CHAPTER 6

INTRASITE VARIATIONS IN OYSTER SHELLS FROM SITES IN THE POOLE REGION

Chapters 4 and 5 dealt with sites in the Southampton region, that is, the Six Dials site in Southampton itself, Newport Roman Villa on the Isle of Wight, Owslebury near Winchester, and Romsey. They were dealt with together because the most likely place of origin for the oysters recovered from these sites was Southampton Water and the Solent which are known to support oyster populations and around which location they were loosely clustered. Further west along the south coast of England is another location where natural populations of native oysters, as well as relaid or farmed beds of oysters, exist, in Poole Bay and Poole Harbour. Oyster shells from archaeological sites on the north and south shores of Poole Harbour and sites in the surrounding Dorset area were examined. Data for modern live oysters from Poole were also obtained and used to interpret the archaeological material. Although emphasis is placed on intrasite comparisons here, the data were also used to make intersite comparisons which will be elaborated in later chapters (9 and 10).

OYSTER MIDDENS AT POOLE, DORSET

Rescue excavations carried out during the 1970s and 1980s provided evidence that Poole was established around 1200. It is situated on the northern shore of one of the world's largest natural harbours. Excavations during the first part of this century showed that a Roman settlement existed at Hamworthy which is located close to Poole but separated from it by a narrow strip of water. No evidence has been found so far to indicate occupation in the area between the fourth and thirteenth century.

The work on the Poole oysters falls into two categories. Initially, the significance of the middens was considered from the point of view of their location and their date. This part of the work was undertaken in collaboration with the late Ian Horsey of Poole Museums whose idea it was to have the shells radiocarbon dated. The second part of the work concerned the macroscopic features of the shells and what this kind of evidence could reveal.

Attention was first drawn to massive oyster middens on the foreshore of the medieval port of Poole and on the Hamworthy peninsula opposite in 1981 (Horsey, 1981). The positions of the sites from which oyster shells were recovered are shown in Figure 6.1. The excavated sites include the interior of the Town Cellars building (PM11); the area of Paradise Street immediately in front of the Town Cellars (PM21); Thames Street leading off Paradise Street (PM9); nearby Pex Marine (PM24); and a borehole at the Shipwrights' Arms in Hamworthy (PM32). Watching brief observations also recorded oysters at Poole Pottery.

Location of deposits

The Town Cellars is a medieval warehouse built directly on top of the shell midden which was sealed by layers securely dated by pottery to c. 1300. The shell deposit covered the whole of the excavated internal area of the building and extended outside it in all directions. It consisted entirely of discarded oyster shells, thickening from 0.2m at the back of the building to 0.5m at the front and increasing as the shells deliberately or inadvertently reclaimed the sloping foreshore outside beneath Paradise Street where it was not possible to determine the full thickness of the deposit.

At adjacent Thames Street the shells occupied a similar stratigraphic context to those from the Town Cellars but appeared as a discrete accumulation. On the Pex Marine site, only the top of the shells, below later medieval rubbish dumped during foreshore reclamation, was sampled. A borehole through the foundations of the Shipwrights' Arms in Hamworthy revealed an oyster midden 3.4m thick.

Quantity of shell

Insufficient data means that it is not possible to estimate with accuracy the full extent of these oyster deposits, but the archaeological evidence coupled with that from boreholes and observation sites may suggest that the midden on the Poole waterfront was continuous along the foreshore for a minimum of 200m; and if the smaller deposits observed under the Poole Pottery warehouse are associated, the lateral extent could be as much as 400m. Its width is also difficult to estimate but 40m may be average. Although the maximum depth of the deposit on the Poole side has not been determined, it would seem to average c. 1m.

The quantity of oyster shell represented by the Poole midden, based on the above size approximations, is enormous. Using the minimum and maximum estimates of length, and the number of individual oysters found in a measured volume of the midden (238 MNI oysters in ½m^3, PM21 502.206 sample 19), it is possible to calculate that the midden might contain between 7,616,000 and 15,232,000 oysters. The Ministry of Agriculture, Fisheries and Food (Lowestoft) have provided unpublished data giving an average wet-meat weight of 7.5g for oysters. A Medical Research Council Report on food values gives a value of 50 calories per 100g of oyster meat. Therefore, the midden could represent between 57.12 and 114.24 tonnes of raw oyster meat. If the average consumption in calories per day for a person is standardised at 2,000, then the Poole midden would have provided from 14,280 to 28,560 man/days (8 man/years) of food. A person would have to eat 532 oysters a day to obtain the required energy level.

Dating of the oyster shells

Six samples of oyster shell were sent to the Harwell Laboratory for radiocarbon dating. The problem of obtaining reliable radiocarbon age determinations from calcitic shells has been discussed by Burleigh (Preece et al, 1983). The major problem is that the original carbon may have been replaced by more recent carbon either by mechanical contamination where particles or solutions have entered the interstices and become absorbed, or by carbon isotope exchange between the shell and the environment. This recrystallisation by solution and reprecipitation (Craig, 1954) can have an important affect on C^{14} dating.

Shells from the samples PM11 (141) and PM32 (1D) examined by Mr T. Yates using acetate peels and a low power petrological microscope showed them to be unaltered calcitic structures in which recrystallisation was unlikely to have occurred. There were, however, cavities in the samples, in one case occupying 15 - 20% of the section, and the growth layers were visible as deeply incised grooves immediately below the shell surface via which mechanical contamination could have taken place. The sample from PM24 (12) which came from immediately below a rubbish tip high in organic acids was considered likely to have been recrystallised (it was not examined microscopically).

The calculation of C^{14} dates and the way in which results are expressed may vary at different laboratories (Mangerud, 1972; Gillespie and Polach, 1979). The Harwell figures were presented without the correction for "apparent age" but this has been calculated using the formula presented by Harkness (Harkness, 1981) and added to the results given in Table 6.1. Unlike terrestrial organisms which mainly utilise carbon containing relatively new carbon isotopes from the atmosphere, marine organisms tend to incorporate older, recirculated carbon from the oceans so that molluscs such as oysters have a C^{14} age at death that can vary from 200 - 300 years to more than 2,500 years according to the region of origin. In the United Kingdom the apparent age correction involves the subtraction of 405 $\pm$ 40 (Harkness, 1981) from the age given by the conventional radiocarbon dating for marine molluscs.

The dates for the Poole oyster shells range from A.D.935 $\pm$ 81 for the lowermost layer from the Shipwrights' Arms core to A.D.1385 $\pm$ 81 for the Pex Marine sample - which, as previously stated, could well have been subject to contamination by more recent carbon. The Thames Street sample dates to A.D.995 $\pm$ 81 and therefore is contemporaneous with the middle layers of the Shipwrights' Arms core sample but earlier than the other samples from the Poole side. The top of the Shipwrights' Arms core contained shells dating to A.D. 1075 $\pm$ 90 which is slightly earlier than the A.D.1095 $\pm$ 108 dates obtained for both the Town Cellars and Paradise Street samples. The Shipwrights' core deposit of 3.4m depth accumulated over a period of about 150 years.

Origin of the oysters

Preliminary analysis of the shells indicates that the oysters were not washed up naturally on the shore but were deposited after harvesting from the sea (Winder, 1992). The existence of the midden was fortuitous in providing both a firm foundation for the Woolhouse and an adjacent hard for beaching craft. The midden pre-dates the founding of Poole. The group of radiocarbon dates for the Poole and Hamworthy oyster shells (excluding those from Pex Marine) places their deposition in the 10th, 11th and 12th centuries. The occurrence of such large middens in the late Saxon and early medieval periods for this locality is enigmatic.

A parallel for waterside activity leading to a town's foundation could be Kings Lynn (Norfolk) in the 11th century (Owen, 1979) where it is argued that salt-workings encouraged visits by merchants; and the town itself was constructed on the piles of sand left by the salt extraction process.

Although Hamworthy was a small port in the late Iron Age and early Romano-British periods, there is no evidence to suggest that the settlement extended beyond the end of the Roman occupation. Neither the documentary nor the archaeological evidence suggests an origin for Poole much before c A.D.1200: neither Poole nor Hamworthy is recorded in the Domesday Book. Despite an intensive series of rescue excavations undertaken by Poole Museums Service Archaeological Unit since 1972, no field archaeological evidence to alter this interpretation of the town's origins has been produced.

However, on the Foundry site excavated in 1987 a single sherd of pottery provisionally identified as an import from Quentovic was recovered in a residual context. This sherd is not closely datable although of post-Roman and pre-conquest date. A sherd of 10th-century English shell-tempered pottery was also present in a residual context on the Thames Street (PM9) site. These sherds seem to confirm the results of the C^{14} dating without suggesting necessarily any permenant occupation - certainly not on any scale. If any small permanent settlement is implied it is best seen in relation to the 7th-century ecclesiastical settlement and later Saxon burgh at Wareham. The Poole area has double tides. Consequently, a sailing boat entering Poole Harbour on the incoming tide would probably reach Poole before the tide turned, and anchor. It would reach the mouth of the Frome on the next tide and finally reach Wareham on the third tide 18 hours later.

Oyster shells are frequently found on Roman and Saxon waterfront sites in London, for example, the Pudding Lane site where analysis of the size, shape and infestation of the shells suggested improvement of natural stocks by the Romans; and one of the interpretations placed on the location of massive dumps of oyster shells beneath the openwork jetty was that processing of the shellfish may have taken place (Winder, 1985).

Post-Roman middens have been recorded elsewhere, e.g. at Bantham, Devon (Silvester, 1981; Griffith, 1986) and at Burrow Hill, Suffolk (Fenwick, 1984). In the investigation of an 11th-12th-century shell midden in Braunton Burrows (Smith et al, 1983) the authors suggest that the midden represents a cooking or processing site for shellfish redistribution. However, there seem to be no middens comparable in scale to the ones at Poole. It is interesting to note that there are unsubstantiated reports of large oyster shell deposits at Wareham. This town on the opposite side of Poole Harbour was in existence before Poole. The silting up of the Wareham Channel and the advent of deeper hulled boats is thought to have been one of the reasons for the establishment of a new port at Poole.

The massive oyster middens at Poole are an important additional strand of evidence for Dorset in the mid/late Saxon and early post-conquest period; but without additional data one can only speculate on the implications. Notwithstanding the difficulties of demonstrating post-Roman settlements, it is unlikely that the excavations at Poole would have failed to locate such settlement had it existed under the medieval town. It is possible that, if a settlement existed, it could have been located away from the middens, either further along the waterfront, on Hamworthy which has not been extensively excavated since the 1930's, or on another part of the harbour. Probably any settlement was only small and could even have been seasonal.

The rapidity with which such waste from the exploitation of marine molluscs can accumulate is well demonstrated by modern parallels. Given the magnitude of the evidence from Poole and Hamworthy, and the fact that no other food remains are incorporated with the oyster shells, it could be that the middens do not simply reflect part of the diet of an as yet unlocated local population. It seems possible that the oysters were being harvested on an almost commercial scale, opened, and the meat salted or pickled in brine in the way documented in the 17th century (Philpots, 1890).

OYSTER SHELLS FROM EXCAVATIONS AT POOLE 1973 - 1983

This part of the study of oyster shells from Poole concentrated on the macroscopic characteristics of the shells and the interpretations that it was possible to place on them. Over a period of ten years from 1973 to 1983 oyster shells were recovered from seven archaeological sites in Poole and Hamworthy. These were Thames Street (PM 9), Town Cellars (PM11), Newports (PM13), Paradise Street (PM21), the Prison (PM22), Pex Marine (PM24), and the Shipwrights' Arms (PM32) (see Figure 6.1). For comparative purposes, samples of modern live oysters were also examined and their details recorded. Some samples were dredged from natural beds in Poole Bay while others were obtained from beds of oysters which had been relaid within Poole Harbour in South Deep and Wych Channel.

Forty-seven samples of archaeological oyster shell were taken and four samples of modern oysters. A total of 3492 shells were examined. These represented a minimum number of 1816 individual oysters. 9.5% of the shells were too badly damaged to be measured. Although details of the characteristics of all the measurable shells were recorded, only 23 of the archaeological samples, grouped into seven appropriate categories, were used for the analysis because of the larger number of shells they contained. Together with the modern samples, this provided eleven groups of shell for analysis.

Aims

There were three main aims to the study of the oyster shells. First, since many of the shell deposits were on the former water's edge, it would be necessary to determine whether the shells were natural shore-line deposits or deliberate dumps. Secondly, an attempt was to be made to find out the extent to which the oysters were cultivated, if at all. Thirdly, it was hoped that the location of the beds being fished might be indicated by a comparison of the archaeological samples with modern oysters of known provenance.

