main argument, with chapters on variation and heredity.

A general criticism, applicable not only to this but to many other American books, is that too little is made of the classical researches that have created the subject and too much of the latest results of the latest bulletin. To some extent this defect is remedied in the lists of papers given at the end of each chapter, where the classical papers are usually included, but there are some omissions; for instance, at the end of the chapter dealing with nitrogen fixation by bacteria there is no reference to Winogradsky's papers. This is a defect that the teacher will have little difficulty in remedying if he wishes to do so, while the inclusion of newer work has, at any rate, the advantage of familiarising the student with the work going on at the various experiment stations.

At the end of each chapter a number of practical exercises are given, bearing on the work that has been discussed. The experiments are simple and convincing, and cannot fail to be helpful to the student. References are also given to larger works so that any particular point can be looked up. The illustrations are numerous and very good.

Probably few teachers of plant physiology realise how many practical applications of their subject there are, or how much is added to the interest of the discussions by bringing in a few illustrations from agricultural or horticultural practice. Particularly in these latter days, when numbers of botanists and mycologists in different parts of the world are applying science to crop production, is there a great amount of material accumulating which must soon react on the study of plant physiology. The teacher, at any rate, will be well advised to look through this volume in search of illustrations, and he may find it worth while to adopt some of the methods.

NON-EUCLIDEAN GEOMETRY.

Bibliography of Non-Euclidean Geometry, including the Theory of Parallels, the Foundations of Geometry, and Space of N *Dimensions.* By Dr. D. M. J. Sommerville. Pp. xii + 404. (London: Harrison and Sons, St. Martin's Lane, 1911, for the University of St. Andrews, Scotland.) Price 10*s.* net.

CONSIDERING its subject, this bibliography seems at first sight extraordinarily large; but there are several reasons why it is not so formidable as it looks. The actual list of titles occupies pp. 1–261; this is arranged chronologically, each year's titles being indexed by the authors' names. Then (pp. 261–310) we have a subject index, an alphabetical list of subjects, and an author index. Finally, Mr. Sommerville has included various topics not strictly belonging to the subject, but more or less closely connected with it; for instance, quaternions, Cantor's theory of aggregates, Minkowski's "Geometrie der Zahlen," and so on. At the other extreme, we have reviews of books, references to the subject in fiction, and even "the realm of spirits."

In a work of this kind it is better to be inclusive than exclusive; so long as the list is reasonably complete, and the subject-index arranged on sound principles, the compiler has done his duty. There is every reason to believe that, in both respects, Mr. Sommerville has achieved success. As a few examples out of many that could be given, we may note the entries under "time of two or more dimensions," and "time as the fourth dimension," the latter including a reference to Lagrange; those on the philosophy of geometry, significantly headed by Bergson; and, on the lighter side, those on the extension of magic squares and cubes to n dimensions.

After making all deductions, we cannot fail to be impressed by the astonishing growth of this theory in recent times. Most remarkable of all, perhaps, is the fact that some eminent men of science are seriously suggesting time as, in a sense, a fourth dimension, the effect of which is to bring the physical universe *sub specie eternitatis* as a given configuration, parallel sections of which are realised by us as successive events, or aspects, in time. How far this is a mere way of speaking, or how far it may lead to a radical change in our assumptions of the ultimate undefinables of physics, it is too early to attempt to decide. Meanwhile, attention may be directed to M. Bergson's "Creative Evolution," in which a distinction is drawn, on purely philosophical grounds, between time as a metaphysical notion and the t of mathematical physics. This contention is not to be lightly dismissed, urged as it is by a philosopher who differs from the bulk of his profession in really understanding the methods and results of physical, biological, and mathematical science.

It is to be hoped that Mr. Sommerville's excellent index will help to arouse even wider interest in the subject, which is not only fascinating and educative in itself, but, as we have just seen, not unlikely to be of wholly unexpected importance in the applications of mathematics to physics. The very last entry that we find is that of Minkowski's collected mathematical memoirs; could anything be more suggestive? G. B. M.