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MEETINGS AND CONFERENCES

THE ELEVENTH ALL-UNION MEETING ON LOW-TEMPERATURE PHYSICS

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THE regular eleventh All-union meeting on low-temperature physics took place between June 27 and July 2, 1964 in Minsk at the Institute of Solid State Physics and Semiconductors of the Academy of Sciences of the Byelorussian SSR.

Representatives of almost all organizations of the Soviet Union carrying out investigations in the field of low temperatures, and also scientists from the German Democratic Republic, Czechoslovakia, Bulgaria, Hungary, and Yugoslavia took part in the work of the meeting. A total of over 400 persons attended the meeting. More than a hundred papers were presented in which investigation of the properties of helium, superconductivity, the physical properties of condensed media, low-temperature thermodynamics, cryogenics, and other problems were discussed. We are unable to dwell on all papers, and will therefore restrict ourselves to a short summary of some of them.

The meeting was opened by the Academician of the Byelorussian Academy of Sciences N. N. Sirota. F. I. Fedorov welcomed those attending the meeting in the name of the Physico-mathematical Section of the Belorussian Academy of Sciences. N. E. Alekseevskiĭ, chairman of the Scientific Council for low-temperature physics then described the general state of low-temperature physics, noted the fruitfulness of the meetings held, and the necessity of further coordination of the subjects of the investigations.

The oldest problem of low-temperature physics is the problem of liquid helium. Here many interesting problems still remain to be solved; in particular, one must explain exhaustively the mechanism of the destruction of superfluidity and to investigate the vortex nature of the motion of He II. A group of Georgian scientists headed by É. L. Andronikashvili has been working fruitfully in this field for many years. This group (É. L. Andronikashvili, R. A. Bablidze, G. V. Gudzhabidze, and Dzh. S. Tsakadze) presented a survey paper on the phase transition in rotating liquid helium.

In the first part of their work they investigated the relaxation of quantum vortices by measuring the attenuation of the oscillations of a disc, suspended on an elastic fiber and rotating along with the liquid helium. They observed that in the rotation of He II with an angular velocity corresponding to the maximum of vortex attenuation, on going through the λ point the disappearance of vortices takes place extremely slowly. For example, for overheating by 0.05°K (T = 2.22°K) the number of vortices and their tension remained unchanged for about 18 minutes.

The second part of this paper was devoted to a clarification of the process of vortex production on cooling of rotating He below the λ point. For this purpose they studied the change in the Q of rotating resonators of second sound due to the appearance in them of quantized vortices. It follows from the experiments that the time of production of vortices $\tau = \tau_0 \exp[-(\omega - \omega_{0c})/\alpha]$, where ω_{0c} is the critical angular velocity for a given vessel, ω_0 is the angular rate of rotation, $\tau \approx 900$ sec and $\alpha = 1.18\ \mathrm{sec}^{-1}$. In addition, they showed that the internal surface of the rotating glass has no effect whatsoever on the production of vortex filaments. The results of measuring of the relaxation time of vortices on increasing the temperature above T_λ coincide in order of magnitude with data obtained in experiments with an oscillating disc.

G. A. Gamtsemlidze reported results of measurement of the attenuation of rotational oscillations of a disc in He II after the liquid stopped rotating. He established that in this case the decrement of the attenuation of the oscillations remains for a rather long time larger than the corresponding decrement for a liquid which has not been subjected to prior stopping of the rotation. This result is explained by the effect of escape of energy along the vortices specific for He II. It was noted that the nature of the amplitude decrease depends strongly on the angular velocity ω of the liquid at the moment of breaking, whereas the total lifetime of the vortices depends weakly on ω.

The Kharkov physicists continued their investigations of the diagram of state of He^3—He^4 mixtures. I. V. Bogoyavlenskiĭ, N. G. Bereznyak, and B. N. Esel'son reported their work on this problem. They established that in the pressure range 50—140 atm the diagram of state of He^3—He^4 mixtures is of the peritectic type.

As previously, the properties of He are being studied intensively in Moscow.

L. P. Mezhov-Deglin told of measurements of the heat capacity of solid He^4 in the temperature range of 0.5—2.5°K and pressures up to 185 atm. The maximum heat capacity exceeds by about a factor of three the best of previously obtained results which indicates the high quality of the investigated crystals. The temperature dependence of the thermal conductivity of such crystals is well described within the framework of the theory developed recently by the Kharkov theoretician R. N. Gurzhi. The Kapitza jump at the He^4-copper boundary was also measured in this work.

