Engineers,* who recommend that the percentage of elongation in 8 inches should be specified as a function of the ultimate strength of the test specimen, by the formula

$$\text{Per cent of elongation in 8 inches} = \frac{1{,}500{,}000}{\text{Ultimate strength.}}$$

Those in column 8 were calculated by Prof. Johnson's modification of the above formula.

$$\text{Per cent. of elongation in 8 inches} = \frac{1{,}800{,}000}{f - 10{,}000} - 10$$

Where f is the ultimate strength of the test specimen.†

These formulæ express Tetmajer's criterion, which is essentially, that if two steels whose ultimate strengths may vary within assigned limits are to be equally suitable for the purpose of construction, the coefficients of ultimate resilience shall lie within narrow limits.

If instead of the ultimate strength we take the elastic limit Tetmajer's criterion would require that the coefficient of elastic resilience shall be constant.

Let λ = the elongation in length l.

$p.$ = stress per sq. inch at elastic limit.

$s.$ = strain = $\frac{\lambda}{l}$

A = Area of cross-section.

E = Young's modulus.

K = coefficient of elastic resilience.

The resilience or the work done by the gradually applied stress $= \int p \, A \, d\lambda = Al \int p.ds.$

By Hooke's law $p = Es.$

Hence the resilience $= Al \times \frac{1}{2} Es^2 = \frac{1}{2} ps \times Al.$

The coefficient of elastic resilience K or the work done per unit of volume $= \frac{1}{2} ps$, and depends only on the material.

If $l = 8$ inches the percentage of elongation in 8 inches $= \frac{100\lambda}{l} = 100s$ and $K = \frac{1}{200} p \times$ per cent. of elongation in 8 inches.

This would apply to the ultimate strength and elongation, and ultimate resilience if Hooke's law were true, and if the material continued to be homogeneous up to the breaking point. But in structural steel neither of these conditions hold.

Beyond the elastic limit there is no known relation between p and s by means of which the expression for the resilience may be in-

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Engineering News, July 16th, 1896.

†Digest of Physical Tests, Oct., 1896.