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RESEARCH NOTES AND APPLICATION REPORTS

# DATING THE AEGEAN LATE BRONZE AGE WITH RADIOCARBON*

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When Cadogan wrote 'Dating the Aegean Bronze Age without radiocarbon' (1978), this writer agreed completely with the view that the absolute dating of the Aegean Late Bronze Age was already established. Correlations with Egypt and other parts of the eastern Mediterranean seemed secure, and virtually all Aegean prehistorians felt that radiocarbon dates could be 'tested' by comparison with the Aegean chronology. By this reasoning, the radiocarbon dates for Late Minoan (LM) I/Late Cycladic (LC) I Thera were rejected because they suggested a date about a century earlier than the 'traditional' dates (Betancourt and Weinstein 1976). The assumptions must now be reconsidered.

The series of radiocarbon dates from the LC IA settlement at Akrotiri on Thera is one of the longest series from any European site. A subset of short-lived samples, processed by the University of Pennsylvania laboratory, remains today one of the most internally consistent groups of dates (Michael 1976, Michael and Weinstein 1977). The evidence from this group needs only a summary here because it is well known, having been discussed many times in the literature (Betancourt and Weinstein 1976 pp. 332–333, illustration 1, Michael 1977, Weinstein and Betancourt 1977). The entire series processed by the Pennsylvania laboratory is particularly useful because the species that yielded the charcoal were determined, and the contexts were archaeologically secure. If one omits from consideration the dates derived from undersized samples, those from contexts before the LM IA/LC IA destruction, and those from long-lived trees which should date building materials erected well before the destruction, one is left with ten samples, all from twigs, grain and other short-lived material. After calibration, this groups yields dates with a cluster in the seventeenth century B.C., by whatever valid calibration or statistical method which may be employed. In short, the series is insistent on a date in the seventeenth century B.C. for the end of LM IA and LC IA.

The difficulties with this conclusion, admirably summarized by Cadogan (1978), stem from the fact that this date is about a century earlier than the 'traditional' chronology based on interrelations with the eastern Mediterranean. Several explanations have been advanced in efforts to explain the discrepancy, but none are satisfactory. As Michael noted when he first advanced the theory, emissions of volcanic carbon dioxide which would raise the resultant dates of plants near fumaroles do not explain the consistent results obtained from several different materials taken from different storage areas (1977 p. 794). Samples taken from short-lived materials might be expected to yield deviant results with one or two dates

* A comment by P. M. Warren on this paper will be presented in *Archaeometry* 29 (2), 1987.

because of short-range variations in absorbed carbon (Baxter and Walton 1971), but this scatter effect is minimized if large groups of dates are averaged, as is the case with the series from Thera (Stuiver 1982 pp. 12–23). An 'island effect' which causes distortions (Olsson, cited in Åström 1984 p. 5) has no serious validity and is not substantiated by radiocarbon dates from elsewhere in the Aegean, such as the island of Kea (Betancourt and Lawn 1984 figure 3). In summary, no scientific explanation suggests the Theran dates should be discounted. On the contrary, they form a tight, consistent series. The only drawback to accepting them is the archaeological evidence, and much has happened to force a re-evaluation in this quarter in the last few years. In recent discussions of the chronology of LM IA, Warren has presented two main barriers to an early chronology (1984, 1985). The first is the Khyan lid, a stone lid inscribed with the name of the Hyksos king Khyan. It was found at Knossos in a context described as MM IIIB (Evans 1921–1935 I pp. 418–421, figures 303 and 304B). The same context, however, also contained LM I or later stone vases (Pomerance 1984b) and LM IIIA pottery (Palmer 1969 pp. 63–64), so that the lid cannot be used as a keystone of chronology by today's standards of scholarship. The second problem is more complex. If LM IA is raised, then later periods must either be expanded, or they must also be raised slightly, an 'accordion effect' which changes several dates. As Warren notes, the correlation of LM IB with the reign of Tuthmosis III has long been accepted because of finds of Aegean pottery in the eastern Mediterranean.

The relevant evidence for these periods is as follows:

(1) LM IIIA:2/LH IIIA:2 The 'traditional' chronology assigns this period to *c.* 1375–1330 B.C. (Cadogan 1978 p. 210), on the basis of LH IIIA:2 sherds at Amarna. However, LH IIIB sherds are also among the Amarnan finds (Hankey 1973). If LH IIIB (and the contemporary LM IIIB) had already begun by the Amarnan period (second quarter of the fourteenth century B.C.), then the rather long LM IIIA:2/LH IIIA:2 must have begun in the previous century.

(2) LM IIIA:1/LH IIIA:1 The Amarnan evidence indicates that the 'traditional' date of *c.* 1425/1400–1375 B.C. (Cadogan 1978) is not possible. A squat alabastron from Aniba places at least part of this period as early as the reign of Tuthmosis III. The Egyptian context of the vase, Tomb SA 17 at Aniba, has been discussed in two independent studies, both of which agree on the firmness of the dating, in the Eighteenth Dynasty and no later than the reign of Tuthmosis III (Weinstein 1983, Kemp and Merrillees 1980 pp. 242–244, 253–254). The alabastron is a local (?) copy of Aegean work. All the best parallels for the ornament come from Crete but have never been properly discussed. Spirals on the upper shoulder are rendered as dark lines with the corners painted solid, a technique which gives the false impression of light-on-dark spirals if the vase is seen only in photographs but is actually dark-on-light; the technique is common in the Knossian pottery of LM IIIA:1 (Popham 1970 plate 18B, D, E left, plate 44D lower center, Niemeier 1985 figure 43 Nos. 19–20, 27–28). On the bottom of the vase is a rosette set within a decorative circle, a motif which is also at home in LM IIIA:1 (Popham 1970 plate 7D), as earlier rosettes lack the enclosing border. A crescent band is also from LM IIIA:1 (Popham 1970 plates 34F upper right, 41A, 45B). The shape of the vase, a squat alabastron with a baggy shape, begins in LM II and becomes more common in LM IIIA; earlier LM IB and LH IIA examples are different in that they always have a higher maximum diameter (for LM IB see Betancourt 1983 No. 65, Hallager 1973 p. 442 figure 2; for LH IIA see Dawkins and Droop 1910–1911 plate 11 No. 137). The only possible conclusion is that the vessel is a copy of Minoan work

