

Book Reviews

Industrial Microbiology. Samuel Cate Prescott and Cecil Gordon Dunn. Third edition revised by Cecil Gordon Dunn. McGraw-Hill, New York, 1959, viii + 945 pp. Illus. \$17.50.

Advances in Applied Microbiology. vol. 1. Wayne W. Umbreit, Ed. Academic Press, New York, 1959. 304 pp. \$9.50.

The "golden age of microbiology" and similar expressions are decidedly more than romantic allusions; they are also euphemisms for the potential, cold profit in regulating microorganisms. Industrial microbiology acquired an identity less than 20 years ago, when microbes were put into tanks and agitated and aerated in a more or less controlled fashion and in pure culture (more or less). The prototypic principles and practices were, in my opinion, set forth by Kluver and Perquin only 27 years ago.

The maturation of a field is signalized by the emergence of its own specialized literature. Indeed, in this regard, commercial microbiology is already suffering from an embarrassment of riches. However, to paraphrase an observation made by one of John P. Marquand's characters, this wealth is not like inherited wealth. That the subject has even acquired sophistication is shown by the appearance of that new breed of scientific communicators, the "symposiasts" [F. Walshe, *Perspectives in Biology and Medicine* 2, 197 (1959)], and now, in commercial microbiology, we have the "advancists" (*Advances in Applied Microbiology*) or the "progressivists" (*Progress in Industrial Microbiology*), depending on whether you are American or British. Faced with these annuals, one is reminded of the war-time suggestion, "Is this trip necessary?" It is difficult to see how publishers can justify putting out this type of annual review on the basis of the volume of new developments, the need for new outlets and sources, or the demand for such publications, at

these prices, by individuals. The answer must be that new technical publications automatically have an ensured world-wide library sale of approximately 2000 copies which, at formidable prices, makes them profitable.

The third edition of "Prescott and Dunn" is something else. The chief virtue of this book, which has assumed a central informational position for undergraduate and graduate students, is its fruitcake quality. It contains a mixture of a lot of desirable things, but unlike fruitcake of quality, it lacks proportion, body, and headiness. The finishing off with frosting in the form of good chapters on gibberellic acid, steroids, amino acids, and "biochemical engineering" does not alter the unfortunate fact that the material in the first three-quarters of the book is practically unchanged from the previous edition, published 10 years ago.

Chapters on textile and wood microbiology have been dropped. Much other unchanged material, now superfluous and archaic, could have been omitted or condensed and made current, especially in the treatments of metabolism. How dated these are is evidenced by the use of the terms *oxidoreductase* and *zymohexase* in the description of yeast fermentation, and of *lactacidase* and *alcoholase*. The only methods which are suggested for the preparation of cell-free enzymes are those of Buchner (1897) and Lebedev (1911)! Statements that succinic acid in yeast fermentation is not derived from sugar, failure to specify that pyruvic acid is an intermediate in the bacterial lactic fermentation of glucose ("a hypothetical 3-carbon compound" is incriminated), presentation of the methylglyoxal theory to explain various fermentation mechanisms, and the review of Kluver's 1931-35 works as the authority for today's understanding of intermediary metabolism of fermentations are a few samples of the inadequacy of the revision.

One finds many serious omissions, which suggests an unfamiliarity with

the key contributions to the intermediary metabolism of fermentations of, for example, the butyric acid bacteria, and the propionic and the itaconic acid fermentations. The inclusion of an exposition of the unifying influence of comparative biochemistry in microbial fermentations would have been valuable.

The superficiality of the chemical treatments of the classical bacterial fermentations on the one hand, and the fastidious documentation of the multifarious steroid oxidations on the other hand, illustrate the incongruities in the book. Undoubtedly, the recent availability of many fine reviews on the latter subject accounts for this. The curious tactic is employed of presenting at length the outmoded theories carried from the previous edition, then, in a concluding appended sentence, modernizing them by the magic wand of referring to some recent reviews.

The technological coverage is no less open to serious questions of judgment. For example, the rotary drum process for submerged fermentations, covered in considerable detail as though it were an integral part of industrial microbiology, was abandoned as economically unfeasible over 20 years ago, even before the first large-scale submerged fermentation came into use. The same is essentially true of many other novelty pieces of equipment and apparatus (including the bazooka), that have never found a niche in the general practice. Having seen one good, representative, factory process flow-chart, a person has seen them all. The presence of 40 flow-charts, many taking up a full page each, simply means that a corresponding amount of space for some modern developments had to be sacrificed.

In spite of its fruitcake character, to say nothing of its size, some essential ingredients are inexplicably missing from Prescott and Dunn. For example, the world's largest controlled microbial process, the methane fermentation of sewage and industrial wastes, is not included, nor is what possibly is the world's smallest but, all the same, important process, the production of *Rhizobium* inoculants for legume seed. Unmentioned is the propagation of the food alga *Chlorella*.

By and large, the relative amount of space devoted to various subjects by an authority in a field is taken as a measure of the relative importance generally attached to those subjects by the professionals. Mystifying, therefore, is the presentation of the entire, perfectly

enormous, antibiotic industry in only about 5 percent of the book. Streptomycin is covered in its entirety in 1½ pages, and the authors manage to encompass chloramphenicol and chlorotetracycline in a total of 17 and 9 lines, respectively. Something called "Vancomycin" is dignified with 15 lines. Another notable miss with the measuring spoon: 5 pages for cheese production (*sans* the chemical transformations) but 37 for sauerkraut and pickles.

