JUTISH GLASS PRODUCTION IN KENT: AND THE PROBLEM OF THE BASE CUPS

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This paper describes and discusses a programme of analytical work on glass from Kent's pagan Jutish cemeteries. Results from the analysis of the Jutish glass are compared with those from similar studies of material from Saxon Southampton, York and Scandinavia, and conclusions are offered from a heuristic viewpoint. A fragment from a 'base-cup' was included in the programme of analysis, so that subsequently new light has been thrown on the nature and provenance of these rare vessels.

To the ancients, glass was simply the product of heating sand with soda, the necessary additives being present, unknown to them, as natural impurities. For the purposes herein, glass is a hard brittle transparent substance produced by the fusion of inorganic materials, these having cooled without crystallisation taking place. Its principal component is silica (SiO_2), the 'network former'. To it must be added 'fluxing agents', either sodium (as Na_2O) or potassium (as K_2O) their function being to lower the melting point and viscosity of the mixture. The last essential ingredients are calcium, added as lime (CaO), and magnesium (MgO) which serve to offset a reduction in durability produced by the alkali metals. Many colouring agents were known to the ancients, and the presence of impurities in these and the major oxide components means that many trace elements are included in the melt.

Glass was produced in workshops run by master craftsmen known, then as now, as 'gaffers'. Their workmen tended lower temperature *fritting* furnaces in which the ingredients were combined at about 750°C, and high temperature crucibles at over 1100°C from which the refined glass was either worked, or cooled into stock glass known as *cullet*.

A dominant historic factor affecting Dark Age glass technology was the cessation of Mediterranean trade with the fall of the western Roman Empire. The major sources of sodium (as *natron*) were in

North Africa and the Middle East. Europe was suddenly cut off from this vital ingredient, and the gaffers had but three options. To keep re-working every scrap of broken glass while their stocks of *cullet* dwindled; in this they had no choice: to find local sources of sodium, which in Kent they may well have done (see below): or to find a substitute for sodium. The last was achieved by obtaining potassium from wood ash, although the product, *forest glass*, was of poor durability compared with the soda-lime-silica glass of the Roman world, a factor that explains the low survival rate of glass from Medieval archaeological sites.

THE SAMPLES AND METHODS OF ANALYSIS

Was there a Jutish glass industry in Kent? No Dark Age glass working site has been located in the county, but given that Saxon archaeology in Kent to date has consisted very largely of cemetery excavation, this means little. Certainly the Continental and Middle Eastern origin of some glass from Jutish cemeteries has never been in doubt, but many vessels and fragments from these cemeteries are not quite like, and in some cases very unlike, the foreign material. On this basis Harden and others have postulated a 'Faversham Industry' (Leeds 1936, 121; Harden 1956, 147).

The lack of any scientific examination of glass from the Jutish burial grounds of Kent prior to this study is probably due to the paucity of sample material. Most of the cemeteries were excavated last century when only intact or restorable glass seems to have been kept. Eight samples were however obtained for the experiments described below, covering the main vessel types and colour variations encountered among the beakers and cups. To serve as controls, two Late Roman samples, two Dark Age imports, and a Later Saxon fragment were also examined.

In the following table of samples (1-13), Harden's typological classification has been used, and the vessel forms so identified are represented in **Fig. 1**. The provenance of each sample is provided (Appendix 1).

The main technique employed was Neutron Activation Analysis. This involves irradiating samples by bombardment with slow thermal neutrons in a nuclear reactor. These interact with the atomic nuclei of elements in the sample, forming radioactive isotopes which decay, emitting gamma rays whose energies are discrete and characteristic of only that isotope. Detection and quantification of elements is then made possible from counts made on the 'energy peaks' of the isotopes.