Perhaps the most interesting problem referring to the properties of helium is the superfluidity of the light isotope of He^3. After the discovery of the superfluidity of He^4 by P. L. Kapitza it was thought for a long time that He^3 does not go over into the superfluid state at any temperature. The point is that He^3 nuclei, unlike He^4, do not have half-integral spin. This causes these two isotopes to have entirely different properties at low temperatures. However, some years ago it was shown in a number of papers that pairing of excitations should occur in He^3 at very low temperatures. Such pairing will lead to a phase transition of He^3 into a new state which may turn out to be superfluid. Laboratories of various countries have sought the superfluidity of He^3. The problem turned out to be unusually complex and until recently it has only been possible to establish that down to a temperature of 0.008°K there was no sign of a phase transition in He^3. At the previous meeting V. P. Peshkov reported the first success in this direction. Experiments with three-stage magnetic cooling of a block of paramagnetic salt with liquid He^3 in its pores showed that at a temperature of 0.0055°K the heat capacity of He^3 reaches a maximum. This behavior of the heat capacity is explained by the author as a phase transition of He^3 into a new phase.

One of the central problems of the theory of the condensed state is the question of the character of the singularity of thermodynamic quantities at a second-order phase transition. Although it is apparently impossible at present to solve this problem in general, it seems probable that this singularity is logarithmic. According to contemporary notions the λ transition in He and the transition to the superconducting state in metals are of the same nature and are related to the condensation of Bose particles. However, experiment shows that at the λ transition in He the heat capacity C_p has a logarithmic singularity while at the superconducting transition C_p undergoes a finite jump. In the work of the Novosibirsk physicists É. G. Batyeva, A. Z. Patashinskiĭ, and V. L. Pokrovskiĭ a metal is considered close to the temperature of transition to the superconducting state T_c ($T > T_c$). At temperatures very close to T_c [$(T - T_c)/T_c < (T/\mu)$, μ is the chemical potential) equations are obtained analogous to those of the Bose liquid near the λ curve. In this temperature range the behavior of thermodynamic quantities is the same as at a λ transition. In particular, C_p has a logarithmic singularity. However, such a small temperature range is unattainable experimentally. In another paper by the same authors it was shown that within the framework of the simple semi-phenomenological theory starting from an assumption of the logarithmic singularity of C_p on the entire λ curve and of the fact that the λ curve has a larger slope in the (μ, T) plane, one can explain the experimentally observed logarithmic behavior of $(\partial p/\partial T)_T$ and the finite nature of $(1/V)(\partial V/\partial p)$ near the λ curve.

N. N. Syrota considered a model of a second-order phase transition as a transition taking place via a continuous set of intermediate equilibrium state.

As in previous meetings, a large number of papers was devoted to superconductivity.

N. B. Brandt and N. I. Ginzburg investigated the effect of high pressures (up to 30,000 atm) on the superconducting properties of various metals. The non-transition metals (Cd, Sn, and In) exhibit a decrease in T_c with increasing pressure, whereas the value of $dH_c/dT|_{T_c}$ remains constant, which is evidence of the constancy of the density of states N(0) on the Fermi surface. The decrease of T_c for N(0) = const can be explained by a decrease of the parameter of electron-phonon interaction of the microscopic theory of superconductivity. Another mechanism occurs apparently in transition metals (Zr, Ti). Here an increase of $dH_c/dT|_{T_c}$ and of T_1 is observed with increasing pressure; one can thus conclude that N(0) increases with pressure.

T. A. Ignat'eva, B. G. Lazarev, L. S. Lazareva, and V. I. Makarov continued their investigations of the effect of impurities (Hg, Bi, Sb) on the course of T_c of thallium under pressure. The dependence of the effect of pressure on the concentration and valence of the impurity atoms was investigated. It turned out that at sufficiently high concentration the effect of the pressure becomes negative regardless of the type of impurity. Various superconducting properties (T_c, $\partial M_c/\partial T$, $\partial T_c/\partial p$) of the compound V_3Ga were investigated by B. G. Lazarev, L. S. Lazareva, A. A. Matsakova, and O. N. Ovcharenko.

