increase may be explained by considering that when a beam is bent to the elastic limit of the outside fibres, connection between these fibres and those just below will prevent the free contraction or expansion of the outside fibres, and thus the beam has its elastic strength increased. In case of harder steels and materials such as cast iron or wood, no such increase may be expected. Experiments are being carried on by the writer to determine as completely as possible the increase of the elastic limit as a function of the shape of the cross section. Up to the present a series of ⊥ beams have been tested, and a series of flat plates. The tests in flexure are compared with tests in tension on material cut from the flexure specimens. The plates were partly $6\frac{1}{2}'' \times 1''$ with span of $28''$ and partly $7\frac{1}{2}'' \times 1\frac{1}{2}''$ in section with a span of $40''$. The increase in the elastic limit for the plates was 55 per cent. in the first case and 27 per cent. in the second case.

A specimen $3'' \times 4''$ in section tested with a span of $57''$ showed an elasti limit of 42,000 lbs. □″. A tension test was not made of this material, but the yield point reported by the mill is 37,950 lbs. □″. Mr. Gus Henning has shown that the elastic limit of rolled material is some 4,000 lbs. □″ less than the yield point from the billet, and if the 37,950 lbs. □″ is thus reduced, the 42,000-lbs. □″ elastic limit in flexure will represent an increase of 27 per cent.

When the height increases in comparison with the breadth, the excess strength in flexure disappears, and for the ⊥ beams tested the elastic limit in flexure was slightly less than that of a tension specimen cut from the web.

It is to be noticed also that, in the case of flat plates, there is not free elastic expansion in the side direction during flexure; consequently the modulus of elasticity should be increased. The tests on seven plates show an average increase of 3.6 per cent. in Young's Modulus.

Note on Compressive Strength of Wrought Iron. By W. K. Hatt.

While the tensile strength of wrought iron or steel is a definite quantity, the compressive strength is not so well defined. In the case of wrought iron the compressive strength is quoted by different authors in values from 40,000 to 90,000 pounds per square inch for a state of stress consisting of compression in one direction only. The strength of any specimen is a function not only of its physical properties but of its shape, and the maximum resistance to compression may be anywhere from the elastic limit to the plastic limit, depending on the shape of the specimen tested. It is not customary to test iron and steel in compression, since the results of a tension test give an index of the capacity of the material to

resist compression; and, while definite standards exist for the shape of tension specimens, no such widely accepted standards exist for tests in compression. Before defining such a standard we must know the relation between the size and shape of specimens of different grades and their strength. Experiments to determine their relation for wrought iron have been undertaken at Purdue University by the writer, in conjunction with Messrs. Fletemeyer and Alling, and the results are now offered to the Academy.

There were tested 140 square-ended cylindrical specimens, ranging in length from 1 to 10 inches, an area from $\frac{1}{4}$ □″ to 1 □″, covering a ratio of $\frac{Z}{K}$ from 5 to 60. The yield point in compression remained practically independent of the shape of the specimen, and the maximum resistance of the specimen was practically the yield point when the ratio $\frac{Z}{K}$ exceeded 38 (10 diameters). For stouter specimens, whose $\frac{Z}{K}$ was less than 38, the maximum load exceeds the elastic limit by an increasing amount, the excess for a given value of $\frac{Z}{K}$ being the same for different grades of iron, and different area of specimen.

The material was plastic at 77,000 lbs. to □″ with a compression of $\frac{1}{4}$.

The writer would recommend that the term compressive strength should mean either the elastic limit or the limit of plasticity, both of which are definite points.

It does not seem that it is necessary to specify any standard shape of specimen for compression.

Camphoric Acid. By W. A. Noyes.

[Abstract.]

The work done with Mr. E. B. Harris[1] indicates that cis-campholytic acid may possibly be the neighboring □′ tetra hydroxylyllic acid,

$$C_6H_7\begin{cases} CH_3 & 1. \\ CO_2H & 2. \\ CH_3 & 3. \end{cases}$$

The paper gave an account of work which has been done in the endeavor to prepare this acid. The acid has not yet been obtained, and the difficulties met with have been unusual, but work on the subject is still in progress.

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1. Amer. Chem. Jour., *18*, 694, 1896.