reinforced by "autofrettage". The idea of self-hooping a wall occurred in 1906 to Malaval, a French engineer of the Naval Artillery Department and apparently was applied for the first time in 1913 to the construction of a high caliber gun. The same idea was resumed by LANGENBERG [1925] then by MACRAE [1930], which devoted much time to studying the problem of stabilizing the self-hooped cylinders. In the field of the high pressures the "autofrettage" process may be easily applied to parts, of which the bore's regularity is of very little importance, provided that this process is applied with appropriate precautions, for instance to pipes and vessels. But its application to a cylinder, in which a shaft moves to and fro is more delicate, because the bore of the cylinder must be ground after applying such a process and because the cylinder in most cases must be stabilized by heat treating it.

In the first place, it is important to know whether the plasticity, which has developed in a cylinder at a yield pressure p_{1y}, will concentrically propagate. If the answer to the question is no, the theoritical considerations, we would develop for explaining the facts, run the risk of being so complicated, that it could no more be hoped, that such facts could be explained by having recourse to a simple theory. By putting very sensitive extensometers in the direction of diameters crossed at a right angle, CROSSLAND and BONES [1958] found, that measurements taken on cylinders, made of a 0.15% carbon steel, showed marked and suddenly appearing differences, which can be attributed to a dissymmetrical progression of the plasticity; but when one plots a diagram by means of the average of the readings, one obtains a regular curve and this is a very encouraging result indeed. When the whole cylinder is overstrained, the readings scattering reduces to nil; thus when the pressure reaches the level p_{1c} the test cylinder shows concentrical deformations. The same authors have observed, that in a low alloy steel, the plastic zone front moves forward concentrically from the beginning to the end of the experience.

COOK [1934] had already noted that mild steel cylinders gave rise to divergent extensometric readings, whereas STEELE and YOUNG [1952] have demonstrated by chemically attacking polished surfaces, that the mild steel plasticity propagates in the form of veins through an ambient material, which remains elastic. As it can be seen, following metals are an exception : the mild steel and probably the materials, which show, when they are submitted to tensile or torsion tests, an upper yield stress and a lower yield stress which are sufficiently remote one from another. The mild steel could obviously be excluded from the theory, which will follow, because it is no more used in the technique of high pressures but it is better to include it in said theory, it being understood, that its deformations will be characterized by the average of the extensometric readings.

Now, we would like to know whether and how the yield pressure p_{1Y} may be more directly connected to other critical quantities, derived from tensile, flexional or torsional tests results. The first vague and confused notions about this problem, are now going to solve. CROSSLAND [1954], who most contributed to achieve this aim, showed experimentally, that the fact of superimposing very high hydrostatic pressures affects in any way neither the upper yield shear stress τ_Y of materials submitted to torsional tests nor their plastic yielding. Test rods were the subject of very precise tests, which fully succeeded, because the Morisson's joint used by the experimenters and described in the same article rubbed very little against the rod. Most materials tested have however been more strongly deformed at breaking point by the sole effect of the surrounding pressure. From these results it appears that a cylindrical wall, closed at both ends and submitted to an internal pressure must overstrain, when its major shear stress given by eq. (11) reaches the yield level τ_Y extracted from the results of a torsional test. One puts thus down into eq. (11) $p_1 = p_{1Y}$, $p_2 = 0$; $l = 1$ and $\tau = \tau_Y$ so that the yield pressure can be obtained

$$p_{1Y} = (1 - 1/k^2)\, \tau_Y. \tag{15}$$

As it can be expected, the mild steel and other materials of the same type are unfortunately exceptions. MORRISON [1940] found, that their upper yield shear stress is a linear function of the shear stress gradient, so that τ_Y in eq. (15) must be corrected.

Eq. (15), although it is perfectly reliable, is unfortunately a function of the quantity τ_Y, which until now is not included in the data the makers of high grade steel supply us with. With a view to determining this quantity τ_Y, one must either carry out a torsion test or base the guess on Maxwell's or Tresca's assumptions. As we already mentioned it, Maxwell's assumption leads to eq. (14) and results in identifying τ_Y with $\sigma_Y/\sqrt{3}$. The other assumption results in identifying τ_Y with $\frac{1}{2}\sigma_Y$, because Tresca assumed, that a body begins to yield at the place where and at the moment when the major shear stress has reached a critical level and this, wichever the kind of stresses occurring may be. The upper yield shear stress in tension is precisely equal to $\frac{1}{2}\sigma_Y$. DEFFET and GELBGRAS [1953] experiments as well as CROSSLAND and BONES' one [1958] have shown, that generally speaking, the results of these experiments can be better accounted for by Maxwell's assumption than by Tresca's one, although they are exaggerated. Tresca's assumption, which leads to underestimated results is nevertheless advantageous, because the