modulus B $[B = \kappa^{-1} = (-dV/dP \cdot V)^{-1}]$ does not seem to show any anomaly. Nevertheless, we strongly suspect that fcc La possesses a region of an anomalously high compressibility corresponding perhaps to a "pseudo" phase transformation (continuous transition) around 70 kbar, when the "point of inflection" is near room temperature. From studying their data one can quite readily conceive that a small anomaly in the V vs. P relation, i.e., a more or less abrupt volume decrease of the order of a few parts in a thousand, may have easily escaped detection. However, the data clearly set an upper bound on the magnitude of any such effect. In constructing our hypothetical phase diagram we heavily relied upon the fact that no change of the crystal symmetry occurs at room temperature between 30 and 120 kbar and also, within the present accuracy, no first-order phase transformation occurs between two different fcc phases (cf. Fig. 10).

The most interesting new feature of the phase diagram is the probable existence of a pressure-induced fcc → fcc phase transformation at 53 kbar restricted to low temperatures. The phase boundary is probably steep and terminates in a *critical point* at a temperature possibly of the order of 100 K (Fig. 10). Although it is at present an open question whether the α/α' phase boundary of Ce (cf. Fig. 11) ends in a critical point (at high temperatures) we believe that there is a striking similarity between the phase diagrams of both elements. We have therefore adopted the conventional notation of the phases of Ce and labeled the adjoining phases in Fig. 10 α and α'.

In our comparison of the properties of Ce and La we have thus far ignored the recent discovery of an orthorhombic phase of Ce at pressures above ~ 50 kbar.[24] Previous work had revealed that the α/α' phase transformation proceeds also without a change of symmetry (fcc → fcc).[25] Conflicting results were reported by McWhan,[26] who claimed α'-Ce to be hcp or a slight distortion thereof. In this context, we would like to propose that perhaps nonhydrostatic stress components (or impurities) may have artificially stabilized noncubic structures in the most recent experiment.[24,26] This does not seem entirely impossible, if the α/α' transformation in Ce is also accompanied by soft phonon modes similar to those of La, to be discussed below. The simultaneous existence of a "metastable" monoclinic modification[24] of Ce at the same pressure where orthorhombic phase is found gives some support to this view. We therefore insist that the fundamental question of the structure of α'-Ce is still completely unsettled. By analogy with the α' phase of La, we expect it to be fcc, in contrast to the recently reported structures. In addition, we think that thorium (fcc) is the electronic 5*f*-band counterpart of α'-Ce.[1] If true, this would (almost) necessitate the fcc structure for α'-Ce as well.

The melting curve data and the high temperature bcc/fcc phase boundary

in Fig. 10 are taken from Jayaraman's work.[27] The dhcp phase (β)* of La is stable below ~ 500 K[21] at normal pressure and below ~ 300 K at ~ 23 kbar.[28] We have connected these two points by a slightly concave curve and, as outlined below, find reason to extend it out to ~ 35 kbar at low temperatures (cf. Fig. 10).

The solid circles mark the position of the "points of inflection" of the resistance. We have included them in the phase diagram, although they probably do *not* indicate a first-order phase transformation. We believe that they point to the existence of a continuous transition, encountering possibly a similar situation as in Ce metal at temperatures beyond the critical point. There, the resistance keeps strongly varying with pressure, though no phase transition, in the strict sense, occurs.[29] If the analogy of La with Ce holds, the locus of the "points of inflection" may therefore eventually find its continuation in a first-order phase boundary at lower temperatures (Fig. 10, dashed extension of the solid circles to $T = 0$ K). In fact, there is some evidence, as discussed in more detail below, that a first-order phase boundary between two fcc phases runs into the pressure axis ($T = 0$ K) at ~ 25 kbar. This is, presumably, a phase boundary between two *fcc phases* (called γ and α) which can exist *metastably* inside the field of stability of the dhcp phase (Fig. 10). We have, somewhat arbitrarily, linked this information to the occurrence of the "points of inflection" at higher temperatures (and pressures) and thus arrive at the phase diagram of Fig. 10. Another obvious variant is shown in Fig. 11 (center diagram). The anticipated critical point between the γ and α phases of Fig. 10 ($T_{crit} \sim 100$ K, $P_{crit} \sim 35$–40 kbar) is now degenerated to a *metastable* critical point. Also, a triple point does not occur in this conception as sketched in Fig. 10 in the immediate vicinity of the critical point. The variant on the right side of Fig. 11, although we do not particularly favor it, shows most clearly that the phase diagrams of La and Ce (cf. left diagram) may be qualitatively isomorphous. There are certainly quantitative differences. One of them is the vastly extended β phase of La in comparison to Ce. Also, the postulated critical points of La should be subtle low temperature effects, contrary to the situation in Ce. In line with this, the volume discontinuities of the fcc $\rightarrow$ fcc phase changes will presumably be much smaller than for Ce.

We have thus tentatively adopted the standard nomenclature of the various phases of Ce in order to sort the probable as well as the possible phases of La. In the following we discuss the experimental results in relation to the proposed phase diagram.

*In the current literature the dhcp phase is labeled α and the fcc phase β. We find evidence for the existence of three *different* fcc phases at low temperatures: γ, α, and α'.