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VOLUME V

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VOLUME V

DARWINIAN, NEO-DARWINIAN, AND NON-DARWINIAN EVOLUTION

April 9–12, 1971

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PREFACE

Berkeley Symposia on Mathematical Statistics and Probability have been held at five year intervals since 1945, with the Sixth Symposium marking a quarter of a century of this activity. The purpose of the Symposia is to promote research and to record in the *Proceedings* the contemporary trends in thought and effort. The subjects covered in the Berkeley statistical Symposia range from pure theory of probability through theory of statistics to a variety of fields of applications of these two mathematical disciplines. The fields selected are those that appear especially important either as a source of novel statistical and probabilistic problems or because of their broad interdisciplinary character combined with particular significance to the society at large. A wide field of application traditionally represented at the Berkeley Symposia is the field of biology and health problems. Physical sciences, including astronomy, physics, and meteorology are also frequently represented. Volume 5 of the *Proceedings* of the Fifth Symposium was entirely given to weather modification.

With the help of advisory committees and of particular scholars, the participants of the Berkeley Symposia are recruited from all countries of the world, hopefully to include representatives of all significant schools of thought. In order to stimulate fruitful crossfertilization of ideas, efforts are made for the symposia to last somewhat longer than ordinary scholarly meetings, up to six weeks during which days with scholarly sessions are combined with excursions to the mountains and other social events. The record shows that, not infrequently, novel ideas are born at just such occasions.

According to the original plans, the entire Sixth Berkeley Symposium was to be held during the summer of 1970, with the generous support of the University of California, through an allocation from the Russell S. Springer Memorial Foundation, of the National Science Foundation, of the National Institutes of Health, of the Office of Naval Research, of the Army Research Office, and of the Air Force Office of Scientific Research. This help is most gratefully acknowledged. Certain circumstances prevented the Biology-Health Section from being held in 1970 and the meeting held in that year, from June 21 to July 18, was concerned with mathematical domains of probability and statistics. The papers presented at that time, and also some that were sent in by the individuals who were not able to attend personally, fill the first three volumes of these *Proceedings*. Volume 1 is given to theory of statistics and Volumes 2 and 3 to the rapidly developing theory of probability.

The Biology-Health Section of the Sixth Symposium had to be postponed to 1971. Every postponement of a scholarly meeting involves a disruption of the plans and all kinds of difficulties. Such disruption and difficulties certainly occurred in the present case. As originally planned, the Biology-Health Section of the Sixth Symposium was to be comparable to that of the Fifth, the *Proceedings* of which extended close to 1,000 pages in print. This is much larger than

Volume 4 of the present *Proceedings* that summarizes the Biology-Health Section held from June 16 to 21, 1971. However, the losses suffered in some respects have been compensated by gains in others. Those gains are reflected in Volumes 5 and 6 of these *Proceedings*.

During the fall of 1970 we became much impressed by the development and rapid growth of a new field of biological studies which includes the areas known as "non-Darwinian" and "neo-Darwinian" studies of evolution. These are studies based on the structure of macromolecules present in many now living species and performing in them similar functions. One example is the hemoglobin molecule, carried by all mammals as well as by fish. The differences among the homologous macromolecules in different species are usually ascribed to mutations that are in some sense inconsequential, and are supposed to occur more or less at a uniform rate. The number of differences between any two species is indicative of the time that elapsed from the moment of separation from the presumed common ancestor. The probabilistic-statistical problems involved in such studies include the estimation of philogenetic trees of several species and, in particular, the estimation of the time since two species separated from their ancestor.

It was found that, with only a few exceptions, mathematical statisticians are not familiar with the new domain and that, at the same time, a great many biologists make strong efforts to treat the statistical problems themselves. A joint meeting of biologists and statisticians was clearly indicated and a separate conference, especially given to novel studies of evolution, was held from April 9 to 12, as part of the Biology-Health Section of the Sixth Berkeley Symposium. It is summarized in Volume 5 of these *Proceedings*. Somewhat unexpectedly, it appeared that the new field of studies of evolution involves controversies that are just as sharp as those that occasionally enliven the meetings of mathematical statisticians . . .

We were introduced to problems of evolution treated on the level of macromolecules by Professor T. H. Jukes, V. N. Sarich, and A. C. Wilson. Their very interesting seminar talks and later their advice on the organization of the conference on evolution are highly appreciated.

