

MATHEMATICAL MODELS, PROBLEMS, AND CONTROVERSIES OF EVOLUTIONARY THEORY¹

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1. The year 1982, the centenary of Charles Darwin's death, witnessed conferences, symposia, and publications in many disciplines devoted to re-assessing the theory of evolution by natural selection and all its ramifications. A brief historical review on developments in evolutionary theory emphasizing the role of mathematics is given in §3 of this paper. §2 presents background material on agents of evolutionary processes. §4 contains an annotated listing of several problems and controversies pertaining to evolutionary processes, and a more extended discussion of the neutralist-selectionist controversy. §5 presents background information relating to sex ratio in various plant and animal species. Several classes of mathematical models of much recent interest centering on sex ratio evolution and related dynamical systems are examined in §§6–8; the purely mathematically oriented reader can pass directly to these sections. The concluding section presents our views on several philosophic issues in evolutionary theory today, and on the nature of the mathematics relevant to the genetics of the current decade.

Taxonomists have recorded 1–2 million plant and animal species and surmise that another 4–6 million species remain to be classified. More than 50% of all living species are of the insect genera; the *Drosophila* flies alone comprise at least 2,500 species. Counts of bird species vary from 8,000 to 10,000. The number of species from the evolution of life to the present is estimated at 4–16 billion. Simpson (1953) projects that more than 99.9% of all species that ever existed are extinct.

The ubiquitous variability within species of biochemical, morphological, physiological, and behavioral traits is also intriguing. As observation, and experimental techniques are being refined, increasing numbers of segregating genes (those exhibiting at least two alternative types) are being detected. Another aspect of nonuniformity is the prodigious variety of sexual mechanisms, mating patterns, life cycles, life styles, strategies for survival and reproduction, growth characteristics, and ecosystem interactions.

Concomitant to the observed diversity in living forms and life patterns, there are some universals and expressions of identity. The basic DNA-RNA structure and its replication mechanism are present in "all" organisms. Proteins

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