

## SEALS OF MIDDLE MINOAN III: CHRONOLOGY AND TECHNICAL REVOLUTION

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The study of Late Bronze Age seal-engraving is, for the most part, concerned with naturalistic treatments of animal and human figures<sup>1</sup>. In this case, 'naturalistic' does not necessarily imply that motifs are all realistically rendered; for their form is often dictated by conventions imposed either by the shape of the field in which they were engraved (some contorted poses being impossible in nature) or by the exigencies of technique (e.g. in the 'talismanic' style or Boardman's 'cut style'). Given the scale of the work, certain short-hands for depicting a motif within the available space or technical conventions for representing particular details were inevitable. The term 'naturalistic' for Late Bronze Age engraving and some of its forerunners in MM III is used only because the artist's subjects were drawn primarily from nature; animals, human figures and plant forms dominated his compositions in the same way that they often dominated those of his contemporaries in fresco-painting, ceramic decoration or the production of stone vases, ivories, inlays and jewellery.

At the same time there had from the beginning existed in Minoan art a strong formal tradition of pattern and this survived to some extent in the Late Bronze Age. Vermeule has, for instance, noted this element in LM IA pottery decoration<sup>2</sup>, and it can be seen in fresco in the 'landscapes' of the Akrotiri paintings or the Hoopoe and Partridge Fresco from the Knossian Caravanserai. This formal pattern element went back much further than the naturalistic element. In Kamares pottery decoration, for example, natural subjects generally form part of or appear to grow out of formal patterns, a kind of 'pictorialization' resulting from the association of abstract forms<sup>3</sup>; and the same seems true of those comparatively few ivory and stone seals from the Messara tholoi which bear recognisably natural motifs: foliage is arranged in symmetrical blocks (CMS II 1 Nos. 58. 241. 242) like abstract patterns (CMS II 1 No. 123); scorpions grow from an S-spiral (CMS II 1 No. 250) in place of other spirals (CMS II 1 Nos. 39. 222b. 224. 227); lions and scorpions together create a formal interlaced design which recalls those created by purely abstract motifs (CMS II 1 Nos. 223a.b). Natural forms rarely occur independently of pattern and when they do, little attention seems to have been paid to their actual appearance in nature.

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<sup>1</sup> This paper was prepared as part of a discussion of the MM forerunners to the seal-engraving styles of the LM/LH period. Improvements have been made as a result of critical reading by John G. Younger and by Peter Warren, the latter especially on chronological problems; I am most grateful to them both. No illustrations are given; much of the material discussed has been adequately illustrated in the volumes of CMS.

<sup>2</sup> E. T. Vermeule, *The Art of the Shaft Graves* (Oklahoma, 1975) 33f.

<sup>3</sup> G. Walberg, *Kamares* (Uppsala, 1976) 126.

On the three-sided prisms of Northern Central and Eastern Crete in the early part of the MM period the animals and human figures, in somewhat clumsy gouged or knife-cut techniques<sup>4</sup>, are symbolic rather than naturalistic representations and there seems to have been no compulsion for engravers to produce more than the basic form of lion, boar, dog, fish, bird, ship, bucranium or human figure. Realistic details are not developed and the symbolic nature of many of the motifs is confirmed by their appearance as 'signs' within the repertoire of hieroglyphic/pictographic script.

The real break between this earlier formal tradition of pictorialized pattern and symbolism, and the new tradition of naturalism seems to come suddenly with the latest of the seals which impressed the Phaistos sealings at the close of MM II; the motifs from nature used in both traditions are largely the same but the whole ethos has changed. It is the aim of this paper to examine the chronology and the technical details of that fundamental change, as the background for the genesis of Late Bronze Age styles. In the same period, the birth of fresco, the shift from Kamares to dark-on-light pottery, new palace architecture, expansion of Minoan influence overseas – all suggest cultural and artistic revolution. That revolution extended to the techniques used to engrave seals and the styles which those techniques were able to produce.

## I. CHRONOLOGY

The period MM IIB to LM IA is spanned by three major stratified deposits of sealings: those from Phaistos *Vano 25* (which may be compared and contrasted with the MM IIB seals from the engraver's atelier and seals and sealings from Quartier Mu at Mallia); the Hieroglyph Deposit from beneath the staircase at the North End of the Long Gallery at Knossos; and the Temple Repository Deposit at Knossos. Between them these should provide enough *termini post quos non* to give a clear chronological framework from the end of MM II to the beginning of LM I.

Unfortunately, even where the ceramic associations of these seals and sealings are undisturbed and clearly identifiable, grave problems remain. There seems little consensus among scholars about the Kamares Ware sequence, about the phases to which it should be correlated or about the absolute dates for those phases. Indeed, since 1950 and the extensive excavation of Phaistos, MM chronology has been thrown into the melting pot. Levi's architectural and pottery sequences have been subject to intense discussion<sup>5</sup>; one general tendency has been to suggest that his and Evans' dates for the Kamares pottery sequence are too high.

MM III presents particular difficulties. One is its length: Boardman blandly states that for his discussion of seal engraving "the problems of absolute chronology may be fairly avoided" and in "a scheme which many scholars would find acceptable" he gives MM III a span of only fifty years from 1600 to 1550 B.C. (with MM I 2000 to 1700 and MM II 1700 to 1600 B.C.), a position not dissimilar to that proposed by Åström<sup>6</sup>. In fact, many more scholars would have MM III begin around 1700 B.C.<sup>7</sup> and last into the second quarter of the sixteenth century

<sup>4</sup> R.D.G. Eveley, *Minoan Crafts: Tools and Techniques* (diss. Oxford, 1979) 231 ff.

<sup>5</sup> e.g. E. Fiandra, *KretChron* 15–16 (1961–62) vol. 1, 113–126.

<sup>6</sup> J. Boardman, *GGFR* 20; P. Åström, *KretChron* (supra n. 5) 137–150.

<sup>7</sup> e.g. P.M. Warren, *AJA* (1980) 487–499.

(though a date rather closer to 1600 B.C. may ultimately become acceptable for the transition to LM IA).

A second problem concerns sub-phases within MM III. Walberg has pointed out that the pottery illustrated by Evans as representative of MM IIIA "is not of homogeneous character" and she "cannot find that hitherto published material permits the establishment of a sub-period corresponding to MM IIIA". She prefers the term Post Kamares to cover the whole of MM III, with apparently some slight overlap from Classical Kamares at the start<sup>8</sup>. Whether this would shorten her period is not clear; she mentions no absolute dates. However, since Walberg wrote, the publication by Betancourt<sup>9</sup> of an important MM III deposit at Kommos, the finds at Anemospelia, and current studies by V. Stürmer give grounds for more optimism that sub-periods may be distinguishable within MM III.

Until these problems are resolved it remains difficult to find chronological *terra firma* on which to base MM glyptic developments. The important progress made in the techniques and styles of seal engraving from the end of MM IIB to the beginning of LM IA should perhaps for the present be traced as much on stylistic as on stratigraphic grounds. Indeed glyptic, in a phase of this kind, may be susceptible to subtler and tighter chronological interpretation than ceramic evidence.