[**Abundance**

It has been suggested (Horsey and Winder, 1991), that the midden beneath the Town Cellars building, and known to extend shorewards beneath Paradise Street in one direction and Thames Street in another, could possibly extend 400 metres along the quayside. However, it is now thought that oyster shells observed at such places as the Poole Pottery warehouse are probably unrelated to the large Town Cellars midden. Therefore, the revised estimate for the number of oysters represented by the midden would be nearer 7 million than

15 million; and the raw meat weight would be about 57 tonnes. This is still a very large quantity of oysters.]

Radiocarbon dating

Small sub-samples of oyster shell were sent to Harwell for radiocarbon dating. The details of this part of the analysis of the Poole oyster shells are given elsewhere. The dates calculated for those oyster shell samples submitted to further analysis were A.D.935 ± 81 for the lowermost layer from the core sample removed from the Shipwrights' Arms site and A.D.1075 ± 90 for the top sample; and A.D.1095 ± 108 for oysters from Paradise Street layer 58. The Thames Street sample used in the present study was dated stratigraphically to the early 15th century but shells from layer 6, underlying much of the site and thought to be continuous with the Town Cellars and Paradise Street middens, were radiocarbon dated to A.D.995 ± 81.

These dates mean that the shells derived from the 3.4 metre thick core sample beneath the Shipwrights' Arms on the Hamworthy side of the harbour accumulated over a period of about 150 years, starting just prior to the deposition of oyster shells on the opposite bank. The slightly later deposit at Paradise Street provided a firm base for the construction of the Town Cellars building and for beaching small craft.

Size

In any sample there is likely to be a wide range of sizes. The size of oyster shells depends on many factors. The most obvious is the age or developmental stage. As it was neccessary to compare the archaeological specimens with modern oysters, the sizes of Poole oysters were analysed using the maximum diameter of the left valve. The basic information about the sizes of shells in the different samples of oysters is given in Table 6.2. This shows that the mean sizes and standard variations differ from sample to sample. These are large oysters.

TABLE 6.2

BASIC DATA FOR LEFT VALVE MAXIMUM DIAMETER OF POOLE OYSTERS

SAMPLE	N	MEAN	ST.DEV
MODERN OYSTERS			
Poole Bay 11.11.87	183	81.49	10.76
Poole Bay 17.11.87	182	81.63	11.16
South Deep 17.11.87	102	96.68	9.38
Wych Channel 11.11.87	139	99.63	10.09
ARCHAEOLOGICAL OYSTERS			
Thames Street			
PM9 F.50 ½ cubic metre	228	93.11	8.49
Paradise Street			
PM21 L.53 - 57	74	78.61	14.38
PM21 L.58 random + block	71	83.41	12.09
PM21 L.58 502.206	90	78.62	13.82
PM21 L.58 all samples	231	81.54	12.79
Shipwrights' Arms			
PM32 samples 1-5	93	89.46	12.60
PM32 samples 6-10	76	91.07	13.78

Note. Measurements in millimetres.

To determine whether the differences were significant in statistical terms, each sample was compared with all the others using two sample *t*-tests. Where a *t*-value of 2 or more was obtained in the test, it was considered that there was a significant difference in the sizes of shells.

First of all the samples of modern oysters were tested for similarity in size. Table 6.3 shows the two sample *t*-test results for the comparisons of the two samples of oysters from natural beds in Poole Bay and the relaid oysters from South Deep and Wych Channel in Poole Harbour. There was no significant difference in size between the two Poole Bay samples but there was a large significant difference between these and the ones from within the Harbour. The *t*-value obtained for the comparison of the South Deep and Wych Channel samples was an unexpected 2.34 - which therefore indicated that they were significantly different but by a narrow margin.

TABLE 6.3 TWO SAMPLE *t*-TEST RESULTS FROM MODERN POOLE OYSTERS

	2 Poole 17	3 South 17	4 Wych 11
NATURAL BEDS			
1 Poole Bay 11.11.87	**0.12**	12.45	15.50
2 Poole Bay 17.11.87		12.14	15.13
RELAID BEDS			
3 South Deep 17.11.87			2.34
4 Wych Channel 11.11.87			

Note. *t*-values less than 2 indicate no significant difference in size between the LVMD measurements of samples.

However, *t*-tests utilise only the mean, standard deviation and the number of specimens in the sample and therefore the results may not truly reflect the similarity or difference between two samples. The histograms of size frequencies for the samples illustrate aspects of variation in size distribution that are not covered by simple *t*-tests. The Kolmogorov-Smirnov test examines the similarity between the size frequency distributions of the samples and this was also applied to the data from the samples.

Table 6.4 presents the results of the additional Kolmogorov-Smirnov tests. Here the situation is clarified since no significant difference in size distribution has been found between the two harbour samples. It is possible to say that the Poole Bay samples were alike; the Poole Harbour samples were similar; but the Bay oysters were significantly different in size and size distribution from the Harbour oysters.

TABLE 6.4 RESULTS OF KOLMOGOROV-SMIRNOV TESTS ON MODERN POOLE OYSTERS

	2 Poole 17	3 South 17	4 Wych 11
NATURAL BEDS			
1 Poole Bay 11.11.87	-	+	+
2 Poole Bay 17.11.87		+	+
RELAID BEDS			
3 South Deep 17.11.87			-
4 Wych Channel 11.11.87			

Note.
+ signifies a significant difference in distribution of sizes
- signifies no significant difference in distribution of sizes

Following this, all the archaeological and modern oyster samples were compared for size. The results of the two sample _t_-tests are given in Table 6.5.

TABLE 6.5

TWO SAMPLE t-TEST RESULTS - MODERN AND ARCHAEOLOGICAL OYSTERS

	5	6	7	8	9	10	11
1 Poole Bay 11	12.0	**1.6**	**1.2**	**1.7**	**0.0**	5.2	5.4
2 Poole Bay 17	11.5	**1.6**	**1.1**	**1.8**	**0.1**	5.1	5.3
3 South Deep 17	3.3	9.5	7.8	10.4	12.1	4.5	3.1
4 Wych Channel 11	6.3	11.2	9.7	12.4	15.1	6.5	4.8
5 PM9 F.50		8.2	6.3	9.3	11.3	2.6	**2.0**
6 PM21 L.53-57			2.2	**0.0**	**1.6**	5.1	5.4
7 PM21 L.58 r+b				2.3	**1.1**	3.1	3.6
8 PM21 L.58 502.206					**1.7**	5.5	5.8
9 PM21 L.58 all						5.1	5.3
10 PM32 1-5							**0.8**
11 PM32 6-10							

Note. t-values less than 2 indicate no significant difference in size between LVMD measurements of samples.

The t-values in Table 6.5 show that the Poole Bay samples were not significantly different in shell size from most of the Paradise Street (PM21) samples. The sizes of the shells from the two sets of samples obtained from the core beneath the Shipwrights' Arms (PM32) were alike. There was also a similarity in size between the Thames Street (PM9) shell sample and one group from the Shipwrights' Arms. The modern Harbour oysters were significantly different in size from all the other samples.

Reference to Table 6.6, showing the conclusions from the Kolmogorov-Smirnov tests on the same set of samples, substantiates and clarifies the results from the t-tests given in Table 6.5.

TABLE 6.6 RESULTS OF KOLMOGOROV-SMIRNOV TESTS ON POOLE OYSTERS

	5	6	7	8	9	10	11
1 Poole Bay 11	+	-	-	-	-	+	+
2 Poole Bay 17	+	-	-	-	-	+	+
3 South Deep 17	-	+	+	+	+	+	+
4 Wych Channel 11	+	+	+	+	+	+	+
5 PM9 F.50		+	+	+	+	-	-
6 PM21 L.53-57			-	-	-	+	+
7 PM21 L.58 r+b				-	-	+	+
8 PM21 L.58 502.206					-	+	+
9 PM21 L.58 all						+	+
10 PM32 1-5							-
11 PM32 6-10							

Note.

+ indicates a significant difference in distribution of sizes.

- indicates no significant difference in distribution of sizes

Table 6.6 shows that in fact **all** of the Paradise Street samples are probably similar in size distribution to the natural Poole Bay oysters; and both the Shipwights' Arms samples are like the Thames Street ones in size. Additionally, a similarity is now demonstrated between the South Deep sample of relaid oysters and the Thames Street sample. A summary of the size relationships demonstrated for the modern and archaeological oyster shell samples from Poole can be seen in Figure 6.2.

FIGURE 6.2

RELATIONSHIPS BETWEEN MODERN AND ARCHAEOLOGICAL OYSTER SHELLS

(based on size)

POOLE OYSTERS

MODERN SAMPLES

POOLE BAY NATURAL OYSTER BEDS	POOLE HARBOUR RELAID OYSTER BEDS
Poole Bay 11 = Poole Bay 17	Wych Channel 11 = South Deep 17

ARCHAEOLOGICAL SAMPLES

PARADISE STREET PM21 L.53-57	THAMES STREET PM9 F.50
PM21 L.58 ran+block	SHIPWRIGHTS' ARMS PM32 L. 1-5
PM21 L.58 502.206	
	PM32 L. 6-10
PM21 L.58 all	

Shape

When the shells were measured, differences in shape were observed between the samples. One simple way of considering shape variations in oyster shells is the degree of roundness or elongation of outline. There is believed to be a link between the outline shape of an oyster and the type of substrate on which it lies. In the Portuguese and American species of oyster - which normally exhibit a more oval shape than our native oyster - an elongate form is induced in oysters on very soft mud while a rounder type occurs on firmer sea beds in deeper water. Our native European flat oyster may also be influenced by substrate but in a unique way determined by its own original template for shell growth.

Some oyster shells have an irregular general shape. This tends to occur when the spat oyster settles from its free-swimming stage onto an object from which it acquires its shape. It can also happen when many young oysters settle on the same object and compete for growing space. Irregularities like these, accompanied by groups of oysters adhering together, are more typical of natural breeding populations than relaid populations where young oysters would be separated from each other and from disfiguring attachments. However, the absence of irregularities and clumping cannot necessarily be taken to imply the reverse. Regular dredging on natural beds can separate and disperse oysters over a wider area, thus enabling individuals to attain a regular shape. Indeed, this seems to be the case with the present-day oysters from Poole Bay and their equivalent in the archaeological record.

One readily quantifiable aspect of shape in oyster shells is the relationship between width and length. Linear regressions were calculated for width over length measurements for left valves in each sample. The results of the linear regressions are presented in Table 6.7 which gives the slope (as the tan of the angle), the y-intercept and the correlation co-efficient. The samples are arranged as in previous tables.

TABLE 6.7 SHAPE OF POOLE OYSTERS BASED ON A LINEAR REGRESSION OF WIDTH OVER LENGTH IN LEFT VALVES

SAMPLE	SLOPE (tan of angle)	Y INTERCEPT	COR COEFF
Poole Bay 11	0.6903	22.1794	0.7579
Poole Bay 17	0.6948	21.0305	0.8115
South Deep 17	0.3828	53.1459	0.4693
Wych Channel 11	0.4869	41.5529	0.5644
PM9 F.50	0.6538	35.9021	0.6771
PM21 L.53-57	0.6168	29.4681	0.6682
PM21 L.58 r+b	0.5942	31.1673	0.5754
PM21 L.58 502.206	0.6733	24.1042	0.6737
PM21 L.58 all	0.5874	31.8684	0.6150
PM32 L.1-5	0.7197	26.4422	0.7818
PM32 L.6-10	0.6861	28.9873	0.7445

In Table 6.8 the angles of slope for the regression lines obtained for width over length are shown in descending order of magnitude. This table shows that whilst none of the samples can be said to have perfectly rounded shells, some are definitely more rounded than others. The modern natural oysters from Poole Bay and the archaeological shells from the Shipwrights' Arms site (PM32) are fairly closely grouped at the top end of the scale of roundness. The shells from the Thames (PM9) and Paradise Street (PM21) sites are intermediate on the scale and separated by a substantial margin from the modern relaid oysters of the Harbour which are at the bottom of the scale.

The correlation co-efficients show that the roundest shells are also the most closely grouped around the regression line with, for example, 61% to 66% of the shells in the Poole Bay samples being accounted for by the line. In contrast, the shells in the samples with the least rounded shells from the modern Poole Harbour beds were only explained in terms of the line in 22% and 32% of cases.

TABLE 6.8 SHAPE OF POOLE OYSTER SHELLS ON A SCALE OF ROUNDNESS

ORDER OF ROUNDNESS	ANGLE OF SLOPE IN DEGREES	SAMPLE
MOST ROUNDED		
1	35.7434	PM32 L.1-5
2	34.7913	Poole Bay 17
3	34.6188	Poole Bay 11
4	34.4540	PM32 L.6-10
5	33.9504	PM21 L.58 502.206
6	33.1745	PM9 F.50
7	31.6671	PM21 L.53-57
8	30.7172	PM21 L.58 r+b
9	30.4310	PM21 L.58 all
10	25.9608	Wych Channel 11
11	20.9451	South Deep 17
LEAST ROUNDED		

Note. An angle of slope of 45 degrees would indicate a shell with equal width and length, i.e. rounded. Less than 45 degrees indicates progressively broader or longer shells, i.e. less rounded.

