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Discussion of ASME Paper No. 60-WA-178

"Calibration Techniques in Ultrahigh Pressure Apparatus"

(Discussion by the author, F.P. Bundy)

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Since the manuscript of this paper was sent in some important experimental results have been reported. These are:

I. G.C. Kennedy and P.N. LaMori report the following values for the volume transitions listed below, using their improved apparatus:

Bi(1-2)	25.4	±0.1kb
Bi(2-3)	27.9	±0.2kb
Tl(2-3)	36.7	±0.1kb
Cs(1-2)	22.6	±0.6kb
Cs(2-3)	41.8	±1.0kb
Ba(2-3)	60	± ? kb

II. H.G. Drickamer reports ΔR tests on Bi and Ba, run in his "optical" apparatus[1], using optical absorption band edge calibration above 25kb;

low Bi	25 kb
Ba	58-60kb
high Bi	89-92kb

Note that these values for ΔR transitions agree quite well with ΔV transitions reported by Bridgman. This agreement strengthens the belief that the ΔV and ΔR transitions originally reported by Bridgman to occur at different pressure are in reality the same phenomena (for a given metal) and that Bridgman's ΔV values have the best absolute accuracy.

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[1] Fitch, Slykhouse & Drickamer, J.Opt.Soc.Am. 47, 1015(1957)

III. Balchan and Drickamer[2] have modified their "optical" ultra-high pressure apparatus to attain considerably higher pressures and have obtained ΔR measurements at pressures as high as 500kb. Their calibration for this high pressure range was based on R/R_o as a function of V/V_o of metals like Pt and Pb which exhibit smooth normal behavior in the 0 to 30kb region according to Bridgman's measurements in apparatus with liquid pressure medium. They then extrapolated to pressure higher than 30kb by using PV data for these metals obtained by shock wave methods. Such a large extrapolation (30 to 300kb) would be considered very precarious except that a strong ΔR transition in Fe was found at 133kb on this scale, which checks very well with a pronounced ΔV transition already known in Fe at 131kb from shock pressure experiments. Pressures in shock wave experiments are known with an absolute accuracy closer than one percent so that ΔR transition in Fe found by Balchan and Drickamer may be considered as a fairly accurate pressure calibration point.

In addition to the Fe transition, Balchan and Drickamer found one in Ba at 144kb, one in Pb at 161kb, and one in Rb at 193kb. They found a rather broad maximum in the resistance of Ca at about 375kb.

On the basis of these very recent results it may now be concluded that a fairly reliable absolute pressure calibration scale up to 200kb at room temperature is available, based on the following nine abrupt electrical resistance transitions:

low Bi, 25.4kb	Fe, 133kb
Tl, 37 kb	high Ba, 144kb
Cs, 42 kb	Pb, 161kb
low Ba, 59 kb	Rb, 193kb
high Bi, 89 kb	

The R/R_o's vs pressure for these metals are shown graphically in Fig. 1.

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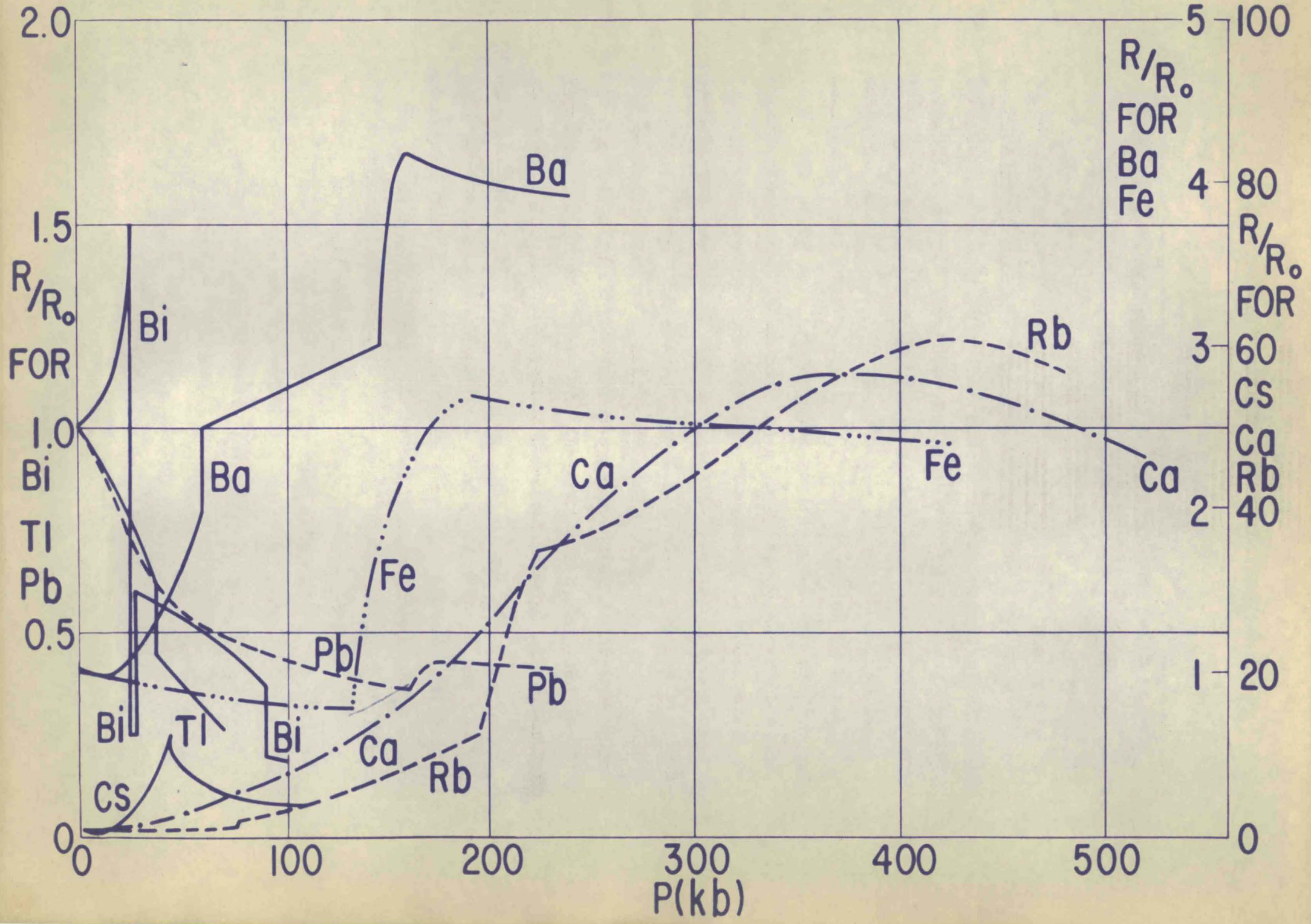
[2] A.S. Balchan and H.G. Drickamer, MS submitted to Rev.Sci. Instr. for publication.


2.0
1.5
1.0
0.5
0
R/R₀ FOR
Bi
Tl
Pb
Ba
Fe
Ca
Rb
Cs
Pb
Bi
Tl
Bi
Ca
Rb
Ba
Fe
Rb
Ca
Fe
Ca
0
100
200
300
400
500
P(kb)
5
4
3
2
1
0
100
80
60
40
20
0
R/R₀ FOR
Ba
Fe
R/R₀ FOR
Cs
Ca
Rb