Book Reviews

Snow Crystals: Natural and Artificial. Ukichiro Nakaya. Harvard Univ. Press, Cambridge, 1954. xii + 510 pp. Illus. $10.

This book is an account of more than 20 years of physical investigations on snow that were conducted at Hokkaido University in Sapporo, Japan, on nearby Mount Asari, and on a slope of Mount Takachi, near the center of Hokkaido Island. The author presents a general classification of snow crystals, recognizing seven distinct phyla. These vary from needles and columns, through fernlike crystals developed in one plane, to combinations of column and plane crystals, columnar crystals with extended side planes, rimed crystals (those with cloud particles attached), and a miscellaneous category of irregular crystals. He describes how this relatively simple approach to the study of snow crystals compelled him to seek knowledge of their physical properties, which in turn forced him into their artificial production in order to understand how they grow in nature.

As if working at extremely cold temperatures and struggling under adverse conditions of war were not enough, fortune tossed a bomb at the publisher's printing office during the last days of World War II and destroyed all the copper plates and the original type. The fact that the work was finally published, first in Japanese, and then in English, and lavishly illustrated with snow crystal photographs that are models of artistry as well as of excellent science, is due to the generous assistance of many individuals and organizations in the United States and in Japan. Nakaya credits a great many people, but he pays special tribute to the help and encouragement given by Charles F. Brooks of Harvard University and by H. C. Kelly and B. C. Dees, now with the National Science Foundation. His own university and the American Academy of Arts and Sciences were among the institutions that provided financial support.

In addition to the solution of many photomicrographic problems, his early work involved measurements of the mass and velocity of the fall of individual crystals in order to find the relationship between these quantities and crystal size and form. Finally, studies were made of the electric nature of snow particles and the frequency of ocurrence for each type of crystal form. Of particular significance was the discovery that plane crystals of hexagonal symmetry and fernlike appearance, although best known, are not the most typical or the most common. They constitute only a small part of the naturally formed types. The author and his band of assistants found the irregular types far more abundant.

This book sheds new light on the long-standing mystery that has surrounded the conditions controlling the formation of symmetrical forms. The mass of single crystals, their thickness, rate of fall, and electric charges are measured, tabulated, and discussed. A cold chamber developed in the laboratory for producing artificial crystals shows considerable ingenuity. Mixing a cold air current with a warm wet air current is not at all difficult. But suspending crystals in the air for long periods of time, in order to consider the question of crystal development apart from that of nucleus formation, is something else again. This was solved in the Hokkaido University Cold Temperature Laboratory by suspending filaments of rabbit hair or silk in the crystal-growing chamber. It was found that all types of crystals could be grown on these filaments by varying the physical conditions.

Nakaya does not, however, delve very deeply into questions of nucleation, the formation of early crystal stages from microscopic and submicroscopic nuclei. For knowledge in this field he recommends the work of Irving Langmuir and Vincent J. Schaefer that was accomplished under "Project Cirrus." Their work "solved the question of formation of an ice cloud by seeding, and our experiments are confined to the problem of development of the snow-crystal proper from the ice-cloud particle," Nakaya explains.

Laymen may find some sections of this source book rather tough sledding, highly technical, and extremely detailed. But for scientists working in meteorology and allied fields, these very sections will provide a gold mine of needed data. No one can open the volume without some gain, however, for much of the text is simple and easily understood. Featured in the illustrations are more than 1500 beautiful crystals, a source of much inspiration for readers with artistic or designing abilities.

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Chemistry of the Defect Solid State. A. L. G. Rees. Methuen, London; Wiley, New York, 1954. viii + 136 pp. Illus. $2.

Into the space of 136 small pages, which include 42 diagrams, six tables, and a bibliography, the author has compressed a large amount of information on the nature of lattice defects and on their effects on physicochemical processes. The material is very well organized into seven chapters dealing with the nature of crystalline defects, elements of the theory of the defect solid state, outline of experimental methods for the study of defects, chemical consequences of defect structures, tarnishing and decomposition reactions, heterogeneous catalysis, and outstanding problems. A bibliography of 66 references is appended.

Much of the material can be followed by readers who are almost unacquainted with the field. For example, the qualitative description of the quantum theory of the defect solid state is very lucidly presented. Other topics are treated too sketchily because of severe space limitations. For instance, the statistical treatment is so condensed that it is difficult to follow the reasoning that connects initial postulates with final equations. However, the author attempts to make the results plausible by comparing them with the quasi-chemical approximation, and this is helpful in such brief discussions.

