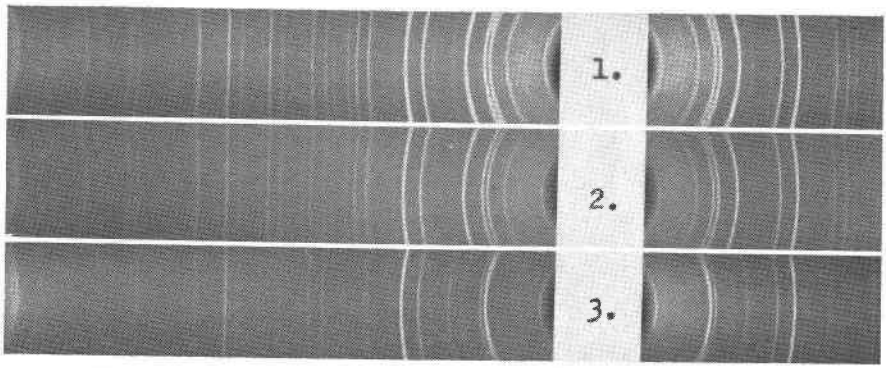

FIG. 1. *X*-ray powder photographs, filtered CuK radiation (contact prints $1°\theta = 1$ mm on film) 1 & 2 Cobalt-nickel-copper selenide; Ato Bay and Eagle group, Goldfields district, Saskatchewan. 3. Pentlandite, Worthington mine, Sudbury Ontario.

Systematically missing spectra indicate that the space group is $Fm3m$.

A preliminary *x*-ray fluorescence analysis indicates that the composition conforms to the approximate atomic formula $Co_{3.0}\ Ni_{2.0}\ Cu_{3.5}\ Se_{9.5}$. It is probable that cobalt, nickel and copper may substitute for each other in varying amount and that the mineral may conform to a general formula of the RX type. Search of the literature has not disclosed any mineral whose chemical and structural features approach closely those here described; Penroseite has a unit cell of 6.01 ± 0.01 (Bannister & Hey, *Am. Mineral.*, **22**, 319–324, 1937), and a composition conforming to the general type RX_2.

A complete chemical analysis of this mineral is to be made, that will permit calculations of the contents of the unit cell and of the specific gravity. Until this more complete description is available, it would be premature to suggest a name for this mineral.

AUTORADIOGRAPHS AS A MEANS OF STUDYING DISTRIBUTION OF RADIOACTIVE MINERALS IN THIN SECTION[1]

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This note describes a simple method of recognizing those grains in a thin section, that contribute to its radioactivity. General information on the subject of detecting and measuring alpha radiation by means of nuclear emulsions is fully described by Yagoda (*Radioactive Measurements with Nuclear Emulsions* 1949), and some ingenious applications of the method to the study of radioactive minerals, by Stieff & Stern

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(*U.S.G.S. Trace Elements Investigations Report 127*, 1950). Recognition of radioactive minerals in thin sections is greatly facilitated where the thin section, and the autoradiograph made from it, are mounted together under the microscope. This can be done by coating the thin section with nuclear emulsion, however, alpha tracks overlying opaque or dark minerals cannot be detected in such a mount. The method here described, simply involves orienting the thin section on the autoradiograph made from it, so that the glass of the thin section and the glass of the nuclear plate (or the celluloid of the stripping film), lie between the rock slice and the emulsion, (see Fig. 1). Once so mounted, the distance between the rock slice and the emulsion is such that the alpha tracks are out of focus when examining the rock slice and vice versa. Photomicrographs of uraninite and radioactive apatite in biotite, and of the resulting alpha track pattern, are reproduced in Fig. 2. These photomicrographs were taken at the requisite focal distances, with the nuclear track plate mounted on the thin section and using a Leitz P3 objective, focal length 6.0 mm. approximately.

Procedure and Material

Kodak Nuclear Track Plates, type NTA or, Kodak Autoradiographic Stripping Film, type NTB.
Kodak D72 developer, development time, 3 minutes.
Kodak F16 fixer, fixing time, 30 minutes.