E. E. Semenenko, A. I. Sudovtsov, and V. M. Kuz'menko reported on the effect of the degree of ordering of the lattice upon the superconducting properties of films (Sn, Tl). The electrical conductivity served as the measure of the degree of ordering. It turned out that critical magnetic fields in superconducting films obtained by low-temperature condensation are very large compared with the fields of equilibrium films of the same thickness because of their fine-grain nature and inhomogeneity. A. P. Smirnov and V. N. Totubalin investigated thin films of tin by a pulse method. It was observed that in destroying the superconductivity by current pulses of short duration the resistance is not fully restored. The fraction of the resistance restored by the current decreases with decreasing temperature.

Yu. F. Bychkov, I. N. Goncharov, M. Litominskiĭ, I. Ruzhichka, and I. S. Khukhareva measured the critical current densities in large magnetic fields in Nb—80% Zr wires subjected to various heat treatment.

A. F. Andreev discussed the thermal conductivity of superconductors in the intermediate state. He showed that the reason for the anomalously small electron thermal conductivity of the intermediate state of semiconductors is an effect of the superbarrier type of reflection of electron excitations by the boundary between the layers. Contrary to the usual superbarrier reflection, the reflection probability is in this case appreciable even under condition of a "quasi-classical" potential barrier, i.e. under conditions when the wavelength of the excitation is much smaller than the width of the transition layer between the phases. A specific feature of the reflection is the unusual relation between the momenta and velocities of the incident and reflected excitations: the momentum remains practically unchanged in reflection, whereas all the three velocity components change their sign. At low temperatures the thermal conductivity turns out to be small not only in heat transfer across the layers of the normal and superconducting phases, but also in heat transfer along these layers. An experimental check of these conclusions is of interest.

A. I. Rusinov and E. A. Shapoval studied the dependence of the energy gap of a superconductor and depth of penetration of an external magnetic field on the magnitude of the field for specular reflection of electrons from the surface of metals. They investigated in detail the limiting cases of absolute zero and temperatures close to T_c for Pippard and London-type superconductors. For Pippard metals ($\kappa^2 \ll 1$) they also obtained expressions for the range of temperatures not too close to T_c [$\kappa^2 \ll 1 - T/T_c) \ll 1$] where a nonlocal situation occurs. In the range of locality the results are in agreement with the Ginzburg-Landau theory.

A. G. Shepelev and G. D. Filimonov continued measurements of absorption of longitudinal ultrasound by a pulse method in single crystals of very pure tin. The temperature dependences of the absorption along different crystallographic directions were analyzed in order to determine the values of the minimum energy gaps at 0°K on the Fermi surface.

Another important problem which is being studied intensely at present by means of low-temperature physics is the examination of the electron spectra of metals (their Fermi surfaces). This problem was widely discussed during the meeting. Very extensive information about the Fermi surfaces of metals was obtained in investigations of their galvanomagnetic properties. Work in this direction was successfully continued during this year.

N. E. Alekseevskiĭ and V. S. Egorov investigated the change in the resistance (of Pd, Ag, W, V, Cr, Ti) in pulsed magnetic fields up to 180 kOe. The results of the measurements make it possible to reach conclusions about the Fermi surfaces of the investigated metals. In particular, it follows from them that the Fermi surface of chromium is open.

N. E. Alekseevskiĭ, G. É. Karstens, and V. S. Mozhaeva reported in their paper on the galvanomagnetic properties of hydrated single crystals of palladium. It was shown that the nature of the angle diagrams and the anisotropy of the resistance in magnetic fields up to 100 kOe do not vary within the limits of the investigated hydrogen concentrations. The effect of the dissolved hydrogen on the shape of the Fermi surface of palladium was discussed.

A very effective and sensitive method of investigation of the electron spectra of metals is also the study of their properties at radio frequencies. In their paper V. F. Gantmakher and I. P. Krylova reported that they observed a size effect at radio frequencies in single crystals of very pure indium at helium temperatures. They noted that when the magnetic field is inclined relative to the surface of the sample a splitting of the lines is sometimes observed. This phenomenon is explained by the drift along the field of electrons belonging to noncentral extremal sections; this makes it possible in principle to differentiate between central and noncentral sections according to the behavior of the lines in the magnetic field. The data obtained by the authors on the dimensions of the extremal sections supplemented the previous information about the Fermi surface of indium.

