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W.M. Flinders Petrie and Richard Colt Hoare
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STONEHENGE:

PLANS, DESCRIPTION, AND THEORIES.

BY
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INTRODUCTION.

THE lack of any thoroughly accurate survey of Stonehenge will be a sufficient reason for the production of the present plan, in addition to those already published. Neither the plans of Wood, Smith, Colt Hoare, Sir Henry James, nor Hawkshaw, lay any claim apparently to accuracy greater than a few inches, thus missing important results and deductions; whereas that now produced is correct to a few tenths of an inch, in fact quite as closely as the surface of the stone can be estimated in most cases.

Though on a small scale for convenience of use, the accuracy of this plan is as great as that of a sheet of ordinary delicacy about 4 or 5 feet across. The original measurements of the stone circle, on the triangulation lines, and the well-wrought stones, were taken to the nearest $\frac{1}{10}$ of an inch, and in all cases correct to within $\frac{1}{4}$ inch; the plotting and copying (on double the scale now lithographed) were correspondingly done to about a thousandth of an inch, in many parts with a magnifier: the present photolithograph is therefore intentionally accurate to $\frac{1}{2000}$ of an inch; and, considering the various sources of error, it may be usefully examined, and measurements taken from it, to $\frac{1}{500}$ or $\frac{1}{1000}$ of an inch. Those readers who merely wish for approximate ideas, can use this for general inspection like any rougher plan; but for investigations on the arrangement and exact dimensions of any part, this plan, measured with an accurate plotting scale and magnifier, will probably give results as trustworthy as could be obtained on the ground.

The work was begun in 1874, but after going some way with it, it was abandoned owing to the errors of the ordinary surveying chain used. In 1877 I made a new pattern of chain, expressly for accurate work;* and with this the present survey was made, in June and September of that year. It was laid by, partly owing to being engaged with plans of the other remains in the southern counties, and partly waiting to obtain accurate sunrise observations at midsummer.

* The essentials of this pattern are, 1st, rhomboidal eyes; 2nd, long links of 20 inches; 3rd, no intermediate rings; 4th, dividing marks on the middles of the links, fixed (from the official standard) after the chain is made and strained; 5th, numbering marks on every link; 6th, lightness, for stretching without perceptible error over hollows.

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The theoretical considerations of the date and origin of this structure are necessarily entered on here, as many of the details now brought to light bear strongly on those questions ; but the object of this publication is more to state facts than theories.

In order to give a fair impression, all the considerations of importance have been mentioned, on each side of the argument, that could be found by careful reading and personal reference ; and as my own opinion has fluctuated more than once, I may at least hope to have attained thorough impartiality.

The various sections are divided as follows :—

FACTS.

1. DESCRIPTION OF THE PLANS.
2. DETAILS OF THE STONES.
3. METHODS OF WORKMANSHIP.
4. NUMBER OF STONES.

THEORIES.

5. THE WORK NOT COMPLETE.
6. POSITION OF THE "ALTAR STONE."
7. MIDSUMMER SUNRISE.
8. SEQUENCE SHOWN BY CONSTRUCTION.
9. SEQUENCE SHOWN BY MEASURES.
10. OBJECTS FOUND.
11. SUMMARY OF EVIDENCES ON PRE-ROMAN AGE.
12. SUMMARY OF EVIDENCES ON POST-ROMAN AGE.
13. SUMMARY OF EVIDENCES ON THE USE.
14. CONCLUDING REMARKS.

STONEHENGE.