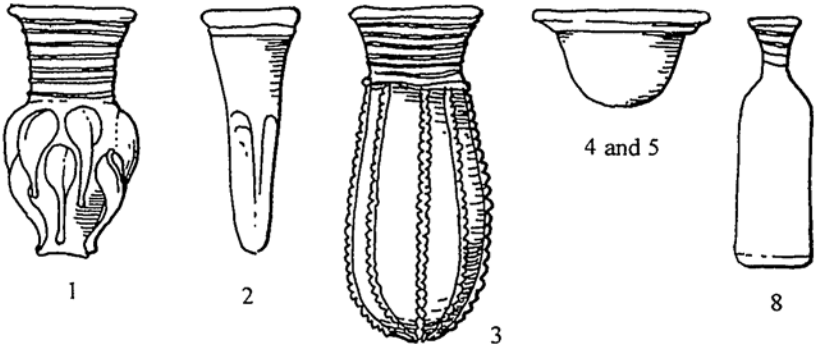

Fig. 1a. Actual sample vessels and identified type forms of samples analysed in this study, Harden's classification, all at approximately (1/5). The vessels and types are: 1) Claw beaker, II,c. Bifrons. 2) Cone beaker, III,c. Bifrons. 3) Bag beaker, VI,a. Faversham. 4 and 5) Palm Cups, X,b. Sarre and Kingston Down. 8) Bottle? This is a reconstruction superimposing the rim and neck of a vessel from the Half Mile Ride cemetery on the form of a bottle (Class IX, b1) from Lyminge, Folkstone, Grave 13 (Warhurst 1955).

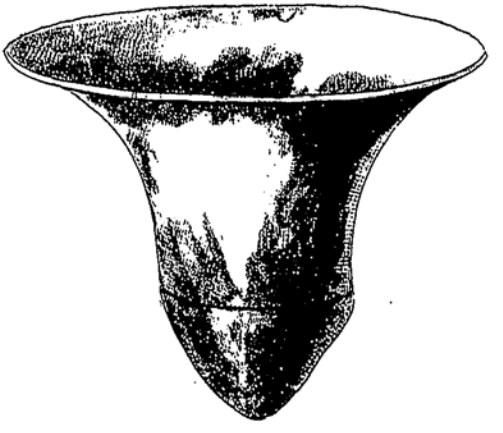

Fig. 1b. The Base Cup excavated by the Rev. Bryan Faussett (Grave 52) in the Jutish cemetery at Gilton, Ash next Sandwich, Kent, in 1762. Reproduced from *Inventorium Sepulchrale*, Pl. XVIII, 5).

Some constituent or trace elements found in glass are not capable of forming an isotope with a half-life of reasonable length, say of several days. For these, the techniques of Atomic Absorption Spectrometry and Flame Emission Photometry were applied. Readers who

TABLE 1. SAMPLES AND CONTROLS USED IN EXPERIMENTS

	Type	Class	Colour	Century AD	Origin
Jutish Vessels					
1	Claw beaker	II,c	Clear brown	mid 6th	Grave goods
2	Cone beaker	III,c	Clear white	late 5th	ditto
3	Bag beaker	VI,a	Clear white	7th	ditto
4	Palm Cup	X,b	Clear blue	7th	ditto
5	Palm Cup	X,b	Clear amber	7th	ditto
6	Unknown	-	Clear white	7th	ditto
7	Unknown	-	Clear white	7th	ditto
8	Bottle?	-	Clear white	7th	ditto
Dark Age Imports					
9	Base Cup	-	Clear green	Late 7th	ditto
10	Cane Bead	-	Blue/white/ red	7th	ditto
Later Saxon Glass					
11	Bottle?	-	Clear white/red	10th	Farmstead site
Roman Glass					
12	Flagon	-	Clear blue	3rd	Villa site
13	Flagon	-	Clear blue	3rd	ditto

wish to know more about these methods of chemical analysis should find them covered in the chemistry section of their local reference library, or in depth by standard works (Fifield & Kealey 1983).

Because of the unique nature of some of the samples, a repeat second series of experiments employing all three techniques was decided on. This allowed the problems encountered during the first series to be addressed. Samples 1, 2, and 3 were unfortunately so small as to be expended in the first series, so that the values obtained must stand.

RESULTS

Twelve oxides and twelve trace elements were detected during the work described above. A rough means of checking the accuracy of estimates of their concentrations is by comparing the results with those from other studies. While local industries and individual glass-

es will have unique compositional identities, broadly, there are upper and lower limits for 'likely' values of the main oxides and elements. A difficulty here is that several techniques other than those herein employed are currently being used in glass studies, so that close comparisons are hard to make. The following comparisons are therefore based on a rather wide spectrum of both analytical methods and research material.