Another way of looking at the shape characteristics of the oyster shells is to divide the width measurement by the length. If the shells are round, i.e. width equals length, the result of this sum is one. When the shells are broad, i.e. width is greater than length, the result is more than one. Where the shells are long, i.e. length is greater than width, the result is less than one. The proportions of shells in a sample tending to be longer or wider can therefore be calculated.

TABLE 6.9
PERCENTAGES OF DIFFERENT SHAPED OYSTER SHELLS IN POOLE SAMPLES
(based on width divided by length in left valves)

SAMPLE	LONG SHELLS (less than 1)	BROAD SHELLS (more than 1)	RATIO (approx)
Poole Bay 11	62.29	37.71	2:1
Poole Bay 17	68.13	31.87	2:1
South Deep 17	76.47	23.52	3:1
Wych Channel 11	84.81	15.83	5:1
PM9 F.50	16.23	83.78	1:5
PM21 L.53-57	41.89	58.11	1:1
PM21 L.58 r+b	52.12	47.89	1:1
PM21 L.58 502.206	52.21	47.76	1:1
PM21 1.58 all	49.78	50.21	1:1
PM32 L.1-5	32.62	67.41	1:2
PM32 L.6-10	32.91	67.12	1:2

The relationships demonstrated between modern and ancient samples of oyster shells in Poole for sizes and size distribution are well defined. Analyses of shell shape have not been so extensive. It is only possible to attempt an interpretation on a local level. We know that there is a contrast is size between the shells from Poole Bay and Poole Harbour. We also know that the shells from Poole Bay show a two to one ratio of elongate and broad shells. The shells from South Deep show a change in proportions of three elongate to every broad shell; and in Wych Channel the ratio is five elongate to one broad shell. So there is a demonstrable difference in shape as well as size for the oysters from these locations.

However, using _t_- and Smirnov tests, a correspondence in size and size structure has been shown between the archaeological and modern oyster samples such that if seems reasonable to assume that the oysters from the Paradise Street site (PM21) were probably collected from Poole Bay while the oysters from Thames Street (PM9) and the Shipwrights Arms (PM32) were derived from beds within the Harbour in places like South Deep or Wych Channel. Are the different shape characteristics seen in the modern samples also reflected in the archaeological oyster shells?

The Paradise Street oysters showed a one to one ratio of elongate to broad shells. The Shipwrights' Arms oysters were in the ratio of one elongate to two broad. The Thames Street shells were in the proportions of one elongate to five broad. So changes in shape can be seen in the archaeological shells in the same way as they can be shown in modern oyster samples but there is a major difference between the old and modern shells. Today it is the proportions of elongate shells in the samples that varies. In the past it was the number of broad shells that showed the greatest variation.

It was stated earlier that outline shape in other species of oyster is thought to be related to the type of substrate on which the oyster lies. Longer shells are found on soft mud and rounder shells on firm ground. (Elongate in this context being the layman's way of describing an increase in the distance from hinge to margin. It must be pointed out that, in biological terms, this dimension is the width of the animal).

TABLE 6.10 DIFFERENCES IN SHAPE IN POOLE OYSTER SAMPLES

MODERN SAMPLES		ARCHAEOLOGICAL SAMPLES	
BAY TYPE OYSTERS			
POOLE BAY 11 & 17		PARADISE STREET	
2:1		1:1	
long		'round'	
HARBOUR TYPE OYSTERS			
SOUTH DEEP	WYCH CHANNEL	SHIPWRIGHTS' ARMS	THAMES STREET
3:1	5:1	1:2	1:5
longer	longest	broader	broadest

Portuguese and American oysters typically have a shell that is greater in size from hinge to margin than at right angles to this. These species are also capable of surviving partial burial in soft sediments. The English flat oyster normally has a rounded shell and is incapable of living in very soft muds. It can be postulated that shell growth response of the flat oyster to different types of substrate would be different. In order to prevent the oyster from sinking and suffocating in soft muds, shell growth would be directed towards an increase in surface area to maintain its position on top of the substrate and would not be concerned with maintaining access for a respiratory current of water as the oyster gradually sank by the heavier hinged end.

It is known that the Poole Bay sea bed is firmer, sandier and cleaner than the bed of Poole Harbour which is characterised by fine silty mud intermixed in areas with gravel or shell debris and patches of clay. The shapes of the Poole oysters probably reflect the two main categories of substrate. For the reason outlined above, adaptation to life on softer sediments may have led to increase of surface area leading to higher proportions of either longer or broader shells (defined by internal anatomy).

The predominance of longer shells in both Bay and Harbour modern samples, when compared with the archaeological shells, may be due to physical changes which have been taking place within the Harbour, possibly resulting in higher levels of silt both on the bed and in the water column. The area of water at high tide level in Poole Harbour has been gradually decreasing over the past 6000 years, this process accelerating in the last century or so due to the colonisation of mud flats by Spartina and reclamation by man for land use (May, 1969). This must mean that whilst the silt load of river systems entering the Harbour remains constant, it is delivered to an area of harbour which is estimated to have decreased by about 2,500 acres from 6,000 B.P. to 1966. Five hundred and eleven acres of harbour are thought to have disappeared between 1807 and 1966. At an average loss of 0.4 acres of water a year, 417 acres would have vanished since the oysters found on the Paradise Street site were dredged. It is possible that these processes have affected the nature of the sea bed sediments and thus the shapes of the oyster shells.

Infestation

The small marine invertebrates that attack oysters, or attach themselves to the shell, have specific ecological requirements and sometimes distinct distributions in nature. Evidence of infestation of oyster shells may indicate the location of the oyster beds being fished. Animal encrustations on the inner surface shows that the shell has been lying on the sea bed after the death of the oyster which is therefore probably the result of natural causes rather than dredging.

Freshly-dredged live oysters are frequently covered by all manner of organisms including soft-bodied animals, like sea squirts and sponges, and seaweeds. In oyster shells from archaeological excavations the only evidence to survive comes from those creatures that have left characteristic marks such as boreholes in the shell or have left hard parts attached to it. The frequency with which each of eight major categories of evidence for infesting or encrusting organisms occurred in each sample was calculated and the rate of infestation plotted in histogram form.

The pattern of infestation in the shells helps to substantiate the idea that variability in appearance can be used to determine the location of the beds from which they were fished and can reflect changes in the substrates of the Harbour and Bay. The percentage frequency of the evidence for infesting organisms is shown for selected samples in Figure 6.3. The modern Harbour specimens were noted as being massively encrusted by the various organisms, including soft-bodied forms, whilst the Bay shells were only minimally affected.

Figure 6.3 shows that overall infestation is much slighter in the archaeological specimens. Encrusting forms are virtually absent from all samples except the Thames Street one. High levels of infestation in the modern specimens could be partly due to greater levels of nutrients accompanying an increase in silt deposits during recent times.

Figure 6.3 also shows the burrows of Polydora ciliata type occurring most frequently in the modern samples and all but one (PM9) of the archaeological ones but the numbers of shells affected by Polydora hoplura are under-representative in the modern samples because the damage is internal and not readily observable in live specimens. It is known, from talks with local oyster fishermen and from examination of empty modern oyster shells, that internal mud blisters and discolouration on shells is not only very common but a great nuisance to the production of quality oysters for the restaurant trade. In archaeological samples P. hoplura is always less common than P. ciliata. Since P. hoplura is an indicator of softer muddy ground in shallow warm water it is possible to suggest that in the 10th, 11th and 15th centuries from which the archaeological specimens were drawn, the low levels of P. hoplura may indicate an environment that was less muddy.

Cliona celata is marginally more frequent in the Harbour specimens. Calcareous tubes from Pomatoceros triqueter, Balanoides type barnacles and Polyzoan encrustations are all more frequent in the Harbour shells especially the Polyzoa. Boreholes caused by predatory gastropods and Sabellid sand tubes are absent from the Harbour shells but present in the Bay shells.

Discussion

There are similarities in size between the modern and archaeological oyster shells. In the same way that there is a statistically significant difference in size between oyster shells from natural beds in Poole Bay and those from relaid oysters in Poole Harbour, a distinction can be made between the various archaeological samples.

The archaeological deposits in Poole must be considered as deliberate dumps of shell rather than natural shore-line accumulations. The shells show no sign of wear or internal encrustation. On the contrary, the shells are mostly clean and fresh-looking with sharp edges. The exception is the bottom layer of the core sample from Shipwrights' Arms. Here some shells were discoloured and had Polyzoa, barnacles and oyster spat inside but, since possible knife marks were also recorded, the shells deposits were probably man-made. Elsewhere, evidence of opening, such as cuts on the smooth inner surface, and V or W-shaped notches were frequently noticed on shell margins. In many instances it was interesting to note that the two valves of the oyster were still in position; this was particularly noticeable in samples from Thames Street and the Shipwrights' Arms.

Various ducumentary sources (Hutchins; Philpots) refer to an incident in 1747 when " in digging a dock for a ship on a tongue of land opposite the harbour called Hamworthy, a large bed of oyster shells was found six-feet-and-a-half thick, regularly piled one upon another. The ligatures of most were visible. The whole bed was covered with about a foot of black mould. But this was not a natural bed of oysters; for they had all been opened, the fishermen having a knack of taking them out without breaking the ligatures." So recent archaeological excavations have provided evidence to support this account.

The fact that such large quantities of shell were thrown on the shore, over a relatively short time span, at a period and in a location for which there is no known documentary or archaeological evidence for habitation, indicates the oysters were not being fished for domestic purposes but on a commercial scale with subsequent processing of the meat since live oysters would normally be transported in the shell. There are written accounts by writers such as Hutchins, Defoe, Britton and Brayley, for the processing of Poole oysters in the 17th century - "In the reigns of James I and Charles I, great quantities of oysters, taken in or near the harbour, were pickled, barrelled, and sent hence to London, Holland, the West Indies, Spain and Italy". The actual pickling process is not described but would probably have involved brine.

The enormous numbers of shells generated by the processing of oysters for export constituted a threat to shipping by blocking the channels where they were thrown overboard. "They were formerly opened at Hamworthy and the shells left on the shore; but, about 1640 or 1670, they were forbidden by the corporation, who imagined such encumbrance might injure the channel; on which they opened them in boats on the mud, near the strand, and threw the shells there, by which that hill of shells was raised, which at high water at least, is surrounded by the sea, and called the "Oyster Bank". That bank is still marked on navigation maps of Poole Harbour today. The extensive middens found beneath the Town Cellars and the Shipwrights' Arms could have accumulated in the same way.

However, the radiocarbon dates for oyster shells from the excavated middens show that they were deposited between the 9th and 12th century. Therefore, the examination of the oyster shells from recent excavations in Poole has provided very strong evidence to support the view that the kinds of oyster fishing and processing activities recorded in documents for the 17th and later centuries were based on a long-standing tradition that stretched back at least six centuries - even though the town of Poole had not yet come into existence. Further evidence could come to light in future excavations in Poole and Hamworthy. Kellys Directory for 1903 has an entry concerning the Poole oyster industry and includes an interesting item of information, which one must assume to have been local knowledge, that "Warehouses on either side of the water are built on oyster shells".

Places where oysters breed well are not necessarily the best places for producing well-developed meat. For this reason young oysters have traditionally been collected from their natural place of settlement and transferred to places where conditions are favourable for fattening the oysters. Nobody knows for certain when this practice was first introduced although it has often been suggested that the Romans introduced oyster culture to Britain. It is known that in the early 19th century many Poole boats took brood oysters from the natural beds in Poole Bay to the creeks of the Thames estuary to fatten for the London market. The last day's catch of the season was always thrown into the channel in Poole Harbour to provide for local demand. Young oysters from Poole Bay and places further afield, like the Solent, continue to be relaid in channels of the Harbour for fattening.

The analysis of the modern oyster samples has proved that there is a difference in size, shape and infestation between the natural oysters from Poole Bay and the relaid ones in Poole Harbour. These differences are also demonstrated in the archaeological samples. It has been deduced, therefore, that some of the excavated samples were derived from Poole Bay and others from Poole Harbour. Fishermen from Poole Harbour may have been relaying oysters as early as the 9th century. It is even possible that the idea was first generated by the Romans when they occupied Hamworthy.

OYSTER SHELLS FROM OWER FARM

A site of comparable date to the Poole oyster middens was discovered on the southern shore of Poole Harbour during excavations carried out in advance of the construction of an oil pipeline by British Petroleum. The shell midden uncovered at Ower Farm was medieval (12th to 13th century) but unlike the Poole middens which were composed entirely of oysters, here oysters were a minor component with cockles and winkles predominating. Examination of the shells provided an interesting contrast to the Poole situation.

The size frequencies for samples of oyster shell taken from the Ower Farm midden are shown in Figure 6.4. The mean maximum diameter of these shells was 70.1 $\pm$ 14.8mm which is fairly small.

