

Electronic Specific Heat of Graphite

IN a previous communication¹ it was shown that the observed large diamagnetism of graphite along its hexagonal axis is that of its 'free' electrons, and is of the Landau type. At high temperatures it conforms to the Curie law $K = -n\mu^2/(3kT)$, and at low temperatures it tends to the temperature-independent value $K = -n\mu^2/(2kT_0)$, where n , the number of free electrons, is found to be just one per carbon atom, and T_0 , the degeneracy temperature, is found to be about 520° K.; μ is the Bohr magneton.

These results fit well with the known electronic structure of graphite. From structural considerations we should expect one electron per carbon atom to be free, and its freedom of movement to be confined to the basal plane. This restriction of the freedom to the basal plane, besides directing the whole of the diamagnetism of these electrons along the normal to the plane, will also make the spacing of the energy levels of these electrons very narrow, and the degeneracy temperature very low, as required by observation.

This number of free electrons, namely, one per atom, together with the very low degeneracy temperature of the electron gas, should make the electronic specific heat of graphite at room temperature, and at low temperatures, much larger than that of most metals. Now the electronic contribution is most easily evaluated at very low temperatures, where the contribution from the lattice becomes relatively small. The available experimental data² for graphite extend down to about 29° K. only, and from these data the electronic part of the specific heat at low temperatures may be estimated roughly as 20×10^{-4} T. cal. deg.⁻¹ per gm. atom. This is more than ten times the electronic specific heat of copper or silver, and is of nearly the same magnitude as that of the transition metals, nickel, platinum and palladium.

It appears that even at 40° K. the electronic contribution to the specific heat of graphite greatly predominates over the contribution from the lattice.

Indian Association for the
Cultivation of Science,
Calcutta. Feb. 9.

K. S. KRISHNAN.

¹ NATURE, 145, 31 (1940); see also presidential address to the Physics Section, Ind. Sci. Congress, Madras Session, 1940.

² Nernst, W., *Ann. Phys.*, 36, 395 (1911); Magnus, A., *Ann. Phys.*, 303, 70 (1923).

Effect of Synthetic Vitamin B₆ on the Hæmopoietic System of Human Beings

SINCE vitamin B₆ (2-methyl, 3-hydroxy, 4,5-di-[hydroxymethyl] pyridine) is a constituent of liver and yeast, both of which relieve some of the symptoms of pellagra and pernicious anæmia in relapse, it was decided to give large amounts of this synthetic vitamin to pellagrins with macrocytic anæmia and to patients with classical pernicious anæmia. The observations of Fouts, Helmer, Lepkovsky and Jukes¹ show that dogs with a deficiency of vitamin B₆ in the diet develop a hypochromic anæmia which is not relieved by iron. These results have been confirmed and extended by McKibbin, Madden, Black and Elvehjem² in puppies. We have searched in vain to date for patients with hypochromic anæmia which did not respond to large amounts of iron. The vitamin B₆ used throughout this study was furnished by Merck and Company, Rahway, New Jersey.

The present report is concerned with the effect of the intravenous administration of from 50 to 100 milligrams of crystalline vitamin B₆ in sterile physiological solution of sodium chloride, each day for a period of ten days, to three pellagrins with macrocytic anæmia and to two patients with pernicious anæmia. Within forty-eight hours, the patients with pellagra and pernicious anæmia experienced considerable increase in sense of well-being and strength. On the fifth, sixth, seventh and eighth days of the study, in every instance, a slight but definite reticulocytosis appeared. The reticulocytes did not rise above five per cent, but the white cell count, which was extremely low in the two patients with pernicious anæmia, increased strikingly during the period of reticulocytosis. This increase was principally in the polymorphonuclear leucocyte series. One hundred milligrams of vitamin B₆, incubated with 100 c.c. of normal fasting human gastric juice, was given orally to one of the patients with pernicious anæmia after reticulocytes and white blood cells had reverted to the original low level, with a response identical to that observed following the administration of vitamin B₆, intravenously.

These findings suggest that vitamin B₆, when administered in large amounts, has a definite effect upon the hæmopoietic system of human beings who have macrocytic anæmia of pellagra or pernicious anæmia in relapse. This substance does not, however, in our opinion, act specifically either as the true anti-pernicious anæmia factor or as the extrinsic factor of Castle.

This study, an account of which was read before the Academy of Medicine of Cleveland, December 15, 1939, was aided by grants from the John and Mary R. Markle Foundation and Anheuser-Busch, Inc.

R. W. VILTER.
H. S. SCHIRO.
T. D. SPIES.

Department of Internal Medicine,
University of Cincinnati
College of Medicine,
and the
Cincinnati General Hospital.

¹ Fouts, P. J., Helmer, O. M., Lepkovsky, S., and Jukes, T. H., "Production of Microcytic Hypochromic Anemia in Puppies on Synthetic Diet Deficient in Rat Antidermatitis Factor (Vitamin B₆)", *J. Nutrition*, 16, 197 (Aug. 10, 1938).

² McKibbin, J. M., Madden, R. J., Black, S., and Elvehjem, C. A., "The Importance of Vitamin B₆ and Factor W in the Nutrition of Dogs", *Amer. J. Physiol.*, 123, 102 (1939).

Effect of Stilbæstrol on the Ovaries of Hypophysectomized Rats

VARIOUS authors have reported that small doses of oestrogen injected in the intact adult rat cause an increase in ovarian weight, generally attributed to an increase in the secretion of luteinizing hormone from the pituitary¹.

Comparatively large oestrogen dosage causes a decrease in ovarian weight in the intact animals. The available evidence strongly suggests that this is due to a depression of hypophyseal activity². So far as can be ascertained, however, little work has been done on the action of oestrogens on the ovaries of the immature hypophysectomized rat, though such a preparation should give valuable information about the direct action of oestrogens on the ovary. Accordingly, immature (40-50 gm.) female rats were