from LM IIIA:1, so that this period must have already begun during the reign of Tuthmosis III. A scarab of Amenhotep III in an LM IIIA:1 context at Knossos (Cadogan 1978 p. 210) suggests the period lasted until late in the fifteenth century B.C.

(3) LM II/LH IIB The only secure evidence is a vase from LH IIB from Kahun from an Egyptian tomb dated to the reign of Tuthmosis III (Hankey and Tufnell 1973). This Mycenaean import indicates that LH IIB and the contemporary LM II were contemporary or earlier than the reign of Tuthmosis III.

(4) LM IB/LH IIA If LH IIB and LM IIIA:1 vases were already in use during the reign of Tuthmosis III, then it is highly likely the LM IB pottery from this period represents heirlooms, buried some years after their manufacture. In this category are a single stray sherd from Taanek, destroyed in the twenty-third year of Tuthmosis III (Lapp 1967), the LH IIA jar from Tomb 20 at Thebes (Davies 1913), and others. One must only date by the latest material found in a specific period; earlier objects are extremely numerous in all times (see the lists of Pomerance 1984a).

(5) LM IA/LH I No Aegean imports occur in well-dated east Mediterranean contexts, but influences may exist. A jug from el-Lisht in Egypt found with Tell-el-Yahudiyah Ware and decorated with birds and dolphins in Yahudiyah Ware technique should be dated to Palestinian MB II, contemporary with the Second Intermediate period in Egypt (Kemp and Merrillees 1980 pp. 220–225). The best parallel for the dolphins is the decoration on a vase from Pacheia Ammos in Crete (Seager 1916 plates 8–9), dated to LM I by both Popham (Mountjoy *et al.* 1978 p. 148 note 21) and by the present author, although the excavator considered it earlier. It suggests that LM I was already under way before the Eighteenth Dynasty.

## DISCUSSION

By the present standards of strict scholarship, very little archaeological evidence exists for the beginning of the Late Bronze Age. The evidence that does exist suggests that the 'traditional' chronology is about a century too late. Only if LM I/LH I began during the Second Intermediate period can the situation accommodate the jug from el-Lisht. No sound evidence exists for LM IB, but LM II/LH IIB was already in progress by the time of Tuthmosis III (jar from Kahun) and LM IIIA:1 must also have begun before the end of this pharaoh's reign (alabastron from Aniba). Such a picture is completely compatible with the chronology derived from radiocarbon dates. A tentative scheme is suggested in table 1.

The implications of the high chronology are widespread. All of the Aegean cultures from

Table 1 *Tentative chronology for the Aegean*

| *Crete* | *Greece* | *Dates* |
|---|---|---|
| LM IA | LH IA | *c.* 1700–1610 B.C. |
| LM IB | LH IIA | *c.* 1610–1550 B.C. |
| LM II | LH IIB | *c.* 1550–1490 B.C. |
| LM IIIA:1 | LH IIIA:1 | *c.* 1490–1430/10 B.C. |
| LM IIIA:2 | LH IIIA:2 | *c.* 1430/10–1365 B.C. |
| LM IIIB | LH IIIB | *c.* 1365–1200 B.C. |

the beginning of the Late Bronze Age move back about a century. As a result, several of the problems confronting those dealing with Aegean chronology, particularly in its relations with northern Europe, find satisfactory solutions. The Mycenaean Shaft Graves are now closer in date to the Wessex Culture, with its faience beads, and to the northern European cultures, with their Aegean-related metalwork and Baltic amber (for the extreme difficulties caused by the 'traditional' Aegean chronology see the discussion of Bouzek 1985 p. 19 and *passim*). Another piece of evidence which fits with the high chronology is a frost effect in the growth ring of bristlecone pines growing at high altitudes, suggesting a volcanic eruption a year or two before 1625 B.C., during the Hyksos period of Egypt (La Marche and Hirschboeck 1984). In view of the large amount of ash ejected by the Theran eruption (Ninkovich and Heezen 1965, Bond and Sparks 1976), a temperature disruption would be expected for this event, and the 1625 ring is the only frost ring in the second millennium B.C. A major Theran eruption during the early Eighteenth Dynasty, when Egyptian records are extremely complete, goes strangely unreported in a nation preoccupied with celestial phenomena (discussion, with different conclusions, in Pomerance 1970); an eruption in the preceding Second Intermediate period would not leave records. The latest imports at Akrotiri, on Thera, are LM IA objects from Crete and Palestinian MB II stone vases, datable to the Hyksos period (Warren 1979 p. 88). Signs of Aegean influence at the very beginning of the Eighteenth Dynasty, such as the dagger of Queen Ah-hotep with its stylized and highly angular Minoan rockwork (Smith 1965 figure 37) make more sense for developed stages of LM I instead of the end of MM III.

In conclusion, if we were to ignore earlier prejudices completely and erect a new Aegean chronology today, it would be somewhat different from the received tradition. This author withdraws many of the opinions he expressed a decade ago (Betancourt and Weinstein 1976); the Aegean Late Bronze Age probably began during the Hyksos period, and radiocarbon was correct all along.

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