mixtures with a large nitrogen content, would not be correct, since special experiments have shown that the lifetime of the $CO_2$ molecule at the lower levels in mixtures with large nitrogen contents increases somewhat compared with the lifetime in the pure carbon dioxide. If the mixture is diluted with more than 80% of nitrogen, the no population inversion may occur under chosen concrete conditions of gas flow, since the temperature of the "freezing" of the populations of the vibrational levels of the $CO_2$ molecules, approximately 500°K, is close to the limiting cooling temperature $T_{lim}$, above which no inversion can appear at all at a vanishingly small content of carbon dioxide in the mixture and at sudden cooling of the gas. It follows from [1, 2] that

$$T_{lim}/T_0 = E_1/E_2 = 0.59,$$

where $E_1$ and $E_2$ are the energies of the lower and upper laser levels.

Our investigation confirms experimentally the correctness of the main physical premises underlying the action of a GKL using a mixture of carbon dioxide and nitrogen.


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## SUPERCONDUCTIVITY OF ARSENIC AT HIGH PRESSURES


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The elements of the fifth group of the periodic system Bi [1], Sb [2], and P [3, 4] become superconducting at pressures exceeding 25, 70, and 110 kbar, respectively.

According to the data of [5], a sharp drop is observed on the plot of the electric resistance of As against pressure at P = 100 kbar; this drop is connected with a polymorphic transition. However, attempts to observe superconductivity of As at high pressure yielded no affirmative result [4, 6]. One might assume that this negative result is connected with the fact that As becomes superconducting at a lower temperature than that used in the investigation.

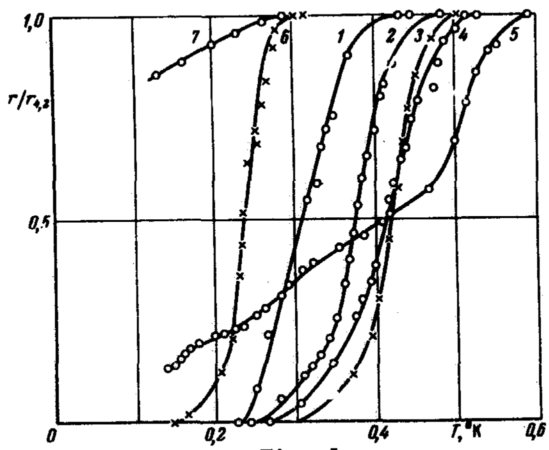


Fig. 1

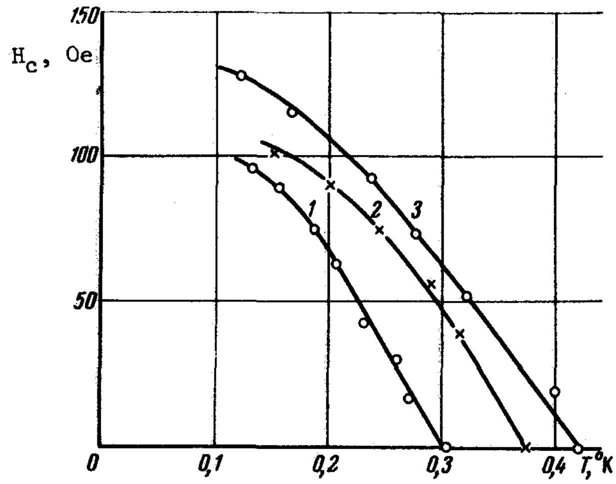


Fig. 3

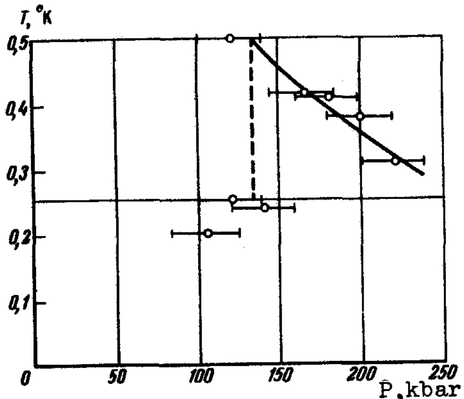


Fig. 2

Fig. 1. Relative variation of electric resistance in the transition of As into the superconducting state at H = 0 and pressures 220 (1) 200 (2) 180 (3), 165 (4), 120 (5), 140 (6), and 105 kbar (7).