#### a) *The Phaistos Sealings*

At Phaistos Levi dates the *Vano 25* deposit in which the sealings were found to his first Old Palace phase, MM IB to IIA in Evans' terminology, and Boardman is inclined to accept for the deposit "a date towards the middle of the MM II phase" (*GGFR* 31; see above for his absolute dating). Other scholars, notably Fiandra, Zois, Platon and Pelagatti, have modified Levi's date, mainly on ceramic grounds, to MM IIB<sup>10</sup>, a date which Pini (CMS II 5 p. XIV–XVI) gives as a probable *terminus post quem non* for the latest seals impressing the sealings. The manufacture of some of the seals like those which impressed the sealings of most large deposits, goes back to MM I or even earlier<sup>11</sup>, while that of others is closer to the date of deposit. Pini notes CMS II 5

<sup>8</sup> Walberg (supra n. 3) 96–108 (quotation from 108) and 125.

<sup>9</sup> *Hesperia* 47 (1978) 115–164.

<sup>10</sup> For full refs., see CMS II 5 p. IX, n. 3; Walberg (supra n. 3).

<sup>11</sup> Compare e.g. CMS II 5 No. 4 with CMS II 1 No. 217 (Lebena Tholos IIa, not later than MM IA), CMS II 1 No. 232 (Marathokephalo Tholoi, MM IB), and CMS II 1 No. 371 (Siva South Tholos, MM IA); CMS II 5 No. 34 with CMS II 1 No. 74 (Ayia Triada Tholos A, MM IB); CMS II 5 No. 163 with CMS II 1 No. 108 (Ayios Onouphrios Tholos, early MM II), and CMS II 1 No. 315 (Platanos Tholos A, MM IA–II); CMS II 5 No. 199 with CMS II 1 No. 68 (Ayia Triada Tholos A, MM IB), CMS II 1 No. 125 (Kalathiana Tholos, MM IB), and CMS II 1 No. 133 (Koumasa Tholos B, EM II–MM II); CMS II 5 No. 206 with CMS II 1 No. 353 (Porti Tholos, MM I); CMS II 5 No. 207 with CMS II 1 No. 44 (Ayia Triada Tholos A, MM IB); and CMS II 5 No. 281 with CMS II 1 No. 3 (Drakones Tholos Delta, MM I), CMS II 1 No. 223a (Marathokephalo Tholoi, MM IB) and CMS II 1 No. 248 (Platanos Tholos A, MM IA–II). I. Pini, CMS II 5 p. XV, also compares CMS II 5 No. 195 with KSPI Tb (=PM I 202, fig. 151) and M.S.F. Hood, *The Arts in Prehistoric Greece* (Harmondsworth, 1978) 217, fig. 215D, n. 60, compares CMS II 5 No. 253 – despite its use of tubular drill and smoother modelling – with HMs 320a and 406 (=KSPI Ta); these three Knossos sealings are from the Room of the Olive Press dated by Evans to MM IA. Comparisons have also been drawn between the motifs of the Phaistos sealings and those from Lerna (EH II): e.g. CMS II 5 Nos. 94–95 with CMS V No. 112; CMS II 5 Nos. 174, 179 with CMS V No. 103; and CMS II 5 No. 192 with CMS V No. 101; see A. Sakellariou, *KretKhron* (supra n. 5) 79–87, and M. Wiencke, *Die kretisch-mykenische Glyptik und ihre gegenwärtigen Probleme* (Boppard, 1974) 149–163.

p. XV) that the complex 'architectural' motifs of CMS II 5 Nos. 242–244 were previously dated by Evans (*PM* I 564f.) and Kenna (*CS* 42) to MM III and a date as late as the beginning of that period may not be impossible also for some 'naturalistic' seal-types represented among the sealings (e.g. CMS II 5 Nos. 258. 259. 270. 276. 304. 322)<sup>12</sup>. Kenna suggested, on stylistic grounds, that the Phaistos sealings spanned the period MM II to III, and Walberg has pointed out that the vase shapes depicted on CMS II 5 Nos. 239–241. 326, together with some of the pattern motifs of the sealings, find parallels as late as her Post Kamares phase, though she confirms a date for *Vano* 25 within her Classical Kamares phase or within MM IIB<sup>13</sup>. On balance we may, with caution, take the latest seal types found among the Phaistos sealings to be representative of Minoan glyptic at the close of MM IIB and the start of MM III, around or very soon after the start of the seventeenth century.

b) *The Mallia atelier*

The *atelier des sceaux* at Mallia was dated by its excavator Dessenne to MM I in the terminology used at Mallia, MM I to II in that of Evans<sup>14</sup>. Poursat, however, has argued for a date towards the end of MM IIB and by subsequent excavation in the atelier confirmed this later dating; the ceramic and glyptic material suggest that the same destruction put an end to both the atelier and neighbouring Quartier Mu<sup>15</sup>. The seals from the atelier contrast markedly with those which impressed the Phaistos sealings. The majority are three-sided prisms of soft stone in the gouged or knife-cut technique characteristically used on that shape, though Poursat has pointed out that the systematic use of solid drill represents a later development within the series of three-sided prisms; and on those grounds of shape and figurative motifs which have been advanced by Sakellariou for distinguishing earlier from later prisms<sup>16</sup> the atelier pieces should be regarded as late. Their simple technique is only occasionally found among the Phaistos sealings and then it is generally more controlled, almost modelled (compare e.g. CMS II 5 No. 287 with CMS II 2 No. 88a). There are few, if any, sealings from Phaistos impressed by prisms with the oval faces characteristic of Mallia (perhaps CMS II 5 No. 238 – again more smoothly executed than e.g. CMS II 2 No. 187a from Mallia – and CMS II 5 No. 239) or with oblong faces like those of CMS II 2 Nos. 108. 112. 169 (perhaps CMS II 5 Nos. 232. 247). The few seals from the atelier with a single flat circular engraved face – cone or signet (Petschaft) – are closer to the Phaistos sealings (compare e.g. CMS II 5 Nos. 173–181 with CMS II 2 No. 142; CMS II 5 No. 99 with CMS II 2 No. 149; CMS II 5 Nos. 209–212 with CMS II 2 No. 166; or CMS II 5 No. 279 with CMS II 2 No. 173), but in every case the Phaistos examples are compositionally and technically

<sup>12</sup> The naturalistic conch-shells of CMS II 5 Nos. 304–306 also have close parallels at Knossos as late as the Temple Repository Deposit, HMs 340 (=KSPI L43) and HMs 217 (provenience within the Palace not traced).

<sup>13</sup> V.E.G. Kenna, Πεπραγμένα του Β' Διεθνούς Κρητολογικού Συνεδρίου, Τόμος Α' (Crete 1968) 191; Walberg, CMS Beiheft I (Berlin, 1981) 241–249 – cf. supra n. 3, 117; also P. Yule, *Kadmos* 17 (1978) 3, n. 12.

<sup>14</sup> BCH 81 (1957) 693–695; *Comptes Rendus* (1957) 123ff.

<sup>15</sup> Die kretisch-mykenische Glyptik und ihre gegenwärtigen Probleme (Boppard, 1974) 111–114; cf. BCH 102 (1978) 834; CMS Beiheft I (Berlin, 1981) 159–165 and 249.

