URANINITE AND ASSOCIATED MINERALS FROM HADDAM NECK, CONNECTICUT

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INTRODUCTION

Many fine uraninite crystals have been found in the Connecticut pegmatites in Glastonbury, Portland, and Branchville. Schairer[1] mentions torbernite from Haddam Neck, but does not record uraninite from that locality.

In the fall of 1932 a box of minerals from a pit that had been opened a short time before at the Rock Landing Quarry, Haddam Neck, was brought to Yale University for identification. The material consisted mostly of smoky quartz and black tourmaline, but there were two remarkable specimens of uraninite, and one crystal and several fragments

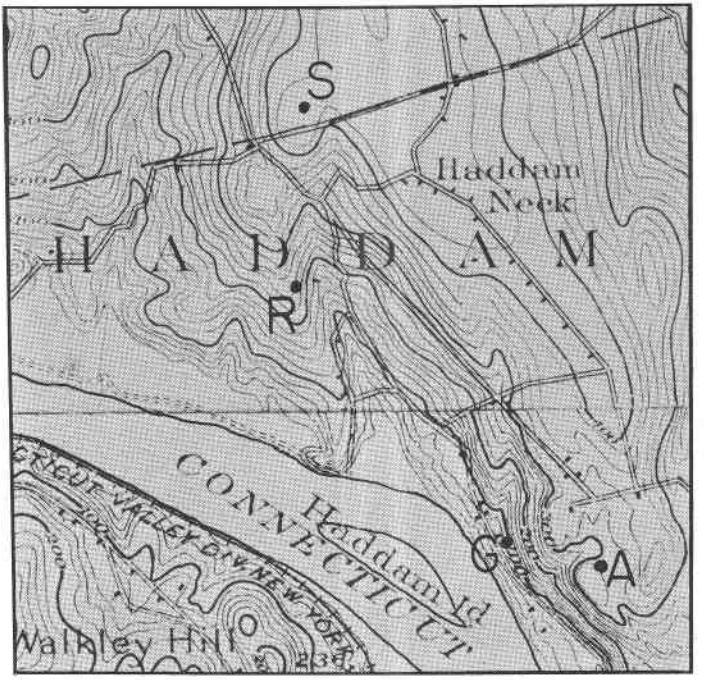


FIG. 1. Index map. S—Swanson Quarry; R—Rock Landing Quarry; G—Gillette Quarry; A—pit from which a number of gem aquamarines have been taken.

[1] Schairer, J. F., The minerals of Connecticut: *Connecticut State Geol. and Nat. Hist. Survey, Bull.* no. **51**, p. 69, 1931.

of columbite. There were also numerous patches and crystals of autunite and torbernite on the other minerals.

Locality

There are several quarries at Haddam Neck and they are somewhat different in the minerals that they yield. The index map, figure 1, shows the locations of these quarries. Lithium minerals have been found in all of these quarries except the Rock Landing Quarry, and it is the only one from which uranium minerals have been reported. Gem tourmaline and beryl crystals have been found in the other quarries, but only black tourmaline and opaque beryl are known at Rock Landing. Triplite is found only at the Swanson Quarry; microlite, red fluorite, and cookeite, only at the Gillette Quarry.

Minerals from the Rock Landing Quarry

1. Uraninite

The uraninite was found in a single pocket, although its alteration products are rather widely scattered in the quarry. In the material studied there were two pieces of fairly pure uraninite, one piece consisting of an intimate mixture of uraninite and columbite, and numerous small fragments of uraninite. The largest piece is $6\times7\times10$ cm. and weighs 1,200 grams. The next largest piece is $2\times3\times4$ cm. and weighs 89 grams. In the large piece there is one octahedral crystal 12 mm. in diameter (Fig. 2), and there are numerous smaller but better formed octa-

