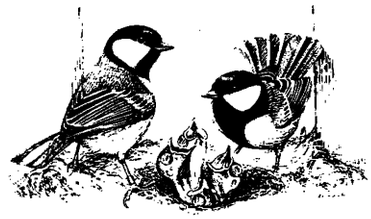
BOOK REVIEWS

Mating and Parenting

Partnerships in Birds. The Study of Monogamy. JEFFREY M. BLACK, Ed. Drawings by Mark Hulme. Oxford University Press, New York, 1996. xii, 420 pp., illus. $125 or £62.95, ISBN 0-19-854861-3; paper, $46.95 or £27.50, ISBN 0-19-854860-5. Oxford Ornithology, 6.

Although the prevalence of monogamy has long been recognized as one of the defining behavioral characteristics of birds, it has also long been considered a "bland" mating system by many avian behavioral ecologists. Monogamy in birds is related to the facts that both the male and the female members of the pair provide care to their offspring and that in a majority of birds biparental care is essential to the rearing of offspring. Avian monogamy-biparental care contrasts strikingly with the mating-parenting patterns of most other kinds of animals, including most members of our own group, the mammals.



A pair of great tits, *Parus major*, with young. At study sites in northern Belgium nestlings with different fathers have been found in about one-third of the nests of this species. [From Dhondt *et al.*'s paper in *Partnerships in Birds*]

Interpretations of avian monogamy usually have been framed in the context of constraints, particularly on males, rather than of the positive aspects of this kind of system. However, it has been shown for a number of species, including most of the ones featured in this book, that two cooperating parents can rear more young than could a single parent, and, moreover, that better options for either sex typically are not available. (In birds, both polygyny and polyandry are rare as compared to monogamy). This is not to say, however, that mating outside the social pair bond (generally referred to as extra-pair copulation, or EPC) is not a common phenomenon. To the contrary, thanks to techniques such as DNA fingerprinting, it has been clearly shown that EPCs leading to extra-pair fertilizations (EPFs) are common in many socially monogamous species of birds. Thus the social and genetic mating systems of birds frequently differ.

This discovery, which also showed that male birds often provide care to offspring that are not their own, has led to a dramatic shift in thinking about the issue of avian monogamy and leads to the question: Just what are the overall reproductive strategies of males and females of socially monogamous species? Answers require consideration of a number of related issues, such as the characteristics of successful and unsuccessful pairs, the benefits of long-term pair bonds, the adaptive significance of divorce, and the adaptive benefits that females obtain by mating outside, as well as within, the pair bond.

This book provides an impressive treatment, empirical and theoretical, of these and other issues related to avian monogamy. Fourteen fine chapters, based on long-term empirical studies of individual species in 12 different avian families, are sandwiched between opening and closing sections that deal with the theoretical issues related to monogamy.

Possibly the single most interesting issue addressed in the book is why individual females of many socially monogamous species engage in extra-pair copulations. This question forms the basis of the chapters by P. A. Gowaty and by T. R. Birkhead and A. P. Møller. The answer seems to center on the female's desire to produce high-quality young. Specifically, because most females do not have the opportunity to form a pair bond with the highest quality male (or males) in the area, their optimal reproductive strategy may be to seek sperm from such males while forming social mateships with an available lower quality male who will provide parental care. As part of her "constrained female hypothesis," Gowaty suggests that, within a species, females of intrinsically high quality or females in especially productive habitat might be better able to rear young without paternal assistance. As a result, such females would be expected to show higher levels of EPC than females more dependent on parental contributions by their mate.

Birkhead and Møller tentatively conclude that interspecific comparisons support this idea. Specifically, in species in which biparental care is essential for reproductive success, EPCs are rare or nonexistent. At the other extreme, in species in which the female is completely unconstrained by the need for male parental care, multi-male fertilizations also are rare; here females are free to mate solely with the single "best" male available. Many species, however, lie between these two extremes. In these cases, females practice both social monogamy and genetic polyandry. For this strategy to work, the female must "consider" her social mate's genetic interests, as well as her own. Commonly, the answer appears to be a compromise, with the brood containing some offspring sired by an extra-pair male and some sired by the social mate.

Thus, the long-standing view that the existence of extra-pair young reflects a strategy primarily driven by male interests clearly is in jeopardy. Although EPCs are indeed beneficial to males, they apparently are no less important to females. It is increasingly likely that an understanding of female reproductive strategies is required to explain the variation in multiple paternity seen both within and across species.

J. David Ligon
Department of Biology,
University of New Mexico,
Albuquerque, NM 87131, USA

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Sciences of Matter

Before Big Science. The Pursuit of Modern Chemistry and Physics, 1800–1940. MARY JO NYE. Twayne (Simon and Schuster Macmillan), New York, 1996. xviii, 283 pp., illus. $32.95. ISBN 0-8057-9512-x. History of Science and Society Series, no. 1.

The teaching of the history of science has not been very well served by sophisticated, up-to-date, and usable textbooks. The more recent the science, especially among the physical sciences, the more critical is the lack of such texts. In what is the first of a new series of books designed to remedy this lacuna, Mary Jo Nye has taken on the daunting task of writing a history of virtually all of modern chemistry and physics—in 229 pages of text. A distinguished historian of 19th- and 20th-century chemistry, she is eminently well qualified for her task.

The terminal dates of the title refer principally to institutional stages in the develop-

"August Kekulé (*front row, center*) became head of one of the most important research schools in German chemistry when he became director of the Chemical Institute at Bonn in 1865." [From *Before Big Science*; Edgar Fahs Smith Collection, University of Pennsylvania]

ment of science: the beginning of the 19th century marked the inception of the professionalization and specialization of the sciences in the university; the 1940s witnessed the birth of government-supported "big science" with the race to utilize nuclear fission for military purposes. The book begins and ends appropriately with chapters on these broader, institutional settings of science.

