Book Reviews

A Planetary Anomaly

Mercury's Perihelion from Le Verrier to Einstein. N. T. ROSEVEARE. Clarendon (Oxford University Press), New York, 1982. viii, 208 pp., illus. $49.

The advance of the perihelion of Mercury's orbit, long an anomaly in Newtonian celestial mechanics, is one of several astronomical tests of the general theory of relativity. This advance of the point in its orbit when Mercury is closest to the sun was first discussed by the French astronomer Urbain Le Verrier in 1859 as the reason why theories of Mercury's motion and observations of its position did not agree.

The detection of the anomaly came at a time when recent events had vindicated Newtonian celestial mechanics: the discovery of Neptune through an analysis of its perturbations upon the orbit of Uranus by Le Verrier and J. C. Adams, and the introduction of an improved theory of the motion of the moon by P. A. Hansen. Though the lunar theory remained problematic, the anomaly in Mercury's motion posed a more serious threat to Newtonian theory.

Searching for the cause of this anomaly occupied the talents of many of the best celestial mechanicians of the late 19th and early 20th centuries, including Le Verrier, Simon Newcomb, and Hugo von Seeliger. Among the many solutions proposed were: the existence of an intra-Mercurial planet or planets (lumped under the common name "Vulcan"); the existence of matter in rings or in a disk both internal and external to Mercury's orbit; an oblateness of the solar disk; and alterations to the Newtonian theory of attraction, specifically through electrodynamical analogies. Einstein's general theory of relativity finally explained, in full, the perihelion advance.

N. T. Roseveare begins his technically sophisticated scientific review of the general problem by outlining the various ways a perihelion advance might be caused: either through the presence of disturbing matter or through the action of a non-Newtonian force law. He then carefully shows that, throughout the late 19th century, all Newtonian solutions seemed to fail with the exception of von Seeliger's theory that matter comprised by the zodiacal light perturbed Mercury's orbit, causing the advance. A discussion of the parallel development of non-Newtonian theories based upon electrodynamical analogies (velocity-dependent force laws) then sets the stage for his ultimate review of how Einstein employed his general theory of relativity to explain the anomaly.

Roseveare treats both obscure and mainstream theories and lays before the reader a detailed narrative of the false starts and misleading paths that were taken to resolve the anomaly. All mathematical theories are treated in enough detail to convey their character; but observational studies and descriptive reviews are somewhat neglected. For instance, only a few of the many fascinating episodes in which astronomers claimed to have sighted Vulcan are recounted, and those only in the briefest fashion. Similarly, though Roseveare correctly notes that observations of the motion of Mercury, or observations that would lead to determination of the mass of the zodiacal light or of Venus, were very difficult to make, little discussion is provided of the details of the attempts.

Another restriction of this work is that archival sources are almost completely neglected. Though some other historical studies containing archival matter are cited, the present work is restricted to published sources, and in at least one place Roseveare admits that this restriction kept him from making a complete analysis.

Roseveare provides a detailed and cogent review of the progress of theoretical studies and succeeds in showing how the new physics was able to account for what remained an anomaly in classical astronomy and physics, although he has not provided a completely satisfying history. This is especially important to note because 19th-century celestial mechanics has long been neglected by historians. Perhaps Roseveare's work will stimulate further interest and activity.

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Victorian Paleontologists

Archetypes and Ancestors. Palaeontology in Victorian London, 1850–1875. ADRIAN DESMOND. Blond and Briggs (Frederick Muller), London, 1982. 288 pp., illus. £15.95.

The subtitle of this book might more appropriately be "Palaeontologists in Victorian London, 1850–1875." Although Desmond states his goals in terms of relating major social and cultural changes to the "deep structure" of science, his real concern is with the motives and ideologies of scientists rather than with the content of their science. The central characters in his study are Richard Owen and Thomas Henry Huxley, along with their respective followers, students, and supporters. The central theme is the conflict between the scientific representatives of a conservative, hierarchical, preindustrial society and the impatient, ambitious new professionals of the industrial age. Paleontology in the decades surrounding the publication of *On the Origin of Species* was one of the arenas in which this clash of ideologies took place.

Desmond's account of the decades-long conflict between Owen and Huxley is more thorough and is likely to be more controversial than any that has yet appeared. Going beyond the familiar anecdotes of their public clashes over Darwinian evolution—which, as Desmond rightly points out, have generally been based on accounts by Huxley and his partisans—Desmond tries to unravel the many professional, social, cultural, ideological, and personal motives that drove the two men and to show how this complex matrix of influences affected their interpretations of paleontological evidence. Inevitably, Desmond's attempt to provide a less biased assessment of Owen has resulted in a more critical look at Huxley. Indeed, he holds Huxley up to a particularly harsh revisionist scrutiny, questioning the motives behind his scientific judgments and emphasizing the un-Darwinian character of much of his paleontology.

Desmond regards Owen and Huxley as representatives of two opposed but interdependent social and cultural communities. He also sees them as members of a single scientific community in which personal goals, ideas, and ideologies coincided and conflicted in patterns that were anything but simple. Desmond is at his best in tracing individual strands in this tangled web of ideas and personalities. His brief sketches of the individuals who made up his various communi-

ties are perceptive and clearly drawn. He also does a skillful job of presenting the context of particular paleontological problems, such as the significance of *Archegosaurus* and the reptilian ancestry of birds. Curiously, given his professed intentions, his account is weakest when he tries to relate these personal and scientific narratives to broader social and economic causes.

