Competition Among Grains in Classical Antiquity

Author(s): N. Jasny

Source: *The American Historical Review*, Jul., 1942, Vol. 47, No. 4 (Jul., 1942), pp. 747-764

Published by: Oxford University Press on behalf of the American Historical Association

Stable URL: https://www.jstor.org/stable/1841501

COMPETITION AMONG GRAINS IN CLASSICAL ANTIQUITY

NEARLY thirty years ago an American economic historian published an article with the piquant title of "Hay and History". In an effort to throw light on the medieval village community and its common interests in pasturage the article pointed out that without pasturage and hay there could be no cattle, no manure, and no maintenance of fertility or protection against erosion of light soils by wind. In the end you stood in imagination amid the ruins of the civilizations of North Africa reflecting on Bottom's remark that "Hay, good hay hath no fellow." This article derives from no such challenging thesis but like it deals with realities that historians overlook who forget that wind, weather, and soil fertility and the relative nutriment, prices, and availability of grains are of fundamental importance in the economy of earlier days as well as in our own. Perhaps the fact that the writer, while interested in classical antiquity, has also been concerned with agricultural economics and thereby in turn not indifferent to those subjects labeled in college catalogues as agronomy, soil physics, and climatology may serve as his excuse for dealing with a topic easily and comprehensibly overlooked by any one and therefore all of the specialists in these several disciplines.[1] His hope is that a discussion of the prosaic problem of grains in the consumer markets of the ancient world will interest scholars of the history of the Mediterranean area in a time when its economy and its people were highly concerned with agriculture and its cereal products.

ELIMINATION AMONG THE GRAINS

There are eight grains which play a major role as human food in the world: wheat, rye, barley, oats, corn, millet, sorghum,[2] and rice, but most of them did not in antiquity figure prominently in the Mediterranean region, with which this paper is concerned.

Corn was unknown in the Old World before America was discovered.

[1] This paper was prepared while the writer was a staff member of the Bureau of Agricultural Economics, United States Department of Agriculture. Mr. H. Goldenstein of that bureau helped to prepare the paper for the press.

[2] Millet and sorghum, correctly speaking, are one grain.

In general, moreover, it cannot be grown in the Mediterranean climate without irrigation because the summers are too dry and in winter, when there is sufficient moisture, the temperatures are too low. Sorghum was known to the nations around the Mediterranean before the Christian Era, but it needed irrigation, and in none of these countries was it found profitable to devote to it a portion of the limited area permanently irrigated. Many centuries later, when the proportion of land which could be irrigated in the summer had been greatly increased in Egypt, sorghum found a certain place there, mainly in upper Egypt. Rice was introduced in Babylonia many centuries before our era and from there penetrated farther west. But this grain, too, gained a stronger foothold in the Mediterranean region only after the permanently irrigated land was greatly extended, a process which occurred well after the classical period had passed. Millet would not have been grown in very large quantities in the cold season even if the temperatures had been favorable. A low yielder, with some exceptions, it proved adapted only as a secondary crop.

The principal assets of rye are its winter-hardiness and, generally, its ability to withstand hardships of any kind, particularly poor soil and considerable soil acidity. The Mediterranean climate is sufficiently warm for all small grains to be grown as fall-sown crops, and the prevalent type of poor soil is alkaline rather than acid. Hence, rye could never obtain a strong foothold in the Mediterranean Basin.

The situation was somewhat more complicated with regard to oats. As a weed of the grