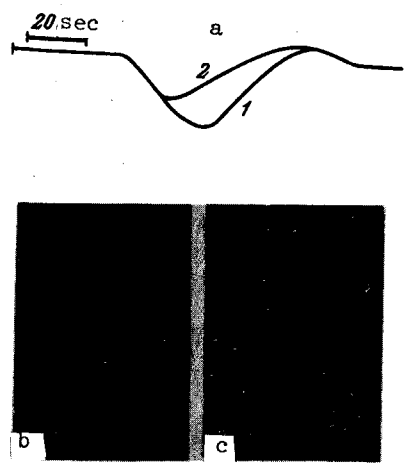
in [7]; the trapping of the backward beam in filaments in the case of SMBS in CS_2 was reported in [8]. The photograph of Fig. 3c was obtained at a laser power close to the SMBS threshold. A similar spot, surrounded by a ring, can be seen on the photographs of the cross sections of the beam trapped in a filament in CS_2 [9].



Further investigations of SMBS will probably make it possible to obtain informa tion on the electro-optical and elastic properties of liquid helium.

Helium scatters light very weakly [10 - 12]. Owing to the large intensity of the SMBS, it becomes possible to investigate molecular scattering of light in liquid helium.

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SINGULARITY OF SPECIFIC HEAT C_p AT THE CRITICAL POINT OF LAMINATION OF A BINARY SOLUTION

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Whereas the singularity of C_v at the critical point of a pure liquid and the singularities of C_p at second-roder phase-transition points have been discussed extensively [1], there is very little material concerning the critical points of lamination of binary mixtures [2]. It can be assumed that a singularity of C_p should take place at these points, but only a single paper [3] is devoted to a reduction of old experimental data [4] confirming this possibility.

Yet binary liquid-liquid systems offer many advantages to the experimenter, both over a pure substance at the critical points and over solids. Indeed, we are able in this case to work with a liquid sample at low pressure at temperature, stirring it during the time of the measurement, and freely varying the concentration of the components at our discretion. Thus the problems of structure imperfections, inhomogeneities, and point defects are eliminated, and the experimental technique remains relatively elementary, owing to the low vapor pressure.

However, besides practical considerations there are also fundamental reasons for paying particular attention to the critical points of binary mixtures.

In discussions of questions connected with the singularities of thermodynamic properties, most authors [1] start from the isomorphism of various physical objects, which is based on the analogy between the models of the lattice gas and the Ising ferromagnet. This isomorphism is very valuable, since it makes it possible to supplement the sketchy data on certain objects by equally sketchy data on others. Attentive analysis, furthermore, shows that the analogy between the critical point of a liquid and a second-order phase transition is not fully complete. The critical point of a real liquid, as well as that of a lattice gas, is defined as a unique point in phase space, corresponding to noncompressibility of the lattice. To the contrary, all real transition points in solids describe curves on the phase diagram, so that T_c is a function of the pressure. This corresponds to an essentially compressible lattice. Thus, it does not follow at all that the singularities of the physical quantities coincide in the two cases.

The critical point of a binary mixture is another matter. On the diagram of state, the critical points of mixtures fall on the line $T_c - x_c$, where x_c is the critical concentration of the mixture and is a single-valued function of the pressure. Thus, from the point of view of the number of degrees of freedom and the character of the functional relations, this system is analogous to second-order phase transitions. The role of the ordering parameters is played here by the deviation $(x - x_c)/x_c$ of the phase concentrations from the critical, the generalized susceptibility (compressibility) of the system is the quantity $(\partial\mu/\partial x)_{p,T}$, and the specific heat $C_{p,\eta=0}$ becomes $C_{p,x=x_c}$.

In our experiment we used a methanol-cyclohexane mixture (28.4 wt.% CH_3OH, 71.6 wt.% C_3H_{12}). According to the data of [5], the critical concentration of this mixture is 28.16 wt.% CH_3OH, and the critical temperature is 319.29°K. According to [6], the critical concentration is 28.12 wt.% CH_3OH and the critical temperature is 318.29°K. The densities of the methanol and cyclohexane at 20°C are 0.792 and 0.778 g/cm^3, respectively [7].

The measurements were made in an adiabatic calorimeter with magnetic stirrer [8]. To increase the accuracy, the calorimeter was surrounded by a double adiabatic shell. This made it possible to measure the specific heat C_p accurate to 0.5 - 1% at a calorimeter-step width 0.005 - 0.01°. Particular attention was paid to the establishment of equilibrium in the system. Several measurement runs were made at different stirring intensities and durations. It turned out that in continuous stirring the time to establish equilibrium is less than five minutes and does not depend on the stirring frequency in the range from 1 to 4 times a minute.

The experimental results are shown in Figs. 1 and 2, where the temperature dependence of the specific heat C_p is plotted on a semilogarithmic scale relative to the two different temperatures 319.272 and 319.250°K corresponding to the "jump" and peak of the specific heat.

