economic strength, technical skill, and just plain luck went into separating uranium isotopes and manufacturing plutonium.

Groueff is at his best in describing the parts played by individuals. He provides an infinitely better measure of Groves's sound technical instincts and remarkable powers of leadership than the general does in his own story, *Now It Can Be Told.* He highlights the contributions of the many behind-the-lines heroes, men of Kellex, Chrysler, Houdaille-Hershey, Tennessee Eastman, Union Carbide, and Du Pont, who fought the war in New York, Detroit, Decatur, Oak Ridge, and Hanford. None of these deserves recognition more than Percival C. Keith, a swashbuckling yet sophisticated Texan and Harvard English major turned chemical engineer. A man who gave rather than got ulcers, Dobie Keith assembled and headed the Kellex team that designed and built K-25, the mammoth gaseous-diffusion plant at Oak Ridge. No comparable figure marks the Du Pont effort at Wilmington and Hanford. The achievements there, fully as remarkable, were the work of organization men.

The episodic treatment, which gives *Manhattan Project* much of its appeal, at the same time sacrifices a central focus and thus blurs some of the most exciting moments in the race to build the bomb. Although the details are present, the book fails to show how black things were in the summer of 1944, when both gaseous-diffusion and electromagnetic plants were in trouble, when it was doubtful that Hanford could turn out plutonium in adequate quantity, and when identification of plutonium-240, a strong spontaneous fissioner, in sample plutonium made it necessary for Los Alamos to pin all hopes for using the Hanford product on perfecting implosion. Another flaw is the constant straining to supply drama and human interest. This can be self-defeating. Groueff also risks putting off serious readers by reporting, as though verbatim, conversations which could not have been recorded or even remembered accurately. These manufactured quotations detract from the stature of the book even though they quite uniformly reflect the substance and spirit of what people thought and often must have said.

These criticisms aside, the book is definitely worth reading—not only for entertainment but for understanding our times. Read this book and you remember that a "crash project," a term loosely used these days, means round-the-clock efforts on parallel approaches to an objective no matter what the cost. You see the forcing effect of technological goals that lie beyond the current state of the art. At the same time you understand why men living in the afterglow of the Manhattan Project sometimes made the mistake of believing that the application of large amounts of money and effort would automatically overcome even the most stubborn technical obstacles. Not least, you appreciate again the creative relationship between government, industry, and academic community which is sustained by the restless drive and energy of American leadership, both public and private. Is this not our greatest national resource?

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The Grand Prize: Opportunity for Retrospection

Nobel Lectures in Physics. Vol. 1, 1901–1921. Published for the Nobel Foundation. Elsevier, New York, 1967. 510 pp., illus. $85 for the 3-volume set.

The Nobel Prizes, initially awarded in the first year of this century, have acquired a unique and sometimes overpowering prestige. This is particularly true of the prizes in the sciences, where there is probably less scope for capriciousness in the award than there is in the literature and peace prizes. The statutes of the Nobel Foundation require every laureate to deliver a public lecture on a subject connected with the work for which the prize has been awarded.

These Nobel Lectures, which constitute part of the official record of the prizes, have been published annually by the Foundation in the languages in which they were originally given. They are now being collected and made available in English in a series of volumes each of which contains the lectures in one field for a 20-year period, together with the presentation speeches and brief biographical sketches of the prizewinners. The volume under consideration covers the prize lectures in physics for the period from 1901 through 1921. (Volumes 2 and 3, 1922–1941 and 1942–1962, were published earlier.)

Such a collection evidently makes its appeal to the reader interested in the history of science. It is not that the Nobel Lectures, by and large, give much new substantive information about the discoveries or developments that they commemorate, for in almost every case these discoveries have been incorporated into the structure of physics and are known, at least in outline, to every serious student of this science. Their historical interest lies rather in their character as historical documents, as contemporary or almost contemporary accounts of major discoveries by the discoverers, emphasizing those aspects of the work that seemed most significant at the time. And this assessment of significance has often changed in important ways over the years, a fact also made evident by a reading of the presentation speeches, usually made by the current president of the Royal Swedish Academy of Sciences.

One is struck, for example, by the Academy's apparent disregard for the theory of relativity, surely one of the major achievements in physics during this period. Thus, when A. A. Michelson was awarded the prize in 1907, neither he nor the presenter of his award found it appropriate to mention the Michelson-Morley experiment which had failed to detect the classically predicted effects of the motion of the earth through the luminiferous ether. And when Einstein finally received his Nobel Prize in 1921, it was "for his services to Theoretical Physics, and especially for his discovery of the law of the photoelectric effect." In his presentation speech to Einstein, Arrhenius made only brief and passing reference to relativity, describing it as the center of widespread discussion—particularly in philosophical circles!

The quantum theory fared somewhat better, as Planck's work was recognized by the 1918 prize. Yet when W. Wien was given the prize only seven years earlier he was cited as having made "the greatest and most significant contribution" to the radiation problem. Einstein's bold hypothe-

sis on the quantum structure of radiation, the hypothesis underlying his photoelectric law, was not even mentioned by Philipp Lenard in his own Nobel address in December 1906, even though Lenard included a bibliography of 55 items containing "all publications which in my opinion have made basic contributions to knowledge" in the field of cathode rays and associated phenomena.

The great experimental discoveries generally did not have to wait very long for their recognition: x-rays, radioactivity, the electron, the noble gases, liquid helium, the Zeeman and Stark effects, and x-ray diffraction were all honored during this 20-year period, sometimes only a year or two after their discovery, and often long before they were fully understood.

Some of these Nobel Lectures undertake to do the sort of thing that Henry James did in the prefaces he wrote for his novels—to tell "the story of the story," to describe the seed of the idea that developed into the discovery. This kind of writing is somewhat uncongenial to most scientists, but those lectures that attempt it are among the most fascinating ones in the collection. Occasionally a particularly personal note is sounded, such as J. D. van der Waals's remark, at the age of 73, that the problem of the volume correction in the equation of state still "continually obsesses me; I can never free myself from it; it is with me even in my dreams."

The Nobel Lectures do not of course even try to capture the emotions that the award of the Prize must evoke in the recipient. Perhaps it is appropriate to close this review with the words that Ernest Rutherford wrote to his mother in New Zealand upon his triumphant return from Sweden after receiving the chemistry prize in 1908. (He had been much amused by the rapidity of his transformation from physicist to chemist.) "I am sure that you have all been very excited to hear that the Nobel Prize in Chemistry has fallen my way. It is very acceptable both as regards honour and cash—the latter over £7000. We have just returned from our journey to Stockholm, where we had a great time—in fact, the time of our lives."

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Books Reviewed in This Issue