Books

A Pleasant Adventure

Phenomena, Atoms and Molecules: an attempt to interpret phenomena in terms of mechanisms or atomic interactions. By Irving Langmuir. 436 pp. Philosophical Library, New York, 1950. $10.00.

Must a book of this sort be reviewed by an expert in the fields covered? That would be difficult when the book is by a worker so versatile as Irving Langmuir. I for one have profited directly from small segments of his achievement, but I certainly cannot hope to follow him with any competence through all of the fields explored in *Phenomena, Atoms and Molecules.*

The book is a reprinting, without comment, except for those in the five-page introduction, of twenty papers, or about a tenth of those the author has written. These twenty and the rest are listed in a complete bibliography at the end of the book. Some of the technical papers are a direct reporting of research and have appeared, for instance, in the *Physical Review* or the *Journal of the American Chemical Society*. Others review fields of Langmuir's work, as the Nobel Lecture on *Surface Chemistry* and a Perkin Medal lecture on atomic hydrogen. A few papers, such as *Science, Common Sense and Decency,* are nontechnical.

For the uninitiate the technical papers can be a pleasant adventure. They begin with the simplest of ideas, the simplest of mathematics; they invoke deceptively simple experiments, and they lead one in plain English to unexpected conclusions. Here is the real wonder in science, the action of a clear and intuitive mind in unraveling seemingly hopelessly confused behavior in terms of a few simple, understandable concepts. There is no better way to find out how science really works than to follow Langmuir, for instance, in his adventures with surface adsorption or surface films.

In that these adventures in science are recounted unaltered as they appeared originally, the telling is most direct and honest. However, through rewriting or even through introductions, the material could easily have been given a more general interest. The simple laws invoked could have been introduced and explained to the uninitiate, and something of further stages of the story could have been told through an evaluation of work done in the twenties and thirties in the light of present-day knowledge.

There is more in this book than the facts of scientific adventure. There is an explanation of that attitude, both of Langmuir and of the company for which he worked, which made this adventure possible. Langmuir chose fundamental problems because they interested him. General Electric profited handsomely through this. Langmuir made valuable inventions and contributions to the art merely by keeping his mind and eyes open as he pursued his task of understanding. Of course, this way of working requires superior talent, but in a day when even universities may have highly organized research programs directed toward narrow ends, one wonders if there is enough of it in American scientific and technical life.

Some of the papers in the book discuss philosophical and social matters. Philosophically, Langmuir classifies many natural and social phenomena as "divergent phenomena" to which strict causality does not apply, and in which large consequences arise from small indeterminate events. Of social problems he says, "I believe the field of application of science in such problems is extremely limited." "There is no logical scientific method for determining just how one can formulate such a problem or what factors one must exclude. I see no objections to recognizing that the field of science is limited." "Why not do what the human race always has done—use the abilities we have—use common sense, judgment and experience?" All this would be extremely discouraging if one were forced to swallow it whole. But systems containing statistical elements can be stable as well as unstable. When they are stable, useful statistical predictions can be made. Even unstable systems can be dealt with to some extent, or at least the fact of and the reasons for their instability may be recognized.

Langmuir's judgments on various matters are those of an able and experienced man, and they are therefore worth weighing. They are stated briefly in a few chapters, with none of the development accorded to his scientific work. Some of them are:

"I believe that this patent system more than any other factor has been responsible for the great industrial progress in our time.

". . . monopolies are necessary and beneficial when properly controlled.

"A much more reasonable principle of taxation would be that taxes would be *distributed according to the best public interest*. With such a principle the importance of incentives would be recognized.

"Some important Army and Navy post-war projects must be assigned to private industrial laboratories almost solely because of the known impossibility of carrying out this work in Government Laboratories under Civil Service restrictions.

"Old age pensions, unemployment compensation, the 'right to a job' often tend to remove incentives which would be in the public interest.

"A science program to be efficient must be planned by scientists.

"The Russians are shrewd bargainers. . . . Then they live up to their commitments scrupulously."

Undoubtedly there is wisdom here, but there may be some difficulty in unerringly picking it out. Honesty and directness are, however, great virtues. Langmuir admits in the preface that he was wrong about Russia, but he nevertheless publishes just what he said.

J. R. Pierce
Bell Telephone Laboratories

On Using Electron Microscopes

Electron Microscopy—Technique and Applications. By Ralph W. G. Wyckoff. 248 pp. Interscience Publishers, Inc., New York, 1949. $5.00.

The progress of the scientist toward an understanding of natural phenomena is most apparent at those times when he is able to discern a general relationship or "law" which embodies a collection of heretofore unrelated experiences. He then advances with a new all purpose mental tool vastly simpler to wield than the manifold specialized ones which it replaces. Other scientists learn its use and wide application of the new principle is made, its limitations begin to appear, finally to stand out clearly and demand another step, another generalization more sweeping than its predecessor. This is the form of progress, but it subsists upon those vital ingredients, the results of accurate observations. These come through the senses and by far the most of them come through vision. A one hundred fold increase in the keenness of vision has been achieved recently through the use of a new instrument. It is not surprising, then, that a great popular as well as scientific interest has been centered upon the electron microscope. It is fitting that a book describing the function and use of this new instrument be written by a scientist who has devoted many years to study in that field of investigation which involves both physics and biology.

