Acknowledgments. We wish to thank Kerza A. Prewitt for providing invaluable cartographic suggestions and criticisms as well as technical assistance for this project. The archaeological work at the Loeve-Fox site was done by the Texas Archeological Survey, The University of Texas at Austin, under a contract with the National Park Service.

Gumerman, George J., and James A. Neely
1972 An archaeological survey of the Tehuacan Valley, Mexico: a test of color infrared photography. *American Antiquity* 37:520-27.
Robinson, Arthur H., and Randall D. Sale
1969 *Elements of cartography*, third edition. John Wiley, New York.

THERMOLUMINESCENT DATING AND THE MONSTERS OF ACAMBARO

GARY W. CARRIVEAU
MARK C. HAN

Thermoluminescent dates for the Julsrud collection, excavated near Acambaro, Guanajuato, Mexico, are shown to be invalid. Evidence is offered showing that these figurines were fired shortly before they were found.

The figurine collection of the late Waldemar Julsrud, excavated in the vicinity of Acambaro, Guanajuato, Mexico, during the early 1940s, has created interest and controversy. Descriptions and analyses have appeared in a number of publications (Julsrud 1947; DiPeso 1953a, 1953b; Hapgood 1973). The purpose of this report is to show that reported thermoluminescent (TL) dates for this collection are invalid. Furthermore, we wish to introduce evidence that the objects were fired shortly before they were found.

Previously published thermoluminescent and radiocarbon dates for this collection range between 6480±170 BP and 3060±120 BP (Hapgood 1973:10). The thermoluminescent dates in this sequence are invalid. Furthermore, a note in the latest monograph of Hapgood (1973:10), concerning the retraction of the TL dates, is in error. He states the reason these dates are unacceptable is that the firing temperature is too low for accurate dating. We have performed measurements that show the firing temperature was between 450°C and 650°C.

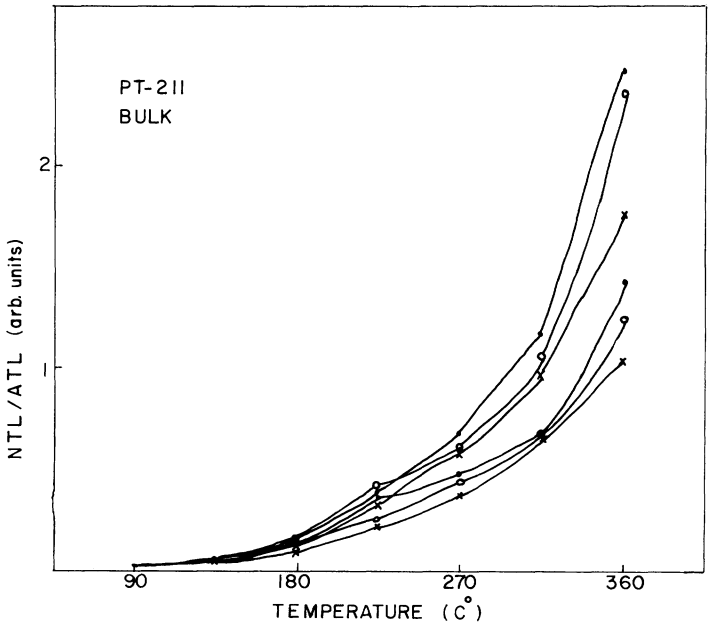

Fig. 1. Ratio of natural to artificial signal (1,000 rads x-ray) for six samples from Julsrud figurine PT 211 as a function of heating cycle temperature.

These results compare well with those of DiPeso (private communication) and are sufficient to anneal geological thermoluminescence (Carriveau 1974).

The dates are invalid because this material fails to pass the essential "plateau" test for thermoluminescent dating. A ratio of the natural thermoluminescence (NTL) to artificial thermoluminescence (ATL) must be temperature independent over a finite portion of the heating cycle. A horizontal plateau in this ratio is necessary to measure a valid TL date (Aitken 1973:373). When no plateau is found, the measured light is due to anomalous fading or a spurious source and cannot be attributed to normal high temperature thermoluminescence accumulated through decay of radioactive elements in the ceramic. A random sampling of twenty figurines from this collection was tested for a plateau; not one passed this essential test. An example is shown in Fig. 1. We hoped that through separation and analysis of the quartz crystals in the ceramic temper, we could eliminate this problem. Fig. 2 illustrates that the test using separated quartz also fails.