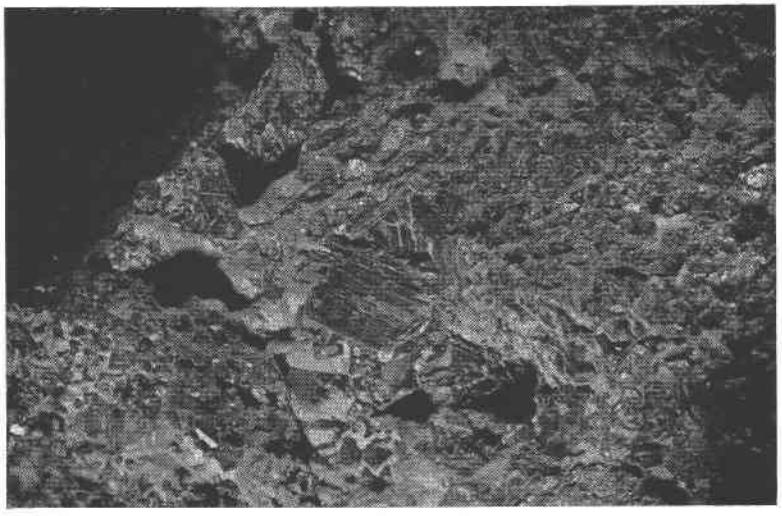


Fig. 2. Large uraninite crystal on a face of the largest specimen. $\times2$.

hedra from 0.5 to 3.0 mm. in diameter. Some of the crystals show cubic and dodecahedral faces.

Identification: (a) The association and crystal form indicated that the mineral was probably uraninite.

(b) *Etch tests:* The smaller specimen was polished on one side (Fig. 5A) and the tests given by Short[2] were applied. The material is completely isotropic, and gives no reaction with HNO_3, HCl, KCN, KOH, $HgCl_2$, or aqua regia. It is slowly darkened by $FeCl_3$. Streak, greenish black; hardness, G−.

(c) *Microchemical test for uranium:* The standard sodium acetate test[3] for uranium was applied and figure 3 shows the tetrahedra of sodium uranyl acetate that were formed.

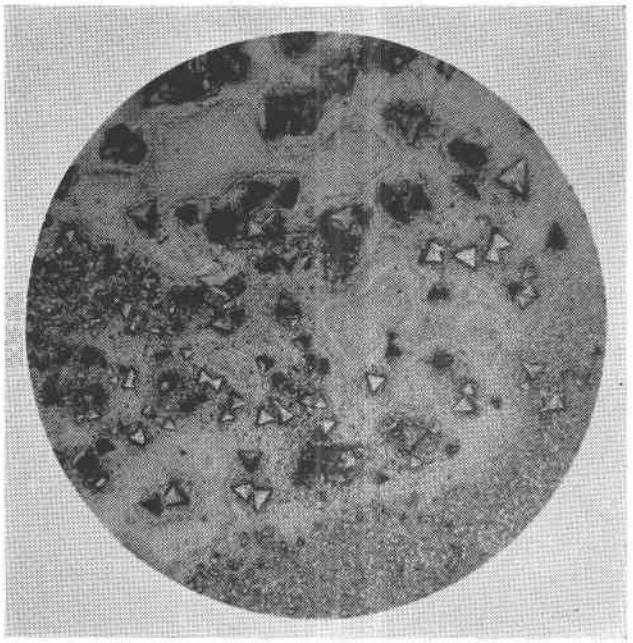


FIG. 3. Photomicrograph of the microchemical test for uranium; tetrahedra of sodium uranyl acetate.

(d) *Radioactivity:* To prove that the material is radioactive a star cut out of sheet lead was placed between the large piece and a commercial orthochromatic photographic film and the set-up was left in a dark room

[2] Short, M. N., Microscopic Determination of the Ore Minerals, *U. S. Geol. Survey, Bull.* no. **825**, p. 102.

[3] Chamot, E. M., and Mason, C. W., *Handbook of Chemical Microscopy*, vol. **2**, pp. 52–58 and 225.

for nine days. The film was developed for seven minutes in stock pyro film developer. Figure 4 shows the result. The smaller piece took a recognizable picture of itself on x-ray film in eleven days. Figure 5B shows this picture and Fig. 5A is a photograph of the specimen.