<sup>16</sup> CMCG 92; *Minoica* (Berlin, 1958) 451–460.

more competent. At Phaistos centred circles were used regularly and with great assurance to create complex patterns; there is only one example of their use from the atelier (CMS II 2 No. 149). Poursat notes (*supra* n. 15, 112) two examples of the tubular drill (which creates circles without a central dot) in the atelier; there may well be three – the experimental CMS II 2 No. 128 together with 150a and 168b which use tubular drill to create semi-circular vase handles, a feature otherwise created free-hand on the atelier seals (e.g. CMS II 2 Nos. 86c. 124c. 134b. 159a. 182b). The Phaistos sealings have produced five instances of tubular drill (CMS II 5 Nos. 25. 45. 103. 253. 263), mostly more assured than those from the atelier (see below). At Phaistos only CMS II 5 No. 250 has anything of the heavy solid drill technique used at Mallia. The crisp and detailed impressions on the Phaistos sealings such as those of the ‘architectural’ motifs (CMS II 5 Nos. 242–244) suggest that hard semi-precious stones (Mohs 7 to 7.5) were in regular use; at Mallia the hardest stones are conglomerate (Mohs 4.5 to 5) for CMS II 2 Nos. 136. 150. 168, and obsidian (Mohs 6 to 6.5), though the unusual brownish material of CMS II 2 Nos. 129. 130 is perhaps not obsidian; CMS II 2 Nos. 128. 148, hitherto identified as rock crystal, are in fact fluorite (Mohs 4).

Stylistic and technical differences, therefore, suggest that the engravers at Phaistos were much more advanced and versatile than those of the Mallia atelier. The marked contrasts seem to imply local difference, that the atelier was deliberately archaistic or out of touch with developments in the Messara; but, given comparable pottery styles in both places and the halting attempts of the atelier to use techniques more ably applied at Phaistos, it seems unlikely that such explanations alone can account for the differences. Could there be a chronological distance, albeit small, between the two groups? Their ceramic contexts suggest not. However, while in ceramics it may not be possible to draw distinctions within the narrow period of MM IIB, in glyptic (which was undergoing rapid technical advance) narrower technical and stylistic divisions – as brief as an artist’s working life, say twenty-five years – may be observable. It may be tentatively suggested that, if the most advanced of the seals which impressed the Phaistos sealings were made at the close of the eighteenth century, then those at Mallia could well belong no later than its third quarter.

### c) *Mallia Quartier Mu*<sup>17</sup>

Of the forty seals from Quartier Mu at Mallia, five (253, 254, 256–258) belong to the Late Bronze Age, though not necessarily as late as the LM III date suggested by Poursat (*supra* n. 17, 187–188); they are finds from the surface or the periphery of the building. The remainder mostly come from the building’s MM IIB destruction levels and the occasional stray surface finds are not, for the most part, stylistically incompatible with the main MM IIB deposit. Some, mainly three-sided prisms, are in a style close to that of seals from the neighbouring atelier. A few seem to be survivals from an earlier period (e.g. 237 and 239; with the latter compare CMS II 1 No. 271 for shape and 163 for motif). Others are in what appear to be MM II styles different from those of the atelier, including three bearing hieroglyphic signs (241–243) and a

<sup>17</sup> Fouilles Exécutées à Mallia: Le Quartier Mu II, in *Etudes Crétoises* 26 (Paris, 1980) 157–234 (numbering given here is from that publication).

number of signets with linear and drilled designs more reminiscent of the Phaistos sealings than of anything from the atelier (e.g. compare 247 with CMS II 5 No. 90; 246 with CMS II 5 Nos. 141–148; or 248 with CMS II 5 Nos. 135–136. 152–157). 248 and 250 are of an unusual blue faience, though the spiral motif of the latter has a parallel in the white faience cylinder CMS IV No. 27; 252 is a unique flattened cylinder of ivory. There is only one hard stone piece (249), a signet of rock crystal (or perhaps softer fluorite?) with convex face bearing a cursory linear design and this was a surface find.

The seals used to impress the Quartier Mu sealings create a similar picture. Three, 263, 269 and 293 (R31–33), were in a style similar to that of the atelier's three-sided prisms (compare 263 and 293 with CMS II 2 Nos. 101a. 145b. 176b; 269 with CMS II 2 Nos. 138a. 170a. 196a which have pairs of similar animal heads, while *CMCG* 96b and CMS IX No. 20a with single heads are closest). Earlier seals are perhaps represented by 290, 291 and 295 (R21, 28 and 29). A few bear comparison with the Phaistos sealings (e.g. 265 (R19) with CMS II 5 No. 139; 292 (R4) with CMS II 5 Nos. 55–59), though they seem, for the most part, less varied and less technically assured; 287 (R23) may be compared with CMS V No. 286 from MM II Monastiraki, a pear shaped signet of the type which appeared earlier than the pawn-like type.

A wider variety of hieroglyph seals is represented among the sealings than among the seals from either the Quartier itself (241–243, proto-signets) or the atelier (CMS II 2 No. 100b, three-sided prism; 112, half cylinder; and perhaps 108, four-sided rectangular seal), and, unlike those, several may have been of hard stone (*supra* n. 17, 221–222). 259–261, 266, 273 and 274 (R1–6) were probably impressed by signets; 267, 268, 280 and 288 (R7–9) by three-sided prisms; and 270, 279 and 283 (R10–12) by four-sided rectangular seals of the type found in Myrtos-Pyrgos phase III (two examples *infra* n. 19) at the same period and still extensively used to impress sealings in later Hieroglyph Deposit at Knossos. A seal (or seals) of this last shape also impressed 264 and 272 (R34 and 17) and the parallels for both designs suggest that this was a hard stone seal (compare 272 with CMS II 2 No. 286 of jasper (close to HMs 178a=*KSPI* P74) and CMS IX No. 29 of chalcedony; 264 with *CS* 170 and CMS IV No. 132 of jasper and CMS XII No. 112 of carnelian).

The range of motifs and styles on the seals and sealings from Quartier Mu is, therefore, wider than that of the atelier; more hard stone seals seem to have been in use; but there is nothing to suggest contemporaneity with the latest naturalistic seals or the hard stone architectural seals which impressed the Phaistos sealings. Centred circles and tubular drilled circles with no central dot are rarer (see below) and are used with less assurance; and the one naturalistic seal used, to impress 276 (R30), is less 'advanced' than the finest naturalistic seals in use at Phaistos. Though the range is wider than that of atelier, the two neighbouring groups should be contemporaneous.

#### *d) The Hieroglyph Deposit*

Since publication by Evans, the Hieroglyph Deposit at Knossos has usually been accepted as a homogenous group with a single dated context. In fact only four sealings can be unequivocally derived from the space beneath the staircase at the North End of the Long Gallery – HMs 172, 170, 176 and AM 1938.940 (= *KSPI* H1–4). Most of the remainder assigned to the deposit by

Evans are not, either in the colour and condition of their clay or in the shape and style of the seals which impressed them, discrepant; however, six were certainly found in nearby Magazines 4, 12 and 13 and there are also cases where Evans gives different find-spots to the same sealing<sup>18</sup>. If we continue to regard the sealings assigned to the deposit as a homogeneous group, especially those which include impressions of hieroglyph seals among their frequently multiple imprints, then we should be aware that for many of them the exact find spots and the stratification remain unconfirmed.