The failure of the plateau test indicated that the figurines cannot be dated using established high temperature thermoluminescent techni-

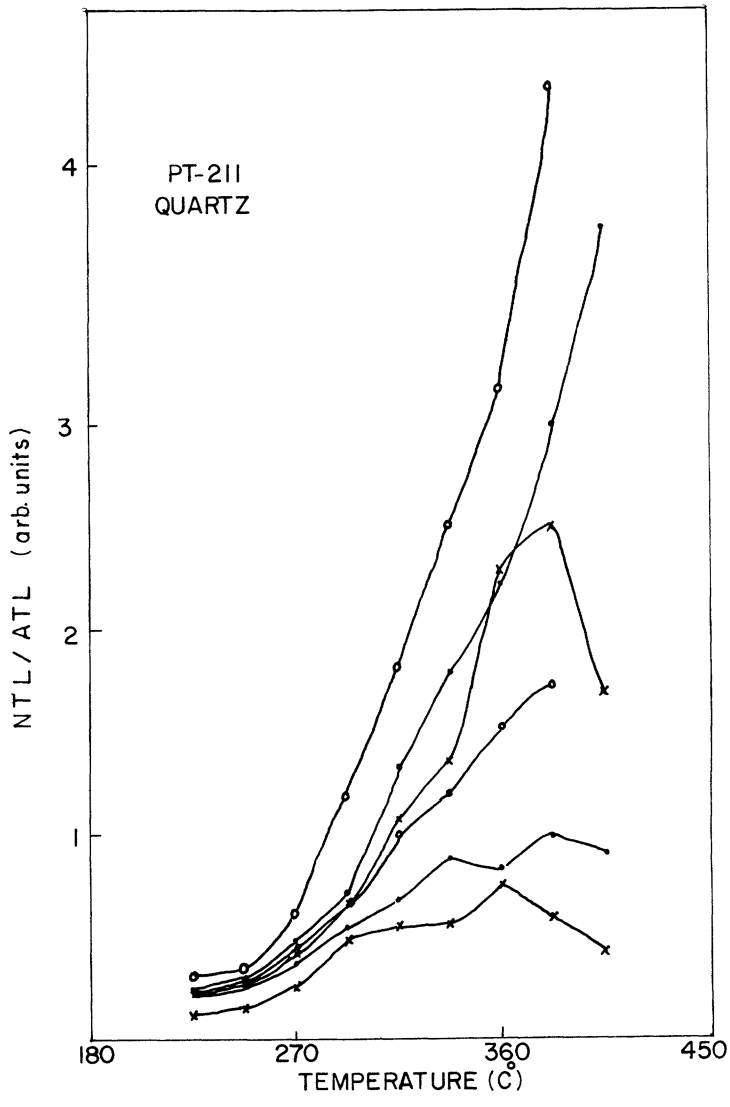

Fig. 2. Ratio of natural to artificial signal (1,000 rads x-ray) for six samples of quartz separated from Julsrud figurine PT 211 as a function of heating cycle temperature.

ques. This should not be considered unusual; it is common for a sizable fraction of samples to fail this test. Unfortunately, the source of these spurious effects is not known, therefore we cannot correct or compensate for them.

The pre-dose technique was also tried and Fig. 3 indicates why this method cannot be used. This figure follows the form of Fleming (1972:150) and his nomenclature is used. Note that there is a decrease in pre-irradiation response, an effect opposite to that normally expected.

The preceding paragraphs illustrate why the collection cannot be accurately dated using normal TL methods. However, results from dating measurements can be used to give an appraisal of their age. During our latest investigation we have remeasured some samples, originally measured in June 1969. Surprisingly, there was a readable light signal where no signal should be expected. Normally, through annealing associated with the natural and artificial TL measurements, all thermoluminescence would have been erased in 1969. The signal we subsequently measured in September 1973 was much too large to be natural TL and had regenerated over a relatively short time (about 50 months).

Information contained in this regenerated signal can be used to estimate the time since the figurines were last fired. Fig. 4 shows the regenerated signal (R) compared to the original light signal (O) measured 50 months earlier. The magnitudes of these signals from six samples result in a 1:8 ratio for regenerated to original. Assuming that the regenerated signal accumulated lineally over a period of 50 months, we calculate that the original signal had accumulated in a time of approximately 400 months. This places the time of firing at about 30 years before 1969, a time very near to the discovery of the figurines (Hapgood 1973:1).

Acknowledgments. We wish to thank Stuart Fleming, Charles DiPeso, and Charles Hapgood for helpful comments on this work.