Critical selectivity and predigestion of subject matter, together with the adoption of a pattern of synthesis and evaluation, would have enhanced greatly the value of the book, as would experience in the modern fermentation industry. As it stands, the book fails to consummate intimacy between the reader and the current real-life practice of industrial microbiology. Naturally, this particular criticism of Prescott and Dunn is less applicable to the *Advances*, in which people associated with the developments of the various specialized topics, and active in them, would be expected to convey authoritative and realistic pictures of their assigned topics. There is no denying that Prescott and Dunn have brought together a great deal of sundry information, and with its extensive bibliography, the book will certainly accomplish the purpose of putting the fermentation tyro on the trail. But it will not get him to his destination.

There is an unsubstantial, an unrealistic, quality to these works, as there is to many books dealing with commercial microbiology; they do not adequately represent the field. Covering virtually the whole scope of microbiology, these treatises still fail to tell exactly what products are in commercial operation, which organisms are preferred or used, and what process is being used, and at what scale. From Prescott and Dunn the novice would gather that microbial processes for butanol-isopropanol, acetone-ethanol, 2, 3-butanediol, propionic acid, kojic acid, mold lactic acid, ustilagic acid, mannitol, fats, pigments, and innumerable other things are the substance of industrial microbiology today. They are not.

The student is likewise misguided when, from *Advances* he visualizes an image of applied microbiology composed of genuine efforts aimed at the development of nonsterile fermentations, preservation of foods by ionizing radiations, basic studies on mechanisms of biosynthesis, germ-free animal techniques, the antibacterial activity of

phenol, and the like. On the other hand, the applied microbiologist will rightly protest that his interests are decidedly not restricted to utilitarian microbiology and that his dish is general microbiology, as this book presumes to be. In either case, the contents do not fulfill the expectations implied by the title. In other words, it is virtually impossible to deduce from these works the status of industrial microbiology's manifold activities and *modi operandi*. If not from these sources, where should the inexperienced person expect to find such information and to discern fact from fancy or reduction to practice from screening, research, and paper patents?

Another curious thing: despite their intention to be all things to all people, judging from the miscellany of topics these books contain, such sources consistently deny admittance to one of the oldest of microbiology's applications, namely, the commercial production of bacterial and viral vaccines, antisera, mold allergens, and other biologicals. It is hard to see why these sacred cows should be concealed from the individual who is interested in obtaining an accurate and a clear perspective of the utile microbe.

The flavor and the pulse of modern commercial microbiology has never been conveyed to readers. This vast technology has a definite personality; it has a rationale; it is unique. The organization of commercial microbiology laboratories; the conference approach to problems; the multispecialist composition of the attack teams; the turnover of problems at the laboratory level; the remarkable intelligence systems that industries have for picking up outside information pertaining to their current interests; the role of consultants; outside research grants; the philosophy and methodologies of screening and developmental research—these constitute the fiber of modern commercial microbiology. Still other facets desperately want codification: basic techniques and apparatus evolved for efficient, massive-scale output of routine microbiological testing; cost and profit analyses; the rationale of medium development and pilot plant research; the logistics of scale-up from pilot plant to factory; laboratory, pilot plant and factory equipment design and operation; systems for isolation from nature and the maintenance of enormous numbers of pure cultures of organisms; assays (microbiological, animal, and chemical); chemical extrac-

tion, purification and isolation, and structure determination on products; sterile packaging; control testing; time breakdown on fermentation cycles, sterility troubleshooting; phage resistant strains for plant production; the whole complex of animal testing of products for toxicity or efficacy.

The principles and procedures for the three basic contributions of industrial microbiology to the science of microbiology need to be spelled out: (i) the mutational development of high-yielding strains, (ii) the use of precursors to influence a fermentation, and (iii) the elimination of the diffusion barrier around the microbial cell.

These are the things that tell the true character of modern commercial microbiology. The kind of team effort that has shown itself to be so successful in the development of some of the extremely complex problems in industrial microbiology is the only way in which an accurate profile of this fabulous subject can be portrayed for others. And, for a realistic portrayal, the members of that team will need more than feel and first-hand knowledgeability—they shall have to be romantics.

J. W. FOSTER

Department of Bacteriology,
University of Texas, Austin

Perspectives on Government and Science. *Annals of the American Academy of Political and Social Science*, vol. 327. Norman Wengert, Ed. The Academy, Philadelphia, Pa., 1960. x + 204 pp. Paper, \$2; cloth, \$3.

The administration of the scientific programs of the federal government, the lines along which the administrative machinery may develop, the policy problems involved, and the relations between universities and government science are examined in the 15 papers of this symposium. Without listing all of the authors and titles, the flavor can be indicated by some samples: William D. Carey discusses the Presidential responsibility for budgeting; Senator Anderson considers the role of Congress and Senator Humphrey the need for a Department of Science; John C. Weaver discusses university aspects and Alan T. Waterman the role of the National Science Foundation in government-university relations; E. R. Piore and R. N. Kreidler describe recent developments in the relationships of government to science; several au-