

STOCHASTIC MODELS FOR CARCINOGENESIS

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1. Introduction

In the last ten years or so a number of papers have appeared, putting forward models of varying degrees of mathematical complexity to describe some of the processes underlying the phenomenon of carcinogenesis. None of these models has gained general acceptance; nor has any clear body of evidence been marshalled which would exclude any of these models from further consideration. One should perhaps consider whether further development of models of this type is profitable at the present time. There is, of course, a danger that models which provide a reasonable description of certain observations may be entirely misconceived. For example, the rapid rise with age in rates of mortality from certain types of cancer, with which some of the models are particularly concerned, is simulated by the pattern of mortality from some other causes, such as accidents, for which the models are clearly inapplicable. There are, we think, two main reasons for maintaining a cautious interest in this topic. One is that many of the concepts on which the models were based were put forward originally by workers in the cancer research field before being formulated in mathematical terms. Salaman [1] points out, for example, that the concept of a number of qualitatively different stages in carcinogenesis was discussed by various workers, including P. Rous and I. Berenblum, between 1935 and 1947. Consequently, there are fairly well established experimental grounds for the formulation of some of the models, and it is reasonable to inquire whether these models satisfy the quantitative, as well as the qualitative, aspects of the data. Secondly, in the present state of ignorance of the biological mechanism of carcinogenesis, it is possible that the mathematical concepts which are evoked to satisfy the available quantitative data might suggest possible lines for future experimentation.

One purpose of the present review is to attempt a unified approach to the various models which have appeared in the literature. This is of some value in indicating that certain features follow as consequences of a general model which embraces many of the particular models. Secondly, we have tried to show the extent to which the different models provide satisfactory descriptions of observed phenomena. The difficulties in covering the literature of relevant experimental data are formidable, and we have not attempted here a general review (which