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An ethnoarchaeological investigation of the effects of cereal grain sieving

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Summary

Results from an ethnographic study on the Greek island of Amorgos has demonstrated that it is not easy to detect sieving on the basis of grain measurements in individual samples. The results also have implications for the identification of barley, as a sieved sample of six-row barley has a grain composition expected for a mixture of the two- and six-row species.

Introduction

When discussing the archaeobotanical recognition and consequences of crop processing, several authors have considered the effects of grain sieving on the composition of cereal samples. For example, Dennell (1972) has experimentally investigated the effect of sieving on species composition in a mixed wheat sample, while the use of grain dimensions to identify sieving or to determine sieve mesh size in archaeobotanical material has been advocated by Dennell (1972; 1974; 1978) and criticised by Hubbard (1976). More recently, Hillman (1984) described the likely effect of sieving on grain size.

This paper, based on an ethnographic study of crop processing on the Greek island of Amorgos (Jones 1984; 1987; 1988; Halstead and Jones 1989), presents evidence for the effect of sieving on grain dimensions and, more particularly, on the composition of barley samples. Cereal grain was collected from both the product and by-product of sieving crops of wheat (*Triticum aestivum* L. and *T. durum* Desf.), barley (*Hordeum vulgare* L.) and a wheat/barley maslin. The term sieving refers here to the use of a fine sieve which retains most of the cereal grain but allows smaller particles to fall through. The opposite process, whereby large particles are removed from grain which passes through a coarse sieve, is not considered here. The subsequent effects of charring on grain dimensions are also not considered in this paper.

The sieves used on Amorgos had a mesh of concentric wire rings supported by 'spokes' radiating from the centre (Fig. 47a). This allowed grains to pass through the sieve both vertically (with the long axis of the seed perpendicular to the mesh) and horizontally. It is unlikely that sieves would have been constructed in this way before metal wire came into common use. More likely forms for early prehistoric sieves are a mesh of gut, leather or wicker (Fig. 47b) or skin pierced with holes (Fig. 47c). Both these types of sieve allow grain to pass through them vertically, but not usually horizontally (unless the grains are very small).

The effect on grain dimensions

The type of sieve used has bearing on which dimension of the grain is most relevant to the effects of sieving. For the circular type of mesh, through which grains can pass horizontally, the minimum diameter is probably most relevant, but for the other types of sieve, through which grains can only pass vertically, the maximum diameter is most important. Some small grains lying horizontally might be retained by sieves which only allow grain to pass through vertically, but otherwise length should be of indirect relevance only.

For two reasons, sieving by-products might be expected to exhibit a relatively marked cut-off (corresponding to sieve mesh size) at their upper limit of maximum grain diameter, while sieving products would show no noticeable cut-off at their lower limit of maximum grain diameter (Fig. 48). First, since only a small proportion of crop seeds are removed by cleaning, grain cleaning by-products are more likely to show unusual metrical properties than are cleaned products, which should be little different to the uncleaned crops (Hubbard 1976, 263). Secondly, while large 'prime' grains are relatively unlikely to pass through to the