Even accepted as a homogeneous group, their dating has been subject to discussion. Evans appears to have revised his date from MM III (*SM* I 19–20) back to the end of MM II (*PM* I 271–285). The exact ceramic associations are not entirely clear but he states that “the earliest contents of the West Wing ... belong to a period – ‘The Third Middle Minoan’ – in which the fine polychrome style was already in a state of decadence” (*SM* I 19).

The finest hard stone hieroglyphic four-sided seals with oblong faces, which impressed many of the nodules, were being made as early as MM IIB. Two examples have been found in phase III of Myrtos-Pyrgos whose ceramic material Cadogan associates closely with that of Quartier Mu at Mallia<sup>19</sup>; others come from Quartier Mu itself (see above). However, several of the naturalistic seals used to create Hieroglyph Deposit impressions, often on the same nodules as others created by hieroglyph seals, seem more ‘advanced’ than anything at Phaistos and the modern tendency has been to give these a date well into MM III<sup>20</sup>. Reich supports Evans’ original (*SM*) dating in the middle of MM III, though his arguments are countered by Yule, who, curiously, seems to have misread him as arguing, on the basis of parallels from Mallia, for a MM IIIB date. Yule publishes for the first time AM 1938.1153h, a nodule from Knossos bearing impressions of a hieroglyphic four-sided seal (or seals) and of a lentoid whose style could hardly place it before LM I; the heavily baked black clay of this nodule and the style of the lentoid which impressed it seem incompatible with the Hieroglyph Deposit<sup>21</sup>. Yule compares the lentoid impression with HMs  $\Xi$  A (= *KSPI* L 29) from the Temple Repository Deposit but still seems troubled by the lack of other stratigraphic evidence for seals bearing hieroglyphs as late as MM III. Reich seems similarly troubled by the use of occasional hieroglyph seals as late as the LM IB sealing deposits at Kato Zakro and Ayia Triada. They need not be troubled: as with the Phaistos deposit, the date of manufacture for seals which impressed MM III or even LM IB nodules may go back into MM II; only the latest of the seals impressing the Hieroglyph Deposit sealings were made during MM III and for these, the *terminus post quem non* originally proposed by Evans in mid-MM III, around 1600 B.C., seems reasonable.

#### e) *The Temple Repository Deposit*

This Knossian deposit has traditionally been dated towards the end of MM IIIB. The ceramic material is clearly identifiable (*PM* I 557, fig. 404) but, as both Furumark and Walberg

<sup>18</sup> *KSPI* p. 66; for the date of ceramic material in the cists of Magazine 13, see P. Warren, *BSA* 62 (1967) 197–198.

<sup>19</sup> *ArchReports* (1976–77) 74–76.

<sup>20</sup> *CS* 37–41; *GGFR* 34; *KMS* 125f.; and O. Pelon, *BCH* 89 (1956) 9.

<sup>21</sup> J. Reich, *AJA* 74 (1970) 406–408; Yule (*supra* n. 13) 1–7 cf. Pini, *Kadmos* 21 (1982) 1–4.

note<sup>22</sup>, it is hard to draw a clear dividing line between the pottery of MM IIIB and that of LM IA. Some of the dark-on-light decoration on vases from the Temple Repository may be as late as the beginning of LM IA and the imported Cycladic bird vase with black and red decoration has parallels both in MC III and LC I – at Phylakopi in phases II and III, in Grave Gamma of Mycenae's Shaft Grave Circle B, from Ayia Irini, Akrotiri, and Myrtos-Pyrgos in phase IV<sup>23</sup>. This suggests a *terminus post quem non* early in LM IA for the seals which impressed the Temple Repository sealings.

Kenna (CS 41–44) and others have pointed to clear stylistic differences between the seal-types of the Temple Repository Deposit and even the most advanced of those from the Hieroglyph Deposit. The more ambitious compositions, the smoother modelling and greater plasticity in rendering animal and human figures, and the simple fact that the older types of seals represented in the Hieroglyph Deposit, especially the four-sided hieroglyph seals themselves, do not appear in the Temple Repository Deposit, all suggest that a gap of some fifty years between the two deposits may not be unreasonable, giving a *terminus post quem non* for the Temple Repository towards the mid-sixteenth century B.C.

#### f) Summary

If the above estimates, based as they are on ceramic dates not yet fully agreed but rather more on style and technique of the seal-types themselves, are acceptable, then *termini post quos non* for the major deposits may be tabulated as follows:

Mallia: Atelier	}	1725 B.C.
Mallia: Quartier Mu		
Phaistos: Vano 25		1700 B.C.
Knossos: Hieroglyph Deposit		1600 B.C.
Knossos: Temple Repository		1560 B.C.

Even given that many seals may have a date of manufacture considerably earlier than that of their deposit or their use for sealing, it should become possible (especially when the Knossian sealings have been fully published in *CMS*) to gain a clearer picture of glyptic development over little more than one hundred and fifty years, a period of technical advance and experimentation during which the foundations of the Late Bronze Age engraving were laid<sup>24</sup>.

<sup>22</sup> A. Furumark, *Mycenaean Pottery* (Stockholm, 1972) 161–165; Walberg (supra n. 2) 124.

<sup>23</sup> R. Barber, *BSA* 69 (1974) 34–35.

<sup>24</sup> Some check on the evidence of these deposits is provided, especially at the lower end, by seals found in stratified contexts at Gournia, Mochlos, Sphoungaras, and Mallia, in the Kamilari Tholos, the Poros Herakleiou Chamber Tomb, the tombs of the two Knossian cemeteries at Prophitis Ilias and Mavrosplio, and in the earliest Shaft Graves at Mycenae.



## II. TECHNICAL DEVELOPMENTS

The development of glyptic styles during the MM period depends as much on technical progress as on changes in artistic taste, and an understanding of that progress in technique is necessary for an appreciation of new styles adopted during MM III. The virtual lack of the preserved tools that must have been used in the engraving process necessitates a reconstruction of the technique from the cuts produced on the extant seals themselves. In addition analogies may be drawn from other areas and periods of ancient engraving, or from the techniques of modern engravers; and modern experiments, such as those of Gwinnett and Gorelick may also be used to simulate ancient conditions<sup>25</sup>. Metal tools are by no means a necessary prerequisite for cutting and drilling soft materials (up to Mohs 4); even wood or cane are effective, spun between the hands over a fixed seal or powered by a hand-operated bow of the type known from the Rekhmire bead-maker fresco of the Egyptian Middle Kingdom (CS 70). Naxian emery would have been readily available to Minoan engravers as an abrasive agent. And Melian obsidian, of which numerous blades were found in the Mallia atelier, could be used for shaping and cutting. A gradual progress in the range of techniques used can be traced from EM II to MM III, by which time complex naturalistic motifs were being engraved with assurance in hard stones, mainly silicates (Mohs 7–7.5).

