a definite relationship between sperm morphology and the "biology of fertilization." The primitive sperm type (in metazoans in general) swims actively and is shed in water for external fertilization remote from the male; specialized sperm are not vigorous swimmers and are transferred by copulation, pseudocopulation, or spermatophores. With sperm morphology giving clues to sperm behavior, it should be possible to make the observation of fertilization more than just a fortuitous event in a few species. Such observation is important in resolving the issue of relative frequency of self-fertilization (an intracolony event) or cross-fertilization (an intercolony event) and the genetic consequences of these strategies.

T. Schopf, in reviewing his pioneering studies (primarily in collaboration with J. Gooch) on the breeding structure and genetic composition of bryozoan populations, assumes on the basis of stable gene frequencies in populations of the single bryozoan species studied in detail that outbreeding routinely occurs, although this has never been demonstrated in vivo. He estimates statistically that the size of the local breeding population is small and that migration (of offspring) is very restricted and concludes that selection seems to be the key factor in determining the particular set of gene frequencies in a local population. With these premises he presents some interesting ideas about bryozoan speciation.

Following R. Ström's review of brooding patterns and their consequences—nonbrooding: planktotrophic larvae, and brooding: lecithotrophic larvae—Zimmer and Woollacott examine larval morphology in detail and propose a reasonable classification scheme for the variety of larvae known. Unfortunately, as they point out, the classification does not correspond well to that of the adults. They conclude that larval and adult stages have been subjected to different selection pressures, undergoing independent radiations. In another chapter Zimmer and Woollacott give more support to the premise that planktotrophic larvae are primitive although most bryozoan larvae are lecithotrophic. They also hypothesize that the peculiar development of the ancestrula (metamorphosed larva) gut from ectodermal and mesodermal blastemas is an asexual regenerative phenomenon of the adult coloniality moved precociously into early development.

The papers by Zimmer and Woollacott provide unsolicited support for the carefully developed evolutionary model described by J. Farmer in which the ground plan of the Bryozoa is derived from a phoronid ancestor by adaptation and evolutionary divergence leading to a colonial habit and small size in the adult stage and an original specialization for planktotrophy and long-range dispersal in the larval stage.

An alternative view deriving Bryozoa (Ectoprocta) from colonial Entoprocta that had larvae with internal budding and a settlement resembling that of the modern *Pedicellina* is expounded by C. Nielsen. His hypothesis strengthens the pre-Hyman view of the phylum Bryozoa as encompassing both Ectoprocta and Entoprocta and is based on far more character comparisons than were used by the classical theorists.

The last word on these evolutionary themes remains to be said. I wonder why Woollacott chose not to complicate these scenarios with the tantalizing hints of possible affinities between pterobranch hemichordates and Bryozoa that he reported on at the 1977 International Bryozoology Association Conference in Woods Hole.

Finally, the genesis of the frontal wall (as well as that of its associated structures) has been recognized as important in developing a natural classification scheme for calcareous bryozoans. Drawing heavily on his own studies with the scanning electron microscope, P. Sandberg reviews skeletal ultrastructures and their relationship to inferred modes of wall development. In essence, he has found that planar spherulitic ultrastructure is a good indicator of "exterior," cuticulate walls and thus provides a tool for analyzing frontal wall origins in cheilostomous bryozoans.

The basic biology papers deal with aspects of both adults and larvae. L. Silén's essay on polymorphism focuses on an intriguing feature of bryozoans. His criterion for systematizing polymorph types is function, evaluation of which is speculative in many cases. Especially noteworthy are Silén's compilation of "laws" governing the induction of polymorphism, among them reduction in zooid bud size for asexual polymorphs and presence of germ cells for sexual polymorphs. With 10 categories and upwards of 20 types of polymorphs, most of them not self-supporting, Silén challenges bryozoologists to undertake more direct observations bearing on the function of polymorphs and to quantify the advantages they supply to the colony (and species) to compensate for the direct drain on the feeding resources of the colony.

