and II. Out of eighteen points for A odd, only two fall significantly below line II, whereas there are eighteen points for A even below this line. Similarly, all the points on or below line IV (five 'unobserved' points and the representative point for the 3.5yr. ^{204}Tl) are for A even (and Z odd). It would appear that very frequently there is a large difference of spin between the ground-states of initial and final nuclei in these latter cases. This conclusion is not surprising when it is realized that the neutron and proton numbers change from the $\begin{pmatrix} \text{odd} \\ \text{odd} \end{pmatrix}$ to the $\begin{pmatrix} \text{even} \\ \text{even} \end{pmatrix}$ configuration in such transitions.

N. FEATHER

Department of Natural Philosophy,
University of Edinburgh.
Dec. 18.

¹ *Proc. Roy. Soc., A*, **165**, 530 (1938).

² *Phys. Rev.*, **49**, 895 (1936).

³ See, for example, Fajans and Voigt, *Phys. Rev.*, **60**, 619 (1941).
Maurer and Ramm, *Z. Phys.*, **119**, 602 (1942). Hagemann *et al.*,
Phys. Rev., **72**, 252 (1947). English *et al.*, *Phys. Rev.*, **72**, 253 (1947).

⁴ See, for example, Kojima, *Proc. Phys. Math. Soc. Japan*, **22**, 384 (1940). Itoh, *ibid.*, 531.

⁵ Konopinski, *Rev. Mod. Phys.*, **15**, 209 (1943).

⁶ "Nuclear Selection Rules" (Camb. Univ. Press, in preparation).
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⁷ *Phys. Rev.*, **56**, 519 (1939).

Electron Tracks in Photographic Emulsions

PHOTOGRAPHIC emulsions have been used to an increasing extent for the recording of nuclear tracks passing through the sensitive layer, in particular by Dr. C. F. Powell and his collaborators¹, and by Demers². Particles of relatively high ionizing power such as alpha-particles and protons give well-defined tracks; those of lesser ionizing power, such as mesons, yield rather tenuous tracks; while electrons do not as a rule produce recognizable tracks in the emulsions available so far, although Demers² claims to have seen electron tracks on one of his emulsions.

A new emulsion has recently been evolved in the Kodak Research Laboratories which is sufficiently sensitive to enable electron tracks to be recorded unmistakably.

The emulsion was tested for proton sensitivity by bombardment with neutrons from a radium-beryllium source, with a 17-cm. thickness of lead interposed between the plates and the source to diminish the gamma-ray intensity incident on the sensitive material. Microscopical examination of the plates after processing showed that the background to the proton tracks was of a much more heterogeneous

nature than was obtained with exposures to a pure alpha-ray emitter, for example, polonium.

Under high magnification, this heterogeneous background was seen to consist of numerous fairly short, highly curved chains of developed grains. It is believed that these are the low-energy ends of tracks due to photo-electrons and recoil electrons liberated by gamma-rays. Electrons, being particles of low mass and low ionizing power, might be expected to produce just such types of tracks in a photographic emulsion, which remind one strongly of similar tracks obtained in a cloud chamber.

Since they are highly curved, very few of these tracks are in one plane, and satisfactory photomicrographs are therefore difficult to obtain. Figs. 1 and 2 are photomicrographs ($\times 2,000$) showing the type of track obtained. Fig. 3 is a photomicrograph at the same magnification of a plate exposed to light to give approximately the same average grain density as the gamma-ray exposure.

I should like to acknowledge the co-operation of Mr. D. H. Perkins of the Imperial College of Science and Technology, London, and my colleagues in this Laboratory in the evolution of this emulsion.

R. W. BERRIMAN

Research Laboratory, Kodak, Ltd.,
Wealdstone,
Middlesex.
Dec. 3.

¹ Powell, Occhialini, Livesey and Chilton, *J. Sci. Instr.*, **23**, 102 (1946).

² Demers, *Can. J. Res.*, **25**, 223 (1947).

Resolution Testing in Autoradiography

THE resolution obtainable in autoradiographs has so far been estimated¹ by the sharpness obtainable when photographic emulsions are exposed in contact with biological sections in which radioactive isotopes have been deposited by biochemical processes. The distribution of the radioactive isotope will, however, vary from one specimen to another, and T. C. Evans² points out that even successive sections from the same specimen will not be absolutely identical. Strict comparisons of the resolution given by different techniques or photographic emulsions are thus most difficult to make.

Preliminary tests showed that a photographic silver image on a material such as the Kodak Maximum Resolution plate could be converted successively to silver bromide and silver iodide and still give a line separation of 0.5μ . These reactions can therefore be used to give a deposit of I^{131} with any required

Fig. 1

Fig. 2

Fig. 3