*a) Cutting and Gouging*

The earliest Minoan seals from stratified contexts belong to EM II and come from Myrtos (CMS V Nos. 14–19) and from the lowest stratum of Lebena Tholos IIa (CMS II 1 Nos. 210–216). The finished pieces from Myrtos are all in soft stone; of those from Lebena two are in soft stone and five in ivory or bone. The shapes of the latter, two rings with ridged hoops, a cylindrical stamp with delicate handle and two theriomorphs, are quite sophisticated but could have been simply whittled with a small knife or obsidian blade and finished with emery and oil. By contrast, the designs on the bases of all these EM II seals are very simple, even crude; they consist of straight lines created by a blade, perhaps with a serrated edge, drawn across the face of the seal which would have been held in the other hand or in a fixed position. One result of this sawing or filing motion is that the straight lines of the design mostly cut directly across the edge of the engraved face. On two of the stone seals, however, (CMS II 1 No. 214 and CMS V No. 14) the lines all end within the area of the face and for this a knife, a pointed burin or a V- or U-sectioned gouge could have been used; scratches made by the tool when it slipped out of the intended groove are observable on one side of the Lebena piece; a tool of this kind could be used to introduce curvilinear elements into the design as on the other side of the same seal.

*b) Drilling*

To create the string-hole of these earliest seals a pointed or round-ended solid drill would be needed, hand-turned or bow-driven with the seal in a fixed position. The potential of such a drill

<sup>25</sup> Expedition 20.2 (1978) 38–47; 22.1 (1979) 17–32; also supra n. 4.

for creating straight sided holes or, when lightly applied, circular cup-sinkings was soon utilized to vary the designs on the engraved face of the seal. If the reconstructed design of the one sealing from Myrtos (CMS V No. 20) is correct, the four dots or cup-sinkings on the seal which impressed it were created in this way.

The combined techniques of filing, gouging and solid drilling could, at their best, produce quite sophisticated designs but remained inadequate for one purpose – the creation of perfect circles. Free-hand attempts always resulted in minor, sometimes major, inaccuracies (e.g. CMS II 1 Nos. 52. 245. 291 b. 341. 382. 426. 488. 490). Uneven wear on a solid drill tends to produce tiny concentric rings within a drill mark (*supra* n. 25) and to produce this kind of effect deliberately special drills may have been occasionally produced, one such perhaps accounting for the unusual sinking on CMS II 1 No. 117 and another for those on CMS XII No. 81 b. For the creation of the perfect circle with a central dot, which became a hall-mark of seal-engraving in MM I–II, Pini has proposed a complicated hollow or cup-like drill with a central spike (CMS II 2 p. XVI f., Abb. 1). This seems to presuppose that hollow or tubular drills (which produce a circle without a central dot) were in use before his more complex form, which is based on the hollow or tubular drill principle. Statistics given below show that this was not the case: centred circles precede plain tubular-drilled circles and were probably produced by a cutting compass (*supra* n. 4) or a three pronged fork-like drill powered by a hand-held bow, a small initial solid drill hole perhaps being used to create a securing hole for the ‘fork’s’ middle prong which was to create the central dot. Prongs of varying size would alter the thickness of the outer circle and the diameter of the central dot, while additional prongs would create multiple concentric circles. Only after this stage was the hollow tubular drill invented to cut circles with no central dot or, applied obliquely, to create arcs and semi-circles.

Some simple statistics on the use of solid drill, free-hand circles, centred circles and tubular-drilled (i.e. uncentred) circles on the seals of CMS II 1, II 2, II 5 and Quartier Mu tend to confirm that the various techniques were invented in the order proposed above.

	Total	Solid	Freehand	Centred	Tubular
CMS II 1	503	34	13	15	4
Mallia atelier	113	70	0	1	3
Quartier Mu	76	24	2	8	5
CMS II 5	326	80	0	66	5
CMS II 2 (excluding atelier)	222	90	0	26	16

The figures are revealing in other respects. In the ‘pre-palatial’ period (CMS II 1) only 10.5% of seals use any form of drilling, while the figure for seal-types used to impress the Phaiastos sealings (CMS II 5) is 47.9% and for ‘proto-palatial’ seals as a whole (CMS II 2, excluding the Mallia atelier) it is 59%. The 65.6% for the atelier and 50% for Quartier Mu are mainly accounted for by frequent use of solid drill on three-sided prisms and in the latter case also on hieroglyph seals. In the last two groups many more seals use both solid drill and centred circles within a single design.

What is most striking is the fact that the hollow or tubular drill is used to produce either perfect circles without a central dot or arcs and semi-circles on only 2.4% of all the seals. This figure includes from the atelier the experimental fluorite signet (CMS II 2 No. 128) and the two conglomerate prisms (150a and 168b) which use it for semicircular vase-handles, as does a similar seal (79b) from House  $\Delta\alpha$  at Mallia, probably also of conglomerate; these are medium-hard stones (Mohs 4 to 5). One can only guess at the material of the seals which made the five Phaistos (CMS II 5) impressions with uncentred circles but the remaining nineteen seals on which the tubular drill was used are all of silicates (Mohs 7 to 7.5). By contrast all the centred circles (with only three possible exceptions – CMS II 1 No. 462a and CMS II 2 Nos. 24, 44) appear on soft stones (below Mohs 4). Of 503 seals in CMS II 1, only six are silicates (103 and 432 previously identified as rock-crystal are in fact fluorite) and, those six include the only four bearing uncentred circles. The inescapable conclusion is that the tubular drill was invented for use on hard stones for which the compass or drill which created centred circles was inadequate or difficult to operate.

It may be surmised that the tubular drill could most easily be made from metal and its almost exclusive use on hard stones tends to confirm this. The date at which it appeared can be quite accurately pinpointed: CMS II 1 No. 366, a rock-crystal cylinder with engraved ends, comes from the Porti Tholos whose latest material seems to be at the end of MM IB: CMS II 1 No. 118, an amethyst scarab, derives from the Ayios Onouphrios Tholos deposit in which the latest material is generally thought to be MM IA, though some of the seals assigned to it cannot be earlier than MM II<sup>26</sup>. The execution of the Porti piece is unsure, almost as though the drill rather than the engraver dictated where the circles would appear and, when it came close to the edge of the face the material sheered away (cf. *CS* 110); on the Ayios Onouphrios piece the drilling broke the seal which had probably been pre-shaped and pre-bored for the string hole; for one of the surviving circles there is evidence that the drill had to be applied several times before it gained purchase in the material at the intended position (cf. CMS II 2 No. 285; IV No. 139; X No. 323a; XII No. 91). Intersecting circles (like those of the Olympic or Audi symbols) were attempted but the material broke away in the intersections on CMS IV No. 133 and XII No. 93b; the seals which impressed two Phaistos sealings (CMS II 5 Nos. 25, 45) achieved these intersecting circles with more success, as did *CS* 109 side b, a three-sided prism of agate from Papouda near Lyttos, which seems to have been designed to show off the artist's new found virtuosity with various types of drill, solid on side a, tubular on side b, and 'fork' on side c. The engravers of CMS II 1 No. 468, a rock crystal cone from Gournia, and CMS II 1 No. 462, a carnelian prism from Asimi Monophatsiou, (both without context date) also seem to have experienced difficulties with the intractability of the tubular drill and the material to which they were applying it. In the MM IIB Mallia atelier its use was still only at an experimental stage in medium-hard stone (see above) and even among the seals which impressed the Phaistos sealings errors were still made (e.g. CMS II 5 No. 103, where the circles are misplaced, as on CMS II 1 No. 366); the tool's full potential remained unexploited (e.g. CMS II 5 Nos. 253 and 263, where the circles are used only as fillers).

