

THE IMPRINTING OF THE PHAISTOS DISC

The study by Haecker and Scheller in a recent issue of *Kadmos*¹ is of special interest because it concentrates on visible data and on details of arrangement which invite an explanation of a kind which is other than linguistic. This line of investigation is one of the few which hold out promise, and it should appeal to those — and they are many — who believe that in the present state of our knowledge the inscription is indecipherable and unintelligible.

However, the instances of inversion and of misalignment of signs on which Haecker and Scheller based their argument can be explained in other ways, and their thesis involves the summary dismissal of the evidence of the 'overcuts' or places where lines or signs appear to impinge on each other in such a way as to give an indication of sequence.² I hope in a subsequent paper to review and amplify the testimony of the overcuts; but here I am concerned with other aspects of the "new argument for reading from left to right" and with the problems presented by the signs of variable orientation.

Haecker and Scheller begin by recalling that though most of the signs have a fixed position in relation to the base line and the centre (that is, they have a 'right' way up), there are a few which appear in varying positions — in particular the lion's head, the eagle, and the hide. They suggest that the vagaries of the eagle are acceptable in the representation of a flying bird, and they attribute the apparently haphazard stamping of the lion's head to the difficulty which the inscriber must have had in identifying the right way up of so compact a design. I shall return to these two signs later, but will first examine in detail the explanation by Haecker and Scheller of the inversion of the hides and of the eccentric alignment of the shield and the crested head in A 3 (Evans' numeration).

¹ H.-J. Haecker — S. Scheller, *Ein neues Argument für rechtsläufige Leserichtung des Diskos von Phaistos*, *Kadmos* 10, 1971, 20–7

² These were noticed soon after the discovery of the disc: A. Della Seta, *Il Disco di Phaistos*, *RRAL*, class. sc. mor., stor. e fil., 18, ser. 5, 1909, 297–367.

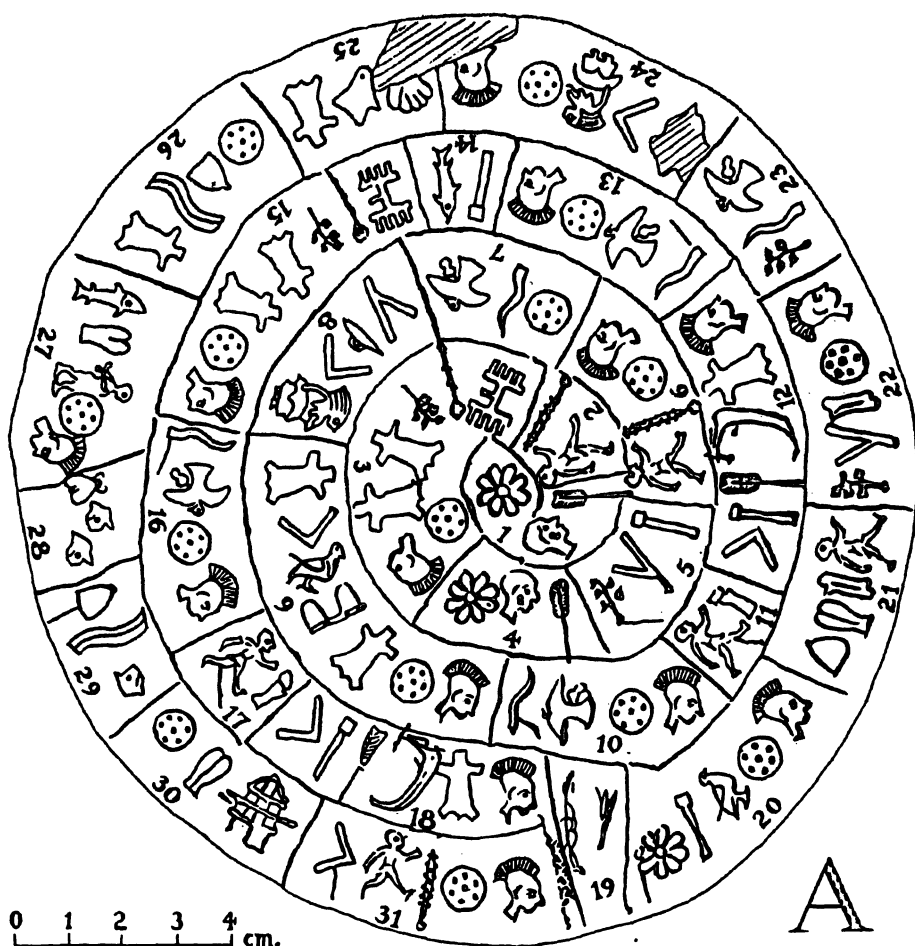
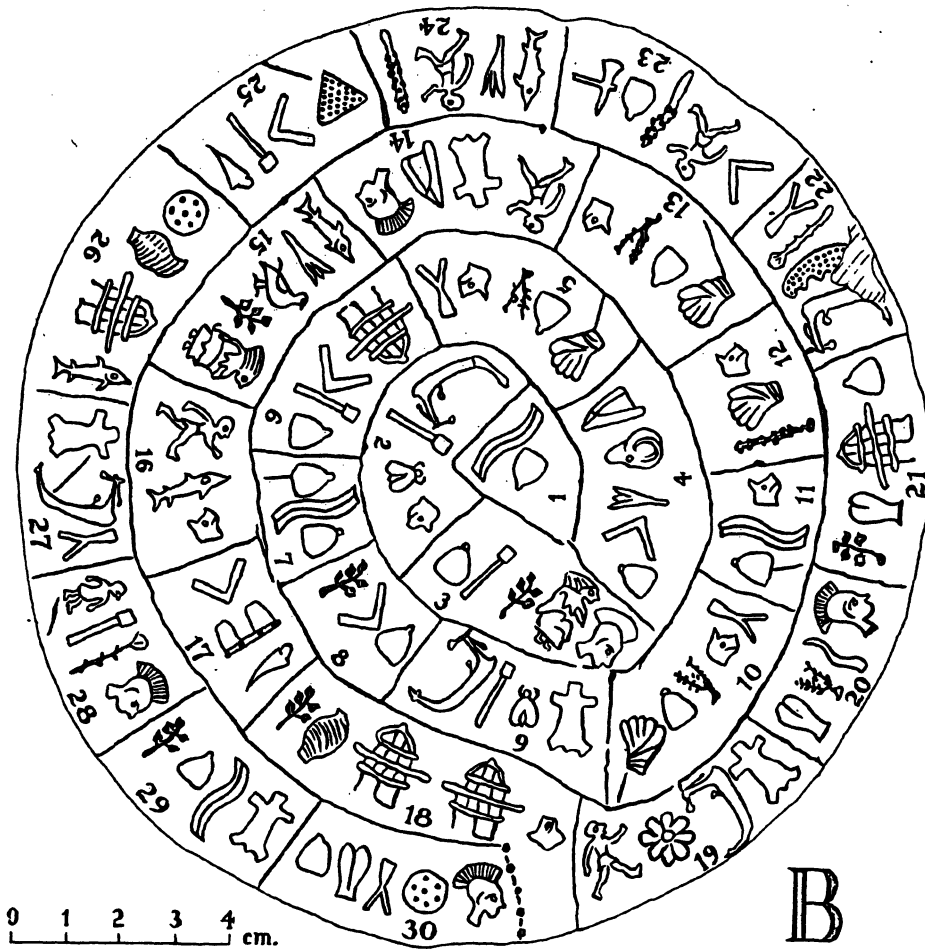


