tackle), cube root (belting problems), Euclid's algorithm of the greatest common divisor and continued fractions* (gearing and screw problems), it would appear that if the course in mathematics is to do nothing more than provide a secure foundation for the work in the shop its abstract content is not likely to be much less extensive than has been usual in secondary schools. The nature of the concrete problems will naturally vary with the requirements of the different schools. But whatever their nature they must be *real* shop problems, that is they must be such that in solving them the pupil is compelled to consider not only the purely mathematical element but also the significance and reasonableness of the numerical data and results and the appropriateness of the algebraic and arithmetic processes used in their solution. Excessive formalism has been the bane of the teaching of abstract mathematics. It is just as common and just as pernicious in the shop as in the class-room.

CHARLES N. HASKINS.

*Die Mathematik in den physikalischen Lehrbüchern.* Von H. E. TIMERDING. Band III., Heft 2. Leipzig, Teubner, 1910. vi + 112 pp.

IN the systematic study of the teaching of mathematics in Germany which is being made under the auspices of the International commission of the teaching of mathematics, the present volume covers the field of the mathematics required and used in the physics of the "Höhere Lehranstalten" and "Hochschulen." The principles of mathematics found in the text-books on physics in use in Germany to-day form the basis of the discussion.

While the author states that the mathematics of physics is mainly of a geometric nature, it is easily seen that he considers the main problem to be concerned with the amount and quality of the infinitesimal analysis used in the texts investigated. Fundamentally, the problem may be stated as follows: The exact theory of most physical phenomena in its development requires a use of the principles of infinitesimal analysis. A scientific attitude toward these problems on the part of the instructor will not allow him to be satisfied with mere formulas or even a confused word picture, or the skillful manipulation of a "near calculus" which may interest but not convince the

* Practical Treatise on Gearing. Brown & Sharpe Mfg. Co., pp. 130–134.

student. The instructor in physics may not count on a thorough training on the part of all his students in the rigid proofs of these fundamental principles. What ought to be his attitude concerning the use of these principles?

As illustrations we present the cases of falling bodies and moment of inertia. They are both included in a course in physics. The former requires either two differentiations or two integrations; while the exact theory of the latter requires fundamentally the principles of integration. The former is usually handled by the aid of the notions of average velocities; while, in the case of the latter, in the expression $\sum mr^2$ the size of the $m$ is — in some cases — carried down to the molecule. Most texts do not go to the limit. Hence the author's statement that the important thing is not what is said but what is left unsaid and that the instructor, if honest, must clearly recognize the necessity of the principles of the infinitesimal analysis. The statement is further made that one reason why so many subterfuges, instead of the symbols of the calculus, are used is because the authors wish their books to sell. The notions of the infinitesimal analysis would not confuse the subject but clear it up. Calculus symbols should not be used as loosely as they are. It is an evidence not of good pedagogy but rather of downright deceit not to use them.

An excellent chapter on the history of physics and its problems, from the beginning of the seventeenth century when it was a branch of the Aristotelian philosophy, to the present with its wondrous development, is included. The correlation of mathematics and physics is discussed, the influence of physics in enriching the mathematics and of the latter in putting physics on a safe foundation of rigorous proofs.

It is pointed out that Germany has lagged behind both England and the United States in the use of such aids as graphs, accurate drawings and illustrations, and others suggested by technology, which help to give the student clear and definite notions of mathematical or physical problems.

The problem of the requisite instructions in mathematics presented from the viewpoint of the teacher of physics is clearly stated and a scientific attitude is called for. What the nature of the correlation of instruction should be the author but slightly suggests. It would seem to call for a training at an earlier period in the principles of the infinitesimal analysis. This correlation is being worked out today.

ERNEST W. PONZER.