While studies of evolution involve observational research, particularly that concerned with the relation between classical population genetics and novel findings on the level of molecular biology, the whole domain is clearly conceptual. Contrary to this, the third part of the Biology-Health Section of the Sixth Symposium was totally given to observational studies in a domain of great importance to society at large and of great public interest.

The domain in question, a highly controversial domain, is that of the relation between environmental pollution and human health. The growing population in the United States and in other countries needs more electric power, more automobiles, and other products. The relevant industries are eager to satisfy these needs. However, the expanded industrial activity, unavoidably conducted with an eye on costs, leads to pollution of the environment. The controversies at

public hearings, in the daily press, and in scholarly publications center around the question whether the currently adopted standards of safety are sufficient or not. The volume of research, largely statistical, surrounding this question is immense. The intention that the *Proceedings* provide a cross section of contemporary statistical work dictated the organization of a special conference entirely given to the problem of health and pollution. This conference, held from July 19 to 22, is summarized in Volume 6 of these *Proceedings*. In organizing the conference we benefitted greatly from the advice of Dr. S. W. Greenhouse of the National Institutes of Health, of Professor B. Greenberg of Chapel Hill, North Carolina, and of Drs. J. M. Hollander and H. W. Patterson of the Berkeley Lawrence Laboratory.

The first purpose of the Health-Pollution Conference was to take stock of the studies already performed. The second and the ultimate purpose was to see whether a novel statistical study is called for, hopefully more comprehensive and more reliable than those already completed. With this in mind, invitations to the conference were issued to Federal and State governmental agencies concerned with health and pollution, to authoritative scholarly institutions, and to a number of particular individual scholars known to have worked on one or another aspect of this problem.

As a special stimulus for thought on the entire problem of pollution and health, its present state and the future, the invitations to the conference were formulated to include a call for submission of skeletal plans for a fresh comprehensive statistical study, capable of separating the effects of particular pollutants. Four such plans were submitted and they are published in Volume 6.

All the participants had complete freedom of expression, both in their prepared papers and in their contributions to the discussion. Thus it is likely that the goal of providing a realistic cross section of contemporary statistical research on the problem is reasonably approached. Also it is not unlikely that the present state of knowledge on human health and pollution, and the scholarly level of the substantive studies prepared are fairly reflected in these *Proceedings*.

In addition to funds provided by the University of California and the National Institutes of Health, the Health-Pollution Conference was organized using a grant from the Atomic Energy Commission, Division of Biology and Medicine. This help is gratefully acknowledged.

The organization and the running of three distinct scholarly meetings, one in April, another in June, and the third in July 1971, each attended by some 100 to more than 300 participants, would not have been possible without the willing, efficient, and cheerful help and cooperation of the staff of the Department of Statistics and the Statistical Laboratory. Our most hearty thanks go to our successive "ministers of finance," Mrs. Barbara Gaugl and Mrs. Freddie Ruhl, who watched the sinking balances and surveyed the legality of proposed expenditures, some appropriate under one grant and not under another, etc. In addition to financial matters, Mrs. Gaugl supervised the local arrangements for scholarly sessions, for several social events and for servicing the participants. In this she

was efficiently helped by Mrs. Dominique Cooke, by Miss Judy Whipple and by a number of volunteers from among the graduate students in the Department. Mrs. Cooke and Miss Whipple had their own very important domain of activities: to keep straight the correspondence and the files. Coming in addition to the ordinary university business, this was no mean job and the performance of the two ladies is highly appreciated.

All the above refers to the early part of the year 1971 and up to the end of the conferences. Then the manuscripts of the papers to be published in the *Proceedings* started to arrive, totalling 1849 typewritten pages, not counting figures and numerical tables. This marked a new phase of the job in which we enjoyed the cooperation of another group of persons, who prepared the material for the printers. At the time, the team of editors, Miss Carol Conti, Mrs. Margaret Darland, and Miss Jean Kettler, under the able guidance of Mrs. Virginia Thompson and supervised by Professor LeCam, Chairman of the Organizing Committee, worked assiduously on proofs of papers in Volumes 1, 2 and 3. The arrival of the material for Volumes 4, 5, and 6, unavoidably involving some correspondence with the authors and conferences at the University Press, created heavy burden. We are very grateful to the four ladies whose cooperation has been inspiring to us.

Last but not least, our hearty thanks to the University of California Press, Mr. August Frugé and his colleagues for their help, cooperation and also their patience when confronted with piles of manuscripts which we hoped to see published both excellently as in the past quarter of a century and "right away, yesterday!"

J. NEYMAN E. L. SCOTT L. LE CAM (CHM.)

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