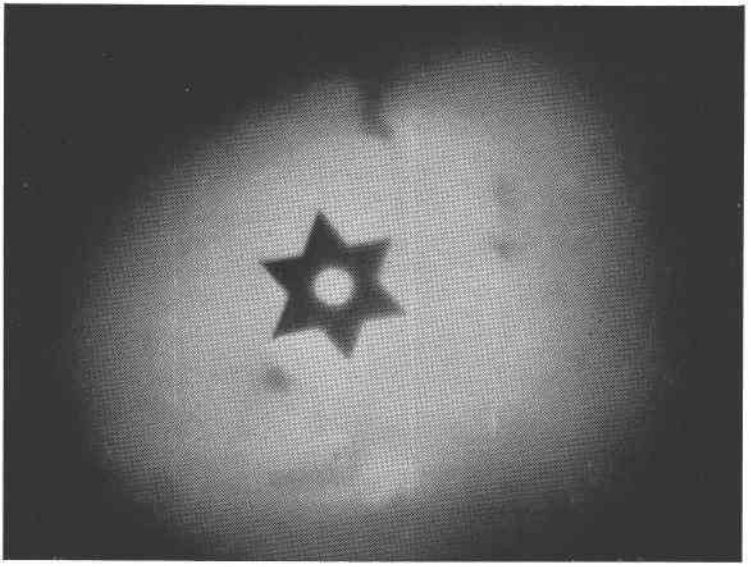
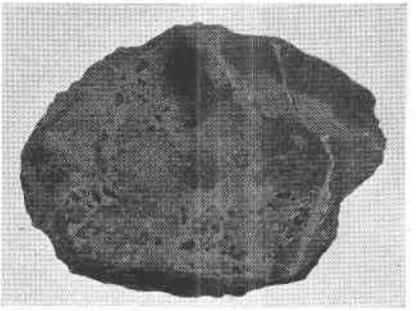


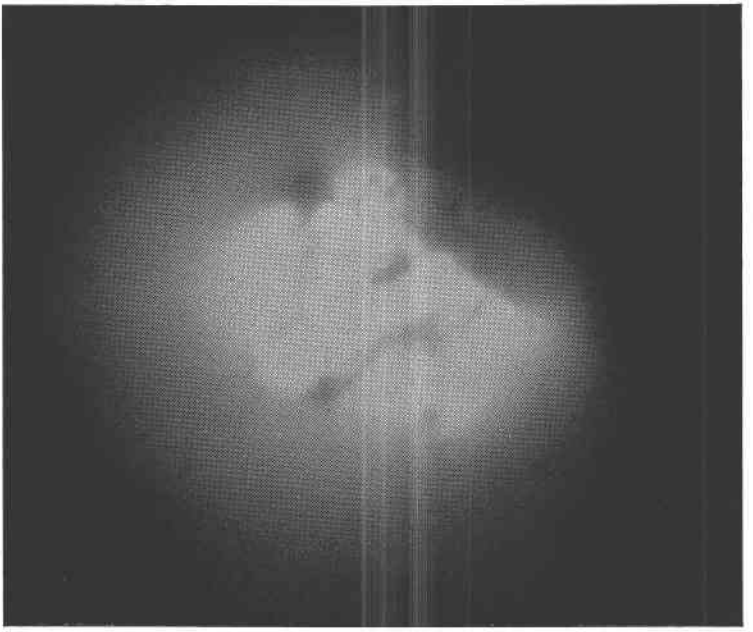
FIG. 4. Shadow of a star-shaped piece of lead made by placing the lead between the large piece of uraninite and a photographic plate.

(e) *X-ray:* Mr. C. J. Ksanda, of this Laboratory, powdered a fragment of a small crystal and made an x-ray powder photograph from it. The crystal was carefully selected under the microscope. It was of uniform color and showed several well-developed dodecahedral faces. The photograph showed only lines belonging to a cubic pattern of face-centered lattice type with $a_0 = 5.454 \pm .006$ Å (see the table for the planar spacings and relative intensities of these lines). The density calculated from this value of a_0 is 10.98, on the assumption that the unit cell contains four "molecules" of UO_2.

The source of monochromatic x-radiation was an ion gas discharge metal tube. CuK-radiation filtered with Ni foil was used. The precision circular camera used has a radius of 57.22 mm. and was calibrated with NaCl.



A



B

FIG. 5. A. The second largest piece of uraninite after polishing. Natural size. B. Effect of the face shown in A on a photographic plate. Natural size. Note the dark patches where feldspar occurs on the specimen.

