It is interesting in this connection to reread the resolution passed by the American Association for the Advancement of Science[1] on "Intellectual Freedom":

> We regard the suppression of independent thought and of its free expression as a major crime against civilization itself. Yet oppression of this sort has been inflicted upon investigators, scholars, teachers and professional men in many ways, whether by governmental action, administrative coercion, . . .

S. C. BROOKS

UNIVERSITY OF CALIFORNIA

MATHEMATICS IN A NUTSHELL

ONE of the prominent features of the recent mathematical developments in our country is the rapid increase in very brief mathematical text-books which are largely intended for the use of students in the army and the navy. While these text-books may serve an actual need it should be remembered that they do not conform with the real nature of mathematics, which involves an unrestricted inquiry into the mathematical elements of our surroundings. Even the large text-book fails to give full freedom to the inquiring student, but it does not impose as many restrictions as the smaller text-book, where the arousing of interest along one line of thought is too rapidly followed by a change of subject.

Unfortunately, there is a tendency to imply that the small text-book contains all that is really important in regard to the subject under consideration. A somewhat extreme instance of this kind appears on page 418 of E. T. Bell's book entitled "The Development of Mathematics" (1940), where it is stated that "in permutation groups, for example, the first week of school algebra will give the prospective calculator all the manipulative skill he needs." Manipulative skill is often a great asset to the mathematician and after it has been acquired one often wonders why it took so much effort to acquire it, but it is unfortunate to understate the actual situations. Its acquisition usually requires persistent efforts on the part of the beginner, as has been experienced by many.

In view of the recent tendency to begin with a very brief text-book on a mathematical subject and to follow it later with a more advanced treatise it may be desirable to refer here to a subject where the opposite procedure was followed and to note some of the advantages which resulted therefrom. In 1870 there appeared under the title "Traité des substitutions" the first text-book on the theory of permutation groups. Its size of xviii + 667 large pages is the more remarkable in view of the fact that when it appeared much less was known about this subject than is known at the present time. Not only was it the first text-book on the subject of permutation groups, but it was also the first text-book on the subject of groups in general or any part thereof, and it therefore exhibits the modernness of this subject.

As late as 1926 the widely known mathematician, Felix Klein, said on page 338 of his "Entwicklung der Mathematik," volume I, that Camille Jordan traversed, in particular, all of algebraic geometry, number theory and function theory to find interesting examples of permutation groups which he then embodied in his text-book. The great wealth of material thus obtained is an important element of the history of group theory and explains to some extent why this subject gained so rapidly in prominence during the latter part of the nineteenth century when American mathematical contributions began to receive wide European recognition largely as a result of the foreign training of their authors.

Hence the extensive introductory text-book on a mathematical subject may also render very valuable service and one may wonder whether our modern tendency towards the very brief mathematical text-book for the beginner is a wise one. At any rate, it may be of interest to observe that a subject which gained so rapidly in the appreciation of the mathematical public as group theory did was introduced in a different way in recent times. It is possible that in the very brief mathematical text-book the student loses too much of outlook for the sake of avoiding difficulties and this outlook is often more inspiring than the simplicity which the very brief text-book usually provides. Many students are not averse to difficulties provided they are surmountable, and it seems worthwhile to make the effort to surmount them.

G. A. MILLER

UNIVERSITY OF ILLINOIS

SCIENTIFIC BOOKS

CITROLOGY

The Citrus Industry. Volume I. *History, Botany and Breeding.* Edited by HERBERT JOHN WEBBER and LEON DEXTER BATCHELOR. Pp. 1028. 233 illustrations. University of California Press. 1943.

DR. WEBBER, when teaching citriculture in the College of Agriculture at Berkeley, planned to write a one-volume text-book. For four years he worked on this, but his notes and manuscripts were lost in the big Berkeley fire in 1923. Two years later he was transferred to the Citrus Experiment Station at Riverside, and returning to his project of a book came

[1] *A.A.A.S. Bulletin*, Vol. 2, January, 1943.

to the conclusion that the subject should be treated in a larger way, and must be a cooperative project, with several authors. The growth of the work is well illustrated by the section on the "Botany of Citrus," written by W. T. Swingle. At first it seemed that 50 pages would be ample, but soon it was necessary to assign 75 pages, then 100. But finally the monograph of the citrus group (including the related genera) ran to 346 pages, and it is evident that future researches will considerably add to this.

