the army, that he became a major general. Upon his retired pay, which, of course, ceased with death, he could live comfortably with his family, but only by practicing economy. To gain a modest fortune it was necessary for him to live the strenuous life of scientific investigation in tropical countries, and the time at his disposal was too short. He carried on until he died worn out.

It was an irony of fate that the soldier who had saved an incalculable number of lives by his campaigns against yellow fever and malaria in Havana and in Panama should be struck down at sixty-five while risking his own health to provide for his family after his death. The republic is not ungrateful to its Deweys and Pershings, who are rewarded with special rank and high pay for life for fighting its battles, but may not the charge of failing to recognize the merits of a great soldier-sanitarian like William C. Gorgas be preferred against it? There might be extenuation if the world had not acclaimed him the most efficient plague-fighter of his day. Great Britain sent for him when its own medical men were baffled by the virulence of influenza in the Rand gold mines in 1913, the War Department lending Colonel Gorgas to find means of checking the epidemic, in which he was successful. If he had been an Englishman, Great Britain would have known how to reward as well as to honor him for his invaluable services. Great Britain could only give to him a decoration coveted by its own scientists. France made him a commander of the Legion of Honor. It can not be pleaded for Congress that it has not the power in such a case to reward conspicuous merit and service. If a precedent had been made when General Gorgas retired from the army, there would not now be the spectacle of a belated effort to do something in a small way for the relief of his widow.—New York *Times*.

SCIENTIFIC BOOKS

Plane and Solid Analytic Geometry. By WILLIAM F. OSGOOD, Ph.D., LL.D., and WILLIAM C. GRAUSTEIN, Ph.D. New York, The Macmillan Company, 1921. Pp. xvii + 614.

This book is somewhat larger than the usual American text-book designed for an elementary college course in analytic geometry. The material is so arranged that it is easy to select therefrom suitable subjects for comparatively short courses, and hence the book will be welcomed by those teachers who believe that it is desirable to place in the students' hands books which will enable the most gifted to go beyond what is discussed in class. Emphasis is laid on presenting the subject in the simplest and most concrete form, and on pointing out its relation to physics whenever possible. It may be recalled that Descartes, who is commonly regarded as the founder of analytic geometry, once said in a letter to Mersenne that all his physics was nothing else than geometry.

In view of the fact that the various mathematical theories are so interdependent good text-books for courses in elementary mathematics must cover the same fundamental ideas. There is, however, considerable latitude as regards the mode of presentation, especially as regards illustrative examples and the choice of the problems which the students are expected to solve for the purpose of developing their ability to use the subject. Students can usually prove a large number of theorems which they do not understand until they have applied them in the solutions of different types of problems. The present volume contains a large number of problems selected by men who are well qualified to determine what is most essential for the later progress of the students in pure and applied mathematics.

About 200 pages of the book are devoted to solid analytic geometry. Most of our courses for engineering students are too weak along this line. Many of the standard texts on applied mathematics presuppose a thorough knowledge of the rudiments of solid analytic geometry, and even the ordinary courses in integral calculus and mechanics frequently make greater demands on space conceptions than the student has acquired in the brief course which he followed. The developments found in these last 200 pages are especially to be recommended to students who seek a clear presentation of very useful facts lying just beyond the ordinary elementary course in analytic geometry.

The text-book under review will doubtless remain a standard for many years. It may be too extensive to meet the wants of most institutions for a first course but it will probably be consulted by many teachers who prefer to place briefer treatments in the hands of their students. The high mathematical attainments of its authors are naturally reflected in many details of treatment, and inspire deserved confidence in the accuracy of the statements relating to matters of fundamental importance. The modern tendency towards the insertion of numerous historical notes in elementary textbooks on mathematics is not followed here.

It may be added that the authors state in a foot-note on page 177 that a tangent can not be defined as a line meeting the conic in a single point. The opposite view was recently expressed by Professor Cajori in an article published in *School Science and Mathematics*, volume 22, page 463, where the author tries to support an inaccurate statement found on page 163 of the second edition of his "History of Mathematics," 1919. It is here stated that Roberval "broke off from the ancient definition of a tangent as a straight line having only one point in common with a curve." It may also be noted here that some readers might question whether it should be said that a mathematical argument can be convincing without being conclusive, as is implied by the authors in a footnote appearing on page 180. In view of the extensive literature on Greek algebra the second paragraph of the Introduction is misleading.

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SPECIAL ARTICLES

WATER CULTURE EXPERIMENTATION

As a one-salt solution is the simplest possible salt solution, so the simplest growth media that can be devised for plants, provided they need but two elements at a time, should be the proper combination of one-salt solutions. Because green plants require at least seven salt elements, available to and absorbed through the roots, complete nutrient solutions having these elements present together are employed as the media in which the plants are grown. The use of at least three simple salts plus a trace of iron (added as a salt) is required to supply the growth media with the necessary elements.

The writer has recently grown wheat for a period of three months, which included the heading out stage of the plants, in a combination of single salt solutions of KNO_3, $CaSO_4$ and $MgHPO_4$ (each of .01 mol. concentration). The plants grown in these solutions were equal or comparable in their various features of growth, including that of total dry weight, to those of plants grown contemporaneously in complete well-balanced nutrient solutions prepared either with the above named salts or with other salts supplying the same elements.

The salts named appear to be the only three salts that can be used as a combination of three single salt solutions that permit of normal and undiminished growth of wheat. This is the conclusion arrived at from an investigation of culture tests using those salts singly as combinations of one-salt solutions that were outlined as combinations of three-salt solutions (complete nutrient solutions) in the Plan of Cooperative Research on the Salt Requirements of some Agricultural Plants.[1]

Because the mono-basic phosphates given in the plan were found to be too acid for these tests with single salt solution, the diabasic phosphates of calcium and magnesium were substituted for those of the respective monobasic phosphates. It appears, therefore, that by using the proper salts, wheat plants grow as well with only two nutriment elements present in the media at one time (exclusive of a trace of iron supplied at weekly intervals to all cultures) as they do in complete nutrient solutions.

The set of plants that made best growth, of those sets tested, as combinations of one-salt solutions named, were apportioned among the solutions as follows: four days continuously in KNO_3, one day in $CaSO_4$ and one day in

[1] See Plan of Cooperative Research on the Salt Requirements of Representative Agricultural Plants, prepared for a Special Committee of the Division of Biology and Agriculture of the National Research Council. B. E. Livingston, editor. Baltimore, 1919.