Fig. 1. The Disc of Phaistos

The maker of the disc (Fig. 1), they argue, became confused because he was operating across the surface on a tight curve, and he stamped the inverted and misaligned signs in the position which seemed to him to be at that moment correct. Now this hypothesis assumes the following procedure:

- (1) The inscriber commenced stamping at the centre from a position in which he was looking across the disc in a line from A21 to A28.
- (2) He stamped A1, A2, and A3 up to the hides without changing either his own position or that of the disc.
- (3) Having stamped the two plant signs in A3 correctly, although they were the wrong way up from his point of view, he placed the



succeeding hides the wrong way up because they looked the right way up.

(4) Realizing his error, he turned the disc or changed his own position (it is of course immaterial which) so that he was looking across a new diameter from A 26 to A 20.

(5) He then stamped the two final signs of A 3, the shield and the crested head, in what seemed to him at that instant the correct alignment, though it is in fact at right angles to the proper line of progress.

(6) Once more realizing that he was at fault, he turned the disc again so that he was looking across a diameter from A 31 to A 24, and then continued on his way avoiding further gross errors of direction.

This sequence involves such massive improbabilities that it is altogether incredible. In the first place, if the maker changed his position at all — a very reasonable assumption — we must suppose that he did so in order the more easily to stamp the signs in their radial positions: is it then likely that he moved in spasmodic jerks and only after making a mistake? If he moved after making a mistake with the two hides, would he immediately have made an even worse mistake with the next two signs? If we accept the proposition that he moved in jerks, how can we reconcile the deft placing of the signs of A2 and the first three signs of A3 with the compound incompetence of stamping the four final signs of A3?

It is much more likely that these signs were oddly placed through shortage of space. It is obvious at a glance that A3 is the most crowded field or 'word' on either side of the disc. Faced with a shortage of space on a tight turn the maker adopted two different devices. In the case of the hide he was operating with a sign which was appreciably broader at one end than at the other — doubly so of course where the sign was duplicated. So at the bend the scribe saved space by placing the narrow ('leg') end of the hide on the inside towards the centre and the broad ('arm') end on the outside towards the rim. This procedure throws no light on the direction of the writing, but it is worth pointing out that, if the scribe were going from right to left, he would already have experienced difficulty with this 'word' in A15, where the slanting of the two hides at the apex of the curve produced an overlap. The wish to avoid a repetition of that mishap might have encouraged him to invert the awkward pair of signs in A3. The crosswise position of the shield and crested head in A3 is best explained, not through a careless mistake of direction but as a clever use of the restricted space available: for looking across a diameter from A26 to A20 the 'word' in A3 can be read straight. It has often been remarked that, in spite of the general spiral arrangement, nearly every 'word' on the disc is level, as though the scribe had been used to working in straight lines. Strictly speaking there are three different lines in A3 — the crested head and shield: the hides and the two plant symbols: and sign 37 (as pivot) and the comb — but to the viewer at A26 the sequence and identity of all the signs in the field are almost as plain as if they stood on one straight base-line. In passing it may be noticed that the arrangement of the signs in A3 provides a small argument in favour of reading (as distinct from stamping) from right to left: viewing from the position of A26, the reader who was proceeding from right to left would have moved *down* from the line of the crested head and shield to the hides and the remainder of the line. If he