1. Description of the Plans.

BESIDE the explanation given on the plans, some general arrangements require notice, before mentioning the stones in detail. Offsets were taken to fix the various points, but their estimated rectangularity was never trusted beyond a few inches, all long lines being tied in by triangulation. The arrows projecting from the stones, show the extent to which the top of each stone has shifted by leaning; this was estimated by considering both faces of the stones, but owing to their often tapering, the extremity of the arrow does not necessarily show the place of the top of the face. It may be reckoned that the ground-level outline of the stone, shown on the plan, has moved about $\frac{1}{10}$ of the shift of the top. The thinner outline of the form above the ground, is only given when the stone is more regular above than below; as its position was arranged probably with reference to its most regular part. The more regular part is always the most prominent (except on the back of No. 52), as the stone was shaped at its largest part. The character of the shading, &c., is sufficiently explained on the plan. The five stones "standing in 1747" are from Wood's plan; and as they are overthrown, or much shifted since his time, it seemed desirable to make this plan as complete as possible by inserting them. They were plotted from Wood's measurements, in connection with neighbouring stones still unshifted, and then adjusted by means of the latter on this plan. Of course their positions and their outlines are far less accurate than those of the other stones, but they are nevertheless the best now to be had; and their present positions are also shown in unshaded dotted outline. No distinction is made on this plan between perfect stones and mere stumps of which the upper part is removed (though these are detailed in the description), as for considerations of arrangement this is wholly immaterial—unlike the shift, which is important.

The large circle is the mean circle which agrees best to all the sarsen stones,* making

* These are tertiary sandstones left lying on the chalk after the denudation of those beds. The bluestones are from Cornwall or Ireland.

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allowance for their shiftings. The next circle similarly is fitted to the outer bluestones ; though to what point of them it should agree is not certain, as their inner faces are often convex, unlike the sarsens ; whether the innermost curve, or the inner corners of the stone, or something between, is not clear. The trilithons* are not on a circle, and the scheme of their placing is obscure. The innermost semicircle is fitted to the bluestones, like the others. The centres of these three circles, and of the outer earth circle, are shown surrounded by little rings on the plan ; the radii of these little rings are equal in each case to the mean error of the various points of the respective circles from a true figure. This mean error of the inner bluestones is 1·7 inch ; of the outer bluestones, 8 inches ; of the sarsen circle, 3·2 inches ; and of the earth circle (shown in Plate II.), 10 inches. The two fine lines crossing obliquely near the centre, will be seen to be in line with four short pieces on the outskirts of the plan, numbered 91, 92, 93, and 94. These are the lines connecting the centres of the stones (91 and 93), and of the pits or barrows (92 and 94), shown in Plate II., lying on the outer earth circle. They so nearly intersect the centre, that it is important to show them on this delicate plan ; their probable error is about ± 2 inches = $\frac{1}{100}$ inch on the plan.

The mean axis was determined by (1) the middle of the entrance, which is closely the same at all heights of the stones, though the opening widens 20 inches at the top ; (2) the centre of the main circle ; (3) the estimated original place of the great trilithon stones 55 and 56, considering that they have slewed northwards in falling ; the estimated distance between them, eliminating the slew, is 13 inches, and this (though quite independent) closely agrees with the standing trilithons which are 12·8 and 12·4 inches ; (4) half the average spacing between the stones, allowed from the side of No. 16 ; this is very vague, as the interval varies from 26 to 51 inches ; the mean, being 36, gives 18 for the half-distance.

The mean axis drawn differs from these elements as follows:—

	Axis.	
Exactly through		entrance opening.
		·6 inch from sarsen circle centre.
From estimated centre of trilithon, ·4 inch		
Approximately by No. 16, 1·8 ,,		

* This term is here restricted to the five internal groups, of two uprights and one impost each, and not applied to the circle stones, as by some writers.

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The very close agreement of the elements is remarkable, but each was determined before they were compared.

Outside the circle will be seen five crosses on each side of the plan, beside others in the circle; these are exactly 25 feet or 300 inches apart; they may be considered the corners of squares of 25 feet (or a large square of 100 feet quartered in each direction), drawn on the mean axis as a basis, the sides being omitted to avoid confusion. The object is to give a scale extending over every part of the plan, so that distortion in photolithographing, and irregular contraction of the paper, may be eliminated for accurate measurements; a scale drawn at the edge in the usual way, is peculiarly liable to derangement; and for rough purposes any inch measure will do, as the plan is on the simple scale of $\frac{1}{200}$.