TABLE 1. PLANAR SPACINGS AND RELATIVE INTENSITIES OF THE *X*-RAY DIFFRACTION LINES OF URANINITE FROM POWDER SPECTRA WITH FILTERED CuK-RADIATION

Line	*d/n*	Intensity observed*	Indices *hkl*	a_0
1	3.147	10	111	5.451
2	2.728	6	200	5.456
3	1.928	8	220	5.453
4	1.645	8	113	5.455
5	1.575	2	222	5.456
6	1.364	2	400	5.456
7	1.251	4	133	5.453
8	1.220	4	204	5.456
9	1.113	5	224	5.453
10	1.050	5	115, 333	5.456
11	.964	1	440	5.453
12	.922	5	135	5.455
13	.909	4	244, 600	5.454
14	.862	4	260	5.453
15	.832	3	335	5.455
16	.822	3	226	5.453

* Estimated intensities of the lines are based on a scale of ten, 10 being the strongest line.

Age determination: Hecht and Kroupa[4] made a micro-analysis of part of one of the uraninite crystals from the larger of these two specimens from the Rock Landing Quarry and obtained

$$\frac{\text{Pb}}{\text{U}+0.36\ \text{Th}}=0.040$$

This gives an age of between 280 and 290 million years, which is in good agreement with results of analyses of radioactive minerals from other Connecticut pegmatites. It places the time of formation as late Devonian.

2. GUMMITE

The uraninite crystals of the two largest specimens are surrounded by yellow waxy gummite which penetrates the feldspar thoroughly, but is excluded from the individual uraninite crystals except along small and rare cracks.

[4] Hecht, F., and Kroupa, E., Die Bedeutung der quantitativen Mikroanalyse radioaktiven Mineralien für die geologische Zeitmessung: *Zeit. anal. Chemie*, vol. **106,** pp. 83–103, 1936. This analysis is also given on p. 61 of the May, 1936, report of the committee of the National Research Council on geologic time, and is mentioned in the 1937 report.

3. Autunite

This mineral is present on several of the fragments of quartz in the material that was brought in, as well as on the larger pieces of uraninite. It occurs for the most part as almost micaceous coatings that apparently were fillings of seams in and between the other minerals. Much of the autunite is in the form of feathery flat needles up to 3 mm. in length, and isolated pseudo-tetragonal plates are rare. Autunite is widely distributed in the new pit at the quarry and it is fairly easy to find small patches of it either on the quarry wall or on loose fragments. Uraninite may be almost as widely distributed, but it is much more difficult to find owing to the abundance of dark smoky quartz and black tourmaline in the quarry.

4. Torbernite

Torbernite occurs as apple green crystals much like those of the autunite in size and shape, and also as seam fillings. Its distribution in the quarry is also much like that of autunite, but it is much less abundant. Both of these minerals were studied under the microscope. They are both negative, practically uniaxial, and their indices fall within the range commonly given.

Fig. 6. Crystal of columbite from the Rock Landing Quarry.

5. Columbite

Columbite is also difficult to recognize in the quarry because of the associated minerals. In most of the hand specimens the columbite is readily distinguished from uraninite by its crystal form and its characteristic iridescent tarnish. The best crystal in the material studied is shown in figure 6. It is a prismatic crystal that measures 1.4×1.4×4.5 cm. The following angles were measured with an ordinary contact goniometer:

$$110 \wedge 1\bar{1}0 = 80°$$
$$110 \wedge 100 = 40°$$

6. Other Minerals

The other minerals to be found at the Rock Landing Quarry are common pegmatite minerals that do not warrant special descriptions—smoky quartz, muscovite, potassium feldspar (perthite), black tourmaline, apatite, and large beryl crystals. There are also many small crystals of chalcopyrite that may have served as the source of copper for the torbernite, or may have been formed from copper-bearing solutions at the same time the torbernite was formed. The quartz and feldspar are in places intergrown as graphic granite. The black tourmaline is in part well crystallized, the rounded, well-terminated crystals commonly being as much as 2 cm. in diameter and 5 cm. long. On many of these crystals there are pyrite cubes up to 2 mm. on a side.