were reading from left to right he would have had to make an awkward transition from the second hide to the shield and he would have had to move *upwards*, which would be highly unusual for linear writing. Whichever way the reader went, however, there was an abrupt change in the line of progress between A4 and A3, from which it may be surmised that the integrity of each 'word' was more important to the maker than easy transition from one 'word' to the next.

There remains the problem of why space was so restricted in this part of the disc. On the right-to-left hypothesis, the maker, having completed A4, had very little room left for his three final 'words' and so was forced to save space by any possible means. On the left-to-right hypothesis we must suppose that the divider between A3 and A4 was already in position barring his path. It is true that the crested head appears to overcut the divider, but this would accord with either hypothesis. There is no merit, I suggest, in the claim that the left-to-right theory is proved by appeal to the axiom that in all forms of writing "the crowding comes at the end".³ If by 'end' is meant the end of a text, the axiom may hold; but there is no good reason why it should apply to a small section or a 'word'. Moreover what is generally true of writing does not necessarily apply to printing, for a type-setter, knowing he has to fit a lot into a line, may save space early in the line and leave plenty of room at the end. But modern analogies of this kind are hazardous and have little bearing on the special problems of the printer of the disc with his limited space, tight curve, and apparently rigid conventions. He had to fit seven signs into the field without serious overlaps, to keep the signs more-or-less vertical from a particular point of view, and to maintain a semblance of linear progress. In short, the solution which he hit upon was the only satisfactory one and it proves nothing at all about the direction of stamping.⁴

The alleged compound mistake in A3 is the keystone of the argument of Haecker and Scheller, but its removal leaves other interesting problems. On side B they point to the position of the ship in B2, the crested head in B3, and the glove in B10, and suggest that in each case the

³ H. D. Ephron, Hygieia Tharso and Iaon: The Phaistos Disk, HSCP 66, 1962, 1—91. He reads the inscription from left to right and translates and scans the text as Mycenaean Greek verse; not surprisingly his version differs in every respect from another Mycenaean Greek translation (from right to left) by B. Schwartz, JNES 18, 1959, 105—12, 222—8.

⁴ Haecker and Scheller's illustration of the 'correct' alignment is impossible. Measurements on a photograph show that their proposed arrangement would cause the crested head to overlap a good portion of the rosette in A4.

inscriber continued too far from left to right and turned belatedly. On the face of it there is not much to choose between a maker who went from left to right and turned his corners too slowly and one who went from right to left and turned them too fast: but we are not necessarily left with a purely subjective choice between Prometheus and Epimetheus, for in each of the three cases mentioned the declination of the signs can once more be attributed to the difficulties of the maker not so much with direction as with space.

From this point, as orientation is central to the argument, I propose for convenience of reference to use compass points, on the analogy of a geographical graticule (Fig. 2).

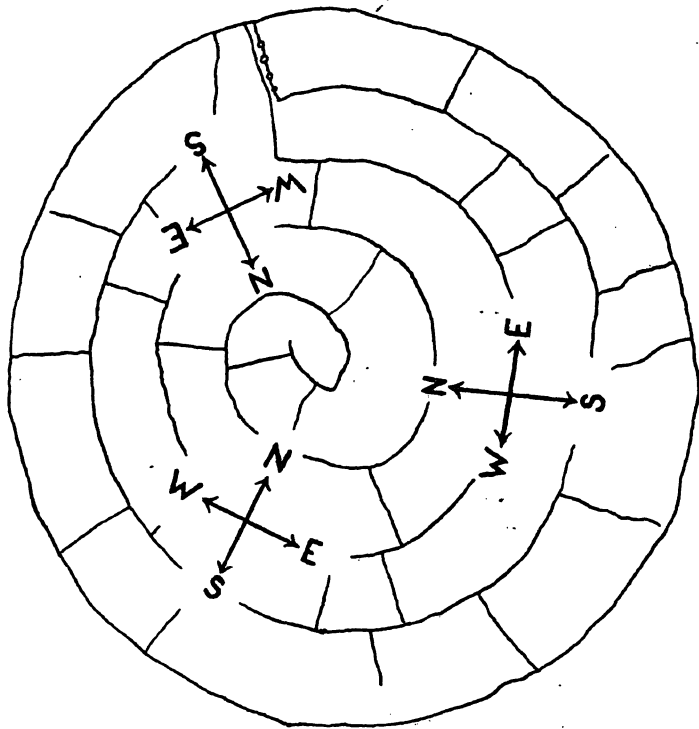


Fig. 2. Index to Orientation of Signs

In B2 it is probable that the ship was turned to the East not merely because it fills better the available space but because it will not fit in its normal N-S orientation. In this respect the illustration by Haecker and Scheller of „richtige Gravitation“ is in error, for by applying microcalipers to a photograph it can be shown that turning the ship into the ‘correct’ orientation results in a breach of both the base line and of the divider between B1 and B2. The ship-sign was particularly