The Roman Glass, Samples 12 and 13

A recent study of 36 fragments of Roman glass from British sites can serve for a useful comparison here, although it employed Ultraviolet and Infra-red Spectrometry and Electron Microprobe techniques (Green & Hart 1989). Samples 12 and 13 are estimated to contain respectively 17.1 % and 19.5 % of Na_2O, compared with a mean of 16.14% for the 36 samples. Samples 12 and 13 seem remarkable for the austerity of their composition. Both had comparatively high antimony contents. Iron or manganese were not detected, although these elements were found in the 36 samples with means of 0.37% and 0.34% respectively. It is perhaps worth considering that the 36 samples were obtained from the north of England, and were somewhat earlier than samples 12 and 13.

The possibility has been mentioned that Dark Age glass is the product of endlessly re-processed Roman *cullet* (Newton & Davison 1989). If Samples 12 and 13 are at all typical, this does not seem likely as their compositional profiles and those of the Dark Age glasses are quite dissimilar. Various trace elements, and oxides such as tin and iron could well have become incorporated during many re-melts.

A Dark Age import, the Cane Bead, Sample 10

This obviously differs from the vessels in that its manufacture employed opacifiers and colorants, the red and blue components being produced by the cuprous oxide and cobalt. The millifiori construction of the bead made it difficult to take a sample that represented (proportionately) the components, or to match this with a second sample. As an illustration, while high tin and iron concentrations were estimated during the first NAA experiment, these were not borne out by the second experiment, when tin was present only at a detectable level and iron was not detected.

Sample 11, probably Late Saxon

This has a potassium content of 4.16 %, with only 10.2 % of sodium.

The presence of cobalt and tin could be explained in the case of this sample as the colorants for blue and white trail decoration. The high potassium concentration makes this very much a mixed alkali glass, and it presumably belongs to an industry that is well on its way to *forest glass* manufacture.
[Sample 9, the Base Cup is dealt with in the Discussion below.]

The Jutish Group, Samples 1, 2, 3, 4, 5, 6, 7, and 8

Previous studies of Saxon and Scandinavian glass have tended to employ multi-variate data analysis by computer, in particular clustering methods, in an attempt to differentiate between a number of sample populations so as to establish sources or affinities. This research had the more limited objective of trying to establish whether the Jutish samples had a unique compositional identity, and if so, to compare it with seven groups of Dark Age Saxon and Scandinavian glass examined by Neutron Activation Analysis and Inductively Coupled Plasma Spectrometry. The seven groups, A-G, are:

A: Saxon Southampton
B/C: Saxon Southampton and Winchester (Heyworth, Hunter, & Warren 1986).
D/F: Helgo, Sweden.
E: Spong Hill.
G: Dorestadt, Holland (Sanderson & Hunter 1982).

By comparing concentration means it was shown that the Jutish glass is somewhat similar to the other sample profiles. It differs in containing higher levels of magnesium, calcium, and lead, rather less iron, and uniquely tin, which was not reported in any of the other sample populations.

In seeking comparisons, one approach is to apply a correlation test using the concentration means as variables. Such a test indicates a positive correlation between CuO and PbO (sample correlation coefficient $r = 0.883$). **Fig. 2** shows CuO plotted against PbO for six of the Jutish samples and groups A, D, E, F, and G, with the Jutish group K clearly demonstrating its individuality. The trace elements Scandium and Cerium are similarly plotted in **Fig. 3**. While none of the groups form tight clusters (Group A being very scattered) separate identities again emerge, with the Jutish group forming one of the closer spreads.

Viable glass must conform to certain compositional rules. Within these, ancient craftsmen would seek to apply a traditional recipe when the availability of raw materials allowed. Rule of thumb mixing