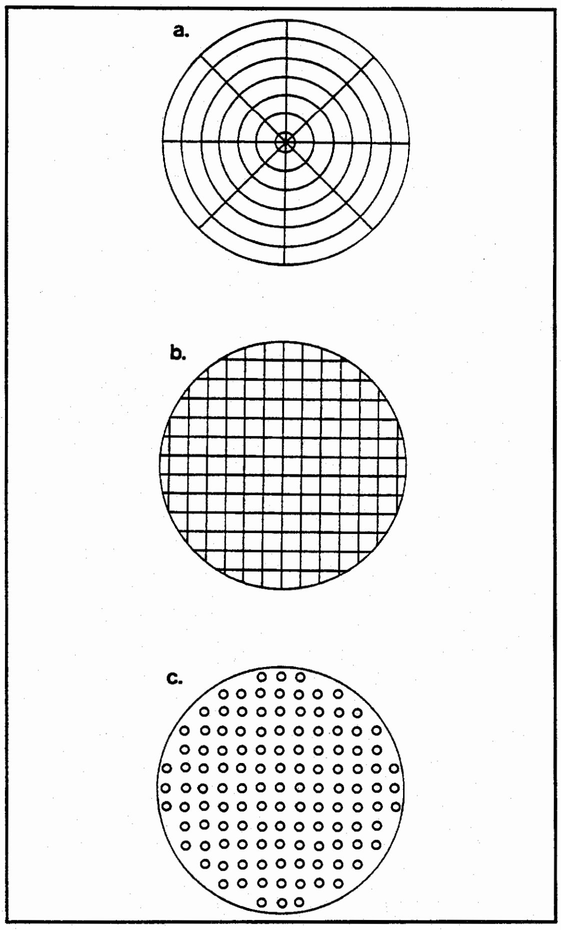

Figure 47. Types of sieve. (a) concentric; (b) checkered; (c) pierced.

sieving by-product, small 'tail' grain may well be retained with the sieving product (Hillman 1984, 23).

Samples collected on Amorgos can be used to explore the metrical differences which are detectable in practice (but with reference to minimum grain diameter because of the type of sieve used on Amorgos). A mixed wheat and barley maslin from Amorgos was sieved, and the length, breadth and thickness of grains from the product and by-product were measured (Fig. 49). In each case, fifty grains of wheat and fifty of barley were measured, the sort of number routinely measured in archaeological samples.

As expected, for both wheat and barley, there is relatively little difference in grain length between the sieving product and by-product. There is much greater difference between the product and by-product in breadth and thickness. In the case of wheat, the difference is

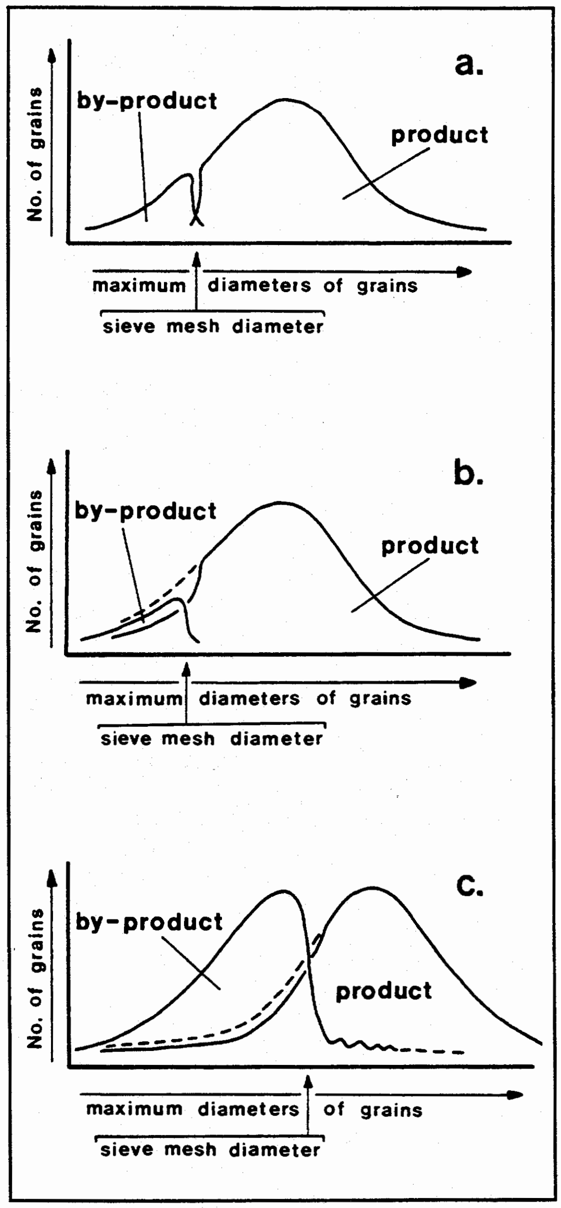

Figure 48. Predicted effects of sieving on maximum grain diameter (after Hillman 1984, 23). (a) theoretical effect; (b) more realistic effect; (c) effect when equal numbers of grains measured from product and by-product.

particularly marked (i.e. there is little overlap) for breadth, because this was usually the minimum diameter of the grains. Conversely, in the case of barley, the difference was most marked for thickness, as this was usually the minimum 'diameter'.