awkward to handle because of its size and its projections, and we may suppose that its normal position — standing on its poop — was dictated by the need to save space. In B2, however, for once there was not enough space for the normal position but plenty for a 'sailing' position. The orientation follows from a proper and elegant use of space and it tells us nothing about the direction of stamping. It can of course be claimed that this explanation involves the assumption that B1, or at least the divider between B1 and B2, was already in existence when the ship was stamped, which indicates a left-to-right movement. But there is another possibility, which is that on both sides of the disc the maker first marked his centre and then worked in from the periphery. Certainly those who favour the right-to-left hypothesis must provide some explanation of the accurate N—S orientation of the signs and — even more notably — of the dividing lines. Experimental extension of these 'word-dividers' on both sides produces a remarkable number of lines passing through the centre, which suggests that the maker had a visible mark to aim at when he incised these dividers and did not simply draw them at right angles to the spiral lines.

The crested head in B3 is in a very tight corner indeed, and there are signs that originally the position was even worse, for both the lady and the crested head overlapped the original divider between B3 and B4.⁵ Traces of the earlier line can be clearly detected on both sides of the crest and it looks as if the groove of that line and also perhaps the incision of the new divider robbed the lady of part of her coiffure. But this tells us nothing about the direction of stamping. As in the case of A3 we are confronted with balancing alternatives: a maker who went from right to left and ran short of space towards the centre, or one who operated from left to right and was hemmed in by too restrictive a divider. In either case the man did the best he could to produce a coherent linear 'word'.⁶

Finally there is the problem of B10 with a glove thrown down carelessly, it seems, in the corner of the field. The proposition of Haecker and Scheller is that the maker, going from left to right, failed to turn after completing B22 but continued until forced to do so by the bend in

⁵ E. Grumach, *Die Korrekturen des Diskus von Phaistos*, *Kadmos* 11, 1962, 14—26. Cf. Ephron p. 13.

⁶ Haecker and Scheller's suggested 'correct' alignment of the crested head looks absurd in comparison as it makes the 'Red Indian' butt the elegant little Cretan dame in the stomach. Once again calipers show the impracticability of the suggestion: placed on an E—W orientation the crested head would overlap both the lady and the base line.

the base-line. But the glove is too low in relation to the line of the signs in B9. Now the signs of the disc are aligned with respect to their neighbours on a kind of 'floating' line which passes horizontally through the middle of their field. If one examines the four other specimens of the glove (A 25, B5, B 12, B 13) one finds that it floats with its top more or less in line with the top of the short signs (e.g. the breast and the lion's head). In relation to the hide its natural position is exemplified in A 25. In B 10 however the glove falls well below the level which might be expected if it were aligned with the hide in B 9, but at the correct level in relation to the other signs in its own field. As far as levels are concerned therefore the glove belongs to the sequence of B 10 and not to that of B 9. What remains to be explained is its unusual orientation. Perhaps the glove was stamped in the diagonal position in order better to fit into the awkward space presented by the left-hand end of B 10, either through *horror vacui* (left-to-right), or through shortage of space (right-to-left). Indeed the signs in B 12, B 11, and B 10 are comparatively tightly packed, and thereby suggest that the inscriber found himself running out of room.⁷ Moreover, this sector of the disc would be especially difficult to read, because of the sharp turn in the base line between the second circuit and the third. The reader, on reaching B 10, might take, as the next sign after the glove, either the running man of B 19 or the lion's head of B 18. To reduce this hazard the inscriber may have swung the glove over so as to provide a cue for the reader's eye which would bring him round to the line of the next 'word' — B 9. This suggestion assumes of course that the disc was being read from right to left.

We may now turn to the other erratic signs which were briefly mentioned earlier: the eagle and the lion's head. The eagle appears in three positions: he heads N. twice (A 7, A 23), E. twice (A 13, A 16) and W. once (A 10) but never S. That an eagle should soar in circles is natural enough, but it is odd that he never heads S. Of course this omission may have been due to accident or superstition. For the moment we merely note that the positions of the eagle are at right angles to one another and that only three of four possible rectangular stances are employed. In the case of the hide and also in the case of the ship we observed that the dimensions of the sign affected its orientation. The same certainly applies

⁷ Comparative measurements show clearly that identical sequences take less room in B 10 and B 11 than in B 13 and A 29. Very tentatively I would raise the question whether there was not in fact originally an even more restricted left hand end to B 10; in some photographs there appear to be traces of a line running from the angle in the spiral line above to the middle finger of the glove: did the maker shift the divider to the left when he found it impossible to fit the glove into the final space?