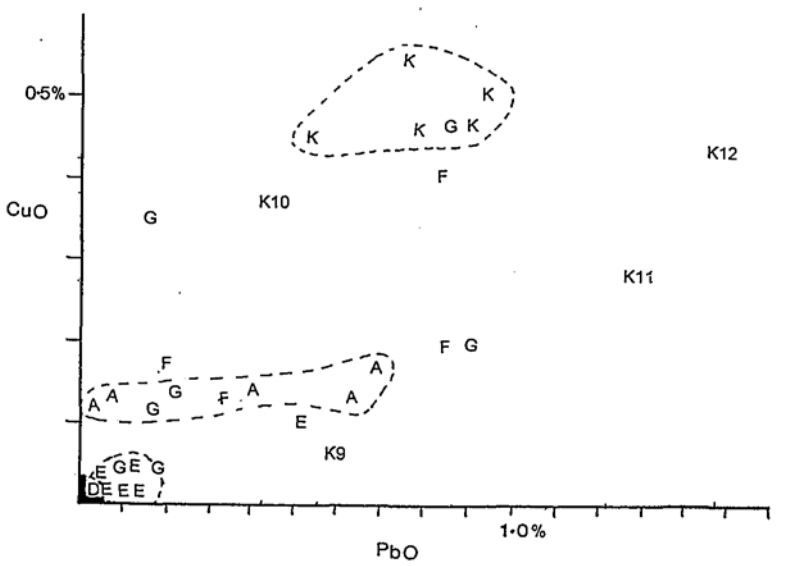

Fig. 2. A plot of copper versus lead for groups A, D, E, F, G and K the Jutish group. Numbered K values are for non-Jutish control samples. D consists of five values superimposed

of these (the *frit*), and the addition of *cullet* from sources beyond the industry, would make for a certain amount of variation. Across a large sample population such variation would be submerged in a broad identity. The extent to which such an identity can be defined from only eight samples is something that can only be resolved if future excavation yields a wealth of specimens.

Sample 9, the Base Cup (Cup 6 in the list below)

This is very different in composition to the Jutish and Roman vessels, most obviously in its low sodium content of 3.09% compared with a potassium content of 5.71%. Alone among the samples, Sample 9 contains lanthanum and has the highest cerium content estimated among the samples. Thorium and dysprosium were detected. The above estimates have to some extent been confirmed by analysis of another example of this rare type. During conservation work on a Base Cup (Cup 2 above) in the keeping of Liverpool Museum, it was examined by electron microscopy and energy dispersive spectroscopy, this indicating a 4.8% sodium content with 2.0% of potassium (pers. comm., Fiona Philpott).

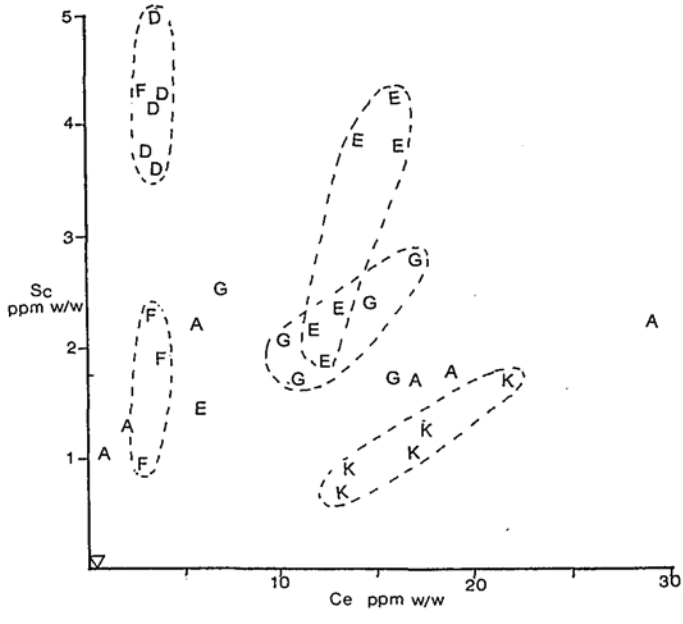

Fig. 3. A plot of scandium versus cerium for groups A, D, E, F, G, and K the Jutish group. The five K values shown are all for Jutish samples.

THE JUTISH GLASS - DISCUSSION

If the Jutish samples are representative of a Kentish industry, then its product has an arrestingly different character. The high concentrations of magnesium and calcium are nearer to those found in mixed alkali Iron Age glasses (Henderson 1988) than in Groups A - G above. So also are the levels of lead and copper, which are often found in association when copper has been used as a colorant. Could such a seemingly non-functional mixture arise from the massive intrusion of alien *cullet* into a soda-lime-silica industry?