Desmond pushes his revisionism too far, and most readers will no doubt find parts of his argument more intriguing than convincing. But he raises important questions, and he explores new areas in the history of paleontology as well as brings a new perspective to some of the old. Certainly it is long past time for a reassessment of Huxley and Owen. For that reason alone, anyone interested in the initial reception of the theory of evolution will find this book interesting if not entirely satisfying.

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Speciation

Mechanisms of Speciation. Proceedings of a meeting, Rome, May 1981. CLAUDIO BARIGOZZI, Ed. Liss, New York, 1982. xiv, 548 pp., illus. $88. Progress in Clinical and Biological Research, vol. 96.

It is likely that the topic of speciation is more thoroughly awash in unfounded and often contradictory speculation than any other single topic in evolutionary theory. That, at least, is the most compelling conclusion to which a reading of this symposium leads.

Of the 25 papers in the volume, several, whatever their merits, do not bear on the subject of speciation; many merely describe chromosomal and other differences among related species (for example, those by Coluzzi, Capanna, Battaglia, and Ehrendorfer); and, though some authors (notably Mayr, Stebbins, Ayala, White, Templeton, Gottlieb, Carson, and Dover) have interesting things to say about conceptual issues, their views for the most part have already been published widely. The volume apparently has not been edited by anyone whose primary language is English. It is not a substantial contribution to the literature on speciation.

There are some points of interest, of course. Mayr introduces the term "peripatric" (not parapatric) speciation to describe his 1954 model of genetic reorganization in small populations. Stebbins advances reasons for thinking that "submicroscopic structural differences" in chromosomes are the major mechanism of speciation in plants. Powell draws attention to the possible role of microorganisms in inducing sterility of hybrids between populations of their hosts. Riley cites evidence that simple genetic changes may trigger mispairing of chromosomes that differ in their organization of satellite DNA, and White argues that differences in such repeated sequences are not the basis of hybrid sterility. Carson asserts that chromosome reorganization is incidental in speciation rather than causal, whereas Nevo believes that "chromosomal speciation . . . is generally prevalent in mammals." Carson believes that speciation and indeed anagenetic adaptive change require the stochastic disorganization and subsequent reorganization of a highly integrated gene pool that resists selection; in contrast, Gottlieb affirms the widely held (but challenged) view that reproductive isolation and adaptation can evolve independently and that the one is not prerequisite to the other.

The highly contradictory and often fuzzy thinking that invests speciation theory appears to have several bases. First, there is a common tendency to suppose that any genetic differences found between species have been instrumental in their genesis, even if the differences may have developed merely in concert with, or subsequent to, reproductive isolation, and even if there is no evidence that they contribute to reproductive isolation. For example, chromosomal differences that reduce hybrid fertility by 50 percent or more nevertheless permit extensive gene flow between the populations. If, as is often the case, the populations exchange genes to a far lesser extent, the structural differences are likely merely to have accompanied speciation, rather than to have driven it as White seems to believe. (Incidentally, White misconstrues Futuyma and Mayer's argument (*Syst. Zool.* **29**, 254 [1980]) against stasipatric speciation; we did not argue that negatively heterotic chromosome rearrangements are unlikely to be fixed, but only that they cannot spread in a large panmictic population as the stasipatric model supposes.) Similarly, there is no reason to think, as some authors in this volume seem to, that allozyme differences between populations are relevant to the evolution of reproductive isolation. In the same vein, the existence of repeated DNA sequences that differ between species but are homogeneous within species might warrant a "molecular drive" hypothesis of the kind Dover advances, but there is as yet no reason to think that these sequences are instrumental in speciation, or that speciation requires a mechanism as novel and speculative as the one Dover offers.

Second, speciation theory is still encrusted by myths that have little basis. Neither theoretical nor empirical population genetics supports the idea that a population founded by few individuals is substantially reduced in heterozygosity. There is little empirical evidence, and, as Templeton remarks, little theoretical reason to expect, that speciation often entails the reinforcement of premating isolating mechanisms, though this idea persists in this volume.

Third, speciation theory is strongly colored by the highly holistic view of the species as an integrated, coadapted gene pool that resists selection. Clearly epistasis and genetic correlations do exist, so this view is not entirely without support. But this concept of species has been counterproductive in certain ways: it has tended to discourage useful reductionist approaches to speciation, and it has led to a proliferation of almost mystical hypotheses for which no mechanistic bases have yet been identified. Thus on the basis of absolutely no evidence we find authors in this volume postulating that speciation is caused by changes in regulatory genes (whatever they may be), by regulatory effects of repeated sequences (which have not been demonstrated), or by chromosome rearrangements that protect gene complexes against recombination; that speciation invariably requires a drastic reduction in population size; that species progressively lose the capacity for further speciation as their gene pools progressively congeal. But virtually all the evidence for genetic homeostasis and coadaptation (reviewed here by Carson) is susceptible to a less holistic interpretation, and, after all, populations do respond readily to selection.

With the exception of Templeton's admirable essay, this book hardly addresses at all the simpler models that can account for speciation. Many species are isolated only by ethological or other premating barriers, which none of the authors treats in detail. Such barriers can arise quite simply, as Templeton stresses, by adaptive divergence or by sexual selection (see for example Lande, *Proc. Natl. Acad. Sci. U.S.A.* **78**, 3721 [1981]), and Kirkpatrick, *Evolution* **36**, 1 [1982]).