The paper of P. A. Bezuglyĭ, A. A. Galkin, and S. E. Zhevago was devoted to the results of an investigation of the Fermi surface of gallium from data on magnetoacoustic oscillations of single-crystal samples at a temperature of 4.2°K and at a frequency of 200 Mcs of the longitudinal ultrasound and in magnetic fields up to 500 Oe.

G. P. Motulevich and A. A. Shubin drew certain conclusions about the Fermi surface of gold, based on an investigation of its optical properties and of the Hall effect. In the opinion of these authors the measurements showed that the deviations of the Fermi surface of gold from sphericity have little effect on the optical constants. The authors estimated the mean velocities and mean effective masses for various parts of the Fermi surface.

Recently the electron spectrum of bismuth has been studied intensely. The availability of a large number of theoretical papers, on the one hand, and various well worked out experimental methods, on the other, make this metal a very interesting object of investigation. Many papers were devoted during the eleventh meeting to the properties of bismuth.

B. I. Verkin, L. N. Pelikh, and V. V. Eremenko investigated experimentally the quantum oscillations of the chemical potential in bismuth, measuring the effect of a pulsed magnetic field on the contact potential difference of a pair of metals, one of which has a small group of current carriers. They observed a strong temperature dependence of the amplitude of oscillation. The periods of the observed oscillations in the reciprocal field correspond to periods of other similar effects.

The quantum oscillations of the Shubnikov—de Haas type for single crystals of bismuth at a temperature of 1.6°K in fields up to 12.5 kG and at a frequency of 5 Mcs were studied by E. P. Vol'skiĭ.

A. P. Korolyuk continued investigations of oscillations of the coefficient of absorption of ultrasound in single crystals of bismuth in the frequency band of 400–600 Mcs at liquid helium temperature. On the basis of the experiments, information was obtained about the shape and dimensions of the Fermi surface of the electrons and holes.

M. S. Khaĭkin and V. S. Édel'man reported measurements of the momentum of the conduction electrons of bismuth by the method of cutting off cyclotron resonances. The limiting momentum in the direction of the binary axis is $(5.4 \pm 0.15) \times 10^{-22}$ g-cm/sec. Specular reflection of conduction electrons from the surface of the investigated sample was observed in the same work.

G. A. Gogadze and I. O. Kulik considered the problem of the oscillation of the tunnel-emission current from thin metallic layers with thin dielectric interlayers. In specular reflection of electrons from the film boundaries, which is possible in the case of bismuth, the oscillation amplitude is considerable.

N. B. Brandt and D. B. Balla investigated the effect of hydrostatic compression up to 25,000 atm on the temperature dependence of the electrical conductivity of single crystals of bismuth along the trigonal axis and perpendicular to it at temperatures between 2 and 800°K. The results allow the authors to assume that at a pressure of 26,000 atm at low temperatures bismuth may go over into a dielectric phase. A large number of investigations were devoted to transfer phenomena. A number of new effects have been noted in this "classical" region in recent years. One of these is, for example, the static skin effect predicted by M. Ya. Azbel'. This phenomenon consists of the fact that in a sufficiently strong magnetic field a direct current flows in conductors mainly close to the surface; this may lead to a linear dependence of the resistance on the magnetic field.

B. G. Lazareva, A. A. Matsakova, and O. G. Ovcharenko reported in their paper resistance measurements on thin plane samples of pure metals at 4.2°K in constant magnetic fields up to 40 kOe. In place of a complex dependence (for example, for tin), they observed considerable sections of linear variation of the resistance in the magnetic field. The results are considered by the authors as one of the manifestations of the static skin effect.

In the theoretical works of R. N. Gurzhi it is predicted that at low temperatures when collisions between excitations (electrons and phonons) which accompany Umklapp processes are little probable, transfer phenomena can exhibit a series of interesting features. At the past meeting R. N. Gurzhi presented another two papers referring to this range of problems. In one of them, high-frequency properties are investigated of very pure metals at low temperatures. It turns out that electron-phonon processes not accompanied by Umklapp exert an appreciable influence on the skin effect. In particular, a broad band of frequencies appears for which the surface impedance depends on the frequency and temperature in an essentially different way than in the usual cases of the normal and anomalous skin effect.

In another paper the electrical conductivity is considered of a series of metals in which the reason for the residual resistance is the scattering of electrons on local defects of the impurity-atom type. It is shown that for an arbitrary anisotropic Fermi surface the resistance of a bulk sample grows initially with increasing temperature, and then reaches saturation, which again changes by the usual growth connected with the effect of Umklapp.

