

THE ROLE OF CHANCE IN GENOME EVOLUTION*

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INTRODUCTION

The role played by chance in evolution is an old but still hotly debated issue. One extreme viewpoint was stated in a very strong form by Jacques Monod in Le hasard et la nécessité (1) : "Chance only is the source of every novelty, of every creation in the biosphere. Sheer chance, chance only, absolute but blind freedom at the very roots of evolution : this central notion in modern biology is not anymore a hypothesis among other possible ones or at least conceivable ones. This hypothesis is the only conceivable, since it is the only one which is compatible with observation and experience. And nothing allows us to imagine (or to hope) that our ideas on this point will need, or will be subject to, revision". At the time this statement was made, most molecular biologists were in agreement with it. Not all, however; indeed objections were raised (see for instance ref. 2), but on philosophical grounds alone. Here we will address this question again and discuss its present status in the light of new results.

First of all, we should rephrase the question. Indeed, mutations, once they have occurred, may subsequently be eliminated or become fixed in the genome. While it is generally agreed that elimination affects deleterious mutations and occurs by negative selection, fixation has been visualized as due either (i) to positive Darwinian selection acting on advantageous mutations; or (ii) to random genetic drift acting on selectively neutral (*i.e.* selectively equivalent) mutations. Since both advantageous and neutral mutations definitely can be fixed in evolution, the issue is of quantitative and not of a qualitative evolution, the issue is of a quantitative and not of a qualitative nature and concerns

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