LETTERS TO THE EDITORS

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A Fast and Efficient Neutron Detector

Measurements of the variation of neutron cross-section with neutron energy have been made at Harwell using an electron linear accelerator pulsed neutron source, and a time of flight spectrometer technique[1]. In these measurements a boron trifluoride proportional gas counter was used, and in order to obtain an adequate efficiency of detection it was necessary to use a rather large gas volume. This counter limited the neutron energy resolution in two ways: at low neutron energies (10 eV.) the counter length of 50 cm. was the main indeterminacy in the neutron flight distance, and at high neutron energies (keV.) there was the additional and larger indeterminacy in the ion collection time in the counter.

Various alternative detection methods have been tried with the object of combining a more rapid response with increased neutron capture, and it now seems necessary to adopt some form of scintillation detector containing boron[2,3]. In the present investigation, the most promising substance tried was borazole[4], $B_3N_3H_6$. Solutions of borazole in *para*-xylene, with *para*-terphenyl added to a concentration of 5 gm. per lit., have the following useful properties: (1) processes of exciton transfer in xylene are not quenched by the borazole; (2) scintillation pulses obtained by irradiation with polonium alpha-particles are proportional in intensity to the molar concentration of xylene; (3) scintillation response time is less than 10^{-8} sec. Thus, for example, an equimolecular solution of borazole in xylene is a detector with a boron density increased by a factor of 400, and a response time shortened by a factor of 100, when compared with the boron trifluoride counter.

I am indebted to Mr. W. L. Borrows, of the Admiralty Research Laboratory, Teddington, for the preparation of the borazole. I also wish to thank Dr. K. W. Bagnell for information about borazole and guidance on boron chemistry, and to acknowledge the help and encouragement given by Dr. E. Bretscher and Mr. G. N. Harding.

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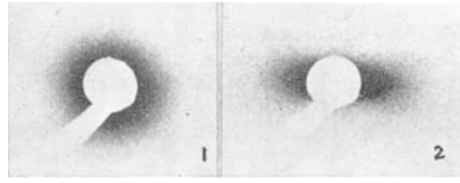
[1] Merrison, A. W., and Wiblin, E. R., *Nature*, **167**, 346 (1951).
[2] Duckworth, J. C., Merrison, A. W., and Whitaker, A., *Nature*, **165**, 69 (1950).
[3] Muehlhause, C. O., and Thomas, G. E., *Phys. Rev.*, **85**, 926 (1952).
[4] Wiberg, E., *Naturwiss.*, **35**, 182 (1948).

Low-angle X-Ray Diffraction of Bone

The study of diffuse scattering of X-rays at low angles has been used for evaluating the size of crystallites and of particles[1]. We have applied this technique to bone tissue in order to study the arrangement of hydroxylapatite crystallites in this structure.

Earlier wide-angle investigations have shown that the *c*-axis of the hydroxylapatite unit cell is parallel to the fibre axis of the collagen[2]. This arrangement can also be demonstrated in *in vitro* experiments[3].

Longitudinal- and cross-sections of compact bone from several animals were prepared by grinding. The sections were about 0·1 mm. thick. Both wide-angle and low-angle diffraction patterns were registered simultaneously on films placed at different distances from the sample. Nickel-filtered copper radiation was used. In Fig. 1 is shown the low-angle diffraction pattern from a cross-section of bone, and in Fig. 2 the pattern from a longitudinal section (longitudinal axis of bone is vertical). The wide-angle and low-angle diffraction patterns from cross-sections showed no appreciable orientation, but in the case of longitudinal sections the low-angle scatter showed marked equatorial orientation, and the 002 reflexion in the wide-angle pattern showed meridional intensifications. In bone, therefore, the hydroxyl-apatite crystallites are elongated with their long axes parallel to the collagen fibres.



Estimations of the short dimension of the crystallite (the width) gave an approximate diameter of 60–80 A. When estimating the long dimension of the crystallites, the small-angle meridional diffraction of the collagen interferes. Several orders of a fundamental spacing of about 660 A. were obtained from the intact bone tissue. The long dimension is estimated to be about three times the width.

Full details of this work will be published elsewhere.

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[1] Biscoe, J., and Warren, B. E., *J. App. Phys.*, **13**, 364 (1942). Guinier, A., thesis, Univ. of Paris (1939). Jellinek, M. H., and Fankuchen, J., *Eng. Indust. Chem.*, **37**, 158 (1945).
[2] Stühler, R., *Fort. Röntg. Str.*, **57**, 231 (1938).
[3] Engström, A., Engfeldt, B., and Zetterström, R., *Experientia*, **8**, 259 (1952).

Shadow Microscopy for Measurement of Height

This note describes a simple optical microscope shadow technique which permits measurement to be made of the heights of small objects such as particles, spores, steps on surfaces, etc., and also reveals qualitative surface topographical features in a striking manner. This is an optical analogy to the familiar metallic shadow-casting method which is used with electron microscopes. I have used it with powers up to that of a 4-mm. objective.

When an object on a specially prepared slide on a microscope stage is illuminated by a parallel light pencil at incidence near to grazing, then a reasonably sharp long shadow is cast on to the slide. Provided the object is appreciably larger than the wave-length of the light used, then the ratio of shadow-length to object-height is the tangent of the angle of incidence. For grazing angles of 5° and 3° the respective lengths