V. F. Gantmakher and Yu. V. Sharvin continued their investigation of the size effect. They observed a difference between the temperature dependences of the individual lines of the effect observed in tin. This difference is related by the authors to the specific role of phonon small-angle scattering in the case of the size effect. In this case, the temperature dependence of the mean free path of the electrons turns out to be considerably weaker than T^5.

Great interest was evoked by the announcement by V. L. Gurevich, V. M. Muzhdaba, R. V. Parfen'ev, Yu. A. Firsov, and S. S. Shalyt on the experimental observation of a new type of oscillations of the magnetoresistance of n-type indium antimonide (this effect was predicted theoretically by V. L. Gurevich and Yu. A. Firsov). The physical reason for this phenomenon is related to the resonance scattering of current carriers by optical phonons in strong magnetic fields $\Omega\tau \gg 1$ where Ω is the cyclotron frequency, and τ is the relaxation time of the conduction electrons. On the curves of the transverse and longitudinal magnetoresistance the authors observed a series of oscillatory extrema periodic in the inverse field. The period of the oscillations is in good agreement with the theoretical formula.

Kh. I. Amirkhanov and R. I. Bashirov continued their investigation of the effect of spin splitting on the Shubnikov–de Haas effect in alloys of InSb and InAs in the region of helium temperatures. Precision measurements of the electrical resistance of single crystals of molybdenum and tungsten of high purity and crystallographic perfection in the temperature range 4.2–400°K were reported in a paper by N. V. Vol'kenshteĭn, V. E. Startsev, and L. S. Starostina. On the basis of the obtained data they discussed the question of the effect of s-d transitions on the temperature dependence of the electrical resistance of the investigated metals.

Several additional papers were presented during the meeting relating to transfer phenomena. Yu. A. Pospelov told of the peculiar temperature dependence of

σ_{zz} of graphite. An expression for $\sigma_{zz}(T)$ was obtained, from which follows the experimentally known nonmonotonic dependence with a minimum at 200°K. L. É. Gurevich and I. N. Yassievich considered the question of the electrical conductivity and the thermal emf in metals in which the electrons are scattered by paramagnetic impurity ions completely or partly oriented by the external magnetic field. Cases are considered when the electric field is parallel and perpendicular to the magnetic field.

M. I. Kaganov, I. M. Lifshitz, and V. B. Fiks presented results of an investigation of momentum transfer in the collision of an electron in a metal with impurity atoms or ions. The transferred momentum is equal within a reciprocal-lattice vector to the change in the electron quasimomentum. Limiting cases of scattering at small angles and at angles close to π are considered. Formulas for the general quantum case are obtained.

A. M. Kosevich and L. V. Tanatarov studied the effect of a local perturbation on the structure of the energy spectrum of an electron with a quadratic dispersion law in a magnetic field. They showed that the character of the electron spectrum in the case considered depends on the direction of the magnetic field relative to the axis of perturbation. When the field is directed perpendicular to the axis of perturbation, the electron has a discrete spectrum. The perturbation model considered can be used to explain the effect of dislocations on the scattering of electrons.

Theoretical studies of the features of the propagation of ultrasound in metals at low temperatures were continued. In the work of I. O. Kulik it was shown with the aid of the methods of quantum field theory that in a magnetic field at T = 0 the speed of sound contains an addition oscillating with the reciprocal magnetic field (an effect analogous to the de Haas—van Alphen effect). K. B. Vlasov and B. N. Filimonov calculated the coefficient of rotation of the plane of polarization of sound in a magnetic field for a broad range of ultrasound frequencies and values of the external magnetic field.

L. É. Gurevich and B. L. Gel'mont established that in metals and semi-metals a new type of waves appears at low temperatures in the presence of a temperature gradient; they called these thermomagnetic waves (TMW). TMW were investigated both in an external field and without it. Conditions for their weak attenuation in the absence of a magnetic field were found. When an electromagnetic wave is incident on a solid in which there is a temperature gradient, the refracted wave may in the presence of a magnetic field turn out to be intensified.