The age distribution for oyster shells in sample 1310 is given in Figure 6.5. The Ower shells were predominantly young with a mode at two years but a fairly wide age range. A growth curve was calculated and can be seen in Figure 6.6. There was a high proportion of irregular specimens, especially with distortions at the heel. Many oysters had settled on cockle shells which were either still attached at the hinge end of the lower valve, or had left their distinctive imprint.

The degree of infestation is shown as histograms for three contexts in Figure 6.7. Infestation was slight. Encrusting forms were absent. *Polydora ciliata* borings were common in terms of frequency of counts but not severe in individual shells. *Polydora hoplura* was only tentatively ascribed to long atypical exterior burrows. Only a few shells had been bored by the Cliona celata sponge.

Small spat oysters less than 10mm diameter were recovered from the washing residues and had obviously become detatched from larger shells. Older oysters were sometimes stuck to each other. The edges of the shells were mostly thin, sharp and unconsolidated, giving a corrugated appearance to the outer margins of the inner surfaces.

The oyster shells occurred in well-separated lenses of varying size within the midden. All the pieces of evidence suggest that oysters at Ower Farm were collected sporadically from a small, natural, overcrowded population that had settled on a rough substrate that included accumulations of empty cockle shells. The oysters may only have been uncovered at very low spring tides. The thin peripheral shell shoots together with the presence of small spat oysters are an indication that the oysters may have been collected in the late summer or early autumn.

Oysters grow well nowadays in the South Deep channel that passes just by the mouths of Newtown and Ower Bays but at a depth that requires dredging. Natural scatterings of cockle shells were recorded on the south channel flank (Dyrynda, 1988, 13). The substrate was found to comprise unconsolidated soft mud, various grades of sand, gravel and stones; with exposed faces of consolidated marine clay on the advancing outer edges of the bends (Dyrynda, 1987, 2.23, 3.8). It is possible that the remnants of the ancient wood and boulder causeway which still traverses South Deep between Cleavel Point and Green Island could have trapped both drifts of old cockle shells and, occasionally, oyster spat which developed into a small population of irregularly-shaped oysters which could be culled by hand at infrequent periods subject to tides. Certainly, if Newtown Bay had such soft muds in the 12th/13th century as it has today, it could not have supported an oyster bed because oysters sink and suffocate in such sediments.

OYSTER AND OTHER MARINE MOLLUSCS FROM CORFE CASTLE

On a clear day, Corfe Castle on the south side of Poole Harbour can be seen from the town of Poole. The ruined castle commands a view of the Purbeck hills and heathland right down to the harbour's edge and across the water to the northern shore. It also lies just three miles from Ower Farm. Shells of the flat European oyster, Ostrea edulis L., and other edible marine molluscs were recovered from 40 contexts during the excavations at Corfe Castle in 1986 and 1987. The number of shells in each sample was small. The data derived from the shells were grouped where appropriate to facilitate analysis of the material. Historical documents were consulted to aid interpretation of the data.

Oyster shells were studied in grouped samples, details of which are given in Tables 6.11 and 6.15. There were very few shells from the 12th-, 15th- and 16th-17th century phases; these have been grouped with the 16th century contexts as a Pre-demolition phase. Modern contexts were not considered in the analysis.

Numbers of oysters

The 40 contexts were grouped and allocated to eleven phases of the occupation of the site. The distribution of the contexts can be seen in Table 6.11. All modern contexts were excluded from the analysis. The relative abundance of oyster shells from the various phases of the site is given in Table 6.12. This shows the numbers of right and left valves for each phase; the proportion of damaged, unmeasurable shells; the total numbers; the calculated minimum number of individuals; and the percentage of the site total found in each phase.

A total of 477 oyster shells was recovered, representing a minimum number of 258 individual oysters. Nearly half the shells (MNI 122; 47.3%) were found in contexts assigned to the 17th century. If the oyster shells from the Demolition contexts of 1646 are added (MNI 37; 14.3%), then 159 individual oysters or 61.6% came from 17th-century contexts. The total number of left valves was 229 and right valves 248.

High percentages of shells were damaged to the extent that they could not be accurately measured. Damage in left valves affected from 27 - 70% of the samples. In right valves between 11.1 and 50% of each sample was damaged. Damage was overall greater in left valves with an average of 49.4% compared with 27.8% of right valves unmeasurable.

Abundance of other marine molluscs

Ten other species of British marine mollusc shell were found during the excavations of 1986-87 (not including the contexts from the modern phase). These were as follows:

Cockle (COCK)	Cerastoderma edule (L.)
Dog whelk (DOG WELK)	Nucella lapillus (L.)
Freshwater mussel (FW MUSL)	Anodonta sp.
Limpet (LIMP)	Patella sp.
Mussel (MUSL)	Mytilus edulis L.
Whelk (WELK)	Buccinum undatum L.
Winkle (WINK)	Littorina littorea (L.)
Saddle oyster (SADL OYST)	Anomia ephippium (L.)
Scallop (SCAL)	Pecten maximus (L.)
Unidentified bivalve (UNID)	? Cultellus sp.

Table 6.13 shows the numbers and Table 6.14 shows the percentages of other marine molluscs. There were very few marine mollusc shells other than the oysters. The most common were the edible cockles of which 35 valves were found comprising 53.9% of all non-oyster shells. 68.6% of the cockles belonged to 17th-century contexts (much the same proportion as the oysters in the same phase). Winkles were the next in abundance although there were only eight specimens - all from 17th-century contexts. The other species occurred in small numbers scattered through the phases.

Size of oysters

Tables 6.15 and 6.16 summarise the size data for oyster shells in grouped samples termed Corfe 0 - Corfe 8. The groups with only a few oysters were not analysed in detail. From these tables it is possible to see that the sample sizes vary a great deal. The numbers of right and left valves in the same samples differs. The left valves are generally bigger than the right valves. The mean maximum width measurements (LVMW & RVMW) for each sample differs.

The size distributions of the right and left valve maximum widths for groups 2, 3, 4, 5, and 6 have been drawn as histograms in Figures 6.8 and 6.9. The sizes of right valves range from 40 - 110mm. The highest frequency in right valves lies between 60/65 and 70/75mm. Left valves range from 50 - 110mm. The highest frequency of left valves is a great deal more variable than in the right ones. Figures are as low as 65/70mm in Corfe 3 (Pre-demolition and demolition layers) and high as 90/95mm in Corfe 2 (1646 Demolition phase).

Two sample *t*-tests were used to determine whether the differences in the mean measurements of the samples were significant in statistical terms. Generally only samples with thirty or more measurable shells were analysed. The results of these tests can be seen in Tables 6.17 and 6.18.

According to these tests, based on means and the standard error of means, there is **no significant difference** between the sizes of the oyster shells in the grouped samples from Corfe Castle.

Age

The age of the right valves was estimated where possible. The right valves are used because the growth lines and bands are not obscured on this flatter valve by the frills, ornamentation and encrustations so frequently found on the left valve. The frequencies of shells allocated to the various age groups and the mean right valve maximum width (RVMW) is given in Tables 6.19, 6.20 and 6.21.

The age distributions are shown as histograms for the grouped samples in Figure 6.10. Ages ranged from 2 - 12 years but most oysters were between three and eight years. The optimum age for cropping oysters today would be around four years. Smaller oysters would not yield much meat nor would they have had a chance to breed. Older oysters have tougher meat which would require cutting and chewing, or cooking. The meat of a younger oyster can be swallowed whole or crushed by the tongue against the palate and eaten raw (alive).

Growth rate

Age assessment becomes progressively more difficult to estimate as the oyster gets older because the growth bands become narrower as the shell starts to thicken up as opposed to increasing in diameter. Energy is diverted to the production of meat and spawning products.

The absolute growth rates of oysters from grouped samples have been plotted (using the data from Tables 6.19, 6.20 and 6.21) and are depicted in Figures 6.11, 6.12 and 6.13. The growth rates are almost identical for the first few years (2 - 5 years) but as growth falls off, the samples show disparities. The sample with the largest number of specimens (Corfe 4: 1646 demolition and 17th century: n = 106) shows the best approximation to the sigmoid curve typical of bivalve shell growth, with more or less constant standard deviation of the means in each age group. The growth rates are good.

Infestation

Eight types of evidence for infesting and encrusting organisms were found on the Corfe Castle oyster shells. The percentage frequency of the different types of infestation evidence for the grouped samples is given in Table 6.22. The rate of infestation is also shown in bar chart form in figures 6.14 and 6.15.

Overall infestation was slight. In each group the borings of P. ciliata are the most frequently occurring (around 50% in all samples after the 16th century - which was a small sample and may have been atypical). P. hoplura was also present in all samples but affected fewer shells (between 10% and 20%). The level of Cliona sponge borings was noticeably higher in the Corfe 2 (1646) samples at 33.9%. The keeled calcareous tubes of P. triqueter were most noticeable in the Corfe 1 (16th century) contexts; they were attached to 15.8% of shells. Barnacles were entirely absent from three of the samples and occurred in small numbers of shells only in Corfe 2 (1646), Corfe 3 (pre-demolition and 1646) and Corfe 4 (1646 + 17th century.)

The highest level of Polyzoa was 10.5% in Corfe 1 (16th century) but it was either absent or its incidence was very low in the other samples. Boreholes affected between 12.5 and 17.8% of shells in all samples. Sand tubes were absent from Corfe 1 (16th century) and Corfe 6 (post-17th century); the highest level of 11.9% was in Corfe 2 ; the lowest in Corfe 5 (17th century) with 2.3%. Most of the evidence is for infesting or boring forms rather than encrusting.

Other characters

The percentages of shells for which various qualitative attributes were recorded are shown in Table 6.23. On the whole, the oyster shells tended to be thick and heavy with up to 52.2% being noted as such in the Corfe 2 (1646) sample. Few shells were recorded as being thinner than would be expected for their size and age. Corfe 5 (17th century) had 10% of these shells.

Corfe 2 had the highest levels of chambering - 28.8%. However, chambering was common to all the samples. Chalky deposits were not so common with levels of 1.4 - 5.4% in some samples and absence in others. The greatest number of worn and flakey shells occurred in post-17th-century contexts.

Adult and spat oysters were occasionally attached to shells. Most of the irregular shaped shells, thought to be typical of overcrowded natural oyster beds, belonged to Corfe 1 (16th century). There were very few cuts or notches and the ligament was not preserved in any of the specimens.

Taphonomy

The spatial distribution of the marine mollusc shells, particularly the oysters, has been considered by examining the stratigraphical evidence along with the relative abundance of shells in the different contexts, and the colouring and condition of the shells. Most of the shells were recovered during the 1986 excavations in the Gatehouse area (253 oysters). The 1987 excavation of Areas A, B and C yielded 100, 76 and 21 oyster shells respectively.

Shells appear in three main types of deposit. The first is occupation or similar layers, usually but not always composed of black silty soil. In the Gatehouse area this includes, for example, contexts 7, 8, 17 and 18. In Area A context 78; in Area B contexts 54, 83, and 85; and context 65 in Area C.

In the second type of deposit shells are found along with limestone lumps of various sizes, flints and sometimes animal bones. This would include context 73 which was hardcore for a yard surface; context 88 that was a packed mortar surface; contexts 94,75, and 66 where hardcore was used to raise the ground level; and contexts 13 and 96 where shells and other hard materials were incorporated into pathways.

Thirdly, it would seem that some of the shells may have originally been used in the mortar of the stonework of the walls themselves, and been released by the demolition process, and the subsequent robbings and weathering. The colouring, condition of the shells, and the attachment of concretions to them in certain contexts, supports this view. Contexts with shells like these are 14, which also contained large blocks of masonry; 9 and 12 which contained debris from robbing and weathering of demolished walls; 55 which comprised rubble and mortar; and 69 which was also demolition material.

Historical information

The oyster fishery in Poole is evidently of some antiquity. It is referred to by several writers. John Britton (date unknown) actually mentions Corfe Castle in connection with the fishery. He says " that there was an oyster fishery in Poole Bay, and that though the town of Poole claimed much dominion in this bay, the Lord of Corfe Castle had a power and jurisdiction, as Admiral by Water and Land, on the seas around the Isle of Purbeck, on the high seas, and throughout the whole island, in persuance of a grant by Queen Elizabeth to Sir Christopher Hatton. The fisheremen of Wareham, upon paying a small fine to the Lord of Corfe Castle, have a right also to fish in these waters."

Another Victorian author, John R. Philpots (1890), records what must have been the heyday for the oyster industry in Poole which coincides with the period just prior to the Castle's demolition and afterwards. He writes "In the reigns of James 1st and Charles 1st", i.e. 1603-1625 and 1625-1649, "great quantities of oysters, taken in or near the harbour, were pickled, barrelled, and sent hence to London, Holland, the West Indies, Spain and Italy...".