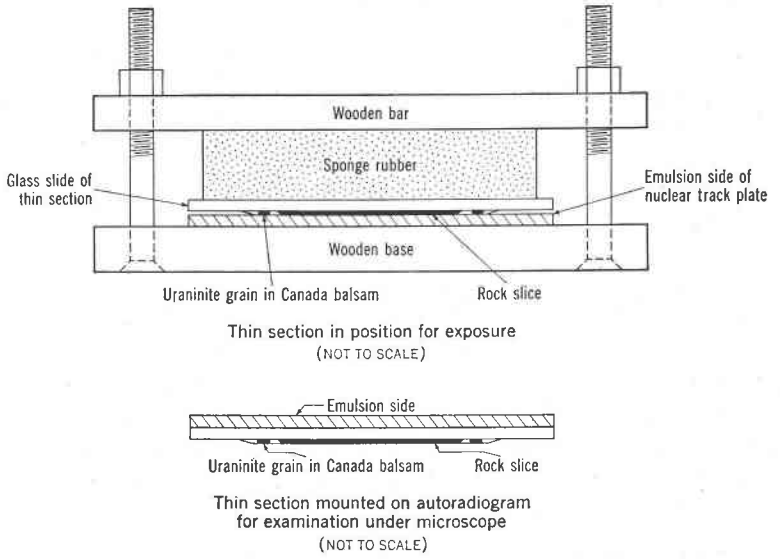

Fig. 1

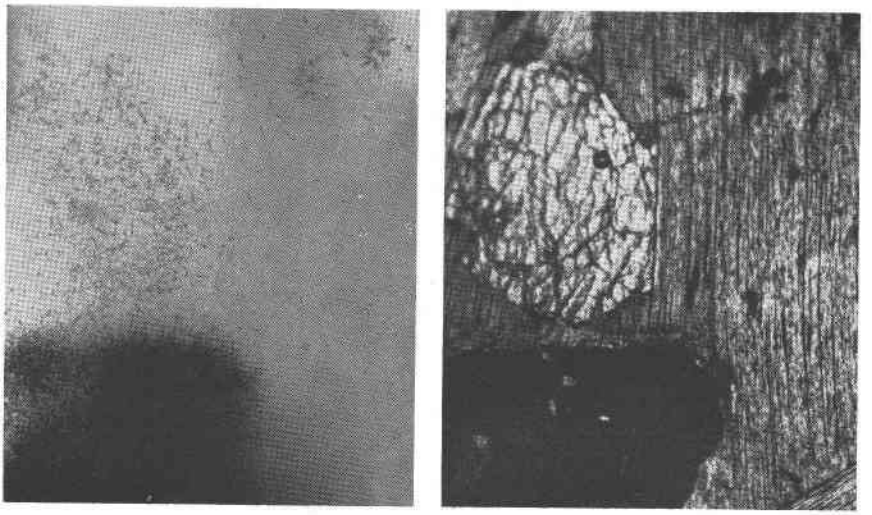

FIG. 2. Photomicrographs of a thin section (right) and corresponding autoradiograph (left). In the thin section the black area is uraninite, the white area is radioactive apatite and the remainder is biotite under plane polarized light. Magnification approximatelv 90 diameters.

Thin sections should be made without a cover glass and with all the Canada balsam removed from the exposed surface of the rock slice. In order to facilitate orientation of the thin section on the autoradiograph, two or three single grains of uraninite (or other radioactive substance), should be cemented in the Canada balsam around the rock slice and ground down with the rock slice.

For exposure, the rock surface is placed against the emulsion side of the plate or film and held there under light pressure. A simple press for this purpose is illustrated in Fig. 1. The mount is then put away in total darkness for exposure. Time of exposure depends on the radioactivity of the minerals in the rock. For uraninite, an exposure of 3 days is ample (see Fig. 2), but for weakly radioactive minerals, exposures of up to a month in duration, may be necessary.

Areas of alpha tracks from the uraninite grains will be clearly visible to the unaided eye and by means of these, the thin section may be roughly oriented and held in position, back to back, on the autoradiograph, by rubber cement (see Fig. 1). With the mount lying on the microscope stage, rock slice down, emulsion side up, the thin section may be precisely oriented on the autoradiograph under a low-power objective (Leitz, P1), before the cement sets.

The mount is studied under a medium-power objective such that the alpha tracks are out of focus when the microscope is focussed on the rock slice and vice versa. It is best to set the focus on one of the dense patches

of tracks from the uraninite and then traverse the mount to look for the weaker centres of tracks. When these are found, it is only necessary to focus down to the rock slice in order to identify the mineral that has caused them. If the mineral is opaque, it is often possible to dig enough of it out of the section with a needle, to be mounted on a glass fibre coated with vaseline, for determination by *x*-ray diffraction.

A METHOD FOR QUANTITATIVE RADIOACTIVITY MEASUREMENTS OF SMALL AMOUNTS OF RADIOACTIVE MINERALS[1]

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The property of radioactivity possessed by minerals containing uranium and, or, thorium may be used as an aid in identifying them, for by accurate quantitative radioactivity determinations the minerals may be grouped according to their uranium and, or, thorium contents. In some instances it is possible by radiometric measurements to determine that the mineral in question is one of a group of only three or four minerals. Of the commoner species, for example, pitchblende, uraninite, and uranothorite all show a radioactivity very much higher than other primary radioactive minerals, whereas allanite, cyrtolite, zircon, and some fergusonites show relatively low activities and euxenites and similar complex minerals usually show an intermediate degree of activity.

In the course of investigations at the Radioactivity Laboratory it has been common experience to be able to obtain only a few, hand-picked grains of a radioactive mineral from the solid specimens or recover a small amount of the mineral by separation tests. The method here described has been used effectively for the measurements of 5–10 mg. samples. The sample powder is weighed, transferred to the tip of a small glass funnel, and counted with an ordinary laboratory-type, thin end-window, Beta tube in combination with a ratemeter or scaling unit. Comparison is made against uranium standards which, in this laboratory, are made up from pitchblende and inert material.

The glass funnel is illustrated in Figure 1; small variations in its dimensions are not important. The funnel-shaped mouth serves two purposes: (1) it allows easy filling of the tip with the sample powder, and (2) it provides a firm base during the counting period.

The funnel is made from a short length of 2 mm.-bore, soft glass tubing. One end of the tubing is heated to a small globule of glass, which is blown into a bubble with a diameter about equal to that of the funnel mouth. The outer half of the bubble is reheated and blown out, and the

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