As predicted (Hubbard 1976; Hillman 1984), there was no noticeable cut-off towards the lower limits of minimum diameter (i.e. the

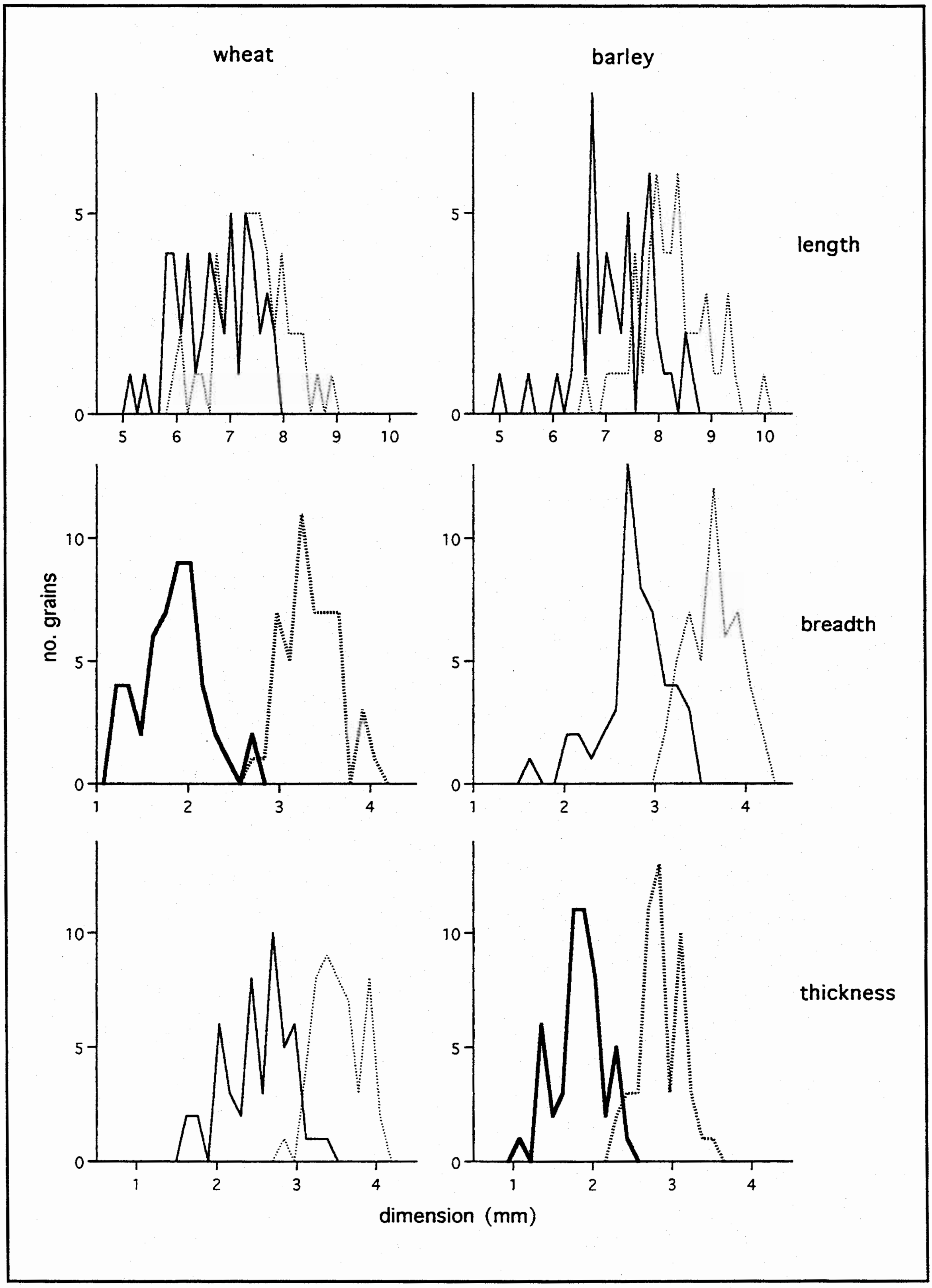

Figure 49. Effects of sieving on grain dimensions in a sample of wheat and barley maslin from Amorgos (50 grains measured from each of the product and by-product, for each cereal). Solid line—by-product; broken line—product. Bold lines indicate minimum diameter (and clearest separation of product and by-product).

