ing surface, it was calculated that twelve cars would have a total of 67.2 square feet, from which it was erroneously deduced that *probably* less than a half of one per cent. of the capacity of the locomotive boiler is required to heat a train of twelve cars. The error consisted in inadvertently taking the heating surface of the boiler at 12,000 instead of 1,200 square feet, and the percentage should have been "probably less than 5 per cent." instead of a half of 1 per cent. It is not asserted that these figures represent, even approximately, the actual proportion of the boiler capacity required to heat a train of cars. They indicate, though—and that is all that was intended—that only a small fraction of the boiler capacity is required to heat cars. Our cotemporary tries to prove, and it is not disputed, that "from 2½ to 3½ per cent. of the total supply of steam is needed for heating." But what does it mean by the following sentence: "The same result, in substance, is reached by remembering that more square feet of grate surface an engine can comfortably burn 80 to 100 pounds of coal per hour, or 1,360 to 1,700 pounds, and computing the horse-power from that at 3 to 4 pounds per hour."

NEW PUBLICATIONS.

"TREATISE ON THE THEORY OF THE CONSTRUCTION OF HELICOIDAL OBLIQUE ARCHES."—*By John L. Culley, C. E.* Van Nostrand's Science Series, No. 87,

THE volume before us treats of a subject which is generally regarded as a kind of bugbear by the constructing engineer. Skew arches, which came into existence, or, at least, into frequent use, with the introduction of railroads, have been and still are avoided in every way possible; but cases occur when no contrivance nor ingenuity can excuse the necessity of an oblique crossing, and a skew bridge then becomes inevitable. The introduction of girders has overcome, in great measure, the difficulties of such cases, and it is safe to say that, in the future, very few oblique crossings will be made on masonry arches. But, here again, occasions will, from time to time, present themselves when, for one reason or another, it is considered preferable to use stone or brick rather than iron or steel, and the engineer or architect should certainly be prepared to meet such emergencies.

In Mr. Culley's little volume, one system—the helicoidal—of designing and constructing such arches is mainly dwelt upon, although some space is allotted to the consideration of the logarithmic method also. The latter we take to be the same as the orthogonal method of the French constructors. Which preceded the other in point of date of invention, we confess we do not know, but one would imagine that the helicoidal grew out of the effort to simplify the logarithmic by substituting straight lines for curves in the development of the soffit. Naturally, the latter is the more perfect and scientific method; there are limitations to the use of the former in the case of full-centered arches, which can, however, be overcome, Mr. Culley tells us, by means of special construction of the wing walls. It would have been useful to explain and illustrate such special construction. He enunciates a perfectly sound principle when he states that, for a considerable degree of obliquity, segmental arches are far preferable to full-centered ones. Indeed, the flatter the segment, the more nearly the helicoidal system approaches mathematical correctness, the limit being reached in the *plate bande*, where the soffit of the natural arch is the same as its development.

In his remarks upon centering for skew arches, Mr. Culley does not enforce the importance of its being particularly solid and well braced. This is absolutely necessary, in order that it may stand the various false strains to which it will be exposed. This adds considerably to the cost, and we may here observe that we cannot consider the comparison which Mr. Culley makes between the cost of skew and right arches as complete. The extra waste in getting out the voussoirs is a comparatively small item. We think a more serious source of increased expense will be found in the fact that the cutting and laying of stones with warped surfaces is a specialty, and not only requires the employment of men drawn from a relatively small class, but demands also more time and care than is called for in straight work.

Mr. Culley appears to us to be somewhat hasty in his sweeping condemnation of echeloned ribs as a means of effecting a skew crossing. Some admirable specimens of bridges constructed upon this principle exist in France, built by engineers of high standing. If securing great strength with the minimum of expenditure be a test of good engineering, then certainly the bridge carrying the Chemin de Fer de l'Ouest over the Chartres highway, built in this way, must be considered as reflecting great credit upon its designer, Monsieur Boucher. We believe this method owes its origin to the recognition of the comparative weakness of skew arches with high rise and great obliquity. In the bridge just mentioned, the span on the square is 9 meters, and the rise 5—a semi-ellipse, in fact, with the minor axis for span. The angle of skew is 36°. How should we design and build a helicoidal arch with these data?

So much for what may be termed "adverse criticism." It is pleasanter to be able to say that Mr. Culley's clever little volume is likely to prove very useful to those who have occasion to qualify themselves in the matter of skew arches. It would be too much to say of it that it clears away all the difficulties of the subject; the fact that the art of properly laying down the lines of such structures cannot be reduced to a general routine, but must vary with almost every particular case, precludes the possibility of doing this by book. But the present volume will be found of great help, and contains much which we do not think can be readily, if at all, found elsewhere. For the rest, we quite agree with Mr. Dobson ("Masonry," Weale's Series, No. 25) that the best way to get a full realization of the principles of the oblique arch is by constructing a model.

It is a pity that the otherwise neat pages of this book should be marred by a number of misprints.

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"THE THEORY AND PRACTICE OF SURVEYING."—*Designed for the use of Surveyors and Engineers generally, and especially for the use of students in engineering. By J. B. Johnson, C. E., Professor of Civil Engineering in Washington University, St. Louis, Mo.* New York: John Wiley & Sons, 1886.

THIS octavo volume of 683 pages endeavors to cover the entire field of the science and art of surveying, first, by describing the construction, use and adjustment of all