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SUNRISE DATING OF DEATH AND BURIAL

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IN recent years one of us (C.G.) has excavated two Middle Saxon cemeteries as part of a programme for the Ministry of Public Building and Works and the other (C.W.) has had the task of analysing and describing the skeletal remains of several hundred persons found in them. Our discussions of them have led us to believe that some information, which is not normally obtained from Dark Age or medieval inhumations, may be extractable here. For this, we devised and experimented with a technique, the results of which are described in this paper. We are aware that these are inconclusive and that the process may, indeed, be invalid, but the possible significance of otherwise unexplained facts leads to the hope that further work on larger sites may enable other workers to achieve more positive results.

PART I

The first of these cemeteries was at Caister-on-Sea, Norfolk. It began to be used in the middle of the seventh century and was not abandoned until the second half of the ninth. It belonged to the settlement which grew up in and around the ruins of the Roman walled town, a settlement which survived until the Danish land-taking about A.D. 880 led to the transference of the village to a new site. Topographical details, pottery, coins and other objects combined to provide adequate dating evidence.

The second was at Burgh Castle, Suffolk, five miles away across the old estuary (Green 1961, Fig. 1). This belonged to the monastery founded about A.D. 635 by St. Fursey within the walled area of the Saxon Shore fort. It contained persons of both sexes and all ages and was apparently used to bury the local converts and their descendants before the first parish churches were founded. The later graves in this cemetery had been destroyed by more recent activity, so that those recorded were roughly of the same period as those at Caister. True grave-furniture was virtually absent from both series.

Of the Caister cemetery a part only was available for systematic excavation, but other bodies disturbed by builders on an adjacent site were recorded wherever possible. At Burgh Castle all that remained of the original burial ground was explored.¹ In both, the bodies were oriented with the feet to the east, but there was considerable variation in their direction. Some pointed well to the north of east, others were swung south of it. At Burgh they lay between N. 85° and N. 121°; at Caister they were between N. 58° and N. 127°.² Of the total, only those which could be determined with reasonable accuracy have been included; many had been so disturbed that their bearings were quite uncertain.

The first analysis of the bodies suggested that this curious variation was not entirely at random and an attempt to explain its significance was made. Briefly it seemed that, in the absence of a compass and consequently of a fixed east point, the bearing of sunrise on the day the grave was dug might have given the line of digging. If so, graves dug during the summer after the vernal equinox would point to the north of east, while those dug after the autumn equinox would point to the south of east, late December giving the most southerly point. This possibility was briefly discussed by Bidder (1906), but he made no attempt to break down his small sample into sex and age groups. In seventeen burials at Mitcham, Surrey, he noted that fourteen were oriented north of east by an average of 11° and inferred from this that most deaths occurred in summer. He further suggested that this was either because summer was the season of fighting or because disease was more prevalent in the hot months.

In the latitude of Burgh Castle (approximately $52^\circ 35'$ N.) the earliest summer sunrise occurs in mid-June; from 16 to 23 June inclusive it bears N. $53^\circ 45'$, after which it moves slowly southward. In winter, from 13 to 29 December, it bears N. $122^\circ 15'$, after which it moves slowly northward once again. From this it follows that graves dug at the winter and summer solstices can be dated within the year with some precision, as they will lie at the extremes of the possible variation. Most graves, however, lie between these extremes and have two possible dates, one before and one after the appropriate solstice.

When the bearings were analysed in accordance with this hypothesis, it was seen that, with the exception of an odd grave at Caister, which lay just outside the winter limit, all fitted neatly into the arc of variation. But another variation soon became evident. At Burgh, the 112 measurable graves lay between N. 85° and N. 121° , the mean of them all being N. 98° , whereas at Caister the 97 determinable graves lay between N. 58° and N. 127° , with a mean of N. 90° . This showed that the average of the Burgh graves bore rather to the south of east. At first this discrepancy seemed to be an obstacle, but it was soon clear that it was rather a confirmation of the hypothesis. At Caister, much of the settlement and the cemetery lay outside the Roman town wall; its elevation was between 25 ft. and 50 ft. O.D. on a slope running down to the shore. From here, therefore, sunrise would always have been seen over the sea. At Burgh, the monastic settlement and cemetery were close within the walls of the fort and from here, sunrise would be seen only over the wall-top. Moreover, had it been viewed from outside the wall on the east the result would have been similar, for the ground rises slightly towards the east and visible sunrise would probably have also been delayed by the presence of woodland. Most, and possibly all, of the difference of 8° in the average bearing disappears when allowance is made for these delayed times of sunrise.