The space allotted to different topics is often puzzling. For example, 8½ printed pages, including four diagrams and one table, are devoted to a rapid-fire survey that covers the use of adsorption and emission of radiation, excitation energies, photoconductivity, luminescence, thermoluminescence, Hall effect, and thermoelectric power measurements for the determination of electronic energy states. By contrast, 1½ pages are devoted to the description of the Hahn emanation method.

Attention should be directed to a number of original contributions by the author. These include suggestions for further research that might clarify outstanding problems, a statistical treatment of solids exhibiting gross departures from stoichiometric composition, and the incorporation of "solution processes" into the mechanism of catalytic reactions. In addition, the author proposes an adequate symbolism and nomenclature for the various types of defects encountered experimentally. The adoption of this or a similar set of conventions should be seriously considered in order to standardize the widely different conventions prevalent in the literature.

The book seems to be relatively free from typographical and other errors. The symbol κ on page 48 is not defined. Unfortunately, the 1952 and 1953 papers pertaining to the use of the semiconductor model in the interpretation of chemisorption phenomena are not mentioned.

Perhaps this book serves its purpose best as a fairly inclusive summary of ideas pertinent to our present understanding of the defect structure in solids, and thus certainly fulfills one of its principal aims.

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***Thomas Young, Natural Philosopher*: *1773–1829*.** The late Alexander Wood; completed by Frank Oldham. Cambridge Univ. Press, New York, 1954. xx + 355 pp. Illus. + plates. $6.

This work by the late university lecturer in experimental physics at the University of Cambridge is the first full-scale biography of Thomas Young since the classic memoir by Dean Peacock, which appeared in 1855. It is a wholly appropriate memorial for the 125th anniversary of the death of one of the most celebrated natural philosophers who ever wrote in the English language. When we reflect that medicine was his profession and that much of his work in physics was strictly avocational, it is indeed somewhat surprising to note how often and in what varied context his name still occurs in the standard textbooks of today: Young's modulus in elasticity, Young's law of nodes in the vibrating string, Young's interference experiment (wave theory of light), and the Young-Helmholtz theory of color vision. And when we further recall that the same man was a sufficiently competent classical scholar and philologist to provide a considerable part of the key to the Rosetta Stone and to write authoritatively on the origin of languages, we cannot help feeling that this versatile genius should be better known in the 20th century.

Although Wood's book is by no means a distinguished literary venture, it should go far toward restoring Young's true position as one of the founders of modern field physics. The familiar story of the establishment of the wave theory of light is retold here, and indeed rather more perspicuously in terms of modern notation than in the pages of Peacock. It becomes strikingly evident, as the author proceeds, that Young very early grasped the real nature of physical theory—the bold and effective use of hypothesis. To be sure, he was bitterly assailed for this by his critics, notably Brougham, who, although a very brilliant man, possessed an inadequate conception of the nature of physical science. This is not surprising, since physical methodology, or the attempt to assess what physicists really do in describing the world, did not become fashionable until the late 19th century. As a matter of fact, Wood makes it clear that much of the bitterness of Brougham's criticism was very likely the result of a personal animus against Young, who had himself referred in print, with unnecessary severity, to an early mathematical paper by Brougham. The resentment of the Edinburgh reviewer was natural, although one may regret the influence it had in delaying serious consideration of Young's wave theory for many years. It seems clear that Young's scientific personality was not all "sweetness and light." His writings betray a very definite egotistical strain coupled with a blunt impatience with the "errors" of others. He must have impressed many of his contemporaries as being somewhat arrogant.

Not the least interesting feature of Young's life is the paradox it affords of a man who chose medicine as his profession but could not resist the temptation to dabble in fundamental science. Except for the two courses of lectures on natural philosophy that he gave at the Royal Institution in 1802 and 1803, this latter concern must be considered primarily avocational. Yet it was precisely here that he made his principal contribution to thought. It is generally agreed that, although he continued to practice medicine until 1822, he was never very successful as a physician. On the other hand, his lectures on physics were a failure as lectures for the audience to which he addressed them, and yet the book that resulted from these lectures has been referred to by Sir Joseph Larmor as the "greatest and most original of all lecture courses" and by the author of this biography as "a more complete account of the subject than has appeared in English either before or since."

Young's claim to fame as a philologist in connection with his deciphering of a part of the Rosetta Stone