It was found directly and with the aid of thermograms [9] that the maximum specific heat of the investigated sample does not coincide with the point of maximum slope of the $C_p(T)$ curve (with the "jump") and lies at a temperature 0.022° lower. If we use the analogy with the critical point of a pure liquid, such a discrepancy can be interpreted as the result of a deviation of 0.5% from the critical concentration of the mixture [10], or else a result of

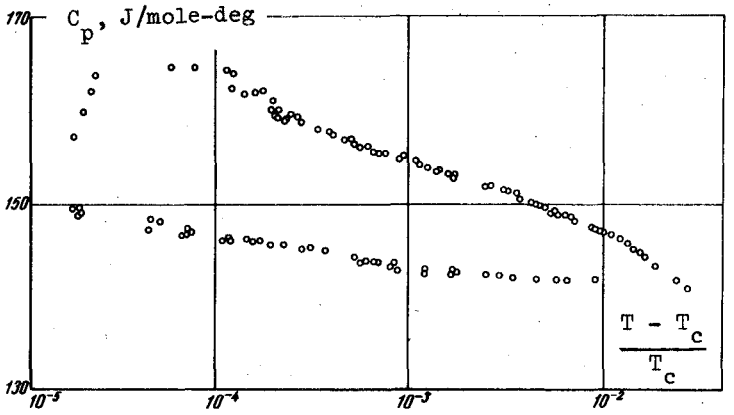

Fig. 1. C_p vs. $\ln[(T - T_c)/T_c]$, where $T_c = 31.9.272°K$.

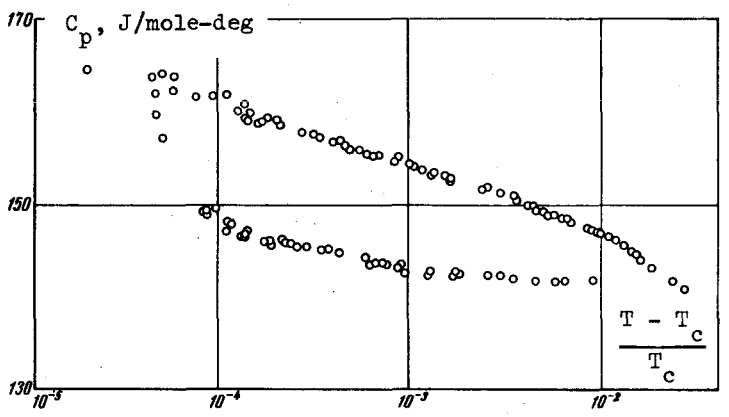

Fig. 2. C_p vs. $\ln[(T - T_c)/T_c]$, where $T_c = 319.250°K$.

the presence of a foreign impurity on the order of 0.1% [11]. The latter is of little likelihood, whereas the accuracy with which the critical concentration is known is worse than 1%. The form of the singularities shown in Fig. 1 then seems to be more correct, since the true critical temperature may turn out to be even higher.

We are thus forced to state that even if the singularity of C_p can be expressed by a logarithmic formula, the coefficients of the logarithm differ greatly for $T > T_c$ and $T < T_c$ (by an approximate factor of two). This means that the so frequently employed concept of "jump of specific heat" becomes meaningless for this case.

We note that the reduction of the data on the temperature of the maximum specific heat (Fig. 2) does not change this main result, since the branches of the curves for $T < T_m$ and $T > T_m$ cannot be regarded as parallel without stretching a point, and the curve at $T > T_m$ may more readily satisfy a power law. We shall not do so, however, until we investigate the concentration dependence of this result. We call only attention here to the similarity between the data of Fig. 1 and the results of D. Teaney, obtained for the antiferromagnetic transition in MnF_2.

In conclusion, the authors thank V. Zigel', V. Chernysh, and V. Kleimenov for help with the experiment.

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TURNING OF MAGNETIC SUBLATTICES AND ANOMALIES OF THE COTTON-MOUTON EFFECT IN TERBIUM IRON GARNET AND IN HEMATITE

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We have recently proposed a new exchange-dipole mechanism of quadratic magnetooptic effects in ferro- and antiferromagnets [1], leading to unusually high values of the Cotton-Mouton effect (CME) in crystals below $T_{C,N}$ [2]. The large value of the CME, the availability of strong light sources of varying wavelengths, and the relative simplicity of observing the CME uncover interesting possibilities for the investigation, by means of a new magnetooptic method, of the exchange interactions in crystal, of the temperature dependences of the sublattice magnetizations, of the orientations of the magnetic moments, and of other phenomena.

In this paper we present the results of an investigation of the temperature dependence of the CME in terbium iron garnet $Tb_3Fe_5O_{12}$ and in the antiferromagnet α-Fe_2O_3 (hematite), and of observations of the CME anomalies connected with the reorientation of the magnetic sublattices.

The CME was investigated at a wavelength $\lambda = 1.15\ \mu$, at which $Tb_3Fe_5O_{12}$ and hematite have a transparency of several cm^{-1}. The CME was investigated in a plate of $Tb_3Fe_5O_{12}$ cut parallel to the (110) plane, with the magnetic field directed along the [100] axis. In the case of hematite, the plate was perpendicular to the optic axis and the magnetic field was in the plane of the plate.

The temperature dependence of the CME in $Tb_3Fe_5O_{12}$ is shown in Fig. 1. The sign of the effect is opposite that of the CME in yttrium iron garnet $Y_3Fe_5O_{12}$ [12]. This difference in signs indicates that the terbium sublattice and the summary iron sublattice result in opposite signs of the effect, and that the CME from the iron ions is lower than that from the terbium ions at room temperature. It can be assumed approximately that the contributions made to the effect by the rare-earth and by the iron sublattices are independent:

$$\Delta n_{CM}(Tb_3Fe_5O_{12}) = \Delta n(M_{Tb}^2) - \Delta n(M_{Fe}^2), \quad (1)$$