a radiofrequency voltage to this electrode. In addition a d.c. potential is applied to the same electrode. The radio receiver is tuned to the same frequency as the oscillator (80 Kc has been used), or alternately (and less effectively) to various overtones of this frequency. A sawtooth voltage at about 20 cycles per second is applied to the reflector grid of the klystron and also to the horizontal plates of the cathode-ray oscillograph in order to sweep the tube through a small frequency range.

When the frequency of the klystron passes through an absorption frequency of the gas, a small part of the microwave energy is modulated because of the varying absorption of the gas as the Stark effect components are moved back and forth in frequency by the alternating Stark effect field. A radiofrequency component then appears in the crystal output and is amplified by the radio receiver and displayed on the oscilloscope screen. The shape of the curve, which is displayed when a line is present, is a complicated function of the nature of the Stark effect of the particular molecule.

The minimum detectable absorption depends upon the nature of the Stark effect of the given substance. Even with the short wave guide used, the apparatus is able to display the $J=1$, $K=1$ line of the inversion spectrum of N^{15} ammonia present in its natural proportion of 0.3 of 1 percent in ordinary ammonia.

Dr. B. P. Dailey and Mr. Robert Karplus have contributed heavily to the success of this experiment. We also wish to thank Dr. Stuart P. Cooke for the assistance rendered by himself and by other members of the Microwave Research Group. Dr. A. G. Hill of the Research Laboratory of Electronics, Massachusetts Institute of Technology, very kindly aided us through loans of apparatus.

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[1] See for example, W. D. Hershberger, J. App. Physics **17**, 495 (1946), W. E. Good, Phys. Rev. **70**, 213 (1946), and C. H. Townes, Phys. Rev. **70**, 665 (1946). We are indebted to Dr. Hershberger for giving us a detailed description of his apparatus.

[2] A principle similar to this has been used in a different way by E. M. Purcell, H. C. Torrey, and R. V. Pound, Phys. Rev. **69**, 37 (1946), and by Arthur Roberts, Robert Beers, and A. G. Hill, Phys. Rev. **70**, 112 (1946).

[3] As described by T. W. Dakin, W. E. Good, and D. K. Coles, Phys. Rev. **70**, 560 (1946).

Conductivity of Sodium-Ammonia Solutions

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IN an earlier communication, two of us in collaboration with J. G. Daunt and M. Désirant[1] had reported failure to reproduce R. A. Ogg's observation[2] of superconductivity in solidified sodium-ammonia solutions. We had then worked under the assumption that the reported persistent currents had the same well-reproducible character as with established superconductors. When from a subsequent communication by Ogg[3] it became clear that the phenomena

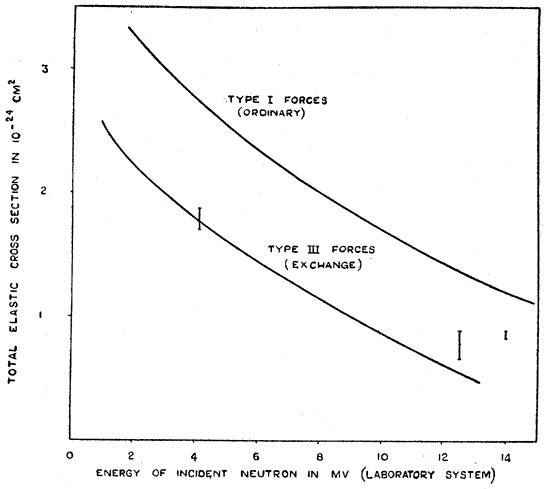

FIG. 1. Variation of resistance of a 2.1 percent ($\sim 1N$) sodium-ammonia solution.

observed by him were of a rare and transient nature, we had to admit the possibility that similar effects might have escaped our notice. In view of the importance of the possibility of superconductivity at relatively high temperatures, and also because of a confirmatory report by J. W. Hodgins,[4] a more extensive investigation of the electric, thermal, and magnetic properties of sodium-ammonia solutions was undertaken. While a full report of this work will be published elsewhere[5] a short statement of some of the conclusions reached may be of interest.

Resistivity measurements using a current-potential method were carried out on thin continuous layers of the frozen solution. In the case of $1N$ solutions, different behavior was in fact observed according to the speed with which the samples were frozen. As is shown in the accompanying figure, in general, rapid freezing yielded low resistance at low temperatures, slow freezing, high resistance. The figure illustrates the subsequent behavior on warming to higher temperatures with a very marked drop of resistivity at -114°C. In all cases, *finite conductivity* was observed throughout the experiments. As became evident from our thermal experiments, these results are readily explicable by the formation of a concentrated highly-conducting eutectic (m.p.: -114°C) (see also Ruff and Zedner[6]) which is readily supercooled.

