

BOOK REVIEW

News From the Molecular Frontier

Review of *Paternity in Primates: Genetic Tests and Theories*. R. D. Martin, A. F. Dixson, and E. J. Wickings, eds. Karger, 1992, xi + 287 pp, \$198.50.

The past decade has produced dramatic changes in the technology used to assess genetic relationships between individuals. Whereas researchers have traditionally been forced to rely upon behavioral or spatial relationships between animals to determine parentage, the advent of procedures such as DNA fingerprinting now makes it possible to analyze kinship using quantitative, genetic estimates of relatedness. The response to this breakthrough has been dramatic; as a glance at almost any leading journal reveals, the number of studies using DNA fingerprinting and related techniques to assess parentage seems to be increasing daily.

Primatology is no exception to this trend. The growing use of DNA technology to address questions in primate biology is evident in the volume edited by Martin, Dixson, and Wickings. The book is a compilation of 17 papers presented at the second Schultz-Biegert Symposium held near Zürich in September 1991. As stated in Martin's introduction to the text, the symposium was intended to bring together researchers using newly developed genetic techniques such as DNA fingerprinting to investigate paternity in non-human primates. The result is a timely and useful resource that should be of value to anyone interested in analyses of kinship and parentage.

Although molecular genetic techniques play a prominent role in the papers presented, these procedures are described in terms that are readily understood. Techniques emphasized by participants in the symposium include the use of single- and multi-locus probes to detect genetic variation, as well as the use of the polymerase chain reaction (PCR) to amplify variable segments of DNA. Clear, concise summaries of these procedures are provided in chapters by Rogers, by Morin and Woodruff, and by Lewis and Cruse. The molecular mechanisms underlying these techniques are described, as are the logistic considerations associated with each procedure. An appendix at the end of the volume further summarizes the molecular techniques discussed during the symposium. The background information provided in these sections is informative and renders the volume accessible to readers with only a modest understanding of molecular biology.

Three of the papers presented, those by Anzenberger, Bercovitch, and Martin, are largely reviews. Issues addressed in these chapters include the effects of sperm competition on paternity and the essential role of paternity analyses in studies of monogamous mating systems. Particularly interesting is the chapter by Martin, who examines the effects of female reproductive physiology and the timing of copulation (relative to ovulation) on male reproductive success. Martin's arguments challenge several commonly held assumptions regarding the evolution of concealed ovulation and prolonged sexual receptivity; although Martin presents few new data to support his views, I found this to be one of the most thought provoking papers in the volume.

The remaining papers consist of case studies of paternity in primates. As such, these chapters form the heart of the volume: examples of how DNA technology can be used to address questions regarding parentage and kinship. Despite an admitted bias toward studies of macaques (Martin, p. x), the range of species considered is fairly diverse; new data on paternity are presented for gorillas, chimps, marmosets, tamarins, and ringtailed lemurs, as well as several species of macaques. The majority of these studies utilize data from captive populations of primates; however, data from natural populations of Barbary macaques, long-tailed macaques, and common marmosets are also examined.

Topics addressed in these chapters include the extent of inbreeding in captive populations, the accuracy of pedigree data based on behavioral observations, phenotypic and behavioral correlates of male reproductive success, and interspecific differences in the amount of genetic variability detected by particular molecular techniques. The use of paternity data to test specific hypotheses is most evident in studies of field populations; in contrast, studies of captive populations are frequently directed toward the exploration of new molecular techniques. Many of these studies are clearly preliminary, thus underscoring the novelty of this line of research.

The format of the volume, the variety of topics addressed, and the variety of problems encountered would seem to preclude any consensus regarding the use of DNA technology in paternity analyses. However, three points consistently emerge from the papers presented. First, DNA fingerprinting and related techniques represent a significant improvement over previous procedures for analyzing paternity in non-human primates. The inadequacy of behavioral estimates of paternity are amply described, as is the frequent failure of electrophoretic analyses to detect genetic variation between individuals. In contrast, DNA technology is unanimously heralded as a promising direction for future research.

Somewhat surprisingly, the second point that emerges from these studies is that older procedures for examining paternity should not be discarded. Specifically, several authors argue that electrophoretic analyses of blood proteins may provide a valuable first step in analyses of paternity. Both the lower cost and simpler technology associated with electrophoresis make it an attractive alternative in species exhibiting sufficient protein variation. In other species, protein electrophoresis can be used to establish paternity in some situations, with DNA technology applied only in those cases not resolved by protein analyses. As revealed in chapters by Smith et al. and Menard et al., the combined use of electrophoresis and DNA fingerprinting may yield better results (i.e., more complete resolution of paternity) than the use of either technique alone.

