all the targets (or stimuli) to be identified by the subject *of one kind*" (*2*; italics in original) nor did he express any of the reservations indicated by Murphy (*1*). We are thus somewhat surprised to be confronted now by criticisms on this score. Although it is true that we employed targets of an unusual nature, it is also true that they were (i) virtually demanded by the experimental paradigm, and (ii) presented to the subjects with fair warning. We feel that they were entirely legitimate.

Rhine and Murphy offer further criticisms of our procedure; we feel, however, that these criticisms are adequately met in the original report, and we will not attempt to deal with them here. We cannot close, however, without pointing out that Murphy's own comments substantiate our distrust of "random numbers." His remarks also, unfortunately, perpetuate the fallacy that patterning in a target is of no consequence, provided that a large number of calls is made; and they call for support on the study of Schmeidler and Murphy (*5*), which is subject to many of the same qualifications (*6*) that apply to Schmeidler's later investigation (*7*).

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References and Notes

1. G. Murphy, *Science* 120, 1041 (1954).
2. J. B. Rhine, *ibid.* 121, 808 (1955).
3. K. Smith and H. J. Canon, *ibid.* 120, 148 (1954).
4. J. B. Rhine *et al., Extra-sensory Perception after Sixty Years* (Holt, New York, 1940).
5. G. R. Schmeidler and G. Murphy, *J. Exptl. Psychol.* 36, 271 (1946).
6. E. I. Burdock, *J. Abnormal Social Psychol.* 49, 314 (1954).
7. G. R. Schmeidler, *ibid.* 47, 757 (1952).

12 September 1955

Fluorescent Thorium Mineral

It has been generally accepted that thorium cannot be a major constituent of any mineral that fluoresces under ultraviolet radiation. In fact, this element is looked upon as a quencher of the fluorescence of uranium salts. Current literature generally recommends the sodium fluoride bead test as a means of distinguishing between radioactive uranium and thorium minerals, and it has been accepted that appreciable amounts of thorium in a mineral will quench any fluorescence of the bead that is produced by uranium. Minerals such as monazite that contain 1 percent uranium and 7 percent thorium will not yield fluorescent beads when the whole mineral grain is used. It has been found that these generally accepted premises are unreliable.

An unusual mineral from Montana has been brought to my attention (*1*). Under the short-wave ultraviolet light, this mineral fluoresces with a bright green color similar to that of uranophane. Under the microscope, it is evident that the fluorescence comes from the interior of the translucent grains and is distributed more or less uniformly. It is not caused by any surface coating.

In the hand specimen, the mineral is of a liver-brown color with a glassy to resinous luster; streak is a pale tan; hardness is about 5.5 (Moh); specific gravity is 4.534; fracture is splintery conchoidal; it is nonmagnetic and infusible before the blowpipe; it is slowly attacked by boiling concentrated sulfuric or hydrochloric acids, leaving a small white residue.

Microscopically, the mineral is transparent, uniaxial positive with moderate birefringence; the indices of refraction are 1.690 and 1.716.

A spectrographic analysis yielded the following results (*2*): thorium, high (10 to 100 percent); zirconium, medium (1 to 10 percent); silicon, low to medium; iron, low to medium; manganese, low (0.1 to 1 percent); and hafnium, low. There were traces of phosphorus, nickel, beryllium, germanium, and aluminum. The presence of a small amount (less than 1 percent) of uranium was noted. No traces of tantalum or niobium were found.

A radiological assay performed on a Ken Research Monitor indicated a thorium oxide content of 65 ± 2 percent. An independent chemical analysis (*2*) showed a thorium oxide content of 64.54 percent. Chemical analysis demonstrated a uranium oxide content of only 0.81 percent.

In view of the very high thorium content of this mineral and its very low relative uranium content, it is noteworthy that grains of the mineral give a strong positive reaction to the sodium fluoride bead test. If a small grain of the mineral is added to a molten bead of sodium fluoride, the bead emits a strong yellow-green fluorescence under both short- and long-wave ultraviolet. Although it is unusual that a mineral containing 65 percent thorium should yield a fluorescent bead, it is very peculiar that the addition of a minute amount of thorium from any other source immediately extinguishes the fluorescence. To make this unusual fact absolutely clear, I shall review the procedure.

A bit of chemically pure sodium fluoride is melted in a loop of platinum wire. The resultant bead is not fluorescent. A small grain of the mineral is then placed on the bead and the whole is reheated to fusion, whereupon the mineral dissolves completely with a slight effervescence. When it is allowed to cool, this bead fluoresces bright yellow-green under ultraviolet. If one then adds a small speck of monazite, thorite, or chemically pure thorium nitrate to this fluorescent bead and reheats to fusion, the resulting bead is not fluorescent. However, repeated additions of grains of the mineral to a fluorescent bead do not diminish the initial fluorescence.

X-ray diffraction patterns of the mineral are similar to those of thorite; although the optical and physical properties described here do not precisely correspond with those of the latter mineral, the specimen is tentatively ascribed to the thorite family.

Mineralogists and chemists should not consider that a highly radioactive mineral which fluoresces under ultraviolet is necessarily high in uranium content. Furthermore, the generally accepted sodium fluoride bead test cannot be relied on to distinguish between thorium and uranium minerals.

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Notes

1. The specimen was furnished by H. Wilson Cain, Thorium Metals Corporation, New York.
2. The analysis was performed by Ledoux and Company, Teaneck, N.J.

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I hope that my children, at least, if not I myself, will see the day when ignorance of the primary laws and facts of science will be looked upon as a defect only second to ignorance of the primary laws of religion and morality.—CHARLES KINGSLEY (1819–1875).