Fig. 2. Pressure dependence of superconducting transition temperature of As.

Fig. 3. Critical fields of As at pressures 220 (1), 200 (2), and 165 kbar (3).

We report here observation of superconductivity of As at pressures 100 - 220 kbar and at temperatures below 1°K. The measurements were made with a setup having a general construction close to that described in [1, 3]. The pressure was determined with a calibration curve drawn through reference points, with accuracy ± 20 kbar. The onset of superconductivity was revealed by the change of the electric resistance. The tests were made on single-crystal As 99.9999% pure.

In the pressure range 100 - 220 kbar, the sample resistance decreased by a factor 7 - 13 when cooled from 240 to 4.2°K. Further lowering of the temperature to below 1°K revealed clearly pronounced transitions into the superconducting state. Figure 1 shows the plots of the superconducting transitions of As in a zero magnetic field at various pressures. The temperatures $T_c$ of the transitions were determined from the midpoints of the curves. The values of $T_c$ obtained in this manner are shown in Fig. 2.

The presented data can apparently be interpreted as follows. In the 220 - 140 kbar pressure region, the sample consists of one crystalline modification with a superconducting-transition temperature that decreases monotonically with increasing pressure, from 0.5°K at P ≈ 140 kbar to 0.31°K at P ≈ 220 kbar. The plots of the critical magnetic fields of this phase are shown in Fig. 3[1]. When the pressure is decreased to ∼ 140 kbar, a new super-

[1]The critical fields were determined from the midpoints of the curves of destruction of superconductivity by the magnetic field.

conducting state and the transition in the magnetic field become greatly diffused at this pressure, possibly as a result of the fact that the sample is not single-phase. This phase has apparently a positive value of $dT_c/dP$. At pressures below 100 kbar, no superconductivity is observed above 0.1°K.


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# DIVERGENCES OF AMPLITUDES OF WEAK NONLEPTONIC PROCESSES IN THE THEORY WITH AN INTERMEDIATE BOSON


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The use of current algebra in the analysis of the amplitudes of weak hadron-lepton processes in the higher orders in the weak interaction has shown [1] that in some cases an exact allowance for the strong interactions does not lead to an effective cutoff of the integrals, which remain divergent and can be cut off, by the same token, only via weak or electromagnetic interactions.

In the case of nonleptonic processes, in the theory with an intermediate boson, the situation is less clear, but here, too, there are grounds for assuming [2 - 4] that the strong interactions do not cut off the integrals with respect to the momenta of the virtual W bosons. To eliminate the resultant difficulties, it was proposed in [3 - 5] that the Hamiltonian of the interaction is the sum of the following terms: symmetrical in SU(3) × SU(3) and SU(3) × SU(3) symmetry breaking terms that transform in accordance with the representations $(3, \bar{3})$ and $(\bar{3}, 3)$ of the SU(3) × SU(3) groups. Then, as shown in [3], the contribution of the diverging terms to the amplitudes of the transitions with $\Delta S = 1$ (and also to the parity-nonconversing amplitudes with $\Delta S = 0$) vanish rigorously.

In this paper we wish to present an estimate of the diverging terms in the amplitudes of weak nonleptonic processes, without using the assumption made in [3 - 5], and to find the resultant values of the cutoff parameter. The main assumption used here will be the hypothesis of partial conservation of the partial current without change of strangeness (PCAC) or more accurately, the assumption that in the limit of zero pion mass the axial current with $\Delta S = 0$ is rigorously conserved.

The matrix element of the transition between the hadron states a and b due to emission and absorption of an intermediate W boson can be written in the form

$$M(2\pi)^4\delta^4(p_a - p_b) = \frac{4\pi g^2}{(2\pi)^4}\int d^4k\,\frac{1}{k^2\mu^2}\left(\delta_{\mu\nu} - \frac{k_\mu k_\nu}{\mu^2}\right) \times \tag{1}$$
$$\times \int d^4x\,d^4y\,e^{ik(x-y)} < b\,|\,T\{j_\mu^+(x),\ j_\nu(y)\}\,|\,a >,$$