In 1936 Dr. Webber retired from his administrative duties at the Citrus Experiment Station, becoming professor emeritus. But he kept his office and went on with his work on the great book. He now began to consider the possibility that he "might be called, and leave the work unfinished and in a muddle"; some provision must be made for continuity and completion, whatever happened. Dr. Batchelor, his successor as director of the station, agreed to become joint editor, and to contribute several chapters for the second volume. These details are given, not only because they are pertinent to the review but because they illustrate very well the growth and wise direction of a great project of prime importance for horticulture, botany and biological science in general. I do not know any other work treating a group of plants, of economic importance, so adequately. It should stand as a model for other books to be written in the coming centuries, dealing with many groups of plants. Three volumes will eventually be published, but the first, now issued, is complete in itself and will evidently be the one of most general interest and value. It should certainly be in the library of every university and botanical station, and should be studied by all those taking advanced botany. Indeed, it is of value to those who are not botanists, who wish to get new light on biological problems. It illustrates well the fact that when any subject is intensively studied, new ideas and facts will emerge, no matter how familiar the topic may have appeared to be.

The volume includes ten chapters and a good bibliography. W. T. Swingle writes on the "Botany of Citrus" and its wild relatives. H. J. Webber discusses the "History and Development of the Citrus Industry," "Plant Characteristics and Climatology" and "The Cultivated Varieties of Citrus." H. B. Frost has chapters on "Seed Reproduction," "Development of Gametes and Embryos," "Genetics and Breeding." E. T. Bartholomew and H. S. Reed write on "General Morphology, Histology and Physiology." H. D. Chapman and W. P. Kelley discuss the "Mineral Nutrition of Citrus." H. D. Shamel has a chapter on "Bud Variation and Bud Selection." It is of course impossible in a review to give any adequate account of the varied contents of all these chapters, and selections made by any reviewer are bound to follow the line of his personal interests or experience. Swingle divides the subfamily Aurantioideae (a zoologist would say Citrinae) into two tribes, the Clauseneae and the Citreae, the whole series including 33 genera, 203 species and 38 varieties. There are, however, numerous minor forms and innumerable hybrids. The hybrids are not given scientific names, but some are very complex and have striking characters. It is said of the citrangedins, which are derived from three genera and four species, being a cross between two hybrids, that if the parents were not known, the plants might be referred to a new genus and species. On page 355 is a diagram showing the intergeneric hybrids of *Citrus* and four other genera. It is open to any one to argue that these are not valid genera, since they cross so readily; but we have a similar case among the orchids, hybrids being produced between universally recognized genera. There is reason for thinking that some of the species admitted by Swingle may actually be of hybrid origin. A good example is the grapefruit, which takes the name *Citrus paradisi,* based on West Indian material by Macfadyen in 1830. This species apparently originated in the West Indies and has not been found native in the Old World. But since it is well known that *Citrus* and its immediate relatives are of Old World origin, the grapefruit must be derived from them. Swingle concludes: "It must be admitted that the true nature of the grapefruit is still unknown. It is to be hoped that the mystery of its origin can be settled by some of the newer methods now used in taxonomic research" (p. 419). The origin and first development of *Citrus* appears to have been on the mainland of southeastern Asia. Bartholomew (p. 695) shows how the fruits serve to relieve a water deficit in the leaves. He has an illustration of two branches cut off and allowed to remain in the laboratory for 48 hours. On one the fruits were allowed to remain, and these have become flaccid, while the leaves still remain normal. On the other, the fruits were detached, and remain firm, while the leaves have wilted and hang down. Years ago, I observed a similar phenomenon in peaches. I placed arsenical poison on some overripe peaches, to destroy the beetles which were attacking them. The fluids passed back into the tree, and several branches were killed. This property of the fruits, as reservoirs of moisture, suggests origin in a country having dry seasons. The fact that *Citrus* is in general intolerant of alkali may suggest origin in uplands.