Persistent current experiments were carried out with ring-shaped specimens similar to those used by Ogg[3] except that in all cases the formation of a continuous annulus was ensured. In the first experiments transient magnetic moments of the order described by Hodgins were indeed observed, but it was then detected that these were produced by the presence of iron objects in the laboratory or by very small vibrations of the search coil. Since the field to be detected only amounts to one-fiftieth of the vertical component of the earth's magnetic field, a slight tilting of the search coil would readily yield a false indication. Great care had therefore to be taken to avoid such disturbances and also others, as for instance would be produced by the dis-

placement of liquid oxygen (paramagnetic) in the presence of stray magnetic fields. Under these stringent conditions, 85 experiments were then carried out, no one of which yielded the slightest indication of a persistent current. Separate determination of the volume magnetic susceptibility of both rapidly and slowly frozen specimens provided no indication of any anomaly.

[1] J. G. Daunt, M. Désirant, K. Mendelssohn, and A. J. Birch, Phys. Rev. **70**, 219 (1946).
[2] R. A. Ogg, Phys. Rev. **69**, 243 (1946); **69**, 544 (1946).
[3] R. A. Ogg, Phys. Rev. **70**, 93 (1946).
[4] J. W. Hodgins, Phys. Rev. **70**, 568 (1946).
[5] A. J. Birch and D. K. C. MacDonald, Trans. Faraday Soc. (submitted for publication).
[6] Ruff and Zedner, Ber. d. d. chem. Ges. **41**, 1948 (1908).

Erratum: On the Scattering and Absorption of Particles by Atomic Nuclei

[Phys. Rev. **71**, 145 (1947)]

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THE neutron scattering cross section as a function of energy in the neighborhood of a resonance as given in Fig. 3 of our paper on the Scattering and Absorption of Particles by Atomic Nuclei is correct only if the spin of the nucleus is zero. This is not true for indium whose spin $I=9/2$, for then the compound nucleus may have a spin I_c of 4 or 5. As a result, the scattering cross section for indium is found by adding the cross sections for both of these states weighting the $I_c=5$ state by $\frac{1}{2}(1+1/(2I+1))=11/20$ and the $I_c=4$ state by $\frac{1}{2}(1-1/(2I+1))=9/20$. The graph in this note shows the scattering of neutrons by indium in the neighborhood of the 1.44 ev level for the two possible assumptions 4 and 5 for the spin of the compound nucleus involved in the resonance. We have used some improved constants recently made available,[1] namely $\Gamma=0.09$ ev and $(1\pm1/(2I+1))\Gamma_n=2.5\ 10^{-3}$ ev The cross section from "potential scattering" alone, $4\pi a^2$, is 6.6 10^{-24} cm².

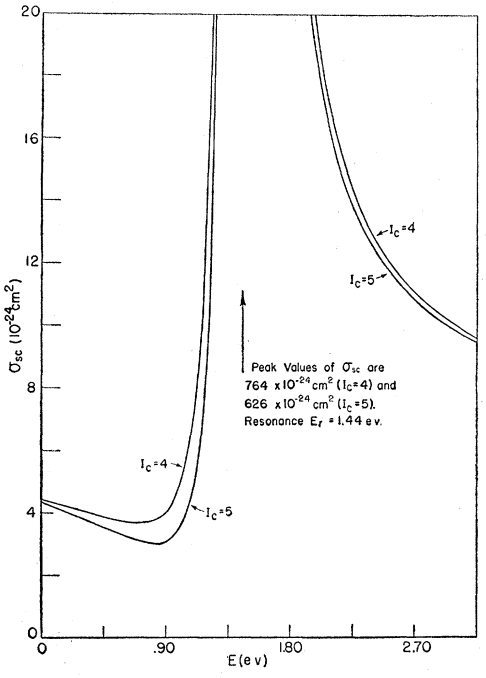

FIG. 1.

[1] B. D. McDaniel, Phys. Rev. **70**, 832 (1946).

Atmospheric Temperatures from Infra-Red Emission Spectra of the Moon and Earth. I. The Ozone Layer

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A FUNDAMENTAL and independent method of determining the temperature of the ozone layer has been applied to previously published infra-red emission spectra of the moon, the earth, and the atmosphere.[1] (The method is a general one, and is applicable as well to the atmospheric constituents H_2O, N_2O, CO_2.) The emissivity of atmospheric ozone in the band ν_2^2 at 9.6 mu is provided by the corresponding absorptivity in the lunar spectrum.[1] A gray-body comparison, in the spectral region occupied by the band, approximately 9 mu to 10 mu, is then made between the radiation intensity of the earth's surface (thermocouple) to space and the return radiation intensity of the ozone layer.[1] The method is a promising one, for even the preliminary, very low resolution spectra yield essentially correct temperatures. The temperature of the ozone layer is found to be −44°C and −53°C for the evenings of September 5, 1941 and November 3, 1941, respectivelv.[3]

[1] Arthur Adel, Astrophys. J. **103**, 19–25 (1946).
[2] Arthur Adel and David M. Dennison, J. Chem. Phys. **14**, 379–382 (1946).
[3] A connection between the comparatively high temperature of −44°C and the unusually high absorption and emission by atmospheric ozone on the night of September 5, 1941, is conjectural. The details of the calculations are contained in a paper which is scheduled to appear in a forthcoming issue of the *Astrophysical Journal*.