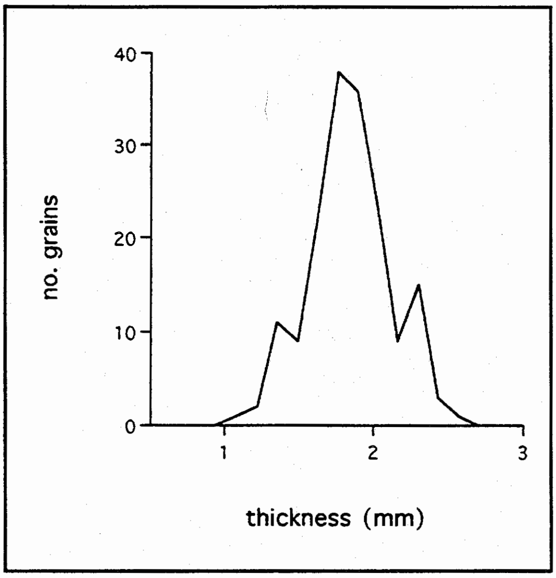

Figure 50. Effect of sieving on barley thickness in the by-product for a larger number of grains (n = 170).

breadth of wheat grains or the thickness of barley grains) in the sieving product. There was also no detectable cut-off, however, towards the upper limits of minimum diameter in the by-product. This could be because of variations in the size of the mesh in different parts of the sieve (which is likely to be even more of a problem for early prehistoric sieves). So, at least on the basis of 50 measurements, it may not always be possible to detect sieving from either the product or by-product. Indeed, measurement of thickness for a larger number of barley grains from the sieving by-product (170 grains, representing all the measurable barley grains in the by-product from that batch of sieving) also failed to reveal any detectable cut-off in the distribution (Fig. 50).

On the other hand, the predicted trough between the two distributions (for product and by-product) of minimum diameter (Hillman 1984 and Fig. 48c) is clear for both wheat and barley (Fig. 51) and corresponds closely to the known mesh size (2-2.5 mm) of the sieve used on Amorgos. Where both products and by-products are suspected to be present, on the basis of botanical composition or archaeological context, therefore, it may be possible to detect sieving by looking for bimodality in their combined grain size distribution, even when the individual distributions are near normal.

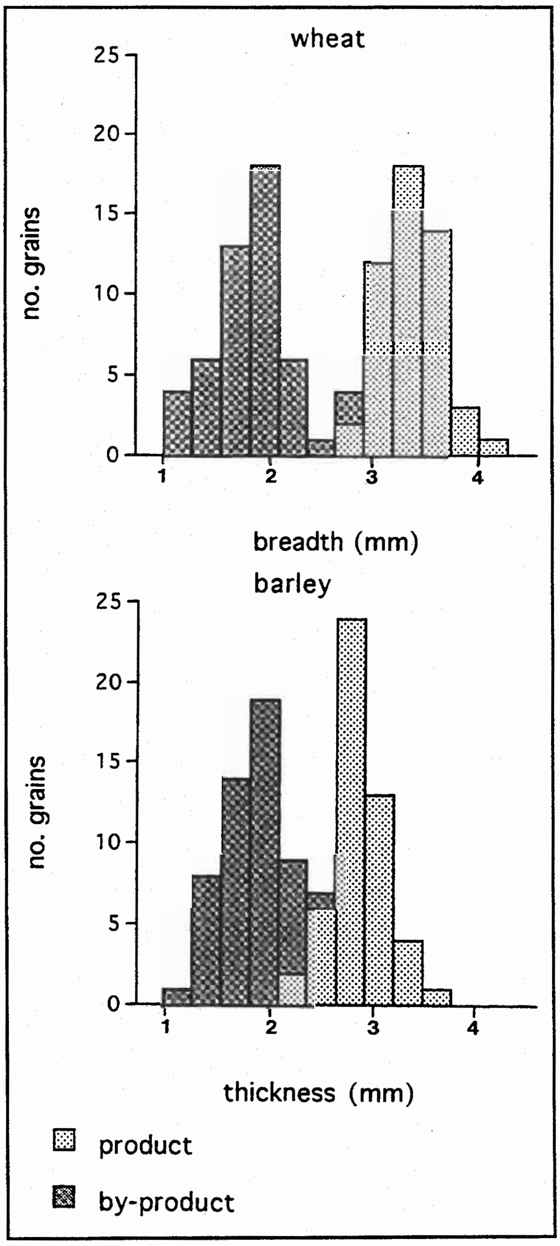

Figure 51. Histograms showing the bimodal distribution of minimum grain diameter in the combined sieving product and by-product (50 grains of each).