The chapter on mineral requirements, well supported by illustrations, some of them in colors, shows the importance of very small amounts of certain minerals, and the ill effects when they are present in excess. These reactions differ in different species; thus, the lemon is considerably more sensitive to boron injury than the orange. This kind of work, likely to be much extended in the future, will throw new light on the distribution of plants.

Dr. Webber's account of the "Cultivated Varieties of Citrus" contains much of general botanical interest. "Two seedlings among the variant types from a lot of approximately a thousand sour orange seedlings were found to lack odor. These two types, which in appearance of foliage and fruit seem mainly to resemble the sour orange, do not produce oil glands and oil. The foliage and the fruit rind when crushed give only the odor of fresh vegetable tissue, not the odor of the oils so characteristic of all members of the citrus family." Presumably this mutation is recessive and it would be possible to breed a distinct type of orange, representing what would be considered a distinct species, or even genus, if found wild. Then there are the blood oranges, which have long been known and are widely cultivated. "It is of interest to note that blood varieties grown in Florida rarely or never show the same intensity and general distribution of color in the fruits as those grown in California." The Washington navel orange, so important in California, is not a success in Florida. The Valencia orange, said to have come from Spain, is "more extensively grown than any other orange in California, Florida, Texas and South Africa, and is doubtless grown more widely and on a larger acreage than any other citrus variety in the world."

Discussions have arisen from time to time, concerning the independence of the scientific worker. He does not like to be regimented. The true solution of such difficulties is to be seen in the book before us. Webber, Swingle and the others did their work according to their best understanding, without external coercion; but no one can deny that for the best results it was necessary for them to cooperate and to have a broad purpose in common. Unquestionably a good deal of scientific work is relatively sterile because done in isolation, without relation to the work of others. Dr. Webber was the ideal man to organize such an enterprise as the all-round study of the citrus problem. His energy and tremendous enthusiasm and his readiness to cooperate with others made this thing possible. As far back as 1892, in Florida, he was associated with Swingle in the study of citrus diseases, and this led to Swingle's botanical work, which made over the whole subject of the citrus allies and added tremendously to our knowledge. Still another factor was the connection with the University of California, making it possible to produce the book in the most excellent and attractive form.

T. D. A. COCKERELL

BOULDER, COLORADO

SPECIAL ARTICLES

AEROSOLIZATION OF PENICILLIN SOLUTIONS[1]

THE use of penicillin as an aerosol in the treatment of infections of the respiratory tract, particularly those caused by pneumococci, staphylococci and streptococci, appears to be feasible for several reasons. Penicillin is known to be bacteriostatic in extremely high dilutions, inhibiting the growth of hemolytic streptococci in quantities as low as .03 micrograms per cc.[2] In addition its activity should not be notably reduced by the organic detritus characteristic of suppurative and pneumonic conditions of the lungs. Since penicillin does not diffuse readily but is rapidly excreted the advantage of local application in all but generalized infections has been stressed by certain investigators.[3] Aerosol inhalational therapy, therefore, appears to be a logical addition to the existing techniques of administering penicillin.

The Long Island Biological Association has conducted a series of experiments to determine if penicillin aerosols can be produced and utilized successfully, using a standard glass nebulizer[4] operated continuously by compressed air. Sodium salt of penicillin was made available by the Committee on Chemotherapeutic and Other Agents of the National Research Council. With one exception we have maintained a concentration of 5,000 Oxford units per cc, using a M/50 phosphate buffer adjusted to a pH of 7. In a desire to conserve penicillin, experiments have not been conducted on an extensive scale.

It is known that the behavior of particulate substances in inspired air is a function of their size; effective penetration of the respiratory bronchioles and alveolae is best attained by small particles. Since rate of air flow through the nebulizing apparatus and physical properties of the solution are two factors influencing particle size, an analysis of buffered penicillin as utilized has been made. Photomicrographic records of penicillin aerosol were made with a modified ultramicroscope. Size determinations, calculated by Stokes Law, showed a distribution illustrated

[1] Aided by a grant from the Josiah Macy Jr. Foundation as part of a project for Chemical Warfare Service.

[2] M. H. Dawson *et al.*, *Ann. Int. Med.*, 19: 707, 1943.

[3] M. E. Florey and H. W. Florey, *Lancet*, 1: 387, 1943.

[4] De Vilbiss 40.