growth and a sharp differentiation between the Old Regime and post-Revolutionary Europe would be of little relevance. Baker tends to view history as a continuum, emphasizing the idea of the "social field" which comes into existence through a set of polar tensions, rather than the idea of a social science assembled from a series of architectural building blocks.

Nevertheless, Baker does not relegate Condorcet to a minor position. The result is a book with two subjects, one discrete and the other continuous, reminding historians that they too must learn to live with complementary views of phenomena. What emerges is Condorcet as a focal point within the developing field, a point upon which converge all the tensions caused by the conflicting ideas that surged from the brains of the argumentative philosophes. Condorcet had the fortune, good or bad, to come at the end of an era. It was his task to imbibe all the arguments that preceded him and to attempt to resolve the most glaring conflicts. Whether or not he was aware of his historical position, it was clear that the time had come for some kind of synthesis or the efforts at enlightenment would have simply fizzled out. The outbreak of the Revolution simply made that need more urgent.

A sketch of what Baker finds recalls all the themes of the Enlightenment. Social science was to be built on the principles of human nature, which were to be derived from sensationalist psychology. The rigors of the necessary empiricism led inevitably to skepticism. No knowledge could be certain, but, unlike d'Alembert, who became morose about this outcome, Condorcet welcomed it. It meant that social science and physical science were to be built on the same epistemological bases, and this kind of intellectual consistency was a firm characteristic of French thought since the time of Descartes. Probabilism was turned by Condorcet from a defeat to an advantage, for it led to the mathematics of probability. Politics, after all, was the art of making decisions, and one could use probabilities to test the worthiness of decisions once rendered. Here is where the moral principle entered: if the number of people agreeing on a given decision reached a certain level of majority, then one could expect a corresponding probability of the decision's being the correct one. All this depended, of course, on the decision-makers' being rational, informed human beings. Hence, those who were to be charged with decisions ought to be educated. Condorcet's long preoccupation with education was the direct result. Not the least interesting aspect of Baker's story is the way in which the events of the Revolution forced Condorcet to a rapid democratization of his notions of politics and education.

None of this is very surprising, but it is good to have a steady scholar chronicle these events and ideas for us. Many other familiar themes and familiar persons are of course discussed at length in the book. Probably the best section is that dealing with the *Esquisse d'un tableau des progrès de l'esprit humain* and Condorcet's conception of history—surely a topic to warm the heart of any historian mad enough to pursue historiography. Baker goes with the traditional argument: Condorcet was not a modern historian. Progress as he conceived it had nothing to do with substantial change; it was rather a matter of perfectibility, the avoidance of error.

Now that the main themes of Baker's book have been indicated, let me raise some questions about intellectual histories in general. For intellectual historians have problems. One of them is the tendency to fall into a series of summaries of the great works of the age, and Baker has succumbed to this temptation. No doubt the works do have to be discussed, but unless one is careful the result is repetitiveness and a sense of tedium. I would argue that Baker's book is overdone, a case of scholarly zealousness that becomes self-defeating. There is an intense sense of the need for proper scholarship today, possibly a result of professional competitiveness or just of a society so riddled by double-talk that it seems essential to uphold strict standards, and perhaps I am being unfair to search for gripping interest in a work that must, after all, be true to its sources (and Condorcet was awfully like a schoolmaster). Yet elegance in writing can be found in intellectual histories, and in most cases it is found where the form is essay rather than narrative. One may argue vehemently with Charles Gillispie, with Jacques Barzun, even with the late Alexandre Koyré, but one is usually not bored by them. It is, I think, because they are masters of the situation and do not allow their material to master them. Baker has, I fear, been overcome by Condorcet. Only in the portion dealing with the events of the French Revolution does Baker's story have a compelling character that makes one wish to read faster. It is a shame, for his techniques of research must be nearly faultless, his thoroughness is enviable, and his subject is worthy of the enormous effort he has clearly put in. Baker will write other books, I hope, and if he can add some charm to his expertise he will achieve an enviable goal.

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Collision Phenomena

Atomic Collisions in Solids. Proceedings of a conference, Gatlinburg, Tenn., Sept. 1973. SHELDON DATZ, B. R. APPLETON, and C. D. MOAK, Eds. Plenum, New York, 1975. Two volumes. Vol. 1. xxiv pp. + pp. 1–478, illus. Vol. 2. xvi pp. + pp. 479–942, illus. Each volume, $39.50.

That this meeting record fills two volumes is a testament to the vigor of the field. The volumes are not elegant but serviceable, as befits a rapidly advancing field of research. As is usual nowadays, the price ensures that there will be few individual purchasers, but every research library should have a set and desk copies are recommended.

In the proceedings volumes the invited papers presented at each session of the conference are followed by contributed papers on the same general topic. The papers in one way or another relate to properties of ion beams in solids, channeling phenomena, stopping power, and efforts to probe the basic properties of solids by using energetic charged particles. Practical applications of these phenomena have been dealt with in other recent books and at other conferences convened especially for that purpose.

The first noteworthy point about the present volumes is that they contain substantial contributions by Russian scientists, five papers and two abstracts. All the Russian papers are theoretical, and they provide insight into the relationship between channeling and photon emission, surface scattering, and axial channeling in thick crystals. In fact, channeling phenomena are the subject of four of the ten sections of the book and are an essential part of the investigations reported in several others.

