Theoretically considered, the magnetic susceptibility is affected by the volume expansion caused by the internal stress in two different ways :—(1) the change of paramagnetic susceptibility due to the diminution of free electrons caused by the expansion ; (2) the change of diamagnetic susceptibility due to the increase of bound electrons caused by the expansion.

Now, according to W. Pauli, L. Landau and L. Posener[2], the first change of susceptibility is given by

$$\delta\chi_1 = \frac{2}{3}\frac{CL^{1/3}}{W^{1/3}}\left(-\frac{2}{3}\rho^{-5/3}\alpha^{1/3}\delta\rho + \frac{1}{3}\alpha^{-2/3}\rho^{-2/3}\delta\alpha\right),$$

where $C = 2\cdot21 \times 10^{-14}$, L = Loschmidt's number, W = atomic weight, ρ = density, α = number of free electrons per atom.

According to Sommerfeld[3], the second change of susceptibility is given by

$$\delta\chi_2 = \frac{3\cdot1 \times 1\cdot84 \times 10^{-5}}{W} \cdot \frac{1}{3}\alpha^{-2/3}\delta\alpha.$$

Hence $\delta\chi = \delta\chi_1 + \delta\chi_2$.

K. Honda, T. Nishina and T. Hirone[4] have given an expression for $\delta\alpha$, namely,

$$\delta\alpha = \frac{A}{3}\left(\frac{4\pi\rho}{3M}\right)^{0\cdot488}\frac{\delta\rho}{\rho},$$

where $A = 2\cdot261 \times 10^{-12}\ Z^{0\cdot513}$ and M = mass of the atom. ρ, $\delta\rho$ and α, $\delta\alpha$ being known from the experimental data, all the quantities in the expression for $\delta\chi$ are known and, therefore, $\delta\chi$ can be calculated. The results of this calculation for platinum, copper and silver are respectively,

$$\delta\chi = -0\cdot023 \times 10^{-6},\ -0\cdot064 \times 10^{-6} \text{ and } -0\cdot010 \times 10^{-6};$$

while those observed are

$$\delta\chi = -0\cdot030 \times 10^{-6},\ -0\cdot078 \times 10^{-6} \text{ and } -0\cdot011 \times 10^{-6}.$$

Thus the agreement between the theoretical and observed values is satisfactory. Therefore, it is to be concluded that the effect of cold-working on the susceptibility is a real one.

KOTARÔ HONDA.
YOSOMATSU SHIMIZU.

Research Institute for Iron,
Steel and other Metals,
Sendai, Japan.
June 21.

[1] K. Honda and Y. Shimizu, NATURE, 126, 990; 1930.
[2] Z. Phys., 41, 99; 1927; 64, 629; 1930; 75, 809; 1932.
[3] Z. Phys., 78, 283; 1932.
[4] Z. Phys., 76, 80; 1932.

Nuclear Moment of Tantalum

SOME time ago the spectrum of tantalum was chosen as a subject of investigation in this Laboratory. The hyperfine structure of the spectrum of tantalum had not been dealt with in the literature of the subject, so far as we are aware.

With a 21-ft. grating in an Eagle-mounting, nearly all the lines of the spectrum proved to be complex. The dispersion, however, being so far from sufficient, the use of interference apparatus was necessary. We therefore used a Hilger quartz Lummer plate combined with the 21-ft. grating in a stigmatic mounting with a concave mirror, so that both instruments gave crossed spectra. As a light source we used a horizontal arc of 5 amp. between two rods of tantalum with a diameter of 2·5 mm. and a pole distance of 1 mm. The arc burned in a current of air of 1·5 cm. pressure.

Mr. C. C. Kiess, of the Bureau of Standards, kindly sent us the preliminary list of terms of the arc spectrum, for which we are very much indebted to him. Grace and MacMillan[1] have recently reported their investigation of the hyperfine structure of tantalum, and they suggest for the nuclear moment the value $I = \frac{7}{2}\, h/2\pi$, without definite proof however. Some of our preliminary results lead to the same conclusion by a different way.

From the complexity of some of the lines, it is evident that the nuclear moment is rather large. In this case the combinations of terms with high J-values will give so many components, that one cannot expect to obtain complete resolution. Even in the case of lines of the 'flag' type, it was difficult to ascertain the number of components. Moreover, the application of the interval rule may lead in this case to erroneous conclusions. The combinations of small J-values seemed to us therefore more suited to give the nuclear moment. From the lines λ 3996·32, ${}^4P_{1/2} - {}^4P^0_{3/2}$, and λ 4692·06, ${}^6D_{1/2} - {}^4P^0_{3/2}$, we find that the ${}^4P^0_{3/2}$ level is fourfold with intervals : 0·418, 0·330 and 0·253 cm.$^{-1}$.

Application of the interval rule for different I-values gives the following result :

$I = 5/2$:	0·418 : 4 = 0·105	0·330 : 3 = 0·110	0·253 : 2 = 0·127
$I = 7/2$:	0·418 : 5 = 0·084	0·330 : 4 = 0·083	0·253 : 3 = 0·084
$I = 9/2$:	0·418 : 6 = 0·070	0·330 : 5 = 0·066	0·253 : 4 = 0·063

Hence we obtain for the nuclear moment the value $I = \frac{7}{2}\, h/2\pi$.

J. H. GISOLF.
P. ZEEMAN.

Laboratory "Physica",
The University,
Amsterdam.

[1] Phys. Rev., 44, 325; 1933.

Upper Pressure Limit of Ignition

ON the basis of their experimental data, Hinshelwood and Grant[1] arrive at the conclusion that the rupture of the reaction chains in the gas phase is due to ternary collisions, the latter fact being responsible for the existence of the upper pressure limit. A similar view was expressed by me in 1930 as the result of the experimental work carried out at the Leningrad Physical-Technical Institute. As early as then, I believed that the existence of the upper limit could be interpreted only on the assumption of the deactivation process in the gas phase being due to ternary collisions. Indeed, the velocity of a chain reaction is $w = n_0/\beta - \delta$, where n_0 is the number of initial centres, β the probability of rupture, and δ that of branching. The condition for the existence of an upper limit is $\beta - \delta = 0$. If both breaking and branching of chains are due to double collisions, the values of β and δ will depend on the same order of the pressure, which leads to the absence of any upper pressure limit of ignition. For the existence of an upper limit, β should depend upon a higher order of pressure than δ. Thus, for example, if the branching of chains required double collisions, their rupture should be brought into relation with ternary collisions.

According to Hinshelwood and Grant, the relationship between the value of the upper limit and the temperature T is $p_2 = A_c{}^{-E/RT}$. It may be recalled that the same equation can be found in our paper of 1930[2] on the oxidation of hydrogen and of