

fore these problems can be satisfactorily solved.

In conclusion one word as to a very practical problem connected with this group. It is but a few years past a century since the use of platinum was introduced into the chemical laboratory. For a few decades the supply exceeded the demand, but the applications of platinum have steadily increased, and never so rapidly as in the last two decades. For many purposes no substitute for platinum has been found. At the same time the supply of platinum is not keeping pace with the demand, and as a result the price of platinum has very materially advanced. While platinum is very widely distributed, there are few places where it occurs in workable quantities. It is possible, however, that it has been often overlooked, as in placer mining for gold, and efforts have been made to attract miners' attention to more careful search for platinum deposits. At the present outlook it will, within a few years, be imperatively necessary either to materially increase the platinum supply of the world or to replace it for many purposes by some other substance. How this problem will be solved cannot now be foreseen.

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SCIENTIFIC BOOKS.

The Elements of Physics for Use in High Schools.

By HENRY CREW, Ph.D., Professor of Physics in Northwestern University. New York, The Macmillan Company. 1899. Pp. 347.

One of the most striking indications of the steadily increasing demand for instruction in science as a part of elementary education, is found in the periodic recurrence of new books on a market that would seem to have become already overcrowded. If the new competitor is written by one who manifests his possession of the teacher's instinct in addition to the scholar's knowledge, its reason for existence is

quickly established. The author of the present volume plainly shows himself to be the possessor of both, though as a teacher he may have had little experience in the grade of schools for which his book is intended. In the preface he expresses his obligations to one friend, a high school teacher, 'for many important excisions in the MS.,' and his readiness to have others 'point out sins either of omission or of commission.'

In criticising such a book it is a pleasure to find so little to condemn, even if a few more excisions may seem advisable. Physics is essentially applied mathematics, even when no attempt is made to introduce openly the ideas of calculus or even of trigonometry. It is most natural therefore that a physicist, who is not himself a high school teacher, should overestimate the ability of the average high school pupil to grasp mathematical conceptions that are not usually introduced in the work of the secondary school.

In the introductory chapter on motion a brief and clear exposition of vectors and scalars is given, and a subsequent application is made in the discussion of uniform motion in a circle, where the position vector and velocity vector are contrasted, and the nature of the path deduced, along with the formula for acceleration in terms of radius, angular velocity, and periodic time. There is no theoretic objection to this, but it is probably safe to predict that many secondary pupils will agree in thinking the discussion much too abstract for them. Indeed it would not be hard to find college juniors of literary bent, who would be sympathetic with their friends in the preparatory school, and who would congratulate themselves on the absence of problems, necessary as these may be to bring home a difficult subject. There are fashions in educational method as well as in dress. Whether the vector analysis fashion can be maintained in elementary schools may be doubted. To immature students the method is certainly not so easily grasped as are some other methods that have hitherto been satisfactory to many.

In the discussion of angular motion much stress is laid upon the distinction between speed and velocity, the former being a scalar and the latter a vector quantity. This distinction has

been more or less familiar ever since its introduction by Thomson and Tait, but to young students it can scarcely fail to bring uncompensated trouble. Among the problems on this subject is the following: "What is the aim of the clockmaker; to produce an instrument which will give constant angular speed or constant angular velocity?" It is perhaps safe to say that few clockmakers would answer with confidence; and probably some teachers would hesitate also, especially after trying to assure themselves that "an ordinary peg top may be used to illustrate the case of a body having a constant angular speed, but at the same instant a variable angular velocity." For mental gymnastics in following out the metaphysics of a definition the distinction may have its value; but there are many whose maturity exceeds that of high school pupils, and who find the word velocity, with suitable adjuncts, quite enough for all practical purposes. The facts give little trouble, for velocity in any given direction can always be specified, while words may become tyrants.

As an exact science physics is built up on dynamics as a foundation. The study of linear, angular, and harmonic motion therefore constitutes its most natural introduction, along with the consideration of the general properties of matter, of momentum, rotational inertia, and universal gravitation. Each of these subjects is treated with intelligence and skill, with mathematics that is not abstruse for a college student, but in a style that seems rather severe for the preparatory schools. Indeed the first hundred pages of the book, relating to subjects that admit of but little experimental illustration, are certainly rather hard for students below collegiate grade. Passing on then to wave motion and acoustics, the rest of the volume is non-mathematical and very attractive.

In the discussion of sound the building of the musical scale is brief, yet clear; but it seems a little unfortunate that the frequency of middle C should be given as 264. This number was adopted by the Stuttgart Congress in 1834, and the scale built upon it was used in Helmholtz's 'Sensations of Tone'; but it never won universal adoption. Within the last few years, and largely through the activity of the late

Governor L. K. Fuller, of Vermont, all the civilized nations of the world have adopted A_4 435, as standard pitch for the construction of musical instruments, England being the last to yield. As all keyed instruments are made with the aim of producing the equally tempered scale, rather than the diatonic scale, it is readily found, by application of the proper factor, $(1.05946)^{-9}$, that the frequency of the middle C , for this international pitch, is 258.65. For the purpose of the physicist the diatonic scale will probably continue in use, and Koenig's forks are universally regarded as the best. These are tuned, unless specially ordered otherwise, to the so-called physical pitch, introduced a century ago by Chladni, with $C_3 = 256$. The wild confusion of a generation ago has now been reduced to order, with the survival of but two definitely related systems. One of these is international pitch, with $A_4 = 435$ as starting point for the scale of equal temperament; the other is physical pitch, with $C_3 = 256$ as starting point for the diatonic scale. Each of these is of course arbitrary, the result of agreement, while the equally arbitrary Stuttgart pitch is now of only historic interest. In a text-book of physics it may be mentioned, but should no longer be taught; and 256 rather than 264 should be the basis for a diatonic table of frequencies.

The closing chapters on heat, magnetism, electricity, and light are well arranged, clearly expressed, and modern in style of treatment, with judicious omission of much that the high school pupil can well afford to disregard until the subject is resumed in college. For example, the polarization of light is not mentioned, while diffraction comes in as an elementary illustration of the wave theory, a few simple experiments being explained which are both interesting and easily made. In the development of the laws of geometrical optics, wave fronts are freely indicated in the diagrams, but equally free use is made of the convenient term 'ray.' The fact that this means merely a direction is no reason for abolishing it, as has been done in a few recent text-books of physics.

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