The location of the beds is given: "Without the bar, and in the boundaries of Poole, is an extensive bed of oysters, from which there are several sloops loaded every year....The last day's catching is, by prescriptive regulation, thrown into the channel within the harbour, where they fatten, and supply the town and country during the winter with excellent oysters, and thus was formed what is now termed the outer channel bed, and at present (1890) the only productive one...".

The evidence seems to suggest that handling oysters on such a large commercial scale may have been short-lived because we are told by J. P. Hore (Hore 1880) that the 17th century saw a severe famine in oysters which led to government legislation prohibiting the export of oysters.

At a local level, the Presentments at the Admiralty Court of the Port of Poole reveal that, at least as early as 1702, restrictions were in force to conserve oyster stocks in the area. There was a close season from 1st May to 24th August and no oysters less than 3 inches (76mm) from "head to lip" were to be caught. If there were more than 100 undersized oysters in a haul of 1000, the fisherman was liable to a penalty of five shillings. It is obvious from the endless cases brought before the Admiralty Court in the 18th century that few fishermen took any notice of the rulings.

Conclusions

The analysis of abundance of oysters and other marine shells from Corfe shows that the majority of shells were recovered during the excavation of the Gatehouse area of the site. Most shells belonged to contexts dated to the demolition period in 1646 or to the 17th century generally.

Using simple techniques to compare the size frequencies in the samples, no significant difference could be demonstrated between the grouped samples from the various phases.

The other marine mollusc shells were few but each species has a preferred habitat. Limpets are generally found on intertidal rocks. Edible mussels also attach themselves to hard surfaces but these can be small stones on an otherwise sedimentary shore. Cockles are found within soft littoral substrates and winkles are also known to graze the algae on such beaches. Dog whelks are thought to prey on oysters, while saddle oysters frequently attach themselves by a chalky stalk to living oysters. The great scallop is a free-swimming animal sub-tidally where whelks also tend to live - but whelks do come ashore to lay eggs. Most of the shells would therefore be available on nearby shores or could be accounted for as being accidentally retrieved while oyster dredging.

A greater range of ages was represented in the Corfe shells than would be expected in the shellfish market today. Larger oysters would certainly be more palatable when cooked. The presence of young oysters is an indication that there were no thoughts of conserving the oyster beds by allowing oysters to spawn at least once before harvesting. Small oysters are nowadays supposed to be thrown back into the water.

Whilst the calculation of absolute growth rate, and assessment of age, is not without problems, a good growth rate is indicated for the Corfe oysters. The curves obtained were almost identical for the initial fastest growing years.

Of the other characteristics noted for the oysters, the presence of chambering is interesting in that it reflects changes in the salinity of the seawater. This happens in conditions of heavy precipitation, either directly from the skies over shallow water or indirectly via streams and rivers carrying run-off. The staining, wear and flakiness of the shells could be related to the way in which the shells had been discarded.

The spatial distribution of the shells on the site, their stratigraphical associations, and incidental information on their condition has made it possible to suggest that shells were disposed of in three main ways. The first, and most obvious, is in deposits of food waste with other domestic rubbish in occupation layers. In the second way, their hard, resistant structure has been put to use along with limestone lumps, flints and bones to form hardcore for raising ground levels, creating yard surfaces and building paths. Finally, it seems quite likely that oyster shells were used in mortar between the stones of the castle walls. This has been observed in medieval buildings at Poole and Southampton, and in a lecture Roy Spring, Clerk of Works to Salisbury Cathedral, has spoken of the way that oyster shells, when mixed with lime, delaminate and expand thus acting as a wedge which is especially useful when final stones are pushed into place in an arch (D. Hinton pers. comm.). This was apparently advocated in the 17th century by Sir Christopher Wren.

The documentary evidence has provided useful insights into the oyster fishing industry of the past. The authority of the Lord of Corfe Castle himself was required for permission to fish in the Harbour and waters around the Isle of Purbeck. Most of the oysters from the Castle dated to the 17th century when oyster dredging and marketing was a thriving business in Poole. There is, however, no evidence to indicate that those responsible for the oyster shells at the castle paid any attention to the restrictions imposed by the Admiralty Court at Poole on oyster size when the stocks rapidly became depleted. There are far more small oysters than the 10% permitted, reaching a peak of 54% in samples from post-17th-century contexts.

OYSTER SHELLS FROM LODGE FARM

Lodge Farm is near Kingston Lacey to the north of Poole Harbour. Two oyster shell samples were examined from the excavations at Lodge Farm. The first sample was from context 122 which represented a dump to the west of the present medieval building and was associated with pottery similar to that from the latest occupation layers at Corfe Castle. This indicates an early 17th-century date for the shells from context 122. The second sample was recovered from the medieval ditch cut by the foundation trenches of Lodge Farm. The pottery from the ditch filling indicates a 14th/15th-century date. Numerous antler bones in the ditch support the view that the ditch was associated with an earlier hunting lodge.

Numbers

The shells represented a minimum number of 81 individuals oysters in context 122 and 82 in context 192. The counts are detailed in Table 6.24. The flat right valves survived better than the cupped left valves in both contexts. Breakage was greater in the shells from the older ditch context (192) than in the kitchen dump (122). For example, only 7.6% of left valves from context 122 were badly broken compared with 23.6% of left valves from context 192.

Other species

In addition to oyster shells, context 192 (from the medieval ditch) contained 4 valves of Cerastoderma edule (L.) - common cockle; 3 valves Venerupis decussata (L.) - carpet shell; 1 valve of Anomia ephippium L. - saddle oyster, a fragment of ?Mytilus sp. - mussel; 4 Helix aspersa Muller - common garden snail; and 1 Cepea nemoralis (L.) - banded snail.

Size

The left valve maximum width (LVMW) measurements of oyster shells from context 122 (17th century) ranged from 60 - 105mm while those from context 192 (14th - 15th century) ranged from 49 - 98mm. The size frequency distribution of LVMW measurements for the two Lodge Farm samples are shown as histograms in Figure 6.16. Superficially, the sizes of shells in these two samples look different. However, there were only 42 measurable left valves in sample 192. This is on the low side for making comparisons. To determine whether the apparent difference was significant in statistical terms, the two samples were compared by *t*- and Kolmogorov-Smirnov tests. The *t*-value obtained was 0.93; *t*-values below 2 usually indicate that the null hypothesis cannot be rejected, i.e. that the two samples probably belonged to the same population. In other words, there was no significant difference in size between the shells in contexts 122 and 192. The Kolmogorov-Smirnov test confirmed that their size distributions were similar.

Age

The age of the right valves was assessed by counting the growth bands of the shell. This is a subjective method. The mean maximum width (RVMW) of the shells in each age group was calculated and the results are shown in Table 6.25. From this information it was possible to draw up histograms of age distributions that are shown in Figure

6.17, and to plot a growth curve from the mean size of shell in each age group that is shown in Figure 6.18.

There were differences in the distribution of ages in the two samples. Both samples had shells ranging from from 2 - 8 years. However, whilst in context 122 most of the shells were 3, 4 or 5 years with just over 51% being in the 4-year group, in context 192 there was a more even spread of ages with significant numbers in 2 to 5 year groups with nearly 33% as 3 years and 31% as 4 years. This would seem to indicate less selectivity in the collection of oysters in the 14th/15th-century medieval ditch shells from context 192 compared with the 17th-century kitchen dump shells from context 122. The high standard deviation of 15.8 in the 6-year group and 20.2 in the 7-year group of context 192 can be attributed to the small numbers of shells and the effect of the inclusion of small stunted shells in the group. 2.46% of shells were stunted in context 122; 7.34% were stunted in context 192.

Infestation

All eight types of evidence for epibionts that are commonly recorded from archaeological oyster shells were found. The percentage frequencies have been drawn up as histograms in Figure 6.19. There was a greater level of infestation by Polydora ciliata in the earlier shells from context 192 (70.6%) than in the later ones from context 122 (40.3%). Identifications of P. hoplura in the Lodge Farm shells was tentative. The U-shaped burrows were absent but there were some peripheral blisters that might have been caused by this species. Based on the occurrence of these shelly blisters, 7.3% of shells in context 192 and 5% of shells in context 122 were affected. 5.5% of shells from 192 and 5% of shells from 122 had been colonised by C. celata. There was one totally affected "rotten-back" in 192 but generally the effect was minimal.

Although many of the calcareous tubes adhering to the external surface of shells had been reduced to the basal attachment, some remained intact and could be identified. Both P. triqueter and H. norvegica were recorded in both contexts with the former type apparently dominating. 7.9% of context 122 and 7.9% of context 192 bore these tubes. Neither sample from Lodge Farm had attached barnacles. There is a possibility that they were washed off. Polyzoa were virtually absent from context 122 with only 0.7% of shells with this type of encrustation. 6.4% of context 192 shells were affected.

There was a most noticeable difference in the numbers of boreholes recorded in the two Lodge Farm contexts. Only 3.7% of shells in 192 but 23.7% of shells in 122 were affected. No Sabellid sand tubes were recorded in the shells from context 192 but 27.3% of shells in context 122 retained evidence of this type. The chalky byssi of saddle oysters were noted in a number of shells. 1.84% of shells in context 192 had byssi and 4.32% in context 122.

Other characters

Not all characteristics of oyster shells can be as easily defined as size and infestation but they are nonetheless of interest in making interpretations of archaeological shells. The percentage frequencies with which the various characters were recorded in the Lodge Farm samples are shown in Table 6.27.

Context 122 contained a large number of thick, robust shells with 41.7% being noted as especially thick and 15.1% being particularly heavy for the size and age of the shell. Only 1.4% of shells were recorded as being thinner than expected. Context 192 had a similar proportion of thick and heavy shells (45% and 16.5% respectively). However, 23.9% of the shells were noted as being unusually thin and brittle.

Chambering and chalky deposits are not universally found in the mature oyster shells. The incidence of chambering was low with 2.8% in context 192 and 3.6% in context 122. The frequency of chalky deposits was higher than for chambers with 26.6% in c.192 and 30.2% in c.122.

The proportion of adult shells stuck together or with minute spat (settled larvae) attached can indicate whether the oysters came from a natural, self-propagating bed or a cultivated one. 2.8% of shells in c.192 had young oysters or oyster spat attached compared with only 0.7% in c.122.

Similarly, a large number of irregularly shaped shells in a sample may also reflect the overcrowded growth conditions in an uncultivated bed. Context 192 had double the number of irregular shells (12.8%) compared with the shells in c.122 (5.8%).

Cuts in the soft nacreous inner surface of oyster shells and V-shaped notches on the margins - usually in the area furthest from the hinge - are thought to be caused by the knife used in opening the oyster and probably indicate that the oyster was opened whilst alive and eaten raw. Cooked oysters are frequently opened by roasting the shells in hot ashes whereby the shell opens naturally without recourse to knives. 12.8% of shells from c.192 had these marks but only 0.7% (i.e. 1 shell) in c.122 was cut.

Conclusions

No statistically significant difference in size could be demonstrated between the oyster shells from the 17th-century kitchen dump context 122 and the 14th/15th-century ditch deposit context 192 at the 0.05% level in the *t*-test or 0.01% level in the Kolmogorov-Smirnov test. This means that the two samples probably came from the same population.

Despite there being no statistically demonstrable size differences in the Lodge Farm oyster shells, differences could be observed in several ways. The size range in the earlier context 192 sample was different from the more recent context 122 sample, i.e. 49-98mm in

192 cf. 60-105mm in 122. In other words c.192 had a greater spread of sizes compared with c.122 which had a more normal compact distribution.

The age distributions show similar differences. In c.122 nearly 94% of the shells belonged to the 3-5 year groups with a peak of abundance at 4 years. This contrasts with c.192 shells in which approximately the same proportion is spread over the 2-6 year groups with the 3- and 4-year groups being equally dominant.

The age and size distributions indicate that the 14th/15th-century deposit is a random collection of shells with only the small 1 year olds and very old oysters absent. On the other hand, the 17th-century deposit seems to indicate a degree of selectivity with the minimum size raised and the maximum lowered. This is consistent with regular oyster fishing practices. We know from documentary sources that oysters were intensively exploited in Poole Bay and Poole Harbour in the 17th century and that there were regulations governing net size in relation to the minimum size of oysters allowed to be caught. Many oysters were removed from the shell and pickled in barrels for export. Older tougher oysters would probably be less suitable for this purpose. Therefore the evidence of size and age of the Lodge Farm shells supports the idea of increasing organisation and subsequent selectivity in the fishing on local oyster beds.

The types of infesting organisms and the proportions in which they occurred varied between the two Lodge Farm contexts. In the earlier 192 deposit infestation was generally slight; barnacles and sand tubes were absent; 70% of the shells were minimally affected by *P. ciliata* borings. In the later 122 sample, fewer shells had *P. ciliata* borings (40.3%); numbers of boreholes had increased considerably; and the remains of sand tubes were found on 27.3% of shells. Whilst the size evidence points to the oysters being collected from the same population, the infestation evidence points to a change in the environmental conditions in the area (such as a cooling of the climate) with a consequent alteration in the types and proportions of the invertebrate organisms present.

