on a wide circle of molecular biologists—perhaps most of all because of his insistence on accuracy and thoroughness in scientific proof. I was a graduate student in Delbrück's lab from 1965 to 1972, a period during which he was using the fungus *Phycomyces* as a simple system to study sensory transducer physiology. Unfortunately, I believe the presentation of some of the scientific developments of those years is inaccurate and undermines the picture of Delbrück as a powerful leader who would search out the right expert when he needed a new approach.

Furthermore, the narrative at many points throughout the book is quite difficult to follow. In many cases stories are told that do not really have a point in the context of the events described. Just as they seem on the verge of some deeper analysis, the authors often move on to the next anecdote. I am disappointed that they do not take us further into an analysis of the rich emotional dynamics of Delbrück's life. They provide an inadequate description of his family of origin, and we learn even less about his relationship with his wife and four children. There is no discussion of the highs and lows that must have come together with the driving ambition. We learn little of any rivalries or even disagreements with colleagues. The one or two that are alluded to are not explored in any depth. The tremendous intensity with which Delbrück tore into problems is not here. Rather, he seems to move through his whole life in an exalted state, enjoying his work, teaching others, spreading the word about his latest choice of experimental material. Only in the all too brief description of his last days, as he struggles with his imminent death, do we finally gain a glimpse of his humanity.

In 1980 after he was diagnosed with a terminal cancer, multiple myeloma, Delbrück began an autobiography. At the time he explained that the project was an attempt to make it easier for science historians to understand his life. Since he knew little time was left, he did what he had done so many times before—influenced another scientist to devote his time and energy to the project. Peter Fischer met the requirements: he had received his Ph.D. degree with Delbrück in 1977, so could understand the science; he was German so could understand the language and culture of the important early years; and, finally, he had shown interest in and talent for writing about science. Following Delbrück's death in 1981 Fischer continued the project, which he has now finished with the help of Carol Lipson, a professor of English at Syracuse University who is also the wife of a former Delbrück research associate. Fischer also received financial help from Delbrück's wife, Manny, and institutional support from Cold Spring Harbor Laboratory. Thus this biography must be considered, as Delbrück himself would have said, an "inside job."

In *PATOOMB*, Jean Weigle, an associate of Delbrück's who had already had a distinguished career as a physicist before joining the "phage group," where he made several important discoveries, confesses how he has "told the story of the permeating influence of a questioning mind, producing in those near it another sort of questioning attitude which could be expressed this way: 'What will Max think of it, if he does think about it?' " In the case of this biography there is still an additional burden: What will all those who loved Max think of it? I think that this burden would fall too heavily on any insider attempting to write this biography. The close family feeling that made for such good science has made for entertaining but superficial science history.

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Delbrück "welcomed at Copenhagen Harbor as he arrives for the Polio Congress in September 1951." Left to right, Gunther Stent, Ole Maaloe, Delbrück, C. Bresdi, and James Watson. [From *Thinking About Science*; photo courtesy of Gunther Stent]

Genetic Rearrangements

Transposition. A. J. KINGSMAN, K. F. CHATER, and S. M. KINGSMAN, Eds. Published for the Society for General Microbiology by Cambridge University Press, New York, 1988. xvi, 375 pp., illus. $75. Symposia of the Society for General Microbiology, vol. 43. From a symposium, Coventry, U.K., April 1988.

The role of transposable genetic elements in reshaping the structure of prokaryotic and eukaryotic genomes is now generally recognized. The phenomena observed by McClintock in her early studies on chromosome rearrangements in maize are now understood as the effects of a family of transposable elements that includes *Ac* and *Ds*. The insertion sequences, IS elements, first identi-

fied by their ability to create mutations within the *lac* and *gal* operons of *Escherichia coli*, are known to be components of several transposable elements responsible for the dissemination of antibiotic resistance throughout the Enterobacteriaceae and their conjugal partners and to play a role in the organization of the R factors, which often contain nested sets of transposable elements. Transposable elements in yeast and higher eukaryotes are now important both as genetic tools and as clues to genome organization.

The present volume brings together current work on prokaryotic and eukaryotic transposable elements, and rapid publication has resulted in a book whose content is still timely. In it subjects not usually covered in current reviews figure prominently. It reports important data shortly in advance of journal publication (Clewell *et al.* on Tn*916*, a conjugative transposon in *Streptococcus*) or data from specialized systems (Chater *et al.* on the role of mobile antibiotic resistance determinants in genome flux in *Streptomyces*, Pays on DNA recombination and transposition in trypanosomes). There are general reviews on transposable elements in *Staphylococcus* (Murphy), the P elements in *Drosophila* (Rio), the yeast retrotransposons such as Ty (Kingsman *et al.*), and I-factors in *Drosophila* (Finnegan). Representative of the elegant in vitro analysis of transposition and resolution are papers on Mu transposition (Craigie *et al.*) and gamma-delta resolvase (Hatfull *et al.*). Phase and antigenic variation as a result of DNA rearrangements and the importance of such variation in the pathogenic properties of certain bacteria are reviewed by Meyer and Haas. The uses and properties of plant transposable elements are briefly treated by Schell (transfer of T-DNA from *Agrobacterium* into plants) and Schwarz-Sommer and Saedler. This important subject should have been covered in greater detail. Chapters with broader perspectives include those by Berg *et al.* on the mechanism and regulation of transposition and by Kuff and Leuders on the structure and evolution of retroviruses with homology to the transposable A-particle elements of mice.

The papers have numerous illustrations and references. For the reader who wants an introduction to the field, Shapiro's *Mobile Genetic Elements* is certainly more suitable (although an update of it is needed). But university and departmental libraries will want to have this current volume available for their faculty and graduate students.

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Lightning

The Lightning Discharge. MARTIN A. UMAN. Academic Press, San Diego, CA, 1987. xii, 377 pp., illus. $49. International Geophysics Series, vol. 39.

Our technologically based society is rapidly becoming more susceptible to the effects of lightning. In his preface to *The Lightning Discharge* Uman states that his goal is to provide a self-contained reference source on the subject. He has achieved this objective; the book also contains hundreds of references to the scientific research on lightning up to 1986, including an alphabetical list of books containing information on lightning that reveals the void this book fills.

This book represents a major departure from Uman's 1969 book *Lightning* in its organizational structure. This time he presents topics by physical process, not by diagnostic technique. There is not much detail on instrumentation, and experimental techniques are only summarized briefly in an appendix. I find the new organization more helpful. The book should be a useful reference for any comprehensive course on atmospheric electricity, and readers can easily glean from it general information about lightning. Each chapter has its own list of references, including some not cited in the text.

Topics covered by Uman include the components that make up a cloud-to-ground lightning flash, mostly related to the more common flash that lowers negative charge to the ground. In addition there is a chapter describing "positive lightning," that is, ground strikes that lower positive charge to ground, which are intriguing in their basic physics and have possible links with various weather phenomena, including severe storms and winter storms. In contrast to ground flashes, to which several chapters are devoted, cloud discharges are the focus of a single chapter, which adequately summarizes the historical data on the subject. Uman includes two chapters that cover relatively new areas of research, lightning on other planets and artificially initiated lightning. The latter phenomenon has recently become widely recognized as an operational problem for launch of all space vehicles and return to Earth of manned ones and is important in aviation because of the advent