J. Winston addresses the hypothesis that partial separation of trophic resources must occur among Bryozoa, later confirmed by her observations linking lophophore characters to behavioral strategy.

The organization of funicular tissue and evidence for its function in colonial nutrition and excretion are reviewed by G. Bobin. This information has not yet been given proper attention in standard invertebrate textbooks.

Brown body formation, the cyclic regression and renewal of the lophophore and gut, has long been regarded as an excretory phenomenon, but D. Gordon concludes that it is instead rejuvenatory, serving to extend the life span of the zooid and therefore the colony.

Morphological evidence for the continuity of the nervous system of adjacent zooids, that is, colonial nervous system sensu lato, is analyzed by G. Lutaud. Although interzooidal neuronal connections have not been verified histologically in the anascans, Lutaud's remarkable photomicrographs seem to provide a clear demonstration that cheilostomes should join the Phylactolaemata and stoloniferous ctenostomes in having continuity of nerve plexes across zooid boundaries. The parietal plexus of cheilostome zooids is hypothesized by Lutaud to receive interzooid information leading to colonial responses. So far the ultrastructure of the basiepithelial nerves, presumed sensory endings, and receptors shows there is a low level of cytological differentiation.

J. Ryland reviews taxes and tropisms of all stages of the bryozoan life cycle and suggests several topics for reinvestigation, notably geotaxis and rheotropism. In a related chapter, J. and D. Soule discuss the bryozoan component of fouling communities and the requisite adaptations, including bioadhesion. Those readers who have suffered cold, wet, blustery days gathering seasonal data on fouling communities along the eastern seaboard will likely wonder why the whole western Atlantic was left out of the range of the distribution of fouling organisms compiled as table 1 of the Soules' review.

Finally, D. Jebram provides an excellent vade mecum for culture work. He shows the sophistication that careful attention to a problem can develop. His descriptions will be useful to all who want to experiment with sessile marine organisms.

This book contains an exhaustive amount of detailed information about bryozoans and this will provide its lasting strength. I agree with the editors that

it should reveal useful information otherwise unavailable on basic problems of fundamental interest to a broad spectrum of biologists and paleontologists. Writers of invertebrate and general zoology textbooks will also find food for thought here and begin to realize that Bryozoa are not a "minor" or "smaller coelomate" group but merit better treatment with the traditional "major phyla."

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Magma Generation

Terrestrial Heat and the Generation of Magmas. A discussion organized by G. M. Brown, M. J. O'Hara, and E. R. Oxburgh, Jan. 1977. Royal Society, London, 1978. Illus. Paper, £17.65. *Philosophical Transactions of the Royal Society of London*, Series A, vol. 288, pp. 383-646.

The recent attention that has been given to convective heat transfer in the mantle, the recognition that radioactivity decreases exponentially with depth in the crust, and an expanding appreciation of geochemical constraints on melting in the mantle have led to an array of models for magma generation. The 18 papers in this book, predominantly by authors from the United Kingdom, resulted from a discussion of critical aspects of models involving melting in the crust and mantle. Every specialist will find more than enough in the papers to raise his or her adrenaline flow-rate, and the generalist will find strong opposing arguments on many issues.

The authors generally support the views that the diapiric rise of partially depleted mantle leads to pressure-release melting at the mid-oceanic ridges and that melting in the subducted plates is induced either by heat generated by shearing of rocks at the top of subducting plates or through the effect of volatiles released from the plates to lower the temperature of melting of rocks above the subducting plates. Not all the authors are enthusiastic about convective models, and several base their arguments on conductive model geotherms. The grossly unequal volumes of magma presumably extruded on opposite sides of a suture prior to continental breakup are blandly dismissed as "asymmetry" by one supporter of plate-tectonic dogma.