to the eagle, which is much broader across the wings than it is long from head to tail.⁸ Where there was plenty of space the maker set the eagle heading N. (in the 'heraldic' position); this occurs in A 23 on the perimeter and in A 7, where the sharp turn provided a large corner which needed filling. In more restricted fields the eagle is turned E. or W. The E. position seems natural enough as this corresponds to the other signs with 'faces', such as the human figures and the dove. Why then is there an example which faces W. (A 10)? If we compare the two examples which face E. (A 13 and A 16) with the specimen in A 10, we see several differences of context: the signs facing E. impinge on the adjoining shield and are widely separated from the horn, which has a long stroke extending under the gap, whereas the sign facing W. is well clear of the shield and is separated by a normal gap from the horn, which has a correspondingly short stroke attached. Length sideways does not appear to be a factor here because measurements reveal only the slightest differences between the space occupied by the signs in the three 'words' involved. It must, however, be admitted that the arrangement in A 10 is much neater than that in A 13 and A 16. It is tempting to see in A 10 an improvement, which would of course imply that the inscriber was working from right to left.

The lion's head at first sight seems to revolve in a bewildering manner.⁹ Starting with the assumption that its natural position is facing E., that is to the right like the human figures, we find that it occupies this position in five places: B 10, B 11, B 12, and — allowing for a slight tilt which may be connected with the notorious 'correction' — twice in A 28. There are three places where it appears in the opposite position (upside down facing W.): A 29, B 16, B 18. In two of the three remaining examples, B 5 and B 13, it faces N. Finally there is one case (B 2) where it should strictly be classified as facing S., though it could be argued that this is another example of the natural position facing right. The 'word' B 2 is virtually semi-circular, and if it is viewed from the angle of B 26 the pillar sign appears in its normal vertical position and the lion's head

⁸ This point was missed by the usually acute Della Seta, who lumped together eagle and lion's head as signs which were stamped at random because they occupied the same space in any position. See loc. cit. p. 305.

⁹ The names of the signs are of course valid only for purposes of reference and few, if any, of them are likely to correspond at all closely to what they meant to the maker. In the case of sign 29 we are probably very naive in calling it a 'cat's/lion's/mastiff's head'. The original designer may have had something quite different in mind: e.g. a gaming piece, a rhyton, a seal — to mention a few of the possibilities for which parallels might be adduced.

faces to the right. What emerges from all this is that the head rolls, not like a wheel, but like a cylindrical die with four flat sides. Furthermore the die appears to be a 'loaded' one because it falls unevenly, in the ratios of 6:3:2:1/0. This oddity seems to require a more systematic explanation than that of a mere failure on the part of the inscriber to distinguish the details of a figure of compact outline.¹⁰

At this point it may be useful to scrutinise the behaviour of two signs which obviously were never intended to have a top and bottom, a left and right: the shield and the rosette. Beautifully as both of these symbols were cut, the designs are not perfectly symmetrical. In the case of the shield the slight asymmetry of the dots provides a key to the concealed orientation of the various examples. I have designated the commonest orientation North, which produces the following table¹¹:

NORTH	WEST	SOUTH	EAST	
NNE 2		SSW 2*		
N 5	W 3	S 1		
NNW 2	WSW 2			
9	5	3	0	Total 17

* One of the examples listed as SSW is the impression in A3. Judged strictly in relation to the rosette at the centre it points W, but as in the case of the lion's head in B2 I have given it the orientation which it has from the point of view of an inscriber or reader looking across the disc from A26/A27.

These results can be expressed in the form of a diagram (Fig. 3).

¹⁰ Pernier's suggestion that changes in the orientation of certain signs might have had a semantic significance (e.g. indicating feminine instead of masculine) has found little support. The theory is open to numerous objections, not the least of which is that signs vary in position in the interior of different examples of what seems otherwise to be the same 'word' (cf. A10 and A13, A3 and A15). See L. Pernier, *Il Disco di Phaestos*, *Ausonia* 3, 1909, 255—302 (esp. 273—4).

¹¹ While the position of each impression of the eagle and the lion's head can be identified at a glance, the shield is obviously more deceptive. In presenting my analysis I must emphasize that it is based solely on examination of a limited range of photographs with magnifying glass and microcalipers. To exclude all possibility of error more sophisticated laboratory methods would be necessary. I hope that someone with access to suitable equipment, better photographs, and perhaps the disc itself, will be encouraged to verify my findings.