Some of the most interesting sections deal with atomic collision phenomena other than channeling in solids. Section 4 addresses ion screening in solids and the question of what physical mechanisms determine the charge state of an ion in a solid. It begins with an admirable review by Werner Brandt in which the physics of static and dynamic screening is clearly spelled out. Brandt goes on to discuss the consequences of screening phenomena as they influence the stopping power of solids for light and heavy ions, radiative electron capture, x-ray yields, and the charge states of ions emerging from surfaces. It is comforting to note that the basic physical concepts introduced by Niels Bohr in his classic 1948 paper are still valid as a starting point for thinking about the complex interactions that arise from the introduction of

a charged particle into a solid. The section concludes with reports by R. Behrisch *et al.* and T. M. Buck *et al.* on the effect of surface conditions on the backscattered fraction of charged hydrogen and helium atoms in the medium energy range (5 to 200 kev). These papers suggest that new aspects of surface physics await discovery by those who search for an explanation of the dependence of the backscattered charged fraction upon surface conditions.

Surface effects are treated from a different point of view in section 7, where the energy spectra and angular distributions of backscattered particles are discussed. The paper by S. K. Erents and G. M. McCracken is of special significance because of its bearing on practical applications. Erents and McCracken have investigated the desorption of condensed gases from surfaces bombarded by 5-kev protons. A thermal spike mechanism in the copper substrate can explain the results for deuterium and helium, but it apparently fails to predict the results for heavy gas atom desorption. Nor does a conventional momentum-transfer sputtering theory work. Additional unexplained data on the desorption of condensed gas mixtures underscore the need for pursuing this kind of research in order to develop a quantitative understanding of the underlying physical processes.

The present status of studies of x-ray emission from ion-ion collisions in solids is set forth in section 5. It appears that a whole new branch of atomic physics involving united-atom phenomena is rapidly developing. F. W. Saris begins the section with a review of molecular orbital theory leading to an understanding of molecular orbital x-ray production. Subsequent papers explore the complexities that arise in the production of noncharacteristic x-rays, that is, x-rays that cannot be attributed to either the target or the incident projectile. From the viewpoint of a solid state physicist, an exciting development is the recent observation of radiative electron capture. F. Bell and H.-D. Betz report their findings in a paper on heavy-ion collisions at Mev energies. A paper by H. W. Schnopper and J. P. Delvaille on the same subject appears in section 6. The important point in both papers is that radiative electron capture of bound target electrons leads to x-ray spectra that can be understood in terms of the electron momentum distribution of the target electrons. If this feature can be exploited it will be a welcome addition to the small family of techniques available for studying electron momentum distributions in solids and will represent a triumph in the study of atomic collisions in solids.

The clarity of the presentations and the inclusion of some theoretical papers among the experimental ones make these volumes a first-rate review of the many contributions being made to physics through studies of atomic collisions in solids.

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Energy Transformation

Bioenergetics of Photosynthesis. GOVINDJEE, Ed. Academic Press, New York, 1975. xvi, 700 pp., illus. $43. Cell Biology.

Bioenergetics of Photosynthesis is a valuable book, for those doing research on photosynthesis and for anyone else who desires authoritative and well-written general discussions of the various physical aspects of photosynthesis.

The book covers the following general topics: chloroplast structure (including chlorophyll organization); the initial physical and photochemical events in photosynthesis and the relationship to membrane structure and chlorophyll organization; electron transport and the mechanism of oxygen evolution; and mechanisms of energy conservation and photophosphorylation.

There has been considerable planning in the preparation of the book. The chapters complement each other well, with little overlap, and they have been reviewed by authorities in the field. The information they contain is current insofar as this is possible. The excellent chapter by Arntzen and Briantais on chloroplast structure was completed before the new information concerning individual polypeptides and their relationship to chloroplast membrane structure became available, but a note summarizing the later data is appended.

The chapter by Kenneth Sauer is a lucid presentation of the physical aspects of the primary steps of photosynthesis and contains a useful description of the various physical methods used in these measurements. Sauer also considers the physical and photochemical properties of reaction centers from chloroplasts and bacteria. There is some overlap between this chapter and the one by Litvin and Sineshchekov, which considers the molecular organization of chlorophyll. It is surprising that the work of Joseph Katz and his group is not given more recognition, in particular as it relates to the nature of the chlorophyll in P700. This should have been considered in the chapter by Litvin and Sineshchekov.

André Jagendorf presents an excellent review of the difficult topic of phosphorylation and with the aid of some informative drawings gives a very understandable outline of the various possible mechanisms for energy conservation and adenosine triphosphate (ATP) formation, with emphasis on the chemiosmotic theory. It is helpful to have in the same book a summary of the work and concepts of Witt's group pertaining to the generation and properties of the electrochemical membrane potential of chloroplasts, since over the years these workers have accumulated a wealth of data in support of the chemiosmotic theory of ATP formation in chloroplasts. The only feature missing in this area is a treatment of the recent work by Stoeckenius and his group, reported after the manuscripts were prepared, concerning bacteriorhodopsin and its role in ion movement and ATP formation in *Halobacterium halobium*. That work gives an added dimension to the biological uses made of radiant energy and must be considered in any future general review of energy conservation mechanisms.

The theoretical aspects of energy transfer and migration are beautifully covered by R. S. Knox, who indicates that there are more physical tools available to biophysicists than they are currently using in their analysis of the photosynthetic process.

I highly recommend this book, which I expect will become a standard reference book in photosynthesis laboratories and for all who specialize in bioenergetics.

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Pollution Indicators

Pollution Ecology of Freshwater Invertebrates. C. W. HART, JR., and SAMUEL L. H. FULLER, Eds. Academic Press, New York, 1974. xvi, 390 pp., illus. $24.50. Water Pollution.

Biological measures for assessing water quality date back to the early 1900's when the Saprobiensystem was used throughout much of Europe to characterize organic pollution in streams and rivers. Although this system has been subjected to much criticism and revision because of its rigidity and its inapplicability to inorganic effluents, the biological indicator concept inherent in it and other formal systems is widely used in the monitoring of changes in water quality. As the editors say, this volume is an attempt to summarize the "nor-