<sup>26</sup> For the standard MM IA date, A.J. Evans, *Cretan Pictographs and Phoenician Script* (London, 1895); K. Branigan, *The Tombs of Mesara* (London, 1970) 166; P.M. Warren, *Minoan Stone Vases* (Cambridge, 1969) 193. For the MM II date of some of glyptic material, CMS II 1 p. 118.

The tubular drill, probably of metal, was therefore invented for use on hard stone in MM IB<sup>27</sup> but its use was not completely mastered until MM III. It seems initially to have been applied to the material in the same manner as the solid drill – vertically in relation to the flat face of the seal. The seal would have been fixed and the drill held in position by the artist's hand, chest or leg (or by an assistant) and turned by a bow operated with the other hand; the result would be a complete circle.

It was soon realized, however, that semi-circles or arcs could be produced holding the drill in the same position while tilting the seal's face. But such a procedure was so clumsy as to be virtually impossible with the drill operated over a fixed seal. Only two shapes lent themselves naturally to it: a three-sided prism could be set down on one face and the drill applied vertically or at only a slight angle to the other two raked faces; a signet laid on its side would present its face for engraving at a similar angle. Such at least, seems to have been the method used for the prisms CMS II 2 Nos. 79. 150. 168 and the signet No. 128; but the pressure, concentrated on a small area, as often as not broke the seal, as it did Nos. 128 and 168 but not 79 and 150. Some other method, less dependent on pressure emanating from the artist, had to be developed<sup>28</sup>.

### c) *The Bow Lathe*

The invention and development of the potter's fast wheel between MM IB and MM II must have produced concomitant innovations in other arts. It is not difficult to imagine the stoneworker taking the rotating axle of the potter's wheel turning it through 90° to the horizontal and rotating it with the same fiddle-bow he had used for the hand-held drill. Various versions of such a lathe have been described and illustrated. The stele of a cutter of ring intaglios, Doros of Sardis, in the second century A.D. depicts it<sup>29</sup>; it has been postulated for the ancient Near East<sup>30</sup> and is still used by Iranian gem-cutters<sup>31</sup>. The great advantage of this lathe over the older (and Egyptian) method which operated a hand-held drill over a fixed seal was that both the engravers hands were now free to manipulate the seal at any angle and with various pressures onto an independently moving drill. The same procedure has been hypothesized by Warren for making stone vases – rotating the vase around a drill, an advance on Egyptian methods – and he suggests that

<sup>27</sup> The postulation of a tubular drill as early as EH II at Lerna and EC II at Ayia Irini is probably erroneous. Of the clay and stone seals from Lerna, CMS V No. 36 has a free-hand circle around a solid drill sinking and the circle on CMS V No. 41 is also free-hand. On some of de Jong's drawings of the Lerna sealing motifs he shows perfect uncentred circles but in each case examination of the sealing itself indicates free-hand renderings (CMS V Nos. 50. 67. 116. 117) or the sealing is too worn to be certain (54 and 82). The centred circle may have been produced by a drill once (79) but in other cases even this was created free-hand.

<sup>28</sup> I am indebted to the modern Athenian engraver Lambrinidis for personal discussion of drilling techniques: he points out that when a hollow (tubular) drill is applied vertically, the motion of slurry (oil and abrasive) fed down the inside of the drill will leave a centre to the circle but one perhaps more uneven than most Minoan instances and apparently one in relief not intaglio; when slurry is added around the outside of the drill – and, while it *can* be so added to a vertically applied drill, it *must* be to a drill fixed horizontally on a lathe – the result is a perfect circle with smooth interior.

<sup>29</sup> AthMitt 15 (1890) 333f.; L. Gorelick and A.J. Gwinnett, Expedition 22.1 (1979) 25, fig. 20; Boardman, GGFR 381, fig. 316; Richter, *Engraved Gems of the Greeks and Etruscans* (London, 1968) 4, fig. a.

<sup>30</sup> Gorelick and Gwinnett (supra n. 29) 24, fig. 19; Nissen, *Seals and Sealing in the Ancient Near East*, in *Bibliotheca Mesopotamica* 6 (Malibu, 1977) 15–23, fig. 1.

<sup>31</sup> H.E. Wulff, *The Traditional Crafts of Persia* (Cambridge, Mass., 1966) 37–40, fig. 48.

it came into use in MM III<sup>32</sup>. For seal-engraving another application of the lathe, which must have been developed almost immediately was the attachment of cutting and polishing wheels, like that reconstructed by Nissen (*supra*. n. 30) for Mesopotamia.

The lathe's main member is a horizontal spindle supported in a wooden frame between two uprights. Between the uprights various grades of metal or stone wheels and polishing blocks of wood or other material can be fitted on the detachable spindle (or interchangeable spindles); to the ends of the spindle projecting beyond the uprights variously shaped points and drills may be attached. Movement of the spindle is provided by a fiddle-bow operated by the apprentice while the crafts-man works the seal onto the various spindle attachments as they turn at high speed. From Iranian turquoise-working practice it is possible to infer three main processes: (1) the cutting and shaping of the seal would be done with the material held in the hand against a rotating wheel (of emery?) with regular dipping in water for cooling and lubrication – the fingers nearest the wheel being wrapped in protective cloth strips; (2) the drilling of the string hole from either end and the detailed engraving of the motif would be by means of a variety of smaller wheels and drills and in this process greater manoeuvrability would be achieved by holding the gem in a hand-vice (modern only), setting it with wax in a dop, or attaching it with strong adhesive to the end of a stout stick – a method also employed, with resin as the adhesive, by Italian engravers of shell cameos and with wax adhesive by German agate engravers in Idar-Oberstein<sup>33</sup>; (3) final polishing would be performed first with progressively finer emery powder, then by a smooth wooden burnishing disc – hand held or attached to the lathe-spindle – and finally by a similar disc with leather covering.