The Mössbauer effect continues to attract the attention of experimentalists as a method of studying the dynamical characteristics of solids. N. E. Alekseevskiĭ, A. P. Kir'yanov, and Yu. A. Samarskiĭ continued their investigation of the anisotropy of the Mössbauer effect on single crystals of white tin, increasing considerably the accuracy of the measurements. The obtained data confirm the previously observed change in the anisotropy of the effect with temperature. N. E. Alekseevskiĭ, A. P. Kir'yanov, Yu. A. Samarskiĭ and V. I. Nizhankovskiĭ measured the chemical shifts of the Mössbauer line in various intermetallic compounds of tin in a broad range of temperatures.

V. A. Bryukhanov, N. N. Delyagin, and V. S. Shpinel' also measured the chemical shift by means of the Mössbauer effect and calculated the change in the electron density on Sn^{119} nuclei on introducing them as impurities into various metallic matrices. In the opinion of the authors a mutual relationship has been established between the electron density at the nucleus of the impurity atom and the dynamic characteristics of the matrix.

A series of interesting papers was devoted to the problems of ferro- and antiferromagnetism.

A. S. Borovik-Romanov and V. A. Tulin reported double electron-nuclear resonance in antiferromagnetic $MnCO_3$. The authors investigated the shift of the antiferromagnetic resonance lines at low temperatures in a sample under the action of an rf field with a frequency close the nuclear resonance of Mn^{55} nuclei. It was observed that at a sufficient intensity of the rf field the shift begins at a frequency of ~540 Mcs and reaches a maximum at 650 Mcs.

A. S. Borovik-Romanov and L. A. Prozorova observed saturation of antiferromagnetic resonance which is of a threshold character. The magnitude of the threshold field is much less than the width of the line and amounts to about 0.2 Oe. The results are considered from the point of view of Suhl's theory.

The temperature dependence of the antiferromagnetic resonance in $MnCO_3$ was investigated by E. G. Rudashevskiĭ in the temperature range between 4.2 and 32°K.

N. M. Olekhnovich and N. N. Sirota investigated the electron density distribution in the antiferromagnetic compounds MnO and $MnFe_2$. The total electron density was determined from x-ray form factors and the electron density of the 3d shell from neutron form factors. It was assumed that in the investigated compounds the electron density between nearest Mn ions decreases practically to zero and consequently there is no exchange interaction between these ions. It is possible that the phenomenon of antiferromagnetism in these compounds is connected with the indirect exchange through the oxygen and iron ions respectively, since in the Mn → O and Mn → Fe direction there is overlap of electron density.

L. É. Gurevich and I. Ya. Korenblit studied the thermal emf of ferromagnetic metals at low temperatures. The longitudinal and thermal emf were investigated in the region of magnetic fields and temperatures when the main role in the magnon energy is played by the exchange term, and under conditions when the magnons are scattered primarily by the electrons. The temperature dependence of the thermal emf was obtained.

The paper of V. A. Tsarev and N. V. Zavaritskiĭ was devoted to the magnetic properties of spinels at low temperatures. They investigated the temperature dependence of the magnetic moment of manganese and nickel ferrites in the range 15–30°K in magnetic fields up to 22 Oe. It was established that the magnetic moment of certain ferrite samples attains a maximum value at temperatures which differ from zero. An attempt was made to explain this phenomenon.

S. V. Vonsovskiĭ and M. S. Svirskiĭ presented the results of a theoretical investigation of the electron interaction of metals containing ions of transition and rare-earth elements which are induced by the virtual excitations of the multiplicity of the incomplete atomic shells of these ions.

The effect of spontaneous striction on the spectrum of spin waves in α-Fe_2O_3 was reported in the paper of A. S. Borovik-Romanov and E. G. Rudashevskiĭ. They showed that an account of the magneto-elastic and elastic terms in the thermodynamic potential of rhombohedral antiferromagnets with weak ferromagnetism leads to the small gap in the wave spectrum which is observed experimentally in experiments on the antiferromagnetic resonance in α-Fe_2O_3.

In the paper of R. A. Alikhanov results were reported on the investigation of the structure and magnetism of solid oxygen from neutron diffraction data. It was established that α-O_2 crystallizes in a lattice with the space group $C_{2h}^2 - P2_1/m$ (density 1.49 g/cm^3).

The dynamics of the α-O_2 lattice were investigated. The magnetic properties of α-O_2 (uniaxial antiferromagnet), β-O_2 (triaxial antiferromagnet), and γ-O_2 (paramagnet) were considered.

