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Evolutionary adaptation is a special and onerous concept that should not be used unnecessarily, and an effect should not be called a function unless it is clearly produced by design and not by chance. When recognized, adaptation should be attributed to no higher a level of organization than is demanded by the evidence. Natural selection is the only acceptable explanation for the genesis and maintenance of adaptation.

2. NATURAL SELECTION, ADAPTATION, AND PROGRESS	20
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Natural selection can be effective only where there are certain quantitative relationships among sampling errors, selection coefficients, and rates of random change. The selection of alternative alleles in Mendelian populations meets the requirements. Other conceivable kinds of selection do not. Selection of alternative alleles works only with an immediate better-vs.-worse among individuals in a population, and the question of population survival is irrelevant. Once a certain level of complexity is evolved, selection will maintain adaptation by occasionally substituting one adaptive character for another, but this will not result in any of the kinds of cumulative progress that have been envisioned.

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3. NATURAL SELECTION, ECOLOGY, AND MORPHOGENESIS 56

The gene is selected through a complex interaction with its environment, which can usefully be considered to include several levels: the genetic, the somatic, and the ecological. The ecological has many aspects, one of which, the "demographic," is given special treatment. Age-specific birth rates and death rates are important factors in the selection of developmental rates and other aspects of life cycles. The importance of genetic assimilation as a creative factor is minimized.

4. GROUP SELECTION 92

Selection at the genic level can produce adaptive organization of individuals and family groups. Any adaptive organization of a population must be attributed to the selection of alternative populations. Reasons are advanced for doubting, *a priori*, the effectiveness of such group selection. *Organic adaptations*, which function to maximize the genetic survival of individuals, are distinguished from *biotic adaptations*, which would be designed to perpetuate a population or more inclusive group.

5. ADAPTATIONS OF THE GENETIC SYSTEM 125

Phenomena relating to the genetic system, such as dominance, diploidy, sex-determining mechanisms, and the distribution of sexual and asexual reproduction in life cycles are easily explained as short-term organic adaptations. The survival and evolution of groups are fortuitous consequences of these adaptations and of their occasional malfunctioning, as in mutation and introgression. There is no respectable evidence of mechanisms for maintaining evolutionary plasticity or of any other biotic adaptations of the genetic system.

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6. REPRODUCTIVE PHYSIOLOGY AND BEHAVIOR 158

Variations in the intensity of reproductive effort, and in the manner in which it is expended, seem designed to maximize the reproductive success of the reproducing individuals. Attention is given to the evolution of fecundity, viviparity, gregarious reproduction, and differences between the sexes in reproductive behavior. These phenomena support the conclusion that the goal of an individual's reproduction is not to perpetuate the population or species, but to maximize the representation of its own germ plasm, relative to that of others in the same population.

7. SOCIAL ADAPTATIONS 193

Selection within a population can lead to cooperative relations among closely related individuals, because the benefits of cooperation would go mainly to individuals with the genetic basis of cooperation, rather than to those of alternative genetic makeup. Selection at the genic level thus explains insect societies and analogous developments in other organisms. Other apparent examples of altruism are explained as misplaced parental behavior. They represent imperfections in the mechanisms that normally regulate the timing and execution of parental behavior. Benefits to groups often arise as incidental statistical consequences of individual activities, just as harmful effects may accumulate in the same way.

8. OTHER SUPPOSEDLY GROUP-RELATED ADAPTATIONS 221

Various supposed biotic adaptations, such as poisonous flesh, senescence, and genetically heterogeneous somata, are examined and found to be spurious or inconclusive. The regulation of population size is shown to arise from individual adaptations or purely physical principles rather than as an adaptive organization of the group.

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Similar arguments are used against the concept of an adaptive organization of ecological communities or more inclusive entities.

9. THE SCIENTIFIC STUDY OF ADAPTATION 251

For a given biological mechanism there are no established principles and procedures for answering the question, "What is its function?" Objectively determined answers to such questions would facilitate progress in many fields of biology, but they must await development of special concepts for the study of adaptation as a general principle. Teleonomy is a suitable name for this special field of study.

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