That a process of this kind was adopted by the Minoans and that adoption of it occurred during MM II is also argued by Yule (*supra* n. 32) and seems confirmed not only by the appearance of harder materials in that period but by subsequent developments in seal shape. During the course of MM III a new range of seal shapes was introduced. The rectangular block with flat faces was replaced by one with convex faces; the longer edges, parallel with the string hole were at first flat but gradually came together to form the mature cushion shape or 'flattened cylinder'. By a similar process of evolution the cylinder with flat engraved ends and the disc with flat faces were replaced first by the discoid with convex faces and then, as the edges farthest from the mouth of the string hole were tapered together, by the mature lentoid shape of LM/LH. The three-sided prism with flat faces was replaced by one with convex amygdaloid-shaped faces and the single-faced amygdaloid was invented. The convex-faced, generally oval ring bezel made its first appearance and the signet (*Petschaft*) gradually went out of use but not before it too had experimented in hard stone examples with a convex face. It seems natural to conclude that the common factor in all these new shapes – the convex face – lent itself more readily to the new hardstone techniques. The cutting wheel ran across it more easily, creating the straight cuts with sharp tapered ends (like those of modern cut-glass) which are characteristic of hard stone engraving from MM III onwards and could not have been created with the saw as sometimes suggested. It may well also be that the pressure of a metal drill (particularly of the tubular vari-

<sup>32</sup> Warren (*supra* n. 26) 161–162; Thera and The Aegean World (London, 1978) vol. 1, 555–568.

<sup>33</sup> John Younger has kindly supplied information about one such Italian engraver with a shop at Pompeii; for the German example, see Yule, CMS Beiheft 1 (Berlin, 1981) 273–278.

ety) was less likely to cause breakage in the material when a convex rather than a flat surface was applied to it. Indeed similar convex surfaces are favoured by modern Iranian engravers (*supra n.* 31).

### III. CONCLUSIONS

The lathe may have been used earlier in the Near East on the curved face of cylinders but its use in Crete, whether vertical for throwing posts or horizontal for stoneworking created an industrial revolution during the MM period. In seal engraving its effects were immediate: the brilliant facets of the 'architectural' motifs cut with the wheel, mostly on hard stone discoids and flattened cylinders early in MM III; and, slightly later, the intricate designs of the talismanic seals, often of carnelian or jasper, which combine wheel cuts with deft use of the tubular drill on lentoids, flattened cylinders (cushions), amygdaloids and three-sided prisms with amygdaloid-shaped faces (a shape almost exclusive to the talismanic group).

Mastery of the tubular drill was a Minoan preserve; it was not used elsewhere before and has not been effectively used since, as some of the halting attempts of the San Giorgi forger early in this century to mimic its Bronze Age use bear witness<sup>34</sup>.

The far-reaching effects of the introduction of the bow lathe into Cretan engraving can be seen not only in its products, but also from the fact that, while there were later periods of gem engraving in which it may not have been used (e.g. the island gems of Melos or the globolo scarabs of Etruria), it has remained the tool of the successful engraver ever since. It appears on the stele of Doros of Sardis (*supra n.* 29) and is still in use in present day Iran (*supra n.* 31) and, in a more mechanised form, in Germany (*supra n.* 33).

Techniques established during MM IB–II and consolidated in MM III were generally not altered in the Late Bronze Age. Those adopted for hard-stone engraving were refined by the dictates of fashion and the idiosyncracies of particular artists or groups of artists whose products and relative dates can be established by study of those refinements and idiosyncracies. Some of the same techniques were, in rare instances, employed by engravers in soft materials whose basic range of tools and techniques could be simpler, though no less effective. This is not to say that the engravers of soft stones (or, for that matter, of precious metals) were always different craftsmen; only that different materials dictated that they mastered and used different tools and techniques.

It is worth noting that many of the bow-lathe techniques, e.g. tubular drilling and the sharp wheel-cuts on 'talismanic' and 'cut style' seals, are rarely – and then usually unsuccessfully – applied to or imitated by contemporary seals in soft materials (serpentine, steatite etc.). Most of the techniques already developed in EM–MM were adequate – and often more effective than the new hard-stone methods – for materials below Mohs 4.5. The centred circle, however it was produced, remained the almost exclusive province of soft-stone engravers and, when a smaller and rather different version of it came into use on hard stones, mostly in LM IIIA, to produce the spectacle-like eyes of animals, it was formed not by the obviously single tool which produced

<sup>34</sup> CMS Beiheft 1 (Berlin, 1981) 17–35.

an accurately centred dot but by two separate drills, tubular for the outer circle and solid for the depression inside it, which was sometimes off-centre.

One might have expected the new hard-stone techniques to exert a strong influence on soft-stone engraving; apart from adoption of the convex-faced shapes, naturalistic motifs and imitation of some types (fuzzy versions of the precisely wheelcut 'architectural' motifs, some weak attempts at talismanic style) they do not. Perhaps lathe-driven tools cut into soft stone too rapidly and unmanageably; when using such material, craftsmen adopted some of the hard-stone engraver's smoother modelling but as often clung to techniques of cutting, gouging and vertical drilling.

Influence more often passed in the other direction, hard-stone engravers attempting to mimic techniques or follow motifs used more consistently by their colleagues working in soft stone. The group of seals represented by 'the Jasper Lion Master'<sup>35</sup> includes both hard and soft materials and imitated (or originated) the motif of two running lions tête-bêche which was common among seals of the soft-stone 'Cretan Popular Group'; the striations, representing dappling, on the body of the stag on amethyst lentoid CMS I No. 13 imitate those used on soft-stone seals of the same group; and many hard-stone seals from Vapheio have stylistic features that show they were based on soft-stone Cretan prototypes, while several of their motifs are otherwise found only on soft stones. The same may hold true for engraving in metals; for the group of seals represented by 'the Mycenae-Vapheio Lion Master' use details, like the prominent saphena vein on the legs of lions and griffins which contemporaries were using in gold work<sup>36</sup>.

There were some late archaizing tendencies: the LH III 'Mainland Popular Group', for instance, reverted to the MM V-shaped gouging technique to produce its animals with foliage fillers and its abstract designs; and there was in the same period a renewed vogue for centred circles on soft stones, often with a smaller dot and thinner surrounding circle than on the MM examples. The only significant new technique to enter the repertoire in the Late Bronze Age was the production of glass seals from steatite moulds like those used for gold and glass jewellery and even for gold ring bezels<sup>37</sup>. Otherwise all the necessary technical foundations for LM/LH engraving had been laid down in the technical revolution of MM III and on the basis of that revolution it is possible to distinguish two broad approaches to engraving during MM III and LM I.

The first is formal, the artist relying on the strong Minoan tradition for pictorialized pattern and symbolism and, like the engravers of the earlier three-sided prisms, making little or no attempt to disguise his newly discovered technical virtuosity. Rather he revels in it, as did the artist of *CS* 109 (see above), and, even when he draws his motifs from nature, the technique seems to assume greater importance than the motif itself, as in the case of the artist who created on side a of *CS* 168 a stag's protome whose outsize antlers, a multiplicity of tubular drilled arcs, dominate his composition out of all proportion to reality. The same kind of approach can also be seen in the 'architectural' seals, in the 'talismanic' motifs and in the 'cut-style'.

<sup>35</sup> BSA 74 (1979) 274–278; CMS Beiheft 1 (Berlin, 1981) 1–15; I now believe it may be safer to speak in terms of a 'group' rather than a 'master'.

<sup>36</sup> Younger, *AJA* 82 (1978) 285–299; *BICS* 29 (1976) 119–120; *TUAS* 6 (1981) 67–81.

