much impressive progress has come from single-minded concentration on genes as units of selection and the conflicts that arise among them from different patterns of transmission; and many books and thousands of papers have been written on life history evolution and the evolution of sex. Williams did not do it alone, but his influence was great, and it was a hard act to follow.

Has he done it again? He has, and more.

Williams starts by distinguishing clearly between replicators and interactors: replicators consist of information, interactors of material stuff. The distinction is not new; the power and precision with which Williams applies it are. He then defines the things on which natural selection can work: any pieces of information whose history can be represented by a dendrogram, including but not limited to genes. Thus selection among clades is in principle possible and a plausible explanation for the taxonomic distribution of sexual reproduction, semelparity, and small clutches. Williams applies his dendrogram criterion ruthlessly to destroy the notion that natural selection could operate on units like species, on trait groups, or on symbiotic associations like lichens. He suggests how to weigh the relative power of selection within and among gene pools: compare rates of turnover of genes with rates of turnover of gene pools, not rates of death of individuals with rates of death of clades. Here Williams updates his 1966 critique of group selection to deal with recent developments.

Williams is not afraid to stick his neck out. The comparative method is currently popular. It combines phylogenetic systematics with new statistical methods to attack questions suggested by comparing traits in related species. Williams takes issue with several of the developing dogmas. Rather than judge adaptation by comparison, he prefers the criterion of conformity to design specifications as determined, for example, by an optimality model. Rather than count the number of independent phylogenetic events, he poses an implicit question: "I am unaware of any study of the logical differences among phylogenetic independence of gene pools, phylogenetic independence of gene lineages within a single gene pool, and developmental independence of different individuals in a population or clone" (p. 103). His challenge is useful; it stems from the dendrogram criterion, a sharp tool that can cut deep.

Most stimulating is the discussion of outstanding paradoxes. Williams is skeptical about current explanations of leks, of female pheromones, and of helpful stress; he has little use for species considered as individuals or as units of selection; he rejects the peripheral isolate theory of speciation. He wonders why body temperature does not vary more in birds and mammals, why vertebrates that live in the ocean (except the Agnatha) do not maintain higher electrolyte concentrations, why there are no viviparous birds or turtles, why we blink simultaneously (and thus are blind 5 percent of the time).

At a few points, he misses important issues. He does not discuss the context-dependency of genetic information. The meaning of a given DNA sequence varies wildly depending upon the organism, tissue, and cell in which it finds itself. "Hier," as a string of letters, means "here" in German and "yesterday" in French; there is information in context. Information resides not only in genes but in the materials out of which organisms are built, as Alberch and Oster have convincingly shown. Thus some of the information in the context that gives genes their meanings does not reside in other genes. Evolutionary biology has not yet digested the implications.

In discussing genetic conflict, Williams neglects to mention a method of resolving conflicts. Consider a cytoplasmic element, like a feminizing bacterium. Its interest is always to occur in a female, through whose eggs it can be vertically transmitted, and to that end it feminizes its host. However, as an evolutionarily stable strategy it is often in the host's interest to allocate sex equally to sons and daughters. Thus there is a conflict of interest between host and parasite. This conflict can be resolved if the cytoplasmic element is incorporated into the host's nuclear genome, as appears to have happened in a pillbug, where the element now functions as part of a sex chromosome—a brilliant solution. Such stable and durable conflict resolution may also account for the incorporation of genes for essential mitochondrial functions into the nuclear genome.

Though he does not discuss fitness directly, Williams does make comments on "success" that leave me puzzled. He judges success not just by counting the number of copies of information present but by measuring the amount of material stuff on which it imposes pattern. To me, evolutionary success is survival up to now; whether a piece of DNA imposes pattern on a nanogram of *Escherichia coli* or a ton of elephant is beside the point. I await clarification.

This book constructively critiques central evolutionary ideas. It should be published with the 1966 book in one volume. Together they make a devastating, and exciting, read.

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Genetics by Nation

The History and Development of Human Genetics. Progress in Different Countries. KRISHNA R. DRONAMRAJU, Ed. World Scientific, River Edge, NJ. 1992. xii. 303 pp., illus. $86. Based on a symposium, Washington, DC, Oct. 1991.

J. V. Neel in his introduction to this volume cites a number of reasons why human genetics has become so active in recent years: the advent of biochemical and molecular genetics; new methodologies in cytogenetics; development of somatic cell genetics; availability of high-speed and high-capacity computers; concern over environmental (radiation and chemical) mutagens; absence of infectious and nutritional diseases in developed countries; interconvertibility of genetic knowledge between various species; availability of funding; and the possibility that with all these developments interested geneticists who previously avoided the field ("closet" human geneticists) could now make scientific contributions.

The book consists of papers presented at a satellite meeting of the 1991 International Congress of Human Genetics. Though it includes a few substantial historical analyses, most of the contributions are limited to reporting names and trends in various countries, including Canada, France, Italy, Hungary, Japan, Israel, Egypt, Chile, and Brazil. No attempt was made to cover recent developments in the United States. The British contributions are limited to an analysis of Fisher's and Haldane's work with special reference to blood groups. Haldane's impact on human genetics in India is covered in a separate chapter by the editor.

A substantial article by E. A. Carlson on the contributions of the pioneering United States geneticist H. J. Muller to human heredity is particularly interesting. Mentioning the eugenic past of human genetics, Carlson refers to the field as a "lotus that emerged from a dung heap" and compares its history to the antecedents of chemistry in alchemy and of astronomy in astrology. No other papers in the volume deal with eugenics and its relation to human genetics, which were discussed in another symposium at the congress.

The history of the active field of human gene mapping is covered by N. E. Morton in characteristically iconoclastic manner. Considering extensive current attempts to identify human genes in complex non-Mendelian diseases by linkage, he points out that "no linkage test in man has detected a major locus not defined by segregation

analysis and/or evident by inspection of pedigrees"—a sobering conclusion.

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Autoimmunity in Nephritis. Francis W. Ballardie, Ed. Harwood, Philadelphia, 1992. x, 140 pp., illus. $30.

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