To determine the dates of the burials, it is necessary to work out the bearing of sunrise each day of the year, corrected for the latitude of the cemetery. For this, the Nautical Almanac gives sunrise times at various latitudes and with the data provided, they can be calculated for any site. After correcting by the time

of the Noon Transit of the sun for that day, the bearing can be worked out from the resultant figure. Those given here are for latitude $52^{\circ} 30' N.$ and are accurate to the nearest $15'$ of arc, enough to cover the slight difference in the latitude of the two cemeteries.

We did not know, however, how valid were the solar data of the current Nautical Almanac³ for the Middle Saxon period. An inquiry directed to the Nautical Almanac office of the Royal Greenwich Observatory brought the following reply:

"... The obliquity of the ecliptic, which is numerically equal to the maximum declination of the sun, has not, as far as we know, varied by more than half a degree over the past two or three thousand years. It is therefore true that the direction of sunrise would have been substantially the same twelve hundred years ago as on the corresponding date at the present time.

"I must, however, point out that the two centuries with which you are concerned were during the currency of the Julian calendar and that the difference between Julian and Gregorian was three days between 600 and 700 and was four days between 700 and 900. In each case the Gregorian calendar date was either three or four days later than the Julian date".

This variation in the calendars, however, does not concern us here, as we are not dealing with historically recorded dates. All ours given here are, of course, those of our current Gregorian reckoning. At the best, the determination of each skeleton's bearing to a degree is an approximation and the grave-digger himself can have dug only roughly towards sunrise. We have, therefore, divided our solar year into weekly periods,⁴ which is as accurate as can safely be anticipated.

In comparing these cemeteries with others, one point must not be overlooked. That at Burgh was certainly of converts of Fursey, his brethren and their successors and that at Caister was almost certainly the same (Green, forthcoming). It may therefore be expected that the instructions for the orientation of graves first given by the monks, which later became customary practice, were identical for each. An attempt to compare the data from these two cemeteries with those at Burwell (Lethbridge 1931) and Shudy Camps (Lethbridge 1936), both in Cambridgeshire, has been made, but the data provided in the latter reports are too few for this to be done adequately. Most of the graves in them seem to lie within the arc of variation, but a few are certainly outside it.

To summarise the detailed distribution in each cemetery, two Tables are given. For the Caister cemetery, the bodies are divided into males, females and children, and the approximate age of each adult is given. The contents of the Burgh graves, being more fragmentary, made identification less certain, so these are not sub-divided. To make comparison more easy the suspected sighting error of 8° in the Burgh orientations has been deducted from each bearing so that they now fall into earlier divisions than the observed bearing would allow. Certain significant differences in the health of these two communities during the growth period of the children have already been described (Wells 1961; 1964, 154-160) and serve to show that two populations racially similar and with

closely related geographical environments, may yet have different social histories. It is hoped therefore that, where possible, similar analyses will be made by excavators of other cemeteries; if our hypothesis is valid, they will throw more light on the vital statistics and living conditions of Dark-age social groups.

It may, of course, be rightly objected that on many days in the year—perhaps more than a third—the sunrise is obscured by cloud and that, therefore, an orientation directly based on it would be unobtainable. This objection is not insuperable. It is possible that dawns were more limpid and less overcast, from the seventh to the ninth century, than they are today although there is no evidence that this was so. But even if a clearly visible sunrise occurred, on average, only once a week, it would surely have been within monkish ingenuity, knowing the approximate daily progression, to extrapolate from one such cloudless dawn to the next. Indeed, if anyone cares to make the experiment with either sun-up or sundown, he will find no difficulty in making a passably accurate forecast to bridge a gloom-filled spell of two or three weeks.

PART II

These Tables plot each inhumation for which a compass bearing was obtainable. In the Caister Table—to which this commentary refers—the bodies are grouped separately for males, females and children, each being shown by its estimated age at death and placed in “boxes” covering about a week each, in orderly recession from a solstice axis.

It can be said at once that this plot does not prove the validity of our “sunrise orientation” hypothesis, but it does offer certain hints that might be explicable in terms of it.

It is clear that most of these inhumations cluster fairly closely on each side of the equinoctial dates; of the 97 burials 15 fall in the “equinox” box and a further 22 in the next pair out. This is not quite what one would expect if the graves had been dug on a known easterly bearing by gravediggers indifferent to undue precision.

If we translate this into a distribution of deaths by dates according to the orientations, we find that 63 of the 97 burials took place between either 3 March and 6 April or between 5 September and 10 October; whilst 91 fell between 18 February—20 April or 22 August—24 October. This is an extremely unlikely distribution statistically; it means, in effect, that 90 per cent of all deaths took place in only one-third of the year.

For our hypothesis to be tenable, this marked departure from random scatter must be explained. It can be seen that only a single death occurred between 21 April and 21 August. This *might* indicate a measure of seasonal transhumance. Such a pattern of behaviour is etymologically attested in the Norfolk place-names Somerton and Winterton—about 6 miles north of Caister. This however was probably at a rather later date than that of the Caister cemetery's use and, furthermore, probably affected only a part—the adolescent

TABLE 1
Distribution of inhumations at Caister-on-Sea by compass bearing and equivalent dates.

