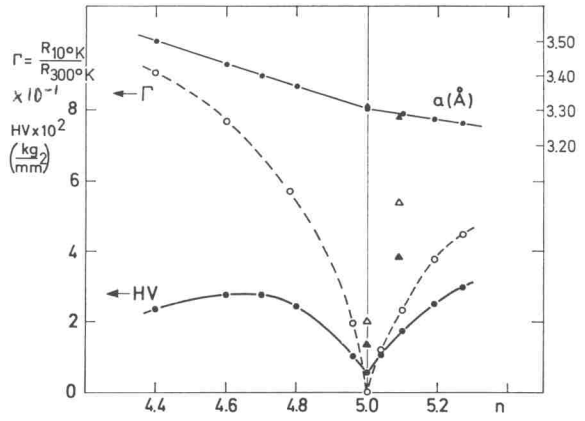

Fig. 1. Plotted versus number n of valence electrons per atom are: Lattice constant a, residual resistivity ratio Γ, and Vickers hardness HV. Data on ternary alloys are marked by triangles

which makes the experiment rather helium- and time-consuming, since every single data point $T_c(p)$ requires warming up and cooling of the apparatus. Fortunately it was no longer necessary for alloys with $n \leqq 4.8$ and $n \geqq 5.1$.

Results and Discussion

The measured variation of T_c with pressure is typical of transition metals in its complexity, as is shown in Fig. 2. For niobium and the niobium-rich alloys a pronounced kink occurs in the otherwise linear $T_c(p)$ behaviour. For example, in niobium T_c increases linearly with pressure from $p=0$ to 21 kbar by 0.23 °K, but does not change within 25 mdeg in the range of 24 to 73 kbar. For Nb-Zr alloys with 20, 40, and 60 at% Zr and for $Nb_{73}Mo_{27}$ no kink is observed; $T_c(p)$ is nearly linear for all pressures. In order not to obscure the diagram, data points are printed only for $Nb_{90}Mo_{10}$ and $Nb_{81}Mo_{19}$. Transition widths (10 to 90% of full resistivity) are indicated by bars at several points. Both scatter of the data points and transition widths are representative of those for all other alloys.

The jungle of information contained in Fig. 2 is easily unraveled by plotting versus n the slopes $d\ln T_c/dp$ for $p<20$ kbar and $p>25$ kbar (Fig. 3). The occurence of the kink in $T_c(p)$ for the niobium-rich alloys is represented by splitting of $d\ln T_c/dp$ into two branches. We discuss first the results for $p>25$ kbar where the slope $d\ln T_c/dp$ decreases monotonically with increasing number n of valence electrons per atom at zero pressure. Included in Fig. 3 are other relevant parameters. One

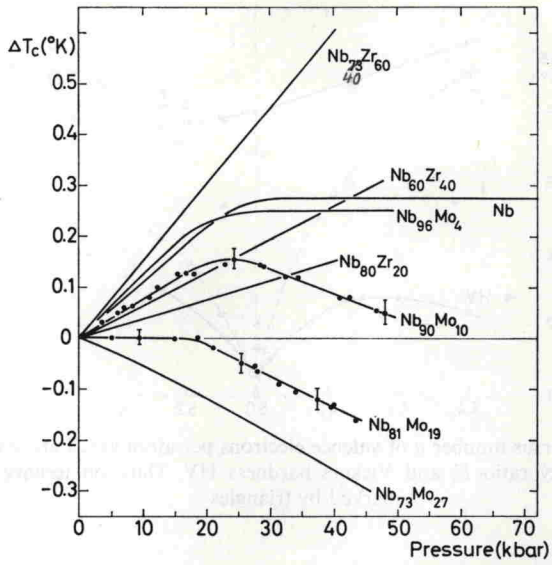

Fig. 2. Variation of transition temperature T_c with pressure p for a number of alloys investigated

notes that $d\ln T_c/dp$ changes sign at a concentration near that at which $T_c(n)$ has a maximum. Since in these alloys $T_c(n)$ is closely related to the d-band structure, this suggests that $T_c(p)$ is likewise connected with the d-band. Analyzing the data in this light, it is found that amongst several possibilities for the connection between $d\ln T_c/dp$ and the electronic structure of the alloys, i.e. with either $d\ln N/dn$, or $d\ln NV/dn$, or $d\ln T_c/dn$, or finally $d\ln T_c/dn - d\ln\theta/dn$, the last provides a linear data fit with the least scatter. This is shown in Fig. 4, from which we obtain the simple relation

$$\partial \ln T_c/\partial p = a(\partial \ln T_c/\partial n - \partial \ln\theta/\partial n) + b \qquad (1)$$

with $a = 0.40 \cdot 10^{-6}$ bar^{-1} and $b = 0.62 \cdot 10^{-6}$ bar^{-1}, θ = Debye characteristic temperature. Substitution of the BCS-expression for T_c in (1) yields

$$\partial \ln\theta/\partial p + (NV)^{-1}\,\partial \ln NV/\partial p = a \cdot (NV)^{-1}\,\partial \ln NV/\partial n + b \qquad (2)$$

$V = V_{BCS}$. For niobium $\partial\ln\theta/\partial p = \gamma_G \cdot \kappa$ can be calculated from the experimental data on γ_G (Grüneisen parameter)[23] and κ (compressi-

23 Collins, J. G., White, G. K.: Progr. Low Temp. Phys., Vol. 4, p. 450. Amsterdam: North Holland Publishing Company 1964.