to the calculation and design of tank bottoms. We are warned, however, in the introduction not to expect 'elaborate calculations and deductions based upon problematical theories and conditions,' but only 'such facts as may have been verified, freed, as nearly as may be possible, from the tons of mathematical rubbish,' etc. The following are, presumably, some of the 'verified facts': On page 59 it is stated that 'the moment of forces about a point may hold each other and establish equilibrium of the body, even though the forces themselves fail to balance.' Also that 'the direction of the resultant of two forces is exerted in a line bisecting the original angle at which the forces met, and the extent of the force exerted by this resultant is the difference between that offered by the two or more original forces, or the moment of those forces.' Again, in Chapter VIII., in the analysis of the stresses in a four-post tower, scarcely any of the stresses have been correctly determined. The tower legs are straight and have an inclination of one in ten; the wind bracing is of the usual type, consisting of horizontal struts and diagonal tie rods. The method of calculating the compression in the struts is as follows: "The inclination of the column being one in ten, one-tenth of the load is transferred to the horizontal member as compression-stress, and the remaining nine-tenths is distributed at the base of the column to the foundation." The column stress being 133.9 tons, the thrust against the strut is therefore 13.39 tons; but, since the thrust from each of the two opposite columns is 13.39 tons, the strut must be designed to resist *twice that or 26.78 tons!* The stress in the strut 'in transferring the wind stress as tensile stress' is not considered, this member being designed only for the compression as above found, together with the stresses due to its own weight. In finding the wind stresses in the diagonals of the upper panel, the stress in each is taken at one-eighth of the total wind pressure on the tank, presumably because there are eight diagonals in the top story of the tower. In this way the stress is computed to be about eight tons, with an assumed wind pressure of seventy tons, whereas the correct stress is about thirty-two tons. Finally the wind stress in each column is taken as constant from top to bottom.

These and other illustrations which could be given suggest that it might have been better to admit some of the 'mathematical rubbish' so carefully excluded.

F. E. T.

Geometric Exercises in Paper Folding. By T. Sundara Row. Edited and revised by Professors W. W. Beman and D. E. Smith. Published by the Open Court Publishing Company, Chicago. 1901. Pp. x+148.

In the author's preface to this little work, dated from Madras, India, 1893, the double purpose is set forth 'not only to aid the teaching of geometry in schools and colleges but also to afford mathematical recreation to young and old, in an attractive and cheap form.' Without attempting to develop a geometry as rigidly confined to folding as the Euclidean is to compass-and-ruler work, it is shown how a large number of interesting metrical and positional relations can be illustrated without the use of instruments other than a penknife and scraps of paper, the latter for setting off equal lengths on folds. Sheets of paper adapted to the work accompany the book, and the allusions in the text to certain kindergarten 'gifts' imply the pupil's possession of an equipment of elementary geometric forms. The processes are based on the principle of congruence.

The first nine chapters are devoted to the regular polygons of Euclid's first four books, and to the nonagon. Beginning with the folding of the fundamental square, and progressing through equilateral and other triangles, the Pythagorean theorem and consequent propositions are reached, with certain puzzle squares based thereon. In Chapter X. progressions—arithmetic, geometric and harmonic—are neatly illustrated, as also the summation of certain series. This section is enlivened by the insertion of the legend regarding the duplication of the cube. It would have been an appropriate place to refer to the adaptation of the cissoid and conchoid of Chapter XIV. to the same problem.

In Chapter XI. the numerical value of π

is calculated and the regular polygons treated, in particular those of five and of seventeen sides.

Congruence, symmetry, similarity, concurrence and collinearity are taken up in the next section, and Desargues's, Pascal's, Poncelet's and other famous theorems presented for demonstration.

The remaining chapters treat of conics and other plane curves, with historical notes and references to certain applications, completing in an attractive way a valuable addition to the literature of elementary geometry—a serviceable condensation of mathematical properties, theorems, puzzles and problems. We may be permitted to doubt, however, whether the average student who has attained to that acquaintance with radicals, logarithms and positional geometry which is evidently assumed in Chapters XI.–XIV., will often stop to obtain his actual results by folding. In fact the frequent use of the word 'draw' implies the author's permission of a short-cut; but it would probably be an encouragement to the pupil actually to bring his folding into the higher problems if in connection with it the use of the compass, dividers and straight-edge were frankly sanctioned. Simply in the interest of accuracy in folding, a thin rule, preferably of nickel-plated steel, beveled, would be desirable.

Where the claim of the author is so modest and his aim in so high degree attained, the task of criticism is a light one. It is singular that the expression 'equal halves,' if in the original, should have passed two revisers unnoticed; and one could wish that pericycloids, the involute and the cartesian ovals had not been omitted, and that the relative importance of the curves treated were better indicated by the space allotted to them.

The editors have performed a genuine service in bringing this work before an American audience and in such neat and attractive form. The twenty-six exquisite half-tone illustrations with which they have replaced the line drawings of the original, are a decided enrichment of the volume. The practically equal number of footnote references to their own series, in one case duplicated, compels the question how far permission to edit carries with it advertising privileges.

F. N. WILLSON.

PRINCETON, N. J.,
February, 1902.

Pleuronectes (the Plaice). By F. J. COLE and JAMES JOHNSTONE. Liverpool Marine Biology Committee Memoirs, No. 8. London, Williams & Norgate. Dec., 1901. Pp. 260, 11 plates. Price, 7s.

In these L. M. B. C. Memoirs a single animal or plant type is described by a specialist in such a way as to serve primarily the interests of college and private students of biology and young amateurs. They are, however, far more than mere laboratory guides, being authoritative sources of information based on original work upon species which for the most part are not elsewhere adequately described.

This, the latest memoir of the series, is devoted to an important food fish, the plaice, containing descriptions with excellent figures of the skeleton, abdominal viscera, blood vascular system, nervous system and sense organs, together with appendixes on life history, habits and practical fishery matters. Its chief interest for biologists in general lies in the discussion of the asymmetry of the Heterosomata, or flat fishes, of which the plaice is probably the best known British representative.

In explaining this asymmetry the authors follow Traquair, disposing first of the mischievous assumptions that the left eye has passed either through the substance of the head or over the top of the head to reach its definitive position on the right side of the body. "The *fact* is," they remark, "that the left eye is *not on the right side at all.* Its presence there is purely illusory. What has happened is that the *whole* of the cranium *in the region of the orbit* has rotated on its longitudinal axis to the right side, until the two eyes, instead of occupying a horizontal plane, have assumed a vertical one, and the left eye is *dorsal* to the right."

The part of the work next in importance to the discussion of the asymmetry is the section devoted to the cranial nerves, which are given a thorough critical treatment. The key to the