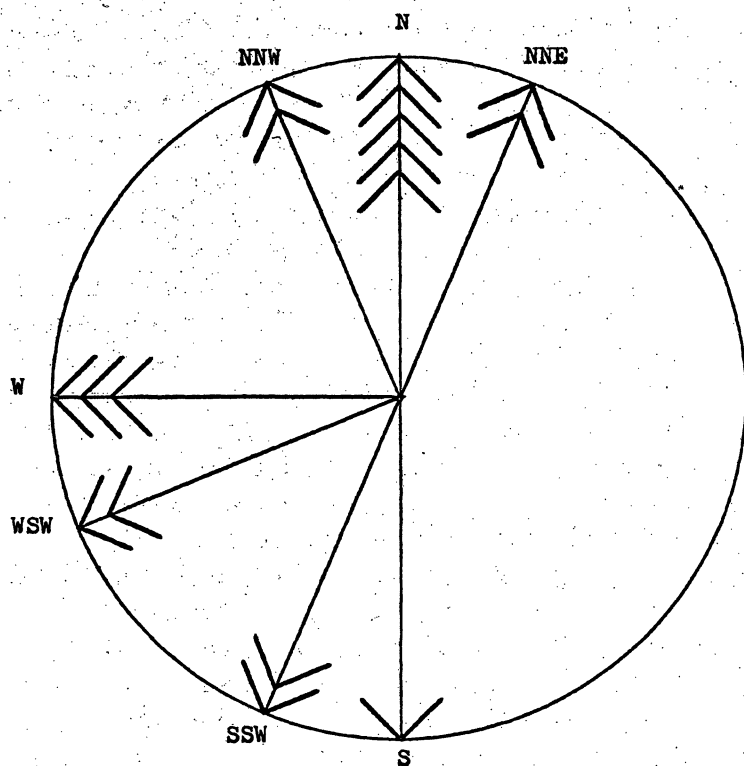


Fig. 3. The Orientation of the Shield Sign

The rosette cannot yield much information because it appears once at the centre (A1) and in only three other places (A4, A20, B19). The impressions in A1 and A4 appear to me to be at right-angles to one another, and both of them seem to be at the same angle in relation to the arrow in their own 'word'. If the 'feathered' end of the arrow is said to be pointing N. the rosette points SW. Likewise, it points W. in A20 and NW. in B19. In brief, it did not turn through more than 90° in the inscriber's hand in five impressions.

If the peculiarities of orientation of these four signs, the eagle, the lion's head, the shield and the rosette be considered together, a fairly consistent pattern seems to emerge. First, they do not turn at random but almost squarely, up, or down, or to the left; second, of the four available directions, one (up) is preferred and accounts for more impressions than the second (left) and third (down) together, while the fourth (right) is never used. Further, this pattern prevails even where — as in the case

of the shield — the orientation has no perceptible effect on the appearance of the design. The conclusion must be that orientation was controlled not only by considerations of design but also by technical restrictions — in other words, by something in the nature of the dies or in the method by which they were impressed.

The tendency of the signs to be set squarely on one or other of two axes may be simply explained. The scribe was working with reference to a horizontal axis which carried his line forward, and to a vertical axis on which most of the signs were aligned. As already mentioned (p 4 *supra*), there are clear indications that he was more accustomed to working on straight lines than on spirals, and that on other texts he habitually operated on the same two axes at right angles to one another. The absence of imprints facing to the right must be due to the way the die was held — which leads us on to ask what manner of stamps the maker had to hand and how he manipulated them.

Most seals are engraved with intaglio patterns, but the dies used by the maker of the Phaistos Disc bore raised patterns which projected from the body of the stamp, and of which the frames were never intended to show. In view of the delicacy of some of the designs, such as the ship and the plant-symbols, it is unlikely — whatever material was employed — that the cutting faces were raised very far from the supporting shoulder; yet the inscriber always managed to impress them clearly without allowing the background to touch the clay. One must assume that he was an expert in applying exactly the right amount of pressure and that his stamps were so made that they could be easily handled, oriented, impressed, and brought cleanly away from the surface. In applying the stamp he must have grasped it by means of some kind of handle, stem, shank, or body, and it is obvious that the orientation of the impression depended upon two factors: the way the stamp was held, and the position of the operator's hand at the moment of impact. But we are still left with the peculiar problem of the missing fourth direction. The answer must lie under one of two heads: either the operator had a reason for deliberately avoiding the fourth position, or he found it inconvenient.¹²

It is certainly possible to invent an explanation for deliberate avoidance of the fourth position. For example we might imagine that the

¹² There is no justification for the theory advanced by Ephron that "the scribe had available more than one die of each sign". (*loc. cit. supra*, n. 3, p. 17). The hypothesis is unnecessary and improbable; it can be refuted by careful comparison of the various impressions.

stamp bearing the shield on its face was shaped in the form of a head, animal or human,¹³ and that this superior pattern was held in a certain direction for reasons of superstition. However, it seems much more likely that the stamp was made in such a way that it was either awkward or impossible to impress it in the fourth position. But none of the shapes nor any of the handles, grips, or tangs of any seals, Cretan or otherwise, seem to impose limits of the kind we seek.

The solution which I propose is that each stamp — whether it was made of ivory or bone, of metal or of stone or of wood — was attached to a wooden or metal handle which projected from it at an angle in relation to the cutting face. It matters little what the angle was: it could have been anything less than the vertical down to the horizontal, that is, parallel to the die-face. The handle or pin might have been two or three inches in length and would have been held in the fingers sloping away from the operator with the operative end — the die itself — pointed at the clay surface. If we assume that the handle was inserted so that it was in line with the axis of the pattern, the user would normally have pointed the die upward towards the centre of the disc when making an impression, which would have produced the N. orientation of the sign. We may suppose that sometimes he varied the position by holding the handle in the opposite direction with the die pointing towards himself, or sideways to the left and parallel to the line of writing. The former position would have yielded a S. orientation and would have enabled him to watch the die more closely as it descended on the clay; the latter would have oriented the sign to the W., and the holding of the handle along the axis of the line would have helped to align the impression with its neighbours. The other orientation in the horizontal axis was never employed *because of the extreme awkwardness of holding the handle in that position* (Fig. 4).¹⁴ The effect is analogous to that observed in most cuneiform scripts, which exhibit a missing segment in the orientation of the wedges. In short the theory here proposed is based on three considerations: (1) the limitation of dies which could be grasped in only one way, by the long handle; (2) the arc of effective movement of the human hand and arm; (3) the bi-axial principles which governed the script.