Date	Bearing	Sex and Age of each inhumation			Date
		Male	Female	Children	
June 16-23	53°45'				June 16-23
June 9-15	54°45'-54°				June 24-July 4
June 2-8	56°15'-55°				July 5-11
May 26-June 1	58°15'-56°15'				July 12-18
May 19-25	60°30'-58°30'	X			July 19-25
May 12-18	63°15'-61°				July 26-Aug. 1
May 5-11	66°-63°45'				Aug. 2-7
April 28-May 4	69°15'-66°30'				Aug. 8-15
April 21-27	72°15'-69°30'				Aug. 16-21
April 14-20	75°45'-72°45'	23	25-31-35	15	Aug. 22-28
April 7-13	79°15'-76°	40	22-23-25-25-35	4-5-7-13-13	Aug. 29-Sept. 4
Mar. 31-April 6	83°30'-79°45'	28-35-37-39	28-30-30-35-40	1-4	Sept. 5-12
March 24-30	87°-83°45'	19-23-26-32-33-40-40	30-47	9-12-13	Sept. 13-19
March 17-23	90°30'-87°15'	(Equinox) 38-38	24-24-25-26-34-35-36-38-38-38	(Equinox)	Sept. 20-27
March 10-16	94°15'-91°	28-33-46-50-X-X-X	30-45	15	Sept. 28-Oct. 3
March 3-9	97°30'-94°30'	26-27-30-35-37-43-49-55	27-30	2-14	Oct. 4-10
Feb. 25-Mar. 2	100°45'-98°	35	27-32	1½-5	Oct. 11-17
Feb. 18-24	104°15'-101°	30-45-45-48-X	25-40-43-43-50	3	Oct. 18-24
Feb. 11-17	107°30'-104°45'		60	13	Oct. 25-31
Feb. 4-10	110°45'-108°				Nov. 1-7
Jan. 28-Feb. 3	113°45'-111°				Nov. 8-13
Jan. 21-27	116°30'-114°				Nov. 14-21
Jan. 14-20	119°-117°	60	28		Nov. 22-29
Jan. 7-13	120°30'-119°15'				Nov. 30-Dec. 4
Dec. 30-Jan. 6	122°-120°45'				Dec. 5-12
Dec. 13-29	122°15'				Dec. 13-29
	(127°)	X			

NOTE: X indicates an individual of unknown age

TABLE 2

Distribution of inhumations at Burgh Castle by compass bearing and equivalent date.
(The figures have been corrected by subtracting 8°)

<i>Date</i>	<i>Bearing</i>	<i>Inhumations</i>	<i>Date</i>	
June 16-23	53°45'		June 16-23	S U M M E R
June 9-15	54°45'-54°		June 24-July 4	
June 2-8	56°15'-55°		July 5-11	
May 26-June 1	58°15'-56°15'		July 12-18	
May 19-25	60°30'-58°30'		July 19-25	
May 12-18	63°15'-61°		July 26-Aug. 1	
May 5-11	66°-63°45'		Aug. 2-7	
April 28-May 4	69°15'-66°30'		Aug. 8-15	
April 21-27	72°15'-69°30'		Aug. 16-21	
April 14-20	75°45'-72°45'		Aug. 22-28	
April 7-13	79°15'-76°	x-x-x	Aug. 29-Sept. 4	
March 31-April 6	83°30'-79°45'	x-x-x-x-x-x-x-x-x-x	Sept. 5-12	
March 24-30	87°-83°45'	x-x-x-x-x-x-x-x-x-x-x-x	Sept. 13-19	
March 17-23	90°30'-87°15'	(Equinox) x-x-x-x-x-x-x-x-x-x	Sept. 20-27	
March 10-16	94°15'-91°	x-x-x-x-x-x-x-x-x-x-x-x-x-x-x-x	Sept. 28-Oct. 3	W I N T E R
March 3-9	97°30'-94°30'	x-x-x-x-x-x-x-x-x-x-x	Oct. 4-10	
Feb. 25-March 2	100°45'-98°	x-x-x-x-x-x-x-x-x-x-x	Oct. 11-17	
Feb. 18-24	104°15'-101°	x-x	Oct. 18-24	
Feb. 11-17	107°30'-104°45'		Oct. 25-31	
Feb. 4-10	110°45'-108°		Nov. 1-7	
Jan. 28-Feb. 3	113°45'-111°	x-x	Nov. 8-13	
Jan. 21-27	116°30'-114°		Nov. 14-21	
Jan. 14-20	119°-117°		Nov. 22-29	
Jan. 7-13	120°30'-119°15'		Nov. 30-Dec. 4	
Dec. 30-Jan. 6	122°-120°45'		Dec. 5-12	
Dec. 13-29	122°15'		Dec. 13-29	

and young adult members—of the community. There is no archæological evidence whatever of this at Caister where the inferred ecology tends to disprove its possibility.