This book, as the title indicates, is chiefly concerned with the *use* of the electron microscope. After a brief discussion of the various kinds of instruments now available here and abroad, and of their relative merits, there follows a chapter on the adjustment of the electron microscope in which features of design and function of the electromagnetic type of microscope and particularly of the types produced by RCA are described in considerable detail. Image formation and malformation are discussed with symptoms of the latter and therapy prescribed. The user hoping to obtain information on electric circuit function will, however, find nothing of this complex phase of microscope adjustment and maintenance. Adequate references are given to American and foreign literature on the subject.

Liberal space is given the subject of preparation of materials for electron microscopy. The advantage gained through the use of electrons is about 100-fold in resolving power over the light microscope but this requires, for full realization, quite new techniques of specimen preparation ranging through the fields of application of the microscope from metallographic studies to those involving the best method preparation of tissue sections in the laboratory of the pathologist. At this time it is the development of such techniques in each kind of work that is progressing with greatest rapidity. Nevertheless, a light microscopist, a bacteriologist for example, will be uncomfortably aware of the fact that the accumulated knowledge on the use of bacterial stains in light microscopy is now of no use to him in electron microscopy. He must use new procedures, and he will probably have to devise more, peculiar to his own field. This section of the book gives good coverage in several fields of application, including the examination of particulate material from paints to viruses, thin section work, surface films, and the manifold replica procedures so generally useful in the study of solid surfaces.

The technique of heavy metal shadow-casting which improves image contrast and adds three-dimensional effects to electron micrographs has added greatly to the usefulness of the microscope. Its application to the preparation of a wide range of subject materials is described in chapter five.

A little over half the book is given to results achieved with the electron microscope with various kinds of materials. It is copiously illustrated with electron micrographs taken by the author himself, and the descriptive material accompanying them is thus the result of firsthand observation. Surface replica work with metals, single crystals, bones, teeth, hair, etc., is shown. Under the head, "Electron Microscopy of Particle Suspensions", several representative pictures are shown, but the emphasis is upon biological subjects, chiefly bacteria. The thirty-two pictures of bacteria illustrate in an impressive manner the advances made possible with the electron microscope in this field. An eleven-page bibliography follows this section.

The final chapters which are perhaps the most interesting from the general point of view deal with the subject of photography of macromolecules. Here those interested in biology, physics, and biochemistry find a common interest. A kind of visual chemistry seems possible when one views directly the giant molecules of hemocyanin or the threadlike molecules of cellulose as they are shown lying in disarray and again forming bands and fibers. Some structural proteins of animal muscle are shown in striking detail. In muscle fibrils is seen the arrangement of the macromolecular constituents. Finally, there are the individual crystals of the tobacco necrosis virus, electron micrographs of which show clearly the three-dimensional symmetry of arrangement of the individual molecules. These pictures reveal directly the type of structure deduced earlier from x-ray analysis and give a kind of confidence in the results that only direct methods can give.

This book will be of general interest, but it will be of special value to one engaged in electron microscope investigation, for it contains the necessary detail described by an investigator who has done the work himself.

D. Gordon Sharp
Duke University

How a Pile Reacts

Elementary Pile Theory. By Harry Soodak and Edward C. Campbell. 73 pp. John Wiley and Sons, Inc., New York, 1950. $2.50.

During the academic year 1946–1947, Clinton National Laboratories (now Oak Ridge National Laboratory) held a Training School for mature scientists and engineers recruited both from academic institutions and from industrial laboratories. A high point of the Training School Program was the course on Elementary Pile Theory given by Dr. Soodak and written up by Dr. Campbell. The declassified and revised edition of these notes, contained in the present book, captures the spirit and content of the lectures, and serves as a course in the elementary theory of the nuclear reactor.

The level of the presentation is such that a reader with a knowledge of elementary physics and of elementary calculus will have no difficulty in comprehending the subject matter. On the other hand, the discussion is sufficiently accurate that a much more sophisticated reader will find it a suitable introduction to pile theory.

A brief introduction states the basic balance condition for a chain reactor to operate at a steady level of neutron density—"the rate of neutron loss is equal to the rate of neutron production."

The authors then introduce the concept of a cross section, in terms of which the probabilities of various processes involving interactions of neutrons and stationary matter are measured. Next treated is the problem of how a fast neutron, born as the result of a fission process, is slowed down till it reaches thermal energies—energies equal to the thermal agitation energy of stationary matter. This requires a study of the energy lost by a neutron in a collision.

Having treated the energy behavior of the neutrons, the authors attack the question of the spatial motion of the neutrons. This is needed to determine what fraction of the neutrons leak out of the pile. Here, almost immediately, the diffusion approximation is made. First the spatial distribution of monoenergetic neutrons is studied in the diffusion approximation and then the spatial distribution of slowing down neutrons is studied in the diffusion plus Fermi age