Examination of the other characters in the shells has shown up the similarities and contrasts in the two Lodge Farm samples. Whilst a high proportion of both samples were described as being especially thick and heavy, the earlier context 192 also had a fair number (23.9%) of particularly thin and brittle shells reflecting the inclusion in the deposit of a greater number of young oysters than in context 122.

There were not many chambered shells in either deposit but about a third of both samples had chalky deposits - possibly indicating an environment subject to salinity changes. This would be explained, for example, by increased run-off of rain and melted snow during the winter causing dilution, or evaporation in the the summer causing concentration of the sea-water.

In context 192, the higher numbers of broken shells that could not be measured, and of worn and flakey shells reflects the greater age of this deposit in comparison with context 122. Oysters from context 192 also had more young oysters attached and far greater irregularity of shape than those in c.122. Both these features are associated with wild or natural beds of oysters which may not be regularly or extensively fished. It is unlikely that the 17th century shells were actually cultivated but intensive dredging of oyster beds tends to separate the oysters so that they are able to achieve a more regular shape.

Although the shells in context 192 were more damaged than in context 122, cuts and notches were clearly visible in 12.8% of the shells compared with 0.7% (1 shell) in context 122. A silvery iridescence was noticeable on the inner surface of a number of shells in c.122; this was thought to be a result of exposure to great heat. From this evidence it is possible to infer that in the 14-15th century at Lodge

Farm the oysters were probably most frequently opened by knife whereas in the 17th century most of the oysters were probably opened by roasting and the shells cast into the hot ashes.

To sum up, the oyster samples from Lodge Farm were both probably fished from natural beds in Poole Bay. The differences between the earlier context 192 and later context 122 can be accounted for in two ways. In the first instance, it seems probable that there was a change in environmental conditions which caused a change in the infestation patterns in the two samples. Secondly, it seems likely that the intensive fishing practices documented for the 17th century and the accompanying legislation related to conservation of the beds resulted in a smaller size range, narrower age range, and more regularity in shape of the oysters.

OYSTER AND OTHER MARINE SHELLS FROM GREYHOUND YARD, DORCHESTER

The town of Dorchester lies about eighteen miles to the west of Poole Harbour and of the previously mentioned sites at Poole, Ower Farm, Corfe Castle and Lodge Farm. Oyster shells were recovered from both Roman and medieval contexts of the Greyhound Yard excavations. All the marine shells were considered for the quantification procedures. However, for most of the site only a few shells were recovered from each context, so twelve contexts with larger than average sample size were selected for the more detailed examination required for inter-phase and intersite comparisons and determination of place of origin. The twelve contexts were placed in five groups considered relevant to the enquiry. Details are given in Table 6.28.

Abundance of oysters

One hundred and thirty-nine large boxes of marine shells were recovered from the Greyhound Yard site. These contained 10,810 oyster shells representing a minimum number of individual (MNI) oysters of 5,927 found in 975 different contexts. The twelve selected contexts contained 1,263 oyster valves or 772 MNI. In other words 13% of the oysters were found in just 1.2% of the contexts, leaving an average of only eleven valves in each of the remaining contexts. The relative abundance of oysters in each phase of the site is given in Table 6.29. In order of magnitude of abundance, the percentage of oysters represented in each phase is given in Table 6.30.

The greatest numbers of oysters were found almost equally in phases 44 and 61, and half this number in phase 45. Negligible amounts were recovered from pre-Roman phases. Only small percentages were found in the remaining phases. If all the Roman phases are grouped and all the medieval phases also, it can be seen that the percentages of oysters in those groups are nearly the same, 45.1% and 40.4% respectively. If the oysters from the medieval group are indeed residual Roman ones, then 85.4% of oysters on the Greyhound Yard site are Roman and very few indeed were eaten and disposed of on site during later periods. Table 6.31 shows the abundance of oysters in the selected contexts and groups.

Abundance of other marine mollusc species

Thirteen other species of British marine mollusc were found in a total of 383 contexts not all of which contained oysters as well. In order of importance, the numbers of these species are presented in Table 6.32. These included cockles, winkles, limpets, carpet shells, mussels, whelks, spiny cockles, great scallops, saddle oysters, dog whelks and variegated scallop. A couple of top shells (Gibbula sp) and venus shells (Venus sp) were present; as well as one worn shell of an exotic species of cowrie from one of the post-medieval phases. Table 6.33 shows the actual numbers of these species and Table 6.34 gives the percentage frequencies.

The species of marine mollusc shell other than oyster were unevenly distributed within the site phases. Most carpet shells (72.6%) were found in phase 44 deposits. Cockle shells were most abundant in phase 61 contexts. Spiny cockle valves were found in equally high levels (22.8%) in phase 44 and 61 layers. Limpets were similar with 23.7%

being found in phase 61 and 22.6% in phase 44 layers. The greatest numbers of mussel shells (24.7%) were also found in phase 61 with almost as many (22.1%) in phase 45. The majority of saddle oysters belonged to phase 45 (36.4%). The highest percentage of whelks (35.3%) were recovered from phase 61; while a massive 62.6% of all winkles were found in contexts from phase 61. One specimen of dog whelk was found in each of phases 45, 63 and 71. Scallops appeared to be most numerous in phase 71 but their numbers are possibly an overestimate as in this single category of very large shells large fragments, with or without a hinge were taken as representing a whole valve.

The distribution of each species of these mollusc shells by phase has been illustrated by histograms in Figure 6.20. Figure 6.21 shows the representation of each species in each phase. Most shells seem to date from phases 44 and 61. Phase 44 is basically late Roman with earlier (1st century) material. Phase 61 is medieval with varying but high amounts of residual Romano-British pottery and other material. There is a real possibility that the marine molluscs were similarly derived from earlier phases. This would mean something like over 80% of all marine molluscs including oysters were Roman in origin.

Size of oysters

Only the sizes of the oyster shells from the twelve selected samples were examined. The maximum width of the right valves was used for the analysis. The minimum, maximum, mean, standard deviation and median were tabulated - see Table 6.35. The first point to note from Table 6.35 is that not all the samples possess a median figure. The distributions of sizes in the samples do not always have a single peak of abundance but sometimes have two or more peaks (bi-modal or polymodal). The smallest shells were found in context 2274 (minimum 28mm), the greatest in 1284 (134mm). Context 2394 had the lowest mean of 80.3mm maximum width; context 2270 the greatest mean at 98.8mm, followed by context 2347 with 93.5mm. Where a single mode or median obtained, the lowest was 65mm in context 2394; the highest was 100mm in 2347. Overall the shells are very large. Sample 2347 had the highest mean and median.

The size frequencies for the individual samples can be seen in Figure 6.22. The size distributions for the grouped samples are illustrated in Figure 6.23. Context 2274 has the greatest range of sizes (28 - 123mm) but is also polymodal, indicating that this sample could well comprise shells from several different dumps of shells. Contexts 2128, 2163, 2270, 2326 and 4615 also have more than one peak of abundance. Among these contexts, 2270 has the smallest range of sizes from 84 - 116mm but this sample is atypical because of its small size (9).

Size comparisons

To see whether the differences apparent from the histograms of size frequency and the summary of basic data were significant in statistical terms, the size frequencies of the individual samples and the grouped samples were compared using two sample *t*-tests. Obtaining a *t*-value of more than 2 would normally indicate that the two samples were significantly different. The results of group tests can be seen in Table 6.36 which shows that the oyster shells in Group 5, that belong to the medieval phase (61) with residual Romano-British pottery, seem to be different in size from the other four groups. The *t*-values obtained in Group 5 comparisons vary from 3.74 to 1.88. There is no apparent significant difference in size between Groups 1 to 4. By looking at the *t*-values resulting from comparisons of the individual contexts in Group 5 with contexts in other groups, a clearer idea of the nature of the difference in this group could be gained (Table 6.37).

Group 5 consists of the oyster samples from contexts 2347 (J), 2270 (K) and 2274 (L). All the *t*-values obtained in comparisons with the sample from 2274 were below 2 and therefore this context showed no significant difference from any of the other samples. The sample from 2270 showed a significant difference in size from all samples with *t*-

values up to 4.92. This sample, however, contained only nine shells; and therefore any results gained from its consideration as an individual sample (as opposed to part of a grouped sample) must be viewed with caution. The sample from context 2347 was significantly different from most samples - with *t*-values ranging as high as 5.44; the exceptions were the comparisons with 2270 (t = 1.34) and 1284 (t = 0.72). Context 1284 is part of Group 2 which did not itself appear significantly different from other groups.

Age of oysters

Using the right valves, an estimate was made of the age at death of the oysters. The percentage frequency with which oysters in each of the selected contexts were allocated to different age groups was plotted on a histogram. These histograms are shown in Figure 6.24. Similarly, frequencies of age groups were drawn for the grouped samples; these are seen in Figure 6.25.

The most obvious feature illustrated by the age group histograms is the very wide range of ages represented in each sample or grouped sample. Ages range from 1 year to 16 years. There is a tendency for the majority of shells to belong in the four to ten year groups. In contrast to the majority of aged oyster samples from other sites, the Greyhound Yard oysters are remarkable in their relatively even spread across the age range, with relatively high percentages of younger and older shells. Context 2274 and context 2128 in Figure 6.24 are particular examples of this. Examination of oyster samples from other sites has shown that, almost invariably, the age groups in a sample are approximately distributed in a normal curve. Only the shells in contexts 1457 and 1343 had this type of distribution. Although for some contexts the odd distribution can be attributed to the small sample size, it would seem that some unknown factor has probably been responsible for the unusual age group distribution in the Greyhound oyster shells to which consideration will be given in due course.

It was previously noted that the shells in context 2347 were significantly different in size from the other samples because of their high mean and median measurement. With regard to the age distribution of shells in this sample, no distinguishing feature can be detected.

Growth rate of oysters

The growth rate curve calculated for the context 2347 sample of oyster shells is compared with curves for individual samples of more than 30 shells in Figure 6.26. A comparison of growth curves of shells in the grouped samples is given in Figure 6.27. For the sake of clarity the points representing age groups with less than 5% of the sample have been omitted and dotted lines used to link the neighbouring points; also the bars indicating standard deviation of the means in each age group have been left out.

The oyster shells in context 2347 share the growth rate of the other samples for the first few years of life. Between the fifth and sixth years the shells from 2347 seem to have experienced a sudden growth spurt which increased the yearly average size from then on.

Group 5 includes shells from contexts 2270 and 2274 which have slower growth than shells from 2347 which is also in this group. The high growth rate of shells from 2347 dominates the group and increases the overall averages.

Infestation of oysters

Evidence was found for ten types of epibiont organism that had encrusted or infested the oyster shells. These included the commonly recorded forms. Boreholes that failed to penetrate the shell were noted. These included the more familiar small regular holes rasped by gastropods such as Ocenebra erinacea (L) (sting winkle) and Nucella lapillus (L.) (dog whelk). In addition, however, the presence of a large boring bivalved mollusc Gastrochaena dubia (Pennant) commonly called the flask-shell was recorded in thicker shells. This is similar in appearance and effect to the ship worm. It has not previously been recorded before in archaeological or modern populations of oyster shells but it has been noted as excavating its flask-shaped burrow in dead mollusc shells, sandstone and limestone along the south and south-west coasts of Britain. Its occurrence in the Greyhound Yard oysters is probably due to the fact that the exceptionally large and thick shells provided just the right habitat.

Histograms were compiled of the percentage of left and right shells in each sample (or group) affected by the various infestation types. The results are shown in Figure 6.28 for individual samples and Figure 6.29 for grouped samples. Polydora ciliata occurred in all the samples and was always the dominant form of infestation. At its lowest rate of frequency it was found in 32% of shells (context 2270); at its highest rate 66.1% (context 4167). The related species P. hoplura was generally recorded in fewer shells in all samples - ranging from 4.2% in context 1284 to 20.7% in context 1343.

Cliona celata was abundant. Only 1.8% of shells were affected in context 4167 but it was more frequent than P. hoplura in most samples and affected up to 60% of shells (context 2270). Given the high numbers of really thick, older shells on the site, it is not surprising that this sponge was so common.

Boreholes, including those caused by Gastrochaena dubia, were found in the highest numbers in contexts belonging to Group 5 with the maximum of 28% in 2270 and an overall figure of 20.6% for the group. None were found in Group 3 (context 2163) and only one in context 1457. Gastrochaena was found in six of the contexts - 8 specimens of them occurring in contexts 2274 and 2347 in Group 5. (It was also noticed in at least five other contexts other than the ones selected for detailed attention). This most noticeable of infestations was therefore found in samples derived from both Roman and medieval phases.

