BOOK REVIEWS

Evolutionist

The Evolution of Theodosius Dobzhansky. Essays on His Life and Thought in Russia and America. MARK B. ADAMS, Ed. Princeton University Press, Princeton, NJ, 1994. xii, 249 pp., illus. $35 or £28.50. From a symposium, Leningrad, Sept. 1990.

The 16 papers collected in this volume present a remarkably well-rounded portrait of one of the most important evolutionary biologists during the last century—Theodosius Dobzhansky. Even Dobzhansky's closest rivals agree that his *Genetics and the Origin of Species* (1937) served as the catalyst for the Synthetic Theory of evolution. Dobzhansky had two important things going for him. Because he was brought up in Russia, he was not convinced, as were so many English-speaking biologists, that Mendelian genetics was incompatible with a Darwinian theory of evolution or that laboratory results and fieldwork could not be brought to bear on each other. When he arrived at Thomas Hunt Morgan's Fly Room at Columbia in 1927, he set about to learn all he could from his American colleagues and then struck out on his own. In population genetics at the time, as William Provine notes, "theory had far outrun facts" (p. 101). Dobzhansky rectified this imbalance. As a result, a whole generation of population geneticists was encouraged to test theories about evolution both in the laboratory and in the field.

Dobzhansky also brought with him from his mentor, Iurii Filipchenko, serious doubts about the adequacy of extrapolating from phenomena occurring in local populations at low levels of analysis (microevolution) to explain more global, higher-level phenomena (macroevolution). Filipchenko viewed inheritance as being of two types: "Mendelian inheritance of variation within species and non-Mendelian (and nonchromosomal) inheritance of variation in macroevolutionary characters delineating higher taxa" (p. 51). As Richard Burian shows, Dobzhansky reflected these doubts in the first edition of his *Genetics and the Origin of Species* but gradually grew more confident as the years progressed, until one of the basic premises of the Synthetic Theory became the legitimacy of reasoning from micro- to macroevolution. As Dobzhansky put it later, Filipchenko "bet on the wrong horse" (p. 51).

Dobzhansky's early work in Russia on the amount of phenotypic variation in ladybugs was designed to discover whether natural populations included enough heritable variation for natural selection to work. As Garland Allen explains, the techniques of chromosome analysis that Dobzhansky learned in the Fly Room provided him with a much more precise and rigorous method of determining variability at the chromosomal level than did mere inspection of phenotypic variability. As a result of this research, a bitter dispute arose between Dobzhansky and another denizen of the Fly Room—H. J. Muller. According to Muller, selection is so perceptive that very little genetic heterogeneity can exist in nature for very long. Dobzhansky insisted that genetic heterogeneity was commonplace and postulated heterozygote superiority as one mechanism for maintaining it.

Thus far I have dwelt on the narrowly scientific issues that concerned Dobzhansky. After all, if Dobzhansky had not been a great evolutionary biologist, no one would have bothered to convene a conference on his life and work. But several of the papers in this collection concern his extra-scientific views and how they bore on his scientific work. As the recent discussion of "culture wars" in the pages of this journal (**265**, 853–55 [12 August 1994]) indicates, the status of social constructivism is an emotionally charged issue. The authors in this volume avoid the sort of simplistic claims that some commentators have made about the projection of culture and class values into evolutionary thought. They show how Dobzhansky was attracted to certain views about the evolutionary process because they supported his social, political, and religious views and struggled with others because they conflicted with them. John Beatty details one of these conflicts. From Darwin to the present, biologists have been concerned about the ruthless character of the evolutionary process. Darwin consoled himself by observing that the "war of nature is not incessant, that no fear is felt, that death is generally prompt, and that the vigorous, the healthy, and the happy survive and multiply" (p. 199).

T. H. Morgan for one was not mollified. Although he admired Darwin's "kindness of heart," he could not ignore the "wastefulness, the cruelty, the tragedy of nature" (p. 201) that his theory implied. Morgan was not alone among biologists in worrying about the implications of biology for fascism, communism, capitalism, democracy—take your pick. Dobzhansky was especially bothered by the dilemma posed by variability. Genetic variability increased the likelihood that a species would survive in a changing environment but condemned large numbers of individual organisms to perish. Genetic heterogeneity might be "good for the species," but it certainly was not good for individual organisms. Dobzhansky was deeply concerned about the apparent moral and political implica-

"The photo given to Dobzhansky in Kiev as a going-away present, inscribed 'to dear ThD from his colleagues.' *Top row, left to right:* Sergei Ivanov, Longin Kosakovsky, Iulii Kerkis. . . . *Bottom row, left to right:* M. M. Levit, Dobzhansky, A. G. Lebedev, N. S. Greze, and G. I. Shpet." [From *The Evolution of Theodosius Dobzhansky*] tions of genetic variability for humankind. He attempted to minimize these negative implications by emphasizing developmental plasticity and the genetic uniqueness of individuals.