These dates also coincide closely with important way stations in the development of atomic theory. Shortly after 1800, John Dalton published his first set of relative atomic weights and then his chemical atomic theory. Shortly before 1940, the first successful nuclear fission was achieved. It is atomic theory, of course, that provides the link between chemistry and physics, and it receives a preponderance of attention. However, Nye also has written excellent chapters on the development of 19th-century electromagnetism and thermodynamics. Moreover, embedded within these chapters are nuggets of insight about the comparative developments of chemistry and physics and their interactions. One of my favorites is Nye's differentiation of "physical" from "chemical" phenomena in the first part of the 19th century in terms respectively of reversibility/continuity and of irreversibility/discontinuity. She then depicts how these sciences came to merge their orientations with the development of thermodynamics and physical chemistry.

Inevitably, the short compass of this book and the author's concern for thematic coherence result in deemphasis or even omission of certain developments and perspectives. I shall concentrate on chemistry. Claude-Louis Berthollet's Newtonian vision of a dynamical chemistry also appeared at the start of the 19th century but receives no account here. There is nothing on the development of biochemistry as a field, although Linus Pauling is characterized as "becoming a 'biochemist'" (p. 144) and Nye has important things to say about the role of natural history in the early development of organic chemistry. Indeed, the general question of how new scientific specialties developed in chemistry and physics is not addressed. And the rise of industrial research in chemistry receives only incidental mention. But extensive excursions into these areas would have both lengthened the book considerably and destroyed its coherence.

"Staff and research students in the Chemistry Department at the University of Manchester, 1907–1908. Many chemists attended the weekly Friday physics colloquia organized by Ernest Rutherford, who received the Nobel Prize in Chemistry in 1908." [From *Before Big Science*; *J. R. Soc. Chem.* **78**, 455 (1954)]

One theme that I think might have merited more treatment than the occasional discussion Nye provides is how chemistry and physics compared and contrasted with each other, both in their theoretical orientations and in their laboratory practice. A more sustained consideration of this theme would have been illuminating in itself and enhanced the benefits of uniting the histories of chemistry and physics in one book.

One can, no doubt, spin endless possibilities of what else might have been contained in this book, so vast and variegated is its subject. What Nye has wrought is, in fact, an extraordinarily well-knit and comprehensive historical account of the development of modern physical science. Since this book presumes some technical familiarity with chemistry and physics, it will not serve all the pedagogical needs of the history of this subject. But for students with some scientific background, and for the scientifically literate public, it will provide an admirable overview of the modern history of two of the grandest sciences that have ever flourished.

Seymour Mauskopf
Department of History,
Duke University,
Durham, NC 27708–0719, USA

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Books Received

Animals and Temperature. Phenotypic and Evolutionary Adaptation. Ian A. Johnston and Albert F. Bennet, Eds. Cambridge University Press, New York, 1996. xvi, 419 pp., illus. $85. ISBN 0-521-49658. Society for Experimental Biology Seminar 59.

Cytology, Genetics, and Molecular Biology of Algae. B. R. Chaudhary and S. B. Agrawal, Eds. SPB Academic, Amsterdam, 1996 (U.S. distributor, Demos Vermande, New York). viii, 439 pp., illus. $140.50 or DFL 225. ISBN 90-5103-126-2.

Developmental Science. Robert B. Cairns, Glen H. Elder Jr., and E. Jane Costello, Eds. Cambridge University Press, New York, 1996. xx, 291 pp., illus. $44.95. ISBN 0-521-49585-7. Cambridge Studies in Social and Emotional Development.

The Eleventh Plague. The Politics of Biological and Chemical Warfare. Leonard A. Cole. Freeman, New York, 1996. viii, 284 pp. $22.95. ISBN 0-7167-2950-4.

Global Change and Terrestrial Ecosystems. Brian Walker and Will Steffen, Eds. Cambridge University Press, New York, 1996. xviii, 619 pp., illus., + plates. $120, ISBN 0-521-57094-8; paper, $39.95, ISBN 0-521-57810-8. International Geosphere-Biosphere Programme Book, 2. From a conference, Woods Hole, MA, May 1994.

Handbook of Neural Computation. Emile Fiesler and Russell Beale, Eds. Institute of Physics Publishing, Philadelphia, and Oxford University Press, New York, 1996. Variously paged, illus. In looseleaf binder, $395. ISBN 0-7503-0312-3.

Many-Body Tree Methods in Physics. Susanne Pfalzner and Paul Gibbon. Cambridge University Press, New York, 1996. x, 168 pp., illus. $49.95. ISBN 0-521-49564-4.

Number by Colors. A Guide to Using Color to Understand Technical Data. Brand Fortner and Theodore E. Meyer. Telos (Springer-Verlag), Santa Clara, CA, 1996. xxvi, 349 pp., illus., + plates. $44.95. ISBN 0-387-94685-3.

Physics and Chemistry at Oxide Surfaces. Claudine Noguera. Cambridge University Press, New York, 1996. xvi, 223 pp., illus. $64.95. ISBN 0-521-47214-8.

Seismology. Hugh Doyle. Wiley, New York, 1996. xvi, 218 pp., illus. Paper, $46.95. ISBN 0-471-94869-1.

Transgenic *Xenopus*. Microinjection Methods and Developmental Neurobiology. Schlomo Seidman and Hermona Soreq. Humana, Totowa, NJ, 1996. xviii, 198 pp., illus., + plates. $79.50. ISBN 0-89603-457-7. Neuromethods, 28.