Alternatively, a high magnesium content has been held to suggest the use of plant or kelp ash as a sodium source (Forbes 1957). Historically, this would fit well with the turmoil following the Jutish migration when *natron* or *natron*-based *cullet* might have been virtually unobtainable. There would have been no lack of ingredients. Six plants of the genus *Salicornia* (most commonly the Perennial Glasswort *S. perennis*) are to be found on the north Kent marshes. As to

kelp, a tradition of burning seaweed for ash to be used in glass production continued in Kent until the nineteenth century. This was noted as a winter occupation for farmers in the 1720s (Lewis 1723). A lane in Margate known as Alkali Row perpetuates the memory. Here the seaweed was burnt and the ashes processed before being exported to Holland, a 'noisome trade' suppressed in 1830 in the interest of the new-born holiday business.

High levels of calcium might owe something to impurities in the silica source. Any fine clean 'white' sand from north-east Kent is more or less bound to contain fossil or sub-fossil shell fragments and chalk nodules, which might appreciably augment the lime added as an ingredient. Apart from further analysis of an extended sample population, experiments in glass-making with wholly local ingredients might throw useful light on the origin of Jutish glass.

Finally, a Dark Age Kentish glass industry has by its very existence something to tell us about the society and environs in which it operated. Glass houses with their gaffers and skilled workers represented a considerable investment, one unlikely to be risked other than in a very safe, stable, law abiding environment. The furnaces for *fritting*, melting *cullet*, and annealing new-blown glassware, would use large quantities of charcoal. This would have to be cut/burned by controlled coppicing throughout a large area to sustain the supply. Raw materials had to obtained and glassware exported, so that the manufacture needed to be at a hub in a secure, viable long distance communication network. All this suggests that, if there was a Jutish industry, it flourished within the walls of a one-time Roman town.

THE HALF MILE RIDE BASE CUP AND ITS ASSOCIATES - DISCUSSION

This cup, and the small group of vessels to which it belongs, are here considered at some length, since their provenance and composition have interesting implications with respect to the evolution of glass technology in north-western Europe. Before considering the results of analysis and possible origin however, it is necessary to address two questions. What are the base cups, and how old are they?

When D. B. Harden produced his review of Dark Age glass vessels found in Britain, he specifically excluded from his classification a group of four rather distinctive cups on the grounds that they were not of Dark Age, but of Tudor date, 'despite the apparently good pedigree' of two of them (Harden 1956, 166). His contention being that they were formed from the broken-off bases of Tudor goblets, hence the name he gave them. Others have agreed with the re-used goblet

base theory while attributing them a Dark Age date and a Continental origin. Thorpe (1935, 73-4) describes stable fifth-century *Waldglas* beakers as the putative sources of the base cups, and provides a scenario in which a thrifty migrant Jutish housewife, a long way from the fine shops on the Rhine, re-finishes her broken treasure. The heirloom cup later becoming a grave goods item. A difficulty here, as will be seen below, is that the story is repeated by at least six housewives. The writer would feel more at home with this theory if an example of the 'parent' stable beaker type had survived, even in fragmentary form. Since the provenance of the corpus of base cups plays an essential part in this discussion it is given below:

Cup 1 Provenance: from Tumulus IV, opened on Chatham Lines in August 1782 by the Rev. James Douglas, and described by him in *Nenia Britannica*, Pl. IV, 5. It was in the keeping of the Ashmolean Museum, but could not be located in 1989 (pers. comm., Arthur MacGregor). Diameter 85mm, Height 50mm. Dull olive green, with weathering. The barrow also yielded a silver gilt radiate-headed fibula, a silver finger ring, and a rock crystal sphere with silver mounts.

Cup 2 Provenance: excavated by the Rev. Bryan Faussett (Grave 52) in the Jutish cemetery at Gilton, Ash next Sandwich, Kent, in 1762 (Roach Smith 1856, 19, and Pl. XVIII, 5). Now in the keeping of Liverpool Museum. Diameter 95mm, height 83mm (Fig. 1b). Clear olive green, no weathering. The grave (No. 52), also contained an iron latch-lifter, an iron box or coffin mount, and a necklace of clay beads.

Cup 3 Provenance: from the Faussett collection? Find spot unrecorded. In the keeping of Liverpool Museum. Diameter given as 70mm.