A number of papers were devoted to various problems of low-temperature physics. I. V. Matyash, V. V. Mank, and M. G. Starkov investigated the diffusion of H_2 into liquid nitrogen in the pressure interval 0–10 atm by means of nuclear magnetic resonance. I. V. Sochava and O. N. Trapeznikova investigated the temperature dependence of the heat capacity of polymethylacrylate and polymethacrylic acid from 50 to 200°K. Conclusions are drawn about the impeded rotation of methyl and ethyl groups in polymethylacrylate, polymethylmethacrylate, and polymethacrylic acid.

V. G. Manzheliĭ and V. G. Gavrilko reported about a method they worked out for measuring the density of solidified gases in a broad range of temperatures. They measured the densities and calculated the volume expansion coefficients of solid methane, xenon, and ammonia.

The optical properties of crystalline oxygen were reported in a paper by A. F. Prikhot'ko, O. S. Pakhomova, and T. P. Ptukha.

An interesting communication was that of the German physicist L. Bewilogua (East Germany) who investigated the low-temperature properties of neon. The author reported the use of liquid neon as a cooling agent for obtaining temperatures of 20–30°K. The use of neon for this purpose is extremely convenient (compared with hydrogen), since comparatively little work is required to obtain 1 kcal of cooling, and in addition neon is not explosive. He also reported the results of an investigation of certain physical properties of liquid neon, such as the heat conductivity, viscosity, atomic volume, and others.

A special session was devoted to techniques of obtaining low temperatures, ultrahigh vacuum, and to certain low-temperature measurements. S. F. Grishin and E. Ya. Grishina reported about a simple device with adiabatic demagnetization of a paramagnetic salt which is comparable in cold output to the usual cryostats in which liquid He^3 is employed, the obtained temperatures being somewhat lower.

Contemporary methods for obtaining and utilizing helium temperatures were reported by M. P. Malkov. Considerable attention was given in his paper to a description of cold cycles for obtaining helium temperatures using the Joule-Thomson effect, a gas-expansion machine, and a Gifford-McMahon displacer. A. F. Shvets reported the construction of a device which made it possible to obtain temperatures from 4.2 to 0.3°K by pumping out He^3 with a carbon adsorption pump.

N. P. Danilova and A. I. Shal'nikov worked out a simple method for obtaining and measuring ultrahigh vacuum (below 10^{-12} mm Hg) in unconditioned apparatus with the help of a helium diffusion pump.

F. P. Korshunov, V. I. Osinskiĭ, and N. N. Sirota carried out investigations of the temperature dependence of certain characteristics of various types of diodes in a wide range of temperatures.

I. M. Dmitrienko, S. P. Logvinenko, and N. I. Ivanov studied the possibility of using GaAs diodes as low-temperature transducers.

A. B. Fradkov presented data on a cryostat for a superconducting solenoid which made it possible to obtain strong magnetic fields at room temperature. V. P. Peshkov and A. Ya. Parshin measured the thermal conductivity of a number of heat switches in various magnetic fields.

Ya. P. Kostin reported the completion of devices for purification of hydrogen. S. V. Odenova, G. A. Udzulashvili, V. E. Khvedelidze, D. G. Chigvinadze, and V. A. Shukhman reported in their paper about a magnetometer with a film Hall-emf transducer made of mercury selenide which operates at liquid-helium temperature. Yu. K. Pilipenko considered the question of the change of activity of a catalyst for ortho and para transformations under operating conditions of a hydrogen liquefier.

Two papers were devoted to superconducting resonators which can be used in accelerator technology.

B. I. Verkin, I. M. Dmitrienko, V. M. Dmitriev, G. E. Churilov, and Yu. M. Borodavko reported on *investigations of superconducting resonators of the* three-centimeter band prepared from lead by a different technique.

I. S. Sidorenko and E. I. Revutskiĭ investigated high-frequency properties of lead superconducting films deposited on current-carrying surfaces of copper resonators.

In closing N. E. Alekseevskiĭ summarized the work of the meeting and noted the most interesting papers.

During the meeting the participants and guests from countries of the people's democracies became acquainted *with the cryogenic laboratory of the Solid State and* Semiconductor Physics Institute of the Academy of Sciences of the Belorussian SSR.

The participants expressed the opinion that in the future meetings should be conducted on a more narrow range of problems.

Translated by Z. Barnea