An obvious alternative is an epidemiological explanation. Even today deaths are not randomly scattered throughout the year and before the recent period of scientific medicine extensive seasonal fluctuation was the rule. We know little about the vital statistics of the Anglo-Saxon period but morbidity and death rates must have varied greatly from month to month. It is likely that epidemics of dysenteric diseases were especially common in late summer and early autumn. They would account for many deaths in infancy and early childhood, but all ages would be involved to some extent. Towards the end of winter and in early spring the respiratory infections would reach their peak; acute bronchitis, pneumonia and perhaps viruses of the influenzal type. These, too, would take a heavy toll of young children, but elderly people—by the standards of the time—would also be particularly vulnerable. Peaks of this kind and distribution would go some distance towards producing the pattern

which is found at Caister. We should expect the late spring and early summer to be the healthiest time of the year and with the fall in soil temperature, in late autumn and early winter, enteric infections would probably abate and a second relatively healthy phase would supervene. It is doubtful whether this hypothesis is sufficient to explain the full picture even if we could be sure that it is an accurate description of what happened. In fact it is extremely difficult to find evidence in support of it, but a few hints can be found in the age distribution of the adult deaths.

It can be seen that the average age of all the male "winter" deaths is 40.1, whereas the average of male deaths in the "summer" half of the year is 33.1. For females the respective figures are 36.9 and 30.9. Our sample is too small to give statistical significance to these values, but it is possible that they do represent a real trend and that if we had a larger population we should find that the relatively "elderly" did indeed die in the late winter and late summer peaks of morbidity. We must recognise, however, that the higher mean age of the winter deaths is partly due to a few exceptionally elderly people dying in this half of the year—though the very fact that they did so might be thought to give some further support to our hypothesis.

A slightly different emphasis may be obtained by noting that, of the 21 individuals who died aged 40 or over, 15 were buried in the winter half of the year. Again this should be regarded as nothing more than a suggestive piece of evidence. It must always be remembered, too, that there is room for substantial, though variable, error when determining the age of adults in archaeological material.

One other point may be noted: of the sexed adult deaths which occur during the winter half of the year, from the end of the autumn equinoctial week to the start of the spring equinox, 23 are male, 13 are female. Of the summer deaths, including the equinoctial weeks, only 17 are male as against 26 female. The sample is too small to prove anything, but it is possible, indeed probable, that the male population was slightly reduced during the summer half of the year. This littoral village community had its clinker-built boats, as we know, and the summer was the time of the year when longer voyages were commonly made in these early craft.

When the Burgh Castle inhumations are similarly converted from compass bearings to dates at death we find that 75 (67 per cent) of 112 fall in the winter period and only 37 (33 per cent) in the summer half of the year. More narrowly 73 fall either in the late winter period of 18 February to 16 March or in the autumn weeks from 28 September to 24 October. This represents the statistically improbable result of 65 per cent of deaths occurring in only two months of the year and is not the result to be expected from random orientation about a roughly determined easterly bearing. In view of the poor state of many of these burials they have not been grouped by age and sex, as were the Caister skeletons, but it seems possible that similar significant variations of burial alignment occurred at this site also.

We are grateful to the Ministry of Public Building and Works (now the Ministry of the Environment) for permission to publish these summarised results and to the Superintendent of H.M. Nautical Almanac Office for his help. Our thanks are also due to Professor F. Hoyle and to Professor H. H. Lamb for advice given.

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¹The Burgh cemetery underlay the Norman motte and the digging of the encircling foss had pared away the cemetery area on north, east and south sides. In 1839 the remnants of the motte were thrown down into the partly-filled foss and the whole area had then been very roughly levelled for agricultural use.

²All compass bearings are from True North. It should be mentioned that each grave with its skeleton was planned on squared paper in reference to a peg-grid of 20-foot squares. As the orientation of the grid was known precisely, it was comparatively easy to read off that of each body much more accurately than could have been done by taking a compass bearing of each in the field.

³*Reed's Nautical Almanac for 1961* (Sunderland and London, 30th annual ed.) was used.

⁴It should be noted that the periods are not all exactly weeks. Owing to the Equation of Time and the consequent slight variations in Noon Transit times, there would occasionally have been slight discrepancies in the sunrise bearing in comparable weeks before and after each equinox. Working to an accuracy of 15' of arc, the bearings fall exactly into the periods now given in both left-hand and right-hand date columns. For the same reason, the origin of the astronomical data used has been given as the 1961 Almanac.