Encrusting barnacles, sea-mats and sand tubes were not common. They were absent altogether from many samples or present in negligible numbers. 12.5% was the highest percentage of sand tubes attached to shells in context 2274.

Conclusions and discussion

The three aims of this investigation into the marine mollusc shells from the Greyhound Yard site were to see if the relative abundance of different species through time fell into any discernible pattern; to find out whether the oyster shells found in medieval deposits had originated in the Roman levels; and to determine the place from which the oysters had been collected. In connection with the last aim, the conclusions are mostly based on intersite comparisons which are described in later chapters.

Marine shells were virtually absent from phases 21 and 22. The few that were recovered from pre-Roman deposits could well have come by contamination from later phases. At the other end of the time scale, contexts from the post-medieval phase 71 yielded only 4% of oysters and 2.3% of all other species; while the 19th-century phase 72 contained just 0.5% of oysters and 0.5% of all other types. Therefore the vast majority of shells were found in the various Romano-British and medieval phases.

The frequency with which the non-oyster species of marine mollusc appeared in different Romano-British and medieval phases of the occupation of the site was complex. The same species were recovered from the Romano-British phase 44 and the medieval phase 61. However, a higher proportion of carpet shells and spiny cockles were found in RB phase 44, whereas most cockles, limpets, mussels, whelks and winkles were found in medieval phase 61. The majority of great scallops were found in post-medieval phase 71. There does seem to be some interphase differentiation in species representation. This is difficult to interpret because of the known residuality problems. It does seem to indicate that, despite residuality and contamination problems tending to homogenise the contents of the layers, e.g. by incorporating material from earlier phases, the relative abundance of species did change with time. It is obvious that the shellfish were probably collected from a variety of coastal localities because the habitats of the species differ from deep water to the littoral on a variety of substrates.

Oysters are first found in substantial numbers in the early Romano-British phases 42 and 43 where 1138 shells representing 10.5% of all oysters were recovered. Phase 44, the Romano-British developments of the central area of the site behind the frontage properties, was responsible for 27.9% of oysters. The contexts from the later Romano-British periods 45, 46 and 51 accounted for 16.8% of oysters. Not knowing exactly to which part of the Romano-British occupation phase 44 belongs, it is not possible to say whether the numbers of oysters fluctuate through time. However, the number of oysters for all the Romano-British phases amounts to 45.1% of the site total. Almost half the oysters can be described as definitely Roman.

The highest percentage of oysters from any single phase (29%) was recovered from the early medieval phase 61. The medieval phases 62 and 63 accounted for a further 11.4%. A total 40.4% of all site oysters belonged to the medieval period. A high degree of residuality from earlier Roman layers was evident in the medieval deposits. For example, 99% of the pottery in contexts 2128 and 2274 was Romano-British. It is therefore likely that other material such as the shells are also residual. This was kept in mind during the detailed examination of the selected samples.

Four out of five of the grouped samples subjected to extra analysis showed no significant difference in size characteristics in two sample *t*-tests. Group 5 was significantly different. *t*-tests on the individual samples of which the groups were composed showed that it was context 2347 alone in Group 5 that was responsible for this difference, the results from context 2270 being regarded unreliable because of the small sample size. The sample from context 1284 was discovered to be significantly different in size in five out of eleven comparisons but this was not apparent in the Group 2 comparisons of which it was a part.

There was a slight difference in the absolute growth rate of the oysters from context 2347 (and Group 5) in comparison with that obtained for the other Greyhound samples. All samples shared much the same growth rate for the first few years but during the fifth to sixth years oysters from 2347 seem to have experienced a growth spurt which led to a higher than average size from then on.

The types of infesting and encrusting organisms, and their relative frequency, recorded for context 2347 oyster shells were not remarkably different from other samples. The large burrow of *Gastrochaena dubia* was recorded in this medieval sample as well as firmly phased Romano-British ones. This could be taken either way, as supporting the idea that the shells in contexts phased to the medieval were derived from Romano-British deposits, or that such infestation was common to oysters in both phases.

The evidence from the analysis of marine mollusc shells from the Greyhound Yard site in Dorchester shows that the relative abundance of the various species changed with time from phase to phase. Oysters occurred in almost equal quantities in Romano-British and medieval phases. Since, with one main exception, there was no significant difference in size between most of the samples selected for detailed examination, and no great differences in age distribution or growth rate, there seems to be a lot of support for the idea that the oysters in the medieval samples originated in the Romano-British phases. The exception was the sample from context 2347 in medieval phase 61 which was significantly different in size from the rest, and had a slightly higher growth rate. However, the age distribution and infestation rates were similar to those in other samples. There were even the distinctive *Gastrochaena* burrows noticeable in the firmly-phased Roman deposits. Oysters from context 2347 might be truly medieval or simply different.

The wide range of ages in the Greyhound Yard oysters, and the even way the specimens are distributed across the age range, is thought to be an indication that the oyster bed in which they originated was an uncultivated one and that no direct or indirect selection procedures were operating during their collection. The age frequencies in the oysters from context 2347, which was noted as being significantly different in size from the other Greyhound Yard samples, exhibited no distinguishing features.

The findings of the intrasite analysis of marine shells from Greyhound Yard can be summarised as follows. Interphase differentiation in relative abundance of species was demonstrated although interpretation of these patterns was not possible because of imprecise dating and problems of residuality.

With the exception of oyster shells from context 2347, there was no significant difference in size between most of the selected samples from Romano-British and medieval phases; and even context 2347 shared a similar distribution of age groups and types of infestation. The evidence suggests that oysters in four of the five medieval contexts examined were derived from Romano-British deposits, while oysters from the remaining context 2347 were different but not necessarily medieval.

OYSTER AND OTHER MARINE MOLLUSCS FROM ALINGTON AVENUE, DORCHESTER

Alington Avenue was basically a rural site on the outskirts of Dorchester. A small quantity of marine mollusc shells was recovered, the majority of which were oyster shells but thirteen other species were also recorded. The shells were found in a wide variety of context types across the site. Most contexts yielded only a few marine shells. Larger numbers of specimens tended to be found in later contexts with a suggestion of contamination from relatively modern material.

Three phases of site occupation yielded the greatest numbers of oyster shells : phase 30 (arabilisation and monument decay), phase 40 (immediate pre-Roman and Romano-British), and phase 50 (post-Roman). No single context contained enough shells to permit statistical analysis at this level. Therefore the shells from contexts belonging to the same phase were grouped together (theoretically) for analysis to see how the grouped samples compared and contrasted with each other.

Numbers

The most frequently occurring marine mollusc shells on the Alington Avenue site were oysters (Ostrea edulis L., 403) followed by the common cockle (Cerastoderma edule (L.), 118), mussels (Mytilus edulis L., 33 plus), spiny cockles (Acanthocardia spp., 11 plus), limpets (Patella vulgata L., 7 plus; Patella aspera Lamark, 14), whelks (Buccinum undatum L., 5), carpet shells (Venerupis decussata (L.), 3 plus; Venerupis rhomboides (Pennant), 1), and specimens of saddle oyster (Anomia ephippium L., 1), American or Blue Points oyster (Crassostrea virginica Gmelin, 1), winkles (Littorina littorea (L.), 3; Littorina saxatilis (Olivi), 1) together with fragments of great scallop or escallop (Pecten maximus (L.)) and common sea urchin (probably Echinus esculentus).

Table 6.39 shows the numbers of oyster shells recovered from each phase of the site, with columns for left valves (LV - those that could be measured), unmeasurable left valves (UMLV), the total number of left valves (TOT LV), and the percentage of unmeasurable left valves (%UMLV). The same details are given for the right valves (RV, UMRV, TOT RV, %UMRV). The total of the left valves plus right valves (both measured and unmeasured) for each phase is then given (TOTAL LV + RV), the minimum number of individuals for each phase (MNI) and the percentage of the total number of oysters for the whole site found in each phase (% site total).

There was a minimum number of 225 individual oysters represented but 115 or 28.5% of the shells were too badly damaged to be measured. There were more right valves then left valves (222 RV cf. 181 LV), and the right valves showed more damage than the left (43.2% RV cf. 36.1% LV). Insignificant numbers of shells were found in contexts belonging to phase 20 and phase 60. The majority were recovered from contexts allocated to phase 50 (58.6%) with 22.1% in phase 40 and 17.6% in phase 30.

Table 6.40 shows the distribution of the other species of marine mollusc shells within the different phases of the site. Phase 20 yielded no marine molluscs and only one fragment of sea urchin. Phase 30 is represented by only three cockle valves, one spiny cockle valve, one mussel valve and one fragment of scallop. Phase 60 contexts did not include any marine mollusc shells apart from the six oyster valves. Most shells were found in contexts from phases 40 and 50. Phase 50 contained twelve of the fourteen types recorded for the whole site. These included 80.5% of all cockles, 81.8% of all spiny cockles, 78.8% of all mussel valves, 66.7% of scallop fragments, 99% of Patella aspersa, 66.7% winkles, 80% of whelks and all Patella vulgata and Littorina saxatilis. Phase 40 contained the only specimen of Venerupis rhomboides and four fragments of sea urchin that were not recorded from phase 50.

Marine shells were found in a variety of context types. Most shells were discovered in the fills of various pit types (38.9%) and ditches (17%). Ploughwash accounted for 9% and wells 7.2%. Small quantities were recovered from other features as follows: contexts associated with wall and building collapse 5.8%; grave fills 5%; fill of agricultural feature 3.5%; ovens, hearths and ashy deposits 2.7%; robbing fills 2.3%; post/stake holes or similar 2.2%; root and other disturbed areas 2%; coffin fills 1.8% and other 0.2%.

Size analysis

Only the right valves of oysters from phases 30, 40 and 50 were analysed since only these occurred in sufficient numbers. Table 6.41 summarises the basic size data for these grouped samples, giving the number in the sample (N), mean, median, transformed mean (TR MEAN), standard deviation (STDEV), standard error of the mean (SE MEAN) and the minimum (MIN) and maximum (MAX) measurement.

Figure 6.30 gives computer style histograms of the frequency of the different sizes in each sample based on actual counts. It is not possible to evaluate the histograms in this form because the sample sizes are unequal. To aid comparison between the samples from this site and between these and samples from other locations, Figures 6.31, 6.32 and 6.33 show the size frequency of right valve maximum width of oyster shells from phases 30, 40 and 50 respectively, based on percentage frequency. None of the histograms apparently show normal distributions, but there are only 28 and 32 shells in phase 30 and 40 samples which is rather small for statistical work. In addition, the larger sample of 91 specimens from phase 50 shows the multiple peaks that might be expected from the grouped data in the sample. All three histograms do, however, show that the sizes of the oysters in each case are fairly large with virtually no smaller or younger specimens. The most frequently occurring sizes are around 70 - 80mm in width.

To determine whether these samples were significantly different or alike in statistical terms, they were compared by using two sample *t*-tests. Figure 6.34 shows the results of these two sample *t*-tests in the form of a matrix in which the three Alington Avenue samples are compared with each other giving the actual *t*-values obtained. If the *t*-value obtained was greater than two, then the two samples can be considered significantly different. The *t*-value however reflects only the probability of two samples being different, and it could be that samples with a *t*-value just over this arbitrary limit - perhaps between 2 and 3 - might still be considered alike especially when compared with sample comparisons that yield t-values of a much higher order of, for instance 3 to 12.

Figure 6.35 is also a matrix of the t-test results, but here the sign "-" has been used to denote no significant difference between samples (i.e. a t-value of less than 2), and the sign "+" denotes a significant difference between the two samples (i.e. t-value greater than 2). It should be noted that where the t-value obtained is only just over the limit of 2, there may be reason for considering these as borderline results in which the samples could be more alike than different. The Alington Avenue grouped samples from phases 30, 40 and 50 are not significantly different from each other.

Age

The ages of the oysters in each sample are shown as histograms of percentage frequency in Figure 6.36. Unfortunately, the small number of shells in phases 30 and 40 tends to distort the results. In phase 30 the oysters range from two to eight years with the largest number being six years old. In phase 40 oysters range from two to eleven years with the maximum number occurring in the five year group. Phase 50 which had the most substantial number of shells shows a range from two to twelve years with most occurring between three and seven, peaking at seven years.

The mean maximum width measurement for each age group was calculated and plotted on a graph to give a curve of absolute growth. The growth curves can be seen in Figures 6.37, 6.38 and 6.39 which represent growth rate of oysters from phases 30, 40 and 50 respectively. The vertical axis represents mean maximum width in mm. The horizontal axis represents years. The points at various co-ordinates indicate the mean growth achieved by each year group. The vertical lines extending from these points represent 95% confidence intervals. Points for which the mean was derived from less than 5% of the sample have not been connected to other points of the curve. In some cases the points, particularly in the very young or old year groups, represent only one shell. These have no confidence limits and may not correctly reflect the mean of the group. A dotted line between two points is a conjectural line where the intervening point represents less than 5% of the sample. The growth curves obtained show good growth rates with a gradual slowing down after six years.