A final point that emerges from the volume should sound a note of caution to those interested in using molecular genetic techniques to assess paternity. Although DNA technology has often been viewed as a ready "cure-all" to problems associated with determining kinship and parentage, current reality falls somewhat short of this expectation. DNA fingerprinting and related procedures are still relatively new and, as a result, remain somewhat experimental. Although DNA technology constitutes a significant breakthrough for studies of paternity, at present these techniques represent a substantial research effort that may be beyond the financial or technical resources of many investigators.

The volume's greatest strength is that it brings together considerable new information regarding the use of DNA in studies of parentage. As the number of studies employing DNA technology increases, so does the number of procedures available for detecting genetic variation. By including descriptions of a variety of these techniques in a single volume, the editors provide a convenient summary of

the procedures currently in use. At the same time, the juxtaposition of studies employing different techniques facilitates comparisons of the types of data generated by each analysis.

The focus on primate species is significant for two reasons. First, due to both their close taxonomic affinity to humans and their importance in biomedical research, non-human primates have been studied using techniques that are not yet commonly applied to other taxa. In particular, I refer to the use of single-locus probes and PCR amplification of variable loci. These techniques offer several potential advantages over conventional DNA "fingerprinting" but, at present, have not been widely adapted for use. However, as this volume indicates, these techniques are actively being used in studies of non-human primates. As a result, much of the information presented at the symposium represents the forefront of DNA technology as applied to studies of parentage.

Second, the taxonomic focus of the symposium is a departure from the emphasis on avian species found in much of the early literature on DNA fingerprinting. Studies of paternity in mammals are subject to difficulties not encountered when working with birds. In particular, whereas avian red blood cells are nucleated, mammalian erythrocytes lack nuclei, a condition that greatly reduces the amount of DNA that can be extracted from whole blood. As a consequence, it may be difficult to obtain adequate quantities of DNA when working with mammals, in particular small-bodied species. Only as studies of mammalian species increase will such problems be resolved. Studies of primates, especially smaller primates such as marmosets and tamarins, represent a significant step in the right direction.

My criticism of the volume pertains more to its organization than its content. I could detect no underlying basis for the order in which chapters were printed and thus I assume that individual papers were published in the order that they were presented at the symposium. This format is adequate for documenting the contents of the symposium. However, both Martin's Introduction and the Appendix at the end of the volume suggest that the editors were striving to do more than simply compile a written record of events; as stated in the Introduction, one of the goals of the symposium was to use this overview of paternity analyses as "a guide to future investigations (p. vii)."

To this end, a greater effort to group chapters according to content would have been useful. In the volume's current format, some papers seem misplaced and information that appears in more than one chapter seems redundant. For example, the book begins with a summary of two molecular techniques currently used to analyze paternity. This discussion of methodology is followed by detailed reports on paternity in three species of primates, which are followed by another discussion of methodology, in this case PCR amplification of hypervariable loci. This arrangement is distracting; a more logical arrangement would have grouped general discussions of methodology at the beginning of the volume, followed by detailed case studies that apply these procedures to specific research problems. Not only would papers with similar goals be grouped together, but readers would be provided with all necessary background information regarding DNA technology prior to tackling more application-oriented chapters.

One final comment concerns the collection of samples for use in paternity analyses. With the exception of the chapter by Morin and Woodruff, very little mention is made of the procedures used to collect blood or other samples for analysis. Yet, as noted by Kummer (p. 2), efforts to collect appropriate samples now may later prove invaluable. To this end, a brief discussion of collection procedures

would have been extremely useful; the Appendix provided at the end of the volume seems to be an ideal context in which to address this issue.

These suggestions aside, the volume represents a valuable resource for students of primatology. The information conveyed should be of particular use to 1) investigators interested in male behavior and reproductive success and 2) researchers interested in applying DNA technology to studies of kinship and parentage. Although the contents of the volume are limited to studies of primates, the questions addressed and the techniques employed in these studies are of widespread interest to vertebrate biologists.

Eileen A. Lacey
Mammal Division
Museum of Zoology
The University of Michigan
Ann Arbor, Michigan