<sup>37</sup> T.E. Haevenick, *RGZMJb* 7 (1960) 36–58, and *Archaeology* 16 (1963) 190–193; J. Sakellarakis, CMS Beiheft 1 (Berlin, 1981) 168–179; Younger, BSA 74 (1979) 258–268; Pini *RGZMJb* 28, (1981) 48–81, pls. 2–15.

The second approach follows the trend towards more complete naturalism, the artist using the new modelling of smooth rounded forms which allows him to disguise his technique and to concentrate on imaginative portrayal of natural scenes, like the artist who created a dog barking at an agrimi out of reach on a rock ledge on *CS 227* or on the seal which impressed the Phaistos sealing *CMS II 5 No. 258*. The attempt by some of these artists to compose in miniature a whole scene complete with landscape of rocks and plant life is peculiar to *MM III* and, like the growing naturalism seen in late *Kamareos* pottery<sup>38</sup>, may have been based on trends in fresco painting which also influenced the carving of scenes on stone vases, an art closely akin to that of the seal-engraver. The later trend, as in fresco, was generally to depict human and animal figures independently of surrounding scenery, stagnation being avoided in glyptic by the adoption of a wider range of more complex pose variants and torsional compositions to fill the field rather than the elaborate surroundings favoured in *MM III*. However, the basic naturalistic canons and techniques for rendering animals and human figures in the Late Bronze Age were laid down by those *MM III* artists who adopted this second approach.

#### DISKUSSION

*N. MARINATOS* fragt, ob die von *J. Betts* genannte technische Revolution eine Folge des Stilwandels in *MM III* ist oder umgekehrt.

*J. BETTS* entgegnet, daß beide Vorgänge wohl zur gleichen Zeit stattgefunden haben. Er will damit nicht sagen, daß die neuen Techniken eigens für den neuen Stil erfunden worden sind. Offensichtlich war die ganze Periode eine Zeit der Revolution, bei der die künstlerischen Veränderungen viel stärker waren. Interessant ist, daß man sich zu diesen neuen Techniken durchgerungen hatte, bevor sich die künstlerische Revolution ausbreitete. Zuerst mußten die Techniken vervollkommen sein.

*I. PINI* zweifelt die zeitliche Einordnung in *MM III* an. Die Bearbeitung harter Steine und der Gebrauch der verschiedenen Spezialwerkzeuge hat nach seiner Ansicht schon in *MM II* begonnen. Er ist überrascht über die Unterscheidung zwischen Bohrern mit zentraler Spitze bei weichen Steinen und ohne diese bei hartem Material. Er neigt noch dazu, an dem von ihm vor einigen Jahren rekonstruierten Bohrer (*CMS II 2 XVI f. Abb. 1*) festzuhalten. Die Handhabung des von *J. Betts* vorgeschlagenen Werkzeugs hält er bei den extrem kleinen Kreisen für zu schwierig.

*J. BETTS* stimmt dem früheren zeitlichen Ansatz zu und nennt sogar ein Datum in *MM I*. Für das Kreiszentrum findet er noch keine befriedigende Antwort. Auf jeden Fall unterschied sich das Werkzeug für die schwierigen harten Steine vollkommen von dem, das früher für weiche Steine benutzt worden war.

*G. WALBERG* setzt die Keramik des Archivs von Phästos in *MM II* an, da sie ihrem Postkamareos-Stil nicht entspricht. Nach ihrer Meinung ist es nicht möglich, die Dauer der Unterphasen der mittelminoischen Periode absolut zu datieren, und es ist gefährlich, mit Angaben wie 50, 75 oder 100 Jahren umzugehen. Die ihr bekannten Funde aus *Anemospilia* sind ohne Zweifel in die Postkamareos-Stufe einzuordnen. In *Kommos* ist ein Teil des Materials stratigraphisch früher

<sup>38</sup> Walberg (*supra n. 3*) 65–67.



anzusetzen. Allerdings gibt es keine großen Stilunterschiede, so daß die Straten von P. Betancourt keineswegs mit der Einteilung von A. Evans korrespondieren.

J. BETTS sieht die Schwierigkeiten der mittelminoischen Keramik-Chronologie, beharrt aber auf der Notwendigkeit besserer absoluter Daten, die er für seine Arbeiten bevorzugt.

G. WALBERG hält es für besser, die absolute Chronologie auszuklammern als mit einer fiktionalen Konstruktion zu arbeiten. Im übrigen hält sie die relative Chronologie für gut.

A. SAKELLARIOU weist auf ihren Beitrag über die Metallbearbeitungstechnik hin. Solche Untersuchungen sind ein Mittel, die Siegelglyptik besser zu erfassen. Daher wünscht sie eine Diskussion auch über technische Aspekte.

J. BETTS sieht Unterschiede zwischen der Technik bei der Anfertigung von Ringen und der hier von ihm vorgetragenen Bearbeitung von Steinen. Interessant ist, daß die Trennung in »Weichsteintechnik« und »Hartsteintechnik« die ganze spätminoische Epoche hindurch möglich ist. Wenn ein Siegelstecher bei weichem Stein Werkzeuge benutzte, die für harte Steine vorgesehen waren, machte er gewöhnlich Fehler. Und ein schlecht bearbeiteter harter Stein könnte als der Versuch eines Siegelstechers gedeutet werden, der auf weiches Material spezialisiert war.

J. POURSAT stimmt den technischen Beobachtungen zu, weniger jedoch den chronologischen Folgerungen. In Mallia sind alle Beispiele für die Verwendung des Röhrenbohrers harte oder halbharte Steine. Er könnte als weitere Belege Fragmente aus Karneol, Achat und vielleicht auch Bergkristall nennen. Der Röhrenbohrer, von dem sogar einige Exemplare aus Kupfer gefunden wurden, ist auch für die Aufhängebohrungen eingesetzt worden. Zur Chronologie bemerkt er, daß die Siegelwerkstatt in Mallia zur gleichen Zeit wie Quartier My zerstört worden ist. Es gibt keine chronologisch relevanten stilistischen Unterschiede. Gleichzeitig ist auch die Zerstörung von Raum 25 in Phästos anzusetzen. Die von J. Betts zusammengestellte Reihe von Architekturmotiven aus Phästos kann er durch ein weiteres Siegel aus Mallia ergänzen. Dieses stammt, wenn auch der Kontext nicht eindeutig ist, aus der mit Phästos gleichzeitigen Zerstörung oder aus der Zeit der Wiederbesiedlung unmittelbar danach. Interessant ist für ihn die zeitliche Trennung der Zerstörungen von Mallia um 1725 und Phästos um 1700 durch J. Betts. Vor kurzem hat G. Cadogan (AJA 87, 1983, 517) das Datum für Mallia zwischen 1650 und 1625 angesetzt, also später als die Zerstörungen von Phästos und Knossos. Er selbst ist der Ansicht, daß diese Zerstörungen nach und nach auf dasselbe Datum hinauslaufen. Seiner Ansicht nach ist es noch die beste Lösung, die Stufe MM III auszulassen, zumal weitere Unterphasen zu beachten sind. Die absoluten Daten für das Hieroglyph Deposit um 1600 und die Temple Repositories um 1550 sind seiner Meinung nach zu niedrig angesetzt.