then found on the condition that the grain temperature is at most 1000°K.

To obtain more precise results one must correct assumptions (b) and (c) simultaneously. This is necessary only for low values of γ, since only then do the grains acquire sufficient energy to make velocity corrections to the force important. We have merely obtained an upper bound: for the extremely low value $\gamma=0.01$, the final kinetic energy, T, <300 Mev/nucleon. Even this bound is probably too high; a low value of γ is likely to be accompanied by an index of refraction very near unity in the ultraviolet, which would modify assumption (a) and reduce the energy attained. Moreover, the low value of r_0 associated with a low γ decreases the volume in which grains are accelerated, and would make it more difficult, on the basis of the proposed mechanism, to account for the observed flux of the cosmic-ray particles.

* Special Scholar of the Canadian National Research Council.
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[4] F. L. Whipple, Proc. Am. Phil. Soc. **81**, 253 (1939).

Superconductivity of Columbium Nitride

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A RECENT investigation of the superconducting properties of columbium[1] included the nitriding of columbium powder and the observation of superconducting transitions of the nitride. Thin ribbons of columbium had been nitrided by Andrews and co-workers[2] and had been observed in zero-field transitions near 15°K. It is the purpose of this note to report on magnetic field transitions of columbium nitride from the superconducting to the normal state over a range from zero to 10,000 oersteds. It was decided to investigate powder specimens in view of the difficulty of interpreting magnetic field data on ribbons, and because nitrided films on columbium cylinders tend to flake off. Fine wires were also found to be unsuitable since they disintegrated after being nitrided.

The powder of 200-mesh particle size was nitrided in prefired Alundum boats in an Alundum combustion tube which was first evacuated and then filled with an atmosphere of Airco "pre-purified" nitrogen. An annular, molybdenum-wound hydrogen furnace was used to provide high temperatures which were measured with the aid of a Leeds and Northrup optical pyrometer.

Two batches of nitrided powder were prepared: the first (A) in 1 atmos. of nitrogen at 1300°C for 3 hr., the second (B) in 1.6 atmos. of nitrogen at 1450°C for 5 hr. By measuring the gain in weight, powder A was found to contain a nitrogen content of 12.8 percent; powder B, 11.1 percent. Samples of each batch were studied by an x-ray diffraction camera and the cubic NaCl structure, observed by other investigators, was verified. We are indebted to Mr. J. K. Roros of the Metallurgy Department of Columbia University for making the x-ray analysis.

The powder samples were sealed into glass tubes filled with helium at a low pressure. Thermal conduction to the cryostat[1] was provided by a copper rod sealed through the glass. Two capsule shapes were used, cylindrical and spherical, both of 10 mm i.d., the cylinder being 16 mm long. Smaller cylinders of inside diameter 3 mm and inside length 20 mm were also used in survey experiments.

The two batches of columbium nitride powder gave similar results on a large number of zero-field transition tests. The half-value of the transition occurred at 15.2°K for material A, and at 15.0°K for material B. The transitions from the normal to the superconducting state began at 16.2°K and ended at 13.5°K for sample A and at 12.2°K for sample B. Powder A, with a somewhat narrower zero-field transition, gave more interpretable results in a transverse magnetic field than did B.

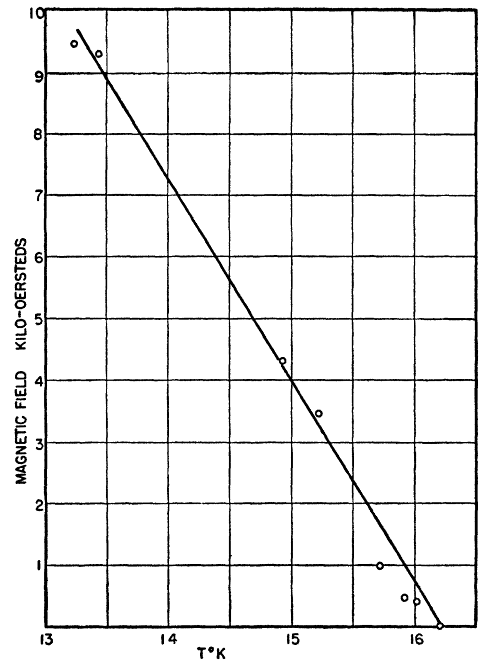

Fig. 1. Magnetic fields necessary to restore the normal state in CbN.

The $H-T$ curve for A is shown in Fig. 1, where the temperature T_0 corresponding to $H=0$ is taken as 16.2°K rather than 15.2°K, the half-value temperature. The slope of this curve was very close to 3300 oersteds/deg. Similar experiments for powder B gave inconclusive results at temperatures lower than 14.8°K, and the indicated dH/dT appeared to be of the order of 6000 oersteds/deg.

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Nuclear Isomerism and Shell Structure

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THAT nuclear isomers occur preponderantly in regions of "magic" nucleon numbers has been cited as evidence for theories of nuclear shell structure.[1] The following note is concerned mainly with the examination of experimental isomeric data for level trends as a function of nuclear structure.

A table of known isomers arranged in ascending order of odd nucleon number shows, apart from the well-known[2] fact that the odd Z-even N and even Z-odd N types are concentrated at the ends of the fourth (N or $Z=50$) and fifth (N or $Z=82$) nuclear shells, that the only isomers occurring at the beginnings of the shells are of the odd Z-odd N type. Since, according to Mayer's[2] theory of shell structure, levels of sufficiently high angular momentum differences also occur at the beginnings of shells, it is not unlikely that isomers should exist there. But in order to explain the presence of odd Z-odd N types only, it might be necessary to postulate stronger odd proton-odd neutron coupling in a newly developing shell.

The most favorable data for studying level trends are located at the end of the fifth shell for even Z-odd N isomers. The transitions here are of multipole order (Λ) equal to five, followed in a number of cases by $\Lambda=2$ transitions. The levels involved will be