The view of C. Froidevaux and M. Souriau that intraplate magma generation is caused by the heat of viscous dissipation during rapid plate motion is in sharp contrast to the view of I. G. Gass *et al.*, who believe a plate must be nearly at rest for thermal or chemical penetration of the lithosphere. In another confrontation, K. S. Heier concludes that the continents formed at "a reasonably constant rate" through geologic time whereas S. Moorbath is in favor of "episodic" continental growth with subsidiary reworking and recycling.

Most of the papers are written in concise language, and the definitions of some usually vague plate-tectonic terms will be helpful to many readers. Particularly rewarding are the clearcut statements about distinguishing reworked crust from mantle-derived crust (Moorbath), the importance of density differences in driving mantle convection (E. R. Oxburgh and E. M. Parmentier), and the considerable extrapolation necessary to apply experimentally determined geothermometers and geobarometers (S. Howells and M. J. O'Hara); the unique demonstration of crystallization in an upwelling diapir (J. Malpas); the compelling evidence that most oceanic basalts are derived from source regions that have been depleted in large ion lithophile elements (R. K. O'Nions *et al.*); and the evenhanded treatment of the plume hypothesis versus the propagating fracture hypothesis for intraplate volcanism (D. L. Turcotte and E. R. Oxburgh).

There are, nevertheless, some arguments that require clarification. For example, in a paper on the thermodynamics of pyroxene geotherms, the author writes that thermodynamic analysis is the best way of calculating the temperatures and pressures under which the garnet lherzolites are formed because "the methods will be independent of bulk rock composition and of mineralogy" (p. 458). An equilibrium constant, K, is then introduced and is described as "a more or less complicated function of the compositions of the phases and, in general, temperature and pressure." This confusion is reinforced by a statement that "there are no safe assumptions about the dependence of K on composition, temperature and pressure" (p. 459).

Only the paper by Howells and O'Hara presents new experimental data. A paper by Y. Bottinga and C. J. Allègre is essentially a correction and extension of a previously published analysis. These authors present a partial melting model and adopt for starting material a mixture of peridotite and basalt, assemblages that, even though they are incompatible at the high pressures of magma generation, are assumed by the authors to form a simple binary system. The value they use for the enthalpy of the basalt-eclogite transition is three times that found by others, and the enthalpies of the plagioclase-peridotite–spinel-peridotite and the spinel-peridotite–garnet-peridotite transitions are too small by an order of magnitude. After an extensive review of the published values for the enthalpy of melting of the end-member minerals characteristic of basalt, the authors throw up their hands because of the incompleteness and uncertainty of the data and adopt N. L. Bowen's old estimate of 100 calories per gram, without a pressure correction. Their model is unique because it is based on the assumption that melting in the mid-oceanic ridge environment begins just above the spinel-peridotite–garnet-peridotite transition and therefore does not involve garnet in the generation or fractionation of these magmas.

Everyone interested in magma generation will find some new ideas in the volume and many points to ponder. Are regional metamorphic gradients a suitable estimate of "normal" or "abnormal" geotherms? Is the narrow range of temperature deduced from granulites evidence that they are residua from crustal partial melting? Are plates the thermal boundary layers of mantle convection? Is upper mantle heterogeneity the result of trapped undepleted mantle? Can intraplate volcanism be attributed to turbulence within the general convective regime? Do rising magmas scavenge the leachable elements? Is the progressive decay in thermal output of the earth responsible for the changing mode of magma generation?

Use of the book would have been greatly enhanced if a subject index had been included. The discussions that follow most of the contributions are especially pertinent and informative.

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Photochemistry

Inorganic and Organometallic Photochemistry. Papers from a symposium, Chicago, Aug. 1977. MARK S. WRIGHTON, Ed. American Chemical Society, Washington, D.C., 1978. viii, 232 pp., illus. $30.

This small book comprises 12 papers presented at the 174th meeting of the American Chemical Society. The papers are generally of substance and collectively constitute a sufficiently enduring collection that the book is recommended