It should be remembered in comparing this plan with others, or with accurate measurements, that some inches difference may easily occur if the stones be not measured on the same level as here; in all cases the most perfect part of the stone was taken close to the ground, and if it had a better form above, this is also shown.

To Wood's plan (1747), Smith (in 1770) added Nos. 39, 72, and 160 *a*; Colt Hoare adds No. 71; Hawkshaw adds a piece which I could not see, between 14 and 36; and finally I may add 66, which makes its first appearance in this plan.

The second plan is not of such accuracy as the first; the stones are only approximately reduced, within about $\frac{1}{500}$ inch; and the earth circle may perhaps in parts have some errors as large. Its mean error already stated (10 inches) was determined by a large scale plan. A true circle is here drawn, with short breaks at each measured point, such points being shown by a small cross, more or less in or out of the true line; thus enabling the differences to be easily seen. The distance of the outer ditch and bank was measured in four places, also marked on the plan. The levels of them, taking the area levels as 0, are thus:—

Top of bank	+ 9	to	18	variation,	+	14	mean	
Bottom of ditch ..	- 16	to	39	,,	-	27	,,	= rise 41 } from
Top of faint outer bank	- 16	to	+ 1	,,	-	10	,,	= rise 17 } bottom of ditch.

The levels of the various parts of the area are marked in inches and tenths, above the Ordnance bench-mark on the Friar's Heel, No. 96.

The method of marking banks and ditches, &c., has been adopted, after much con-

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sideration and experiment, as being free from the ambiguity of ordinary shading, and also admitting of greater precision of drawing.

The two mounds within the area are shown on this plan; they have been often called pits (from Wood), owing to their having a hole in the top, probably from old diggings in them. The northern one is nearly half cut away by a road; it has a ditch and bank, unlike the other. The forms of all the outlying stones, Nos. 91, 93, 95, and 96, are given in the corner of Plate I.; the closer shade on 91 showing approximately the place of the base, before it tipped outward.

The details of the junction of the circle and the avenue, and of the banks that cross the avenue lower down, are all carefully entered, exactly as they appear on the ground.

The avenue is raised between the banks, which are very faint on their inner edges, and in all parts flat and ill-defined. The north-east end and the branches are very faint, and scarcely traceable in parts. The greater width of the north branch is curious, and as it is not noticed in the small plans of the Ordnance Survey and Hoare, there would almost seem to be some uncertainty in the plan, as it has not been verified; three measured points on each side however agree.

The parallel banks are quite unnoticed in Hoare's and the Ordnance plans. They are slight but sharp, and the ground between them has been lowered. Of what date they may be is not certain, but if not intended for a recent road they are probably ancient. Against the idea of a road there are the following facts: (1) They are 42 feet apart, but the road they would join is the usual regulation width of 30 feet; (2) there is no ditch, and the ground is flat between; whereas the main requisite of a road is to raise the centre, and make side ditches; (3) they end abruptly, and have been recommenced farther easterly (traceable by lines of buttercups, though now ploughed), and also westerly as seen on the small plan of $\frac{1}{10000}$ on Plate II.; this discontinuous work is not like modern road making; (4) the western part passes a barrow; and here, instead of cutting a slice out of it to make room for a road, the bank runs up over the foot of the barrow, and the barrow ditch is flattened at its edges but not filled up; also the barrow is just in the midst of the length of this piece. All these points are unlike the beginning of a modern road. The banks pass over the avenue west bank and ditch, but are cut away at the east bank sharply, to allow of a cart track passing, which runs down the avenue bank. This looks as if they were older than the cart track, and therefore not recent.