¹³ There are many theriomorphic seals. The well known and frequently illustrated 'bird'-headed ivory conoid specimen from Sphungaras (HM 939: Evans, PM I 95; Kenna, CS 15) would serve to illustrate the shape — though not the scale — of the kind of stamp imagined here.

¹⁴ A right-handed man would point the handle to the left but not to the right. In the case of a left-handed one the positions are reversed but the same principles apply.

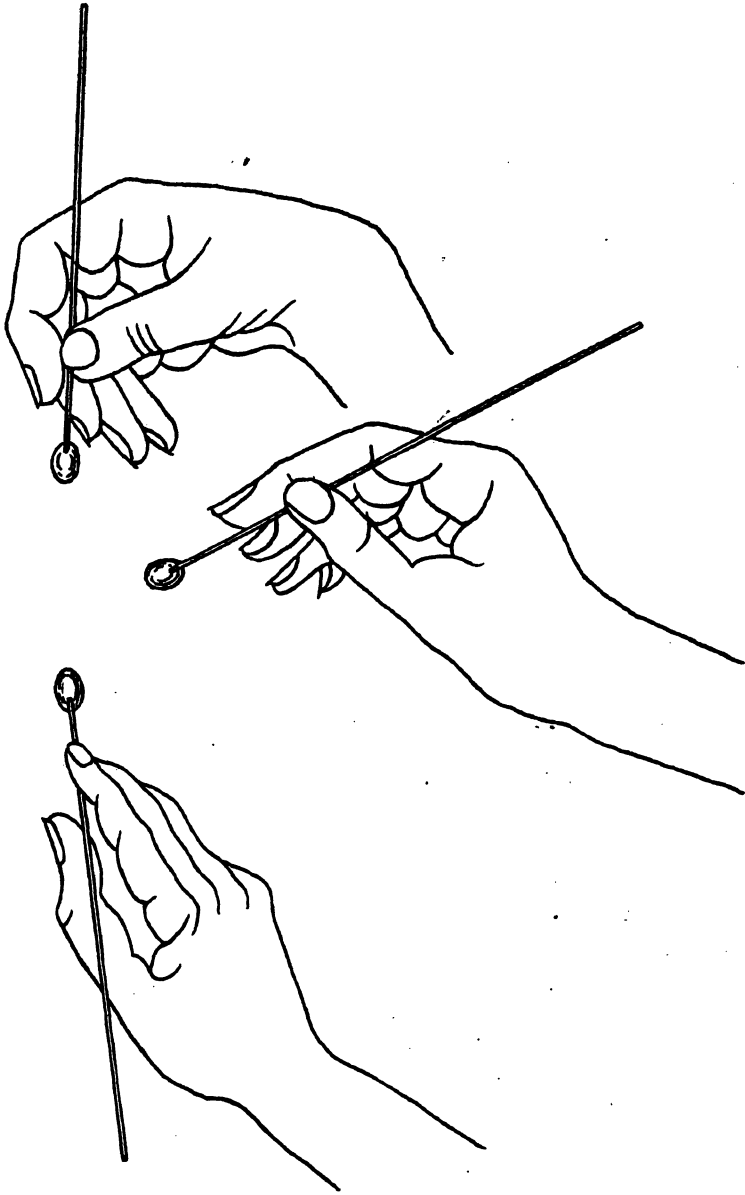


Fig. 4. The three positions of the hand for stamping the dies

The kind of die which is envisaged here would have offered many advantages to the user: he could be sure of the orientation of the sign when looking down at the back of the stamp; he could place the sign accurately in position without allowing his hand to obscure his view or to smudge the surface; he could easily apply the right kind and amount of pressure and remove the die cleanly from the clay; and he could lay

the seal down on a level surface so that its face was tilted towards him, making selection the work of an instant. With a row of such dies within reach the maker could select the correct one and impress it in precisely the right alignment and orientation in a matter of seconds.¹⁵

It will be objected that all this is as speculative as some of the hypotheses advanced by the 'decipherers', and that the theory is unsupported by evidence for stamps or seals with separate handles. If the handles were wooden, their disappearance can be taken for granted: but the holes into which they might have fitted are not far to seek. Seals with holes drilled in them are the rule, but these are invariably described as attachment or string-holes, which is doubtless an accurate description in the vast majority of cases. We know, however, that the maker of the Phaistos Disc possessed two kinds of stylus (or at least one stylus with two different ends), which he used to engrave the lines and to make the five dots at the start or finish of each side; and it does not seem an immensely ingenious innovation to substitute a stylus for a string, which might have been useful for pulling a seal off but which could only get in the way when putting it on. It is also probable that Cretan seal-makers sometimes first drilled a hole or holes in the body of their rough material and then used a pin to hold and manipulate it during the subsequent process of cutting the face.¹⁶ The usefulness of the pin might thereafter have been found to continue when the finished product was put to work. Referring again to the Sphungaras seal (HM. 939) as one of several suitable examples I would observe that the angle of the attachment hole would have imposed a slope on a handle quite sufficient to limit lateral manipulation to three-quarters of a circle.