Cup 4 Provenance: 'found fourteen feet below the surface opposite the Grand Shaft, Dover, in 1854' (Baldwin-Brown 1915, Vol. 4, 485, Pl. E2). Diameter 76mm, height 44mm. Dover Museum lost all its glass and records when bombed out of its Market Square premises in the Second World War (letter from the Curator).

Cup 5 Provenance: from Chessell Down, Isle of Wight (Jutish cemetery), most probably found by G. Hillier in 1855. Diameter 70mm, height 32mm. Known to be in Carisbrooke Castle Museum until 1939, it cannot now be located (pers. comm., Mark Tosdevin).

Cup 6 (Sample 9, the Half Mile Ride cup) Provenance: it was discovered by the writer while cataloguing the Rowe Bequest. This consists of archaeological material once housed in the old Margate Museum prior to the Second World War, and now in the keeping of Thanet District Council. When unpacked, it was found to still bear a light coating of chalk dust and soil. It was accompanied by a Jutish bronze buckle of seventh-century type. In the box containing these two items was a card inscribed 'cem near wall, 4 ft. 3in. down, Sept 1924. Saxon buckle c. 500 BC [sic]'. This was in the handwriting of Dr Rowe, and there can little doubt that the items are associated with the later phase of his rescue excavations in the Half Mile

Ride Jutish cemetery. The inscription is cryptic, and may mean that the items were found by a gravedigger working in the 'modern' St John's cemetery, which intrudes on the ancient burial ground (Perkins 1987). Diameter 88mm, height 62mm. Clear olive green with some weathering. In the keeping of Margate Old Town Hall Museum.

During nearly seventy years, the Half Mile Ride cup shared the many vicissitudes of the 'Rowe Bequest', and at some time was broken. A V-shaped area representing about a quarter of the rim and body became detached and fragmented. Worse, most of the fragments are now missing. While regrettable, this damage has allowed scientific examination. The remaining small fragments could play no part in any restoration work, and the writer selected two of these as material for analysis.

It must surely be accepted from the above that the base cups are Dark Age vessels. That they are found as Jutish grave goods means that were interred not much later than AD 700, if not well before. If the two cups so far analysed are typical, then by their composition they have been blown in the potassium-rich *forest glass* (Ger. *Waldglas*). Importantly, this tells us that a fully developed *Waldglas* industry in the Rhineland and nearby was producing and exporting products to Kent and the Isle of Wight as early as the seventh century, when the soda-glass Jutish vessels were being made, and when burial with grave goods was still an accepted rite. Hitherto the date for the commencement of *Waldglas* manufacture has only been estimated 'at some time before the tenth century' (Newton & Davison 1989, 27). This event has been associated with a decline in beech pollen, which it is suggested, marks a wholesale use of that wood in glass production (Newton 1985).

CONCLUDING SUMMARY

The case for a Dark Age Kentish glass industry was long ago discussed by Leeds, Harden and others, the premise being based on the distribution of certain vessel types around what seemed to be an east Kent focus. This study sought an answer to the same question by analysis of the glass at main ingredient and trace element level. To what extent it has achieved this depends on the reader's acceptance of the validity of the data conveyed visually by Figures 2 and 3. The writer believes that a good case for a Kentish industry has been made, while being aware that the small size of the sample population lays the work open to reservations on statistical grounds.

Did the Base Cups come into being as a form of unstable palm cup,

or as the bases of stable goblets? On balance, the writer is inclined to believe the latter, while observing that the tendency of these goblets to selectively destruct, leaving the housewife cup in hand, must have made them something of a novelty purchase. Now at least, analysis and provenance has firmly re-located the Base Cups as Dark Age products of the Continental *Waldglas* industry rather than medieval or even Tudor fragments.

The analytical work described herein was time consuming, requiring the writer's labour in chemical and radiation laboratories for many 'leisure' days over four years. While the research had academic aims, it was always intended that it should be published, making what contribution it could to Anglo-Saxon and Kentish archaeology. If taxed as to why it has taken a decade for it to appear, the writer can offer no excuse, *mea culpa*.

