zirconium. α phase: dotted line—first com-
pression cycles (after pressure had exceeded
4.2 K. ω phase: triangles. Inset: Comparison
circles) and steatite cell (open circles). The error
he Zr-samples (10 to 90% of residual resistance)
termined by the transition width of the lead
nanometer

that this behaviour is a consequence
e technique, measurements were also
to about 13 kbar. The results are in-
cles). Since in the liquid cell pressures
ıed, the samples showed the same $T_c(p)$
he solid cell on their first compression
rved between the two techniques were:
tal points was less with the liquid cell,
samples were practically constant with
e solid cell they increased slightly with
transition widths of the lead samples,
ty in the liquid cell of ± 0.3 kbar at any

ıe described behaviour of the samples
ıaterial. It is supposed that the samples

are in a perturbed lattice state, induced by the cold rolling. As in transi-
tion metals such a lattice perturbation is often accompanied by an
increase in T_c, this would explain the relatively high $T_c(0)$ of 0.66 K.
The results seem to indicate, that high homogeneous pressures favour
the annealing of these defects. Then the value $dT_c/dp = 3.5 \times 10^{-6}$ K/bar
will come closest to that of an unperturbed specimen. Another possible
explanation would be the existence of another—probably metastable—
phase. As will be pointed out below, the only other known high pressure
phase, ω-Zr, shows quite a different behaviour. Thus, the explanation
in terms of phases would require the existence of a third phase.

In order to show the strong influence of lattice defects, they were
deliberately produced in another experiment by altering the pressure
at 4.2 K. The resulting dT_c/dp increased near 14 kbar to $\sim 15.6 \times 10^{-6}$ K/bar (crosses). In addition, we observed a large irreversible
shift in T_c: Upon releasing the pressure from 40 kbar at 4.2 K, we
measured $T_c(0) = 1.03$ K. While decreasing the pressure at 4.2 K a
dT_c/dp of 3.6×10^{-6} K/bar was found, which equals the value determined
by "tender" pressurizing at room temperature. If it is supposed that
no further lattice defects are produced during removal of pressure,
this result should be expected. Most important is the fact that the
irreversible shift of T_c has disappeared after an annealing period of
24 h at room temperature. We may assume that the lattice defects which
were generated at 4.2 K, and which are of influence on T_c, have dis-
appeared during this time.

It remains to explain the bend in the $T_c(p)$ dependence (crosses)
near 14 kbar. This pressure corresponds approximately to the yield
strength of Zr at low temperatures*; above this pressure deformation
is predominantly plastic, and lattice defects are produced at a higher
rate. Another possibility is the existence of a phase transition at this
pressure and 4.2 K, either into the already known ω-Zr or into an as
yet unknown phase. However, as will be shown in the next section,
ω-Zr, once formed, will not reconvert, even at room temperature,
and so give rise to an irreversible change in T_c, which is stable against
warming up to 300 K. Thus, the possible existence of a new low temper-
ature—high pressure phase cannot be excluded.

Comparison of our results with those of Brandt and Ginzburg[5]
shows that their value of dT_c/dp is about the same as in our cold work

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* Heavily deformed Zr has a 0.2%—yield strength of about 6 kbar at room tem-
   perature; at 4 K it is about twice as much[14].
14 Gmelin's Handbuch der anorgan. Chemie, System Nr. 42, 8. Aufl. Weinheim:
   Verlag Chemie GmbH 1958.