Infestation

Figure 6.40 gives histograms of the percentage frequency of the occurrence of evidence of infestation or encrustation of the oyster shells from each phase. In each sample Polydora ciliata is the dominant type. Polydora hoplura is also present but to a lesser degree. In phase 20 these are the only two types of infestation recorded, with 33.3% being affected by ciliata compared with 16.7% by hoplura. In phase 30 five infestation types are recorded. Polydora ciliata burrowed into 72.7% of the shells while P.hoplura was found in only 5.5% of shells. The percentage frequency of the other organisms was very low: Cliona celata 3.6%, calcareous tubes 1.8% and barnacles 5.5%. Phase 40 shells had no barnacles attached. P. ciliata affected 75% of the shells, P.hoplura 5.4%, Cliona celata 3.6%, calcareous tubes 5.4% and boreholes 7.1%. All seven types of infestation affected the shells in phase 50. P.ciliata affected 62%, P.hoplura 4.1%, Cliona celata 8.2%, calcareous tubes 5.9%, barnacles 0.6%, Polyzoa 3.5% and boreholes 8.2%.

Conclusions and discussion

Despite the fact that several hundred oysters and cockles are represented by the remains from the Alington Avenue site, and a great variety of other species is also recorded, in terms of food value there are not many marine mollusc shells for the period of time that the site was used. This is probably related to the fact that much of the area was given over to agricultural activities and burials rather than accommodation and domestic use. The shells are scattered fairly evenly across the site with greater numbers surviving in the deeper features. Very few of the deposits seem to have been of specifically primary origin. Many are secondary or tertiary, associated with ploughwash or disturbance.

It seems likely from the distribution of shells through time that most were consumed during the middle phases of the site with the peak of abundance for all types in phase 50 (post-Roman). Here there is a suggestion of contamination by relatively modern material in the form of one shell of the American or blue points oyster (Crassostrea virginica) which is not native to Great Britain but was imported on a limited scale from some time prior to 1939. In recent history oyster shells are known to have been scattered on fields as fertiliser or possibly to lime the soil. It is likely that ploughing may have introduced this specimen of alien origin to deeper layers, maybe with other material. Similar disposal techniques may have been practised in the distant past, accounting for the distribution apparent from the excavations.

The variety of types of marine mollusc indicates that several coastal areas may have been exploited for this food resource. There is no evidence for anything other than random and sporadic collection. The cockles, spiny cockles and carpet shells would have to be dug from mud or sand on the beaches. Mussels attach themselves by byssus threads to rocks, which are also occupied by limpets, at low tide and below. Whelks are carnivorous gastropods living in the low intertidal zone down to deep water in estuaries and open seas, preferably on mud mixed with sand and shells. Winkles graze algae from the surface of mud beaches as well as rocks on the shore and are typically intertidal compared with the other species which are also sublittoral; and oysters, saddle oysters and scallops are almost entirely sublittoral. Oysters may occupy areas low down on the shore which are exposed at extreme spring tides, but the growth rate, size and infestation patterns of the samples from Alington Avenue suggest their origin in deep open-water beds. Casual collection on the beach was practised but boats and other equipment could well have been employed to collect oysters. There is no evidence to point to actual farming (e.g. relaying) of oysters. V-shaped notches were recorded on the edge of ten shells, mostly on the side directly opposite to the ligament. These are thought to be the result of opening the oyster with a knife.

The oyster shells from Alington Avenue are amongst the largest recorded to date. These shells are not just big because they have attained a great age (although some are twelve years or more). The size can be attributed to excellent growth rate.

At least seven right valves of oyster were worn down smooth and straight on the same part of the edge of the shell. Perhaps these particular shells had been used as scrapers, for cleaning animal skins for example.

OYSTER AND OTHER MARINE MOLLUSCS FROM HALSTOCK ROMANO-BRITISH VILLA

Halstock Roman Villa lies on the extreme edge, the Dorset/Somerset border, of what might be considered the Poole catchment area. The oyster and other marine mollusc shells from Halstock were examined to determine whether there was any intrasite variability either spatially or temporally; to see whether there were similarities to marine molluscs recorded from other sites; and to find out whether the shells and their distribution could provide some evidence regarding the eating habits of the inhabitants and the way in which they disposed of the shells.

The oyster shells were first considered from the site as a whole because of the small numbers recovered from so many contexts, the lack of detailed dating and the degree of mixing thought to have occurred. Only the slightly larger number of oyster shells from the pond fill were dealt with separately.

Numbers

The contexts were divided into various categories and the relative abundance of shells in each type is shown in Table 6.42. A minimum of 364 oyster shells was recovered from 191 contexts at Halstock. Table 6.42 also shows the spatial distribution of the oyster shells according to various context types. The greatest concentrations were found in the pond, tanks and well; while a thin scatter over a wide area in association with the buildings comprised the second largest group. The other groups in descending order of importance were ditches; watercourses and drains; floors, walls and hypocausts; burnt areas; shallow depressions; and turf and top soil. Shells from turf and top soil were discounted from any further analysis.

Table 6.43 gives the number of measurable and unmeasurable left and right valves recorded. The minimum number of individuals represented was 189. A high percentage of the shells was badly broken and unmeasurable. The higher degree of damage in left valves (41.8%) compared with right valves (29.7%) is typical of excavated oyster shells. The cupped lower valve is more susceptible to damage than the flat one.

Size

Table 6.44 presents the basic size information for oyster shells. The size frequencies of the samples can be seen in Figures 6.41a-h, 6.42a-h, and 6.43a-h. Large and heavy oyster shells were common on this site. Considering, for example, the maximum width measurement of all right valves recovered, the sizes ranged from 33-115mm with a mean of 78.3 $\pm$ 16.6mm. The highest count occurred in the 85-89mm bar. (See Figure 6.41c). Looking at the right valve maximum width (RVMW) of the shells from the pond fill (Figure 6.42c), the sizes ranged from 52-103mm with a mean of 80.7 $\pm$ 14.9mm. The greatest numbers occurred in the 80-84 and 90-94mm bars.

The histograms of the size frequency distribution of the shells from the whole site and the pond fill seem to indicate that the samples comprise more than one group since each bar chart shows more than one peak. It is more typical for archaeological samples of oyster shell to exhibit a single peak in the distribution (which tends to approximate to a normal curve). This is not unexpected since most of the shells seem to have been excavated from a very thin layer between the turf and topsoil and the natural, and a certain amount of mixing has probably taken place.

It was not possible to compare the size of shells from the different levels within the features because there were too few shells. Even the pond fill only contained 48 shells (minimum number of individuals MNI 24).

Shape

The linear regression slope obtained for the left valves from the whole site was 39.8 degrees and 42.9 degrees for the right valves - indicating fairly round shells. However, the general impression gained from handling the shells was that they were probably from a natural population. This is based on the fact that 7% were noted as being very distorted. Also many of the shells were older than would normally be cropped from a cultivated population where 4 years would seem to be the average.

Age

Figure 6.44 is a histogram showing the percentage of right valves belonging to each age group for all contexts at Halstock. There is a very wide range of ages from 1-14 years, although the 1-,2-,12-,13- and 14 year groups each contain less than 5% of the sample (just one or two shells). These age groups were omitted from the growth curve. It can be seen that most of the oysters were older than the 4 years at which they are generally cropped nowadays. At Halstock 7 years is the most common age with a wide spread either side, 3-11 years.

Infestation

The relative abundance of different infestation types in the shells from the site as a whole can be seen in Table 6.45. Four types of evidence of infestation were recorded. These were <u>Polydora ciliata</u>, Polydora hoplura, Cliona celata and the healed-over boreholes of Ocenebra erinacea or Nucella lapillus.

Nearly half the shells were affected to some extent by P.ciliata. Usually infestation was slight although 7.5% of the shells were noted as being severely affected and one was completely rotten. Infestation by other organisms was almost negligible. The presence of the burrows of P.hoplura means that the oysters might have originated on the south coast rather than the Essex or north Kent coast as P. hoplura is absent from these areas (at least at the present time). Oysters are known to have grown in many places along the south coast in the past, e.g. Poole, Christchurch, the Solent, Southampton Water and the Isle of Wight. Halstock has not yielded enough specimens, firmly dated, to enable a comparison of infestation patterns with those recorded for other archaeological sites. These patterns might be used to suggest where the oysters were collected.

Other species

In addition to the oyster shells, several other species of marine and land mollusc shells were found at Halstock (see Table 6.46). The accumulations of the common garden snail, Helix aspersa M., and other snails could easily have been of natural origin and do not necessarily represent food remains. The marine molluscs were the limpet, Patella sp.; whelk, Buccinum undatum L.; common cockle, Cerastoderma edule (L.); spiny or prickly cockle, Acanthocardia sp.; edible mussel, Mytilus edulis L.; and scallop, Pecten maximus (L.). Only cockles were found in any quantity (50 valves, of which 47 were found together in a ditch by the bath-house). These probably represent an individual meal. The other shells were few and fragmentary.

Conclusions and discussion

At an intrasite level there was variation in the spatial distribution of oyster shells with about 60% of the total being recovered from deeper features such as the pond, tanks, well, ditches, watercourses and drains. A comparison of the characteristics of oyster shell samples from different periods of occupation was not possible.

Relatively few oyster or other marine mollusc shells were found at Halstock. Their occurrence in deeper features may be a result of higher survival rate in the fill of these features as opposed to the more disturbed upper surface layers. It is not possible to tell what proportion of the shells available for disposal have survived. For example, many shellfish may have been consumed during the occupation of the site but only the larger, heavier shells in the protection of the deeper features survived. It may be that only a few oysters and other shells remained on site by chance while the majority were disposed of elsewhere. Oyster shells are known to have been used in the past for various purposes. On the other hand, very few marine molluscs may have been eaten at Halstock. They would have to be brought from quite a distance at some expense. Very few other species were found. The couple of dozen cockles were probably the remains of an individual meal.

The oysters tended to be large, heavy, older shells with relatively little infestation or encrustation. The size was studied using all the shells from the site, and also the pond fill separately. The results indicated that both categories of shell comprised more than one distinct group. No comparison was possible of the size of Halstock oysters with oyster shells from other sites for this reason.

It seems probable that the shells at Halstock were collected from a natural or wild population, for two reasons. The shape of the shells tended to be irregular. Also most of the oysters were older than four years: 77.7% were between 5 and 15 years old. When oysters are cultivated, they are usually cropped at 4 or 5 years. At Halstock the preponderance of older oysters might, as previously stated, have been due to the greater survival rate of these particular specimens or the fact that larger shells were being collected. If the collection of oysters was not on a systematic, regular basis from either a natural or cultivated population, then perhaps the collector might have considered that the largest oysters were the best. To-day, and in the past, where oysters have formed a regular component of the diet, there seems to have been a preference for younger oysters in which the meat is tender and can be eaten whole and uncooked from the shell. A larger oyster has tougher meat that must be cut up and possibly cooked. In France there is a small market today for larger oysters which are called "pied du cheval".

It is worth noting here that some of the Halstock oysters were found in association with areas such as a corn drier furnace area; a burnt area possibly below a brazier stand in a corridor; above a pit filled with ash and soot; and above ash and soot in the stoke hole of a furnace for the bath suite. One of the simplest methods of opening and cooking oysters is to place them "deep shell down on a bed of hot coals, or better still, charcoal" (Rydon, 1968, 112).

The dominant infesting organism in the shells was Polydora ciliata, but the related Polydora hoplura was also present to a lesser extent. The latter species is prevalent in the south and south-west of England but absent or virtually absent from the Essex and north Kent coasts at the present time. Therefore the presence of P. hoplura in Halstock shells suggests a south coast origin. The lack of encrusting organisms, e.g. barnacles, might be due to their absence on the shells in the first place, to poor survival during burial, or their accidental removal by post-excavation washing.

To sum up, it would seem that oysters and other marine molluscs probably formed only a small part of the diet of the inhabitants of the Halstock villa. Shellfish would have been an occasional treat obtained on a casual basis from a natural population. It is likely that at least some of the oysters were cooked. The size and age characteristics are unlike any samples examined from other sites.

In Chapter 6 the intrasite variation in oyster shells from seven sites in and around Poole Harbour in Dorset has been described. In later chapters the size, shape and infestation patterns of oyster shells from sites in the Poole region will be compared with each other, with samples from sites in other regions, and with samples of oysters from living populations. The next chapter (Chapter 7) provides the data for oyster shells from the third of the four regions under consideration: north Wessex and London. Oyster shell samples are examined from a variety of different types of site and period. These include Ludgershall Castle near Andover; Brown Street in Salisbury; Cross Street in Wokingham; Reading Abbey Wharf; and in London - Moorgate Street, Guildhall House and Pudding Lane. The evidence from each site will be considered separately as in Chapters 5 and 6.