ACKNOWLEDGEMENTS

Researches described herein were carried out by the writer in the late 1980s as a programme of study leading to the award of the degree of Master of Science. The venue was the physical and chemical laboratories of the then Polytechnic of East London, now East London University, and the writer would like to take this belated opportunity to thank his supervisors, Dr Lyn Day and Dr John Evans, for their help during several years of part-time study. Particular thanks are also due to Mr David Kelly, in his role as Curator, Maidstone Museum, without whose kind help the work would not have been possible.

[Editor's Note. This article has been published in an abridged form. In-depth data on apparatus, sample preparations, standards and a number of statistical tables and graphic illustrations have been omitted, although freely available in the case of specialist enquiry from the author at the Trust for Thanet Archaeology, Crampton Tower Yard, High Street, Broadstairs, Kent, CT10 2AB.]

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APPENDIX 1
THE PROVENANCE OF THE SAMPLES

Sample 1 A fragment from a Claw Beaker (Class II, c) in clear 'beer- bottle brown' glass from the Jutish cemetery at *Bifrons*, Kent. This is from one of the graves excavated in 1867 by Lord Conyngham's game keeper, of which no grave numbers or other data has survived. The beaker is in the keeping of Maidstone Museum as part of the Tomlinson loan, the fragment being one of several that could not be used in its restoration. Harden places this vessel among the 'degenerate types' of the mid-sixth century (Harden 1956, 159).

Sample 2 A fragment from a Cone Beaker (Class III, c) in colourless glass. This is from the *Bifrons* cemetery, Grave 1, and is illustrated by Harden (1956, 140, Pl. XVI, f) who suggests a fifth or early sixth century date. It is in the keeping of Maidstone Museum.

Sample 3 This is a fragment from a Bag Beaker (Class VI, a) in colourless glass. It was a nineteenth century find from Faversham and nothing further is known. Ascribed by Harden (1956, 41) to the seventh century.

Sample 4 A rim and body sherd from a Palm Cup (Class X, b) in clear blue glass. Found during exploratory trenching in an unexcavated section of the Jutish cemetery at Sarre, Thanet, in 1983 (Perkins 1988). It accompanied the burial of a young female with late sixth - seventh century grave goods (Grave 2, 1983 series). The sherd was probably strung through the hollow rim and worn on the breast as an item of adornment, as also Samples 6 and 7 below.

Sample 5 A fragment of a Palm Cup (Class X, b) in clear amber glass. From an excavation in 1974 at Kingston, Kent, Site IX, 123, layer 2. This was a rescue excavation on the border of the Kingston Down Jutish cemetery. The context was believed to be the plough damaged mound of a Jutish barrow (pers. comm., N. Macpherson-Grant).

Sample 6 A rim fragment with a rounded hollow lip in colourless glass. Same provenance as Sample 4.

Sample 7 A rim fragment with a rounded hollow lip in colourless glass, very similar to Sample 6 but from a different vessel. Same provenance as Sample 4.

Sample 8 From a rim and neck sherd in colourless glass. Unidentified, but probably from a Pouch Bottle of Harden's Class VII, a, 2 (Perkins 1987, 228 and Fig. 4, 16). Confirmed as a find from Dr A. Rowe's Jutish cemetery excavations at Half Mile Ride, Margate, in 1924.

Sample 9 A Base Cup in clear green glass from the Jutish cemetery at Half Mile Ride, Margate, in 1924. This object and an accompanying bronze buckle may have been brought to Dr Rowe by a gravedigger, see main text.

Sample 10 A fragmented Cane Bead of millefiori construction in opaque black red and white glass. These imported beads can be firmly dated to the seventh century. A sample fragment was selected in which all three colours were about evenly represented. This is a surface find from the area of an unexcavated Jutish cemetery at Minster, Thanet, see Hawkes 1984; Boast & Gibson 2000.

Sample 11 This is a sherd from a slender-neck column of a vessel in colourless glass, decorated with alternate opaque blue and white spiral trails. It is from an Early Medieval site at Netherhale Farm, Birchington (Perkins 1980). Associated ceramic finds indicate a tenth-century date.

Sample 12 A fragment from a Roman flagon in clear pale blue glass, probably third century. From a Roman settlement site at Shuart Farm, St Nicholas at Wade, Thanet. Thanet Archaeological Society archive.

Sample 13 A fragment from a Roman flagon in clear pale blue glass, probably third century. From a Roman villa site at the Mount, Maidstone. (pers. comm., D. B. Kelly).