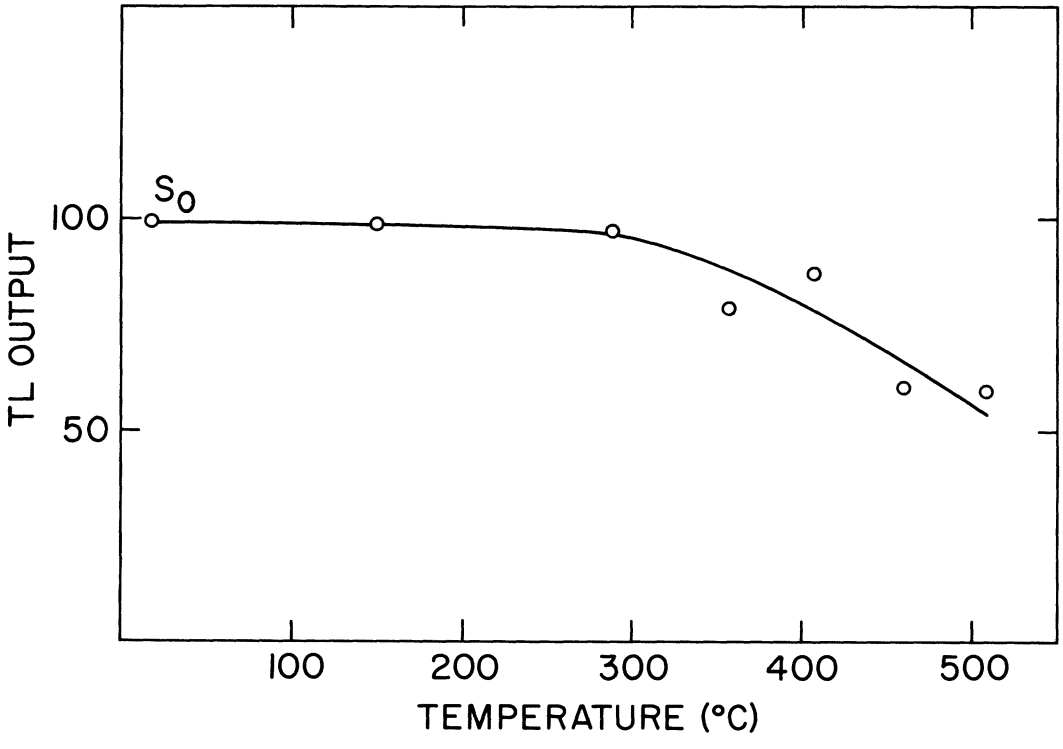

Fig. 3. Change of the S_0 to S_N for the quartz extracted from Julsrud figurine PT 321B with variation of activation temperature. Test dose is 20 rads beta.

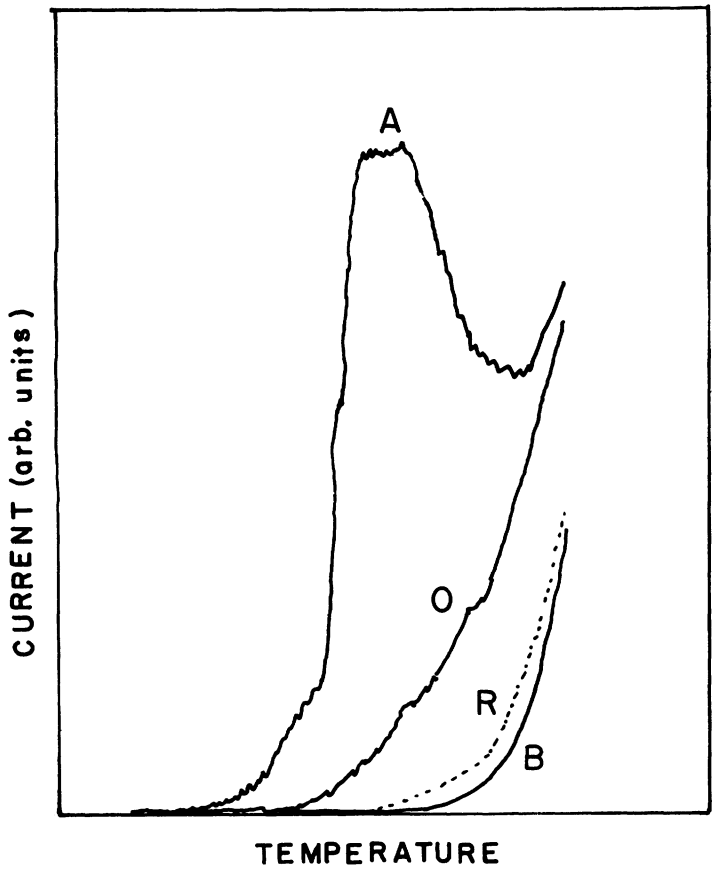

Fig. 4. Glow curves for Julsrud figurine PT 210; A = signal after 1,000 rads x-ray; O = original signal accumulated since firing (measured 6/69); R = regenerated signal (measured 8/73); B = background.

Aitken, M. J.
1968 Thermoluminescent dating in archaeology: introductory review In *Thermoluminescence of geological materials*, edited by D. J. McDougal, pp. 369-78. Academic Press, New York.

Carriveau, G. W.
1974 Annealing threshold and thermoluminescent dating of ceramic material. *MASCA Newsletter* 10:2.

DiPeso, C. C.
1953a The clay figurines of Acambaro, Guanajuato, Mexico. *American Antiquity* 18:388-89.
1953b The Clay Monsters of Acambaro. *Archaeology* 6:111-14.

Fleming, S. J.
1972 Thermoluminescence authenticity testing of ancient ceramics using radiation-sensitive changes in quartz. *Naturwissenschaften* 59:145-51.

Hapgood, C. H.
1973 *Mystery in Acambaro*. Griswold Offset Printing, Brattleboro, VT.

Julsrud, W.
1947 *Enigmas del pasado*. Acambaro, Guanajuato, Mexico.

A NEW APPROACH TO THE SIGNIFICANCE OF THE "WEIGHTED" SPEAR THROWER

JOHN L. PALTER

Many archaeologists continue to assume that spear thrower adjuncts were intended to serve some practical purpose related to the performance of the weapon despite the inconclusive results of the experimental use of the "weighted" spear thrower. Contrary to popular opinion, there is little evidence to substantiate the claim that