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The row of barrows on the $\frac{1}{10000}$ plan are very nearly in a straight line, except the last. Their average departure of their centres is 52 inches, on a line 850 feet long in all. Further details of their distances are given in 9. *Sequence shown by Measures.*

2. Details of the Stones.

After much consideration, the irregular lettering and numbering of Colt Hoare was abandoned; it begins with the entrance stones as A¹ and A², goes then to the trilithons B¹ B² . . . F¹ F², thus not leaving enough letters for the outer circle without a double alphabet, and then using numbers for the bluestones. The present system is entirely by numbers for each stone; lettering the fragments of a single stone, as 59*a*, 59*b*, 59*c*. The order begins always at the axis, and goes with positive rotation E., S., W., N. 1 to 30 are the outer sarsens (allowing numbers for the blank spaces); 31 to 49 the outer bluestones; 51 to 60 the trilithons; 61 to 72 the inner bluestones; 80 the "altar stone"; 91 to 96 the outlying stones and tumuli; the lintels are all numbered 100 more than their higher numbered supporter; i. e. the numbers agreeing with 1 prefixed to the lintel. Thus the numbering of the sarsens begins at 1 and 51, and the bluestones at 31 and 61; an easily remembered arrangement. The numbers of the successive circles are all in sequence, though each set begins a fresh decade; except that No. 50 is unapplied, but as a lintel in that set has no supporter it appropriates No. 150 very suitably.

The following details of the stones are accompanied by Hoare's lettering for reference. The levels are in inches above the Ordnance bench-mark on the Friar's Heel, No. 96. The heights are above the ground at the spot in question. The word "Outline" is reserved for fallen stones; "Plan" for the horizontal section of stones. "Emergence" is the line of the face at ground-level. "Impost" is used for a trilithon top-stone; "Lintel" for a circle top-stone.

No.	Hoare.	Height.	Level of top.	Diff. from mean of group (213'3).	REMARKS.
Sarsens.					
1	A ¹	159	208'1	- 5'2	
2		170	211'9	- 1'4	
3		171	209'3	- 4'0	
4		170	211'9	- 1'4	

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No. Sarsens.	Hoare.	Height.	Level of top.	Diff. from mean of group (213'3).	REMARKS.
5		174	215'0	+ 1'7	
6		165	215'9	+ 2'6	
7		162	211'3	- 2'0	
8		..	..	..	Sides worked.
9 <i>a, b</i>		..	..	..	9 <i>b</i> , sides worked; end very flat, with tenon.
10		160	220'0	+ 6'7	
11		96	..	..
12		..	..	..	Two tenons on end.
14*		..	..	..	31 to 36 thick.
15		..	..	..	Two tenons on end.
16		165	215'5	+ 2'2	Bench-mark at 78'3 level.
19		..	..	..	End and north side worked. Top 13 out of ground.
21		152	212'7	- '6	
22		153	209'2	- 4'1	
23		153	209'4	- 3'9	
25		..	..	..	Fallen westwards.
26		..	..	..	No worked faces.
27		167	214'2	+ '9	
28		165	214'4	+ 1'1	
29		156	212'3	- 1'0	
30	A ²	153	207'6	- 5'7	
Bluestones.					
31	1	..	127'5	..	Rounded top, broken.
32	3	..	..	..	Foot buried, fixed by probing; two faces shown here on top. 17'5 thick, all down.
33	4	..	..	..
34	5	3 ⁸	..	..	Upright.
35 <i>a, b</i>	6, <i>n n</i>	..	..	..	Only a stump, widely cracked, like two stones. 35 <i>b</i> , probably part of 35 <i>a</i> .
36	7	..	..	..	North end buried; a square stone lying with edge up, emerging at lines drawn across face.
37	8	..	..	..	} Schistose, see 14, shaded plans from Wood, 1747.
39	10	..	..	..
40	11	..	..	..	Overthrown before 1747.

* 14 was leaning on 38 in 1747 emerging at the full line; it now has fallen farther, occupying the dotted outline, and resting on 38, at a slope of 1 in 4. 38 has apparently tipped over sideways, as well as inwards, owing to the pressure of 14 upon its east corner; having been in 1747 in the shaded plan, and now emerging at the dotted line (which also shows place of east end under turf), rising 45° to north. 39 occupied the shaded plan on end in 1747, but has been pushed inwards to the present dotted outline by the fall of 14, and now rises 1 in 2 to north.