Dobzhansky thought of himself as a moderate with respect to the nature-nurture issue. Neither genes nor environments determine the fate of organisms. Instead there is a very complex interaction between the two. At the height of the IQ controversy, as Diane Paul shows, Dobzhansky was distressed by certain geneticists who seemed to be claiming that genes have nothing to do with individual differences in human cognitive abilities and aptitudes. Politically palatable as this position might be, Dobzhansky found it crudely mistaken. For those authors who see eugenics as being inherently evil, the fact that Dobzhansky joined the Board of Directors of the American Eugenics Society in 1964 is likely to come as a shock. Either Dobzhansky was not as saintly as he has been portrayed or possibly eugenics is not quite as evil as it has been portrayed. Dobzhansky for one thought that those people who carry "serious diseases should be convinced—and failing that compelled—not to reproduce" (p. 225).

That Dobzhansky was on the board of a eugenics society is disconcerting enough to a contemporary reader without discovering that he was also the president of the American branch of the Teilhard Society. Ruse concludes the collection by explaining how Dobzhansky could embrace the theological musings of Teilhard de Chardin when other scientists either pointedly ignored them or denounced them outright. Part of the answer is that Dobzhansky came from a long line of priests—Eastern Orthodox priests, I hasten to add—and remained deeply religious all his life. For this reason and others, he believed in progress with respect to both biological evolution and human affairs of the sort proposed by Teilhard. In short, Dobzhansky's own evolution was as complex and multifaceted as the biological process he strove to understand.

David L. Hull
Department of Philosophy,
Northwestern University,
Evanston, IL 60208, USA

The Golden Bough

Phyllotaxis. A Systemic Study in Plant Morphogenesis. ROGER V. JEAN. Cambridge University Press, New York, 1994. xiv, 386 pp., illus. $74.95 or £45.

Phyllotaxis—the elegant geometrical pattern of leaves along a twig, of florets on the face of a sunflower, of scales on the surface of a pineapple—has long been a source of wonder and inspiration and has drawn the attention of such great minds as Leonardo da Vinci, Kepler, and Goethe. In most plants, such leaves, florets, or scales appear to be arranged in two families of regular spirals, or parastichies, that intersect at roughly right angles. Remarkably, in almost every case the numbers of spirals in these families are adjacent numbers in the Fibonacci sequence {1, 1, 2, 3, 5, 8, 13, . . .}, in which each number is the sum of the preceding two. The divergence angle between successive leaves is the golden angle, an irrational number roughly 137.5°, deeply linked to the Fibonacci sequence and to the golden rectangle of Greek antiquity.

Roger Jean presents an overview of these fascinating phenomena and their roots in a new book that should interest biologists, mathematicians, and historians of science. Over the last 18 years, he has presented several models that shed light on the labyrinthine interconnections among parastichies, Fibonacci numbers, the golden angle, divergence angle, branching processes, growth, allometry, self-similarity, spatial packing, and fractal geometry. Taking these as his base, Jean reviews various aspects of the history of research on phyllotaxis, focusing first on the mathematical relationships seen in phyllotactic patterns and then on how and why such patterns arise.

After important early contributions by da Vinci and others, the modern study of phyllotaxis began in 1837 with a paper by the brothers Bravais (one a botanist, the other a crystallographer), in which they coined the term and summarized some of the precise relationships shown by leaves packed in spirals along stems. Over the next century this paper helped inspire an extensive literature, which became a tangled and confusing web when it was realized that many different sets of spirals could be drawn through any given leaf arrangement. By 1917, D'Arcy Thompson concluded that an irreducible subjectivity had transformed the entire subject into mysticism and fantastic speculation. Jean untangles this confused web and provides an integrated approach to the description and mathematical study of phyllotactic spirals. He outlines the key results of the last 150 years and tabulates the expected relationships among parastichy numbers, divergence angle, primordia size, and size of the shoot apex. The results are quite general: a survey of nearly 13,000 observations on 650 species indicate that 96.5% conform to classic, Fibonacci-type phyllotaxes.

How do plants achieve such a regular leaf arrangement? Jean addresses this question at length, though with mixed success. The main constraint creating Fibonacci spirals appears to be the efficient packing of leaves or other organs on a cylindrical or disk-like lattice. Divergence by the golden angle distributes successive leaves or florets more evenly around a plant's stem or inflorescence than any other angle; deviations of as little as 0.1° from the golden angle decrease the tightness and evenness of packing dramatically, increasing self-shading (as proposed by da Vinci) or decreasing the efficiency of floral packing (see illustration). Hypotheses to account for spiral morphogenesis have centered on diffusion of chemical inhibitors or promoters from leaf primordia; on competition among competing leaves or procambial strands for nutrients; on filling of

Vignettes: Committee Work

Individual scientists have no doubts about Nature's indifference to popular opinion, no matter how well informed. But the scientific enterprise today is controlled not by individuals but by committees, these relatively modern institutions which, in the words of Sir Barnett Cocks, a former Clerk of the British House of Commons, are cul-de-sacs down which ideas are lured and then quietly strangled.

—*Donald Braben, in To Be a Scientist: The Spirit of Adventure in Science and Technology* (Oxford University Press)

It is an old joke that a camel is a horse designed by a committee, a joke which does grave injustice to a splendid creature and altogether too much honour to the creative power of committees.

—*Michael French*, in *Invention and Evolution: Design in Nature and Engineering* (second edition; Cambridge University Press)