Peter Joseph William Debye

March 24, 1884 — October 2, 1966

Peter J. W. Debye came to Cornell University in the fall of 1939 to present the Baker Lectures in Chemistry; he departed, to our great sorrow, in the fall of 1966, while still working on several exciting research problems, among the many which interested him during his active and rewarding scientific career. But a chronology of his sojourn in Ithaca is somewhat misleading. Through his reputation and influence as an explorer and expositor of physical phenomena, he may be said to have arrived in the early years of the second decade of this century, and he will remain as long as there is a single student of physics or chemistry on the Cornell campus.

To our nonscientific colleagues a listing of the numerous awards and honors which have been bestowed on Professor Debye by his scientific peers will convey some impression of the significance of his contributions. He was awarded the Nobel Prize in Chemistry in 1936. In addition, he received fourteen medals and citations, eighteen honorary degrees, and was elected to membership of twenty national academies.

After serving as departmental chairman at Gottingen, Leipzig, and other universities, he became Director of the Max Planck Institute in Berlin in 1934, and in the decade of the 1940's he was Chairman of the Department of Chemistry at Cornell. Between 1952 and 1966, he was a Professor Emeritus, but a very active one.

In science, as in art, there is style. Debye's theories, his ways of looking at physical phenomena and of expressing his understanding of them, were as uniquely Debye's as a painting is unmistakably an El Greco or a van Gogh. The essential element of his style was simplicity, which for Debye was not merely a technique; it was an earnest conviction. He knew that physical phenomena must have simple explanations; he took complexity to be lack of understanding. If a theory was not yet simple then it was not yet right—it was unfinished and imperfect. To achieve simplicity one must identify the essentials and isolate them from the irrelevancies. To recognize the essentials, to express them clearly and pictorially, and then to pursue their consequences with superb technical facility was Debye's style.

A scientist verifies that he has recognized and isolated the essentials by constructing a *model*—a hypothetical system which consists of abstractions of physical entities and of the laws which govern their behavior. If the consequences of the model correlate well with measurements made on the real physical system, then it provides an "explanation" of the phenomenon. A successful model has no redundant elements and in the minds of scientists becomes the embodiment of the very physical system it illustrates. It permits visualization of the phenomenon in its starkest simplicity, unencumbered by irrelevancies. In the role of a master model-builder, Debye has left an indelible mark on physical science. One cannot now consider an aqueous solution of a strong electrolyte as anything other than a somewhat organized yet dynamic distribution of small, charged spheres in a uniform dielectric; the dynamics of a crystal are accountable in terms of an ensemble of coupled, harmonic oscillators, and at low temperatures the important crystal vibrations are those of a continuum; an amorphous structure scatters light as would plane traveling ultrasonic waves. These ideas and a host of others, each of breathtaking audacity because of its simplicity, burst upon science as sudden illuminations.

The illustrations and analogies which so enlivened Debye's lectures are unforgettable. Those who heard them can no longer think of density fluctuations without seeing the tiny stick he asked us to imagine thrown into the medium to measure spatial correlations, and we cannot think of a dipole without seeing a cigar. (In a photograph of Debye, which is now famous because of the cigar he is shown holding, a plus sign was dubbed in at one end and a minus sign at the other.) These two homely examples of Debye's models point up another aspect of his style in his approach to model-making. Models may be either physical or mathematical; Debye's were physical. Though he had mathematical abilities of the highest level (one of his earliest papers, published in 1905, contained the independent discovery of the method of steepest descents, and its application to the determination of the asymptotic behavior of Bessel functions), he had a deep distrust of overly mathematical theories, and dismissed as "mere mathematics" any explanation of a physical phenomenon that lacked a concrete, visualizable basis.

Debye reached scientific maturity at exactly the right time and place. Thoroughly grounded in (indeed, one of the great masters of) the classical disciplines of mechanics and electrodynamics, he also knew their basic limitations. When quantum mechanics was discovered, he was ready; in fact, he promoted its development and made some of its important early applications. Thus, through a receptivity that was genius in itself, and a lucky accident of time and place, Debye was to be one of the first to combine in a single intellect a knowledge of classical mechanics, electrodynamics, thermodynamics, statistical mechanics, and quantum mechanics. He had all the materials for his models, and he used them as would a great artist—each step simple, spare, and incisive. It was a unique experience to observe how Debye immediately recognized the basic components of a new problem and their relations to known phenomena in other areas. When he read a publication, its essentials were immediately incorporated as a constituent element in his overall picture of the physical world. This explains, in part, his phenomenal memory of everything he had read or heard. It may prove that he was one of the last of the great natural philosophers, who recognize no boundaries between the various portions of science. At the same time, he was among the first in the twentieth century to demonstrate the artificiality of the historical boundary between physics and chemistry.

Although Debye was considered a theoretical physical chemist, for many years he occupied chairs in experimental physics. And this was not an empty title. Almost unique among theoreticians, he was not only vitally interested in explaining experimental results and suggesting new experiments to test a theory, but he participated actively by giving practical advice, designing new laboratory techniques, and following the day-to-day progress of his experimental coworkers. Indeed, many of his theories were tested and confirmed by his associates in his own "institute." He did not withhold his interest nor avoid involvement with practical applicatons. A number of his investigations actually started from industrial problems that came to his attention. It is thus not surprising that he was much sought after as a consultant. Were one to attempt to delineate his field of activity it would be the determination of molecular structure in its most general sense, in that he started with the underlying postulate that the geometry of molecules, the force fields around them, and their interaction with the radiation field in which they were immersed, determined the physical and chemical properties of matter.

For decades Professor P. J. W. Debye graciously received many visitors, among them scholars, students, and historians of science who came to pay their respects, to discuss, to learn, sometimes to dispute, but often simply to establish contact with a great intellect and to gain wisdom. To questions as to how he selected problems for investigation his reply was that he worked only on those problems which interested him and which he could solve; as to how he partitioned his time, he said that he devoted all his efforts to a single problem until it was resolved. He thoroughly enjoyed his scientific pursuits but balanced this with full appreciation of physical well-being. He stressed the importance of giving students enough time to think seriously about their assignments, and he frequently talked of the importance of generating and living in intellectually stimulating surroundings which could lead to scholarship and scientific discovery. He believed that the intense preoccupation of serious scientists with a problem generates an atmosphere which is pregnant with ideas, which goads the imagination of those who are immersed in it to the discovery of principles of the physical world.

With the departing of Debye the world has lost one of the few "total" scientists; total in his devotion to his task, total in the breadth of his interest; total in the mastery of his discipline, and total in his human simplicity and straightforwardness.

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