It is not, of course, necessary to suppose that all the dies conformed to the suggested pattern, though I prefer to imagine the maker of the Phaistos Disc selecting his symbols from a neat row of serviceable tools

¹⁵ One of the chief advantages of using stamps is speed. "An experiment showed that a text of 250 characters could be impressed on clay, using a fount of 52 different symbols, in only 14 minutes, to make an object resembling the Phaistos Disc. This corresponds to 3.5 seconds per character." A.L. Mackay, *On the Type-fount of the Phaistos Disc*, *Statistical Methods in Linguistics* 4, 1965, 15—25.

¹⁶ Drilling the holes at an early stage averted the hazard of wasting labour on the face if the piece was fractured by the relatively violent action involved. For examples of unfinished seals with string holes already started — admittedly of later date — see Kenna, *Cretan Seals*, 76–7. Conceivably the use of an inserted handle might explain some of the cases of seals with more than one bore-hole. If a seal were normally carried on a string but was attached to a handle for use in printing, it would be convenient to have separate holes for the different purposes.

such as I have described rather than fumbling among forty-five necklaces.¹⁷

In accordance with this hypothesis of a handle, it is possible to calculate the position of the handle in the horizontal plane for each impression of the three most variable signs, the eagle, the lion's head, and the shield. For instance, the missing position of the eagle is head-downwards, which indicates that the handle extended parallel to the wings on the side with the talons and the 'snake' (if that is what it is and not a figure-of-eight shield or a Ganymede).

An analysis of the estimated direction of the handle for the thirty-three impressions of the eagle, the lion's head and the shield is set out below. In describing the handle as directed towards the centre, for example, I mean that the handle was in line with the vertical or radial axis with the holding end towards the inscriber and the stamp end pointing at the centre. 'Perimeter' designates the reverse position and 'left' means that the handle was aligned with the horizontal axis with the stamp towards the left.

Direction	Eagle	Lion's head	Shield ¹⁸	Total
Centre (N)	A13, A16 2	A28(2), B2?, B10, B11, B12 6	A6, A9, A10, A13, A22, A24, A30, A31, B26 9	17
Perimeter (S)	A10 1	A29, B16, B18 3	A3?, A20, B30 3	7
Left (W)	A7, A23 2	B5, B13 2	A7, A15, A16, A26, A27 5	9
	5	11	17	33

In two cases the orientation is marked '?' — with the lion's head in B2 and the shield in A3. The strict bearings of these signs are: lion's head E., shield W. It has, however, been suggested that because of the proximity to the centre and the curve of the 'words' in which they stand they

¹⁷ A.L. Mackay (see n. 15) estimated with suitable caution that the type-fount consisted of about 55 symbols. I am indebted to Dr Mackay for kindly giving me information about his most interesting calculations.

¹⁸ It will be recalled that the assignment of a 'direction' for the shield appeared to be a matter of choice. Having found that this sign also showed a missing sector, it seemed reasonable to identify this position with the missing fourth position of the other signs (but see n. 11).

should be read from below, that is from A26 and B26. Whether the shield in A3 is counted as S. or W. is not of great importance, but if the handle of the lion's head were thought to point E. the theory which I have put forward would be weakened. It would then become necessary to suppose that this odd fourth position among thirty-three imprints was either fortuitous or the outcome of some still mysterious principle.

Finally two questions may be asked: can an explanation be found for each individual orientation, and does this hypothesis of the handle support one of the two rival theories of the direction of the script?

With regard to the orientation of the eagle I made suggestions earlier in an attempt to explain the various positions in terms of its shape and the available space, but similar arguments cannot apply to the lion's head and the shield. In both cases it appears that there was a preferred orientation, namely N.; but precisely why variations were made in particular cases is not clear. Theoretically it would seem that an orientation in the horizontal axis (W.) might have made alignment easier, while the position pointing S. might have suited impressions in cramped spaces by bringing the stamp directly under the user's eye; but not all the examples justify this theory. These variations were possibly sometimes due to nothing more significant than the angle at which the operator happened to pick up the stamps, which presumably lay on their sides or, if they were indeed attached to handles, might have been kept ready for selection and use with these handles embedded in a 'pin-cushion' of clay.¹⁹

The theory of a single grip combined with three positions of the hand appears to have no relevance to the problem of sequence in stamping. In determining whether the man who stamped the disc went from left to right or from right to left, the best hope of progress probably lies in rigorous examination of the relationship between each sign and line and its neighbours, particularly in places where an intersection can be identified.²⁰

¹⁹ Very speculatively I raise the question whether the pillar or mallet sign (23) could be a formalised representation of a stamp with a handle (cf. hieroglyphic sign 26, the peg, mace, or pin).

²⁰ I am greatly indebted to the Editor for helpful advice and for the drawing of the illustrations.