The effect on crop composition

Dennell (1972) has demonstrated experimentally that sieving affects crop composition as well as grain size distribution, with the smaller-grained einkorn *(T.*

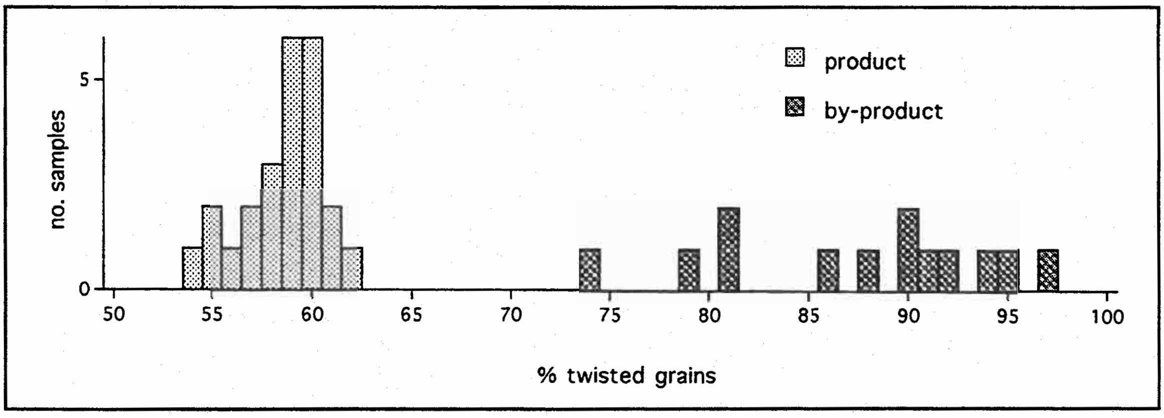

Figure 52. Histogram showing the proportion of twisted barley grains in sieving products and by-products.

monococcum L.) being selectively removed from a mixed einkorn and emmer (*T. dicoccum* Schübl.) crop by sieving. A similar effect was suggested by Gordon Hillman (pers. comm., in Milles 1986, 119) with regard to barley, as the lateral twisted grains of six-row barley tend to be smaller than the central straight grains.

This effect can be demonstrated empirically for six-row barley on Amorgos. The relative proportions of straight and twisted barley grains were calculated for samples of sieving products and by-products from barley and maslin crops. For samples with fifty or more barley grains, the percentages of twisted grains amongst total barley grains are plotted in Fig. 52. It is apparent that the proportion of twisted grains is greater in sieving by-products than in products. The percentage of twisted grains in the products is always slightly less than the 66.7% expected for six-row barley (mean 58.6%), while the percentage in sieving by-products is always greater than 66.7% (mean 87.5%).

This observation has significance for the archaeological identification of barley species. Since all the grains of two-row barley are straight, a percentage of less than 66.7% twisted grains might be taken to indicate a mixture of two- and six-row barley (e.g. Halstead and Jones 1980). In fact, a reduced proportion of twisted barley grains may indicate sieved (but pure) six-row barley (e.g. Milles 1986). This interpretation would be strengthened by other indications of sieving, such as the absence of small weed seeds (Hillman 1981; 1984; Jones 1984; 1987) or the existence of complementary samples with enriched proportions of twisted grains.

Conclusion

This study has demonstrated that sieving does not always result in a noticeable cut-off in the distribution of seed dimensions (in either the product or by-product) although, if a clear cut-off was detected, it might indicate particularly rigorous sieving. It may, nevertheless, be possible to detect sieving in quite small samples of grain by comparing the dimensions in different samples. Sieving also has implications for the identification of barley: because the proportion of straight barley grains is increased by sieving, a sieved sample of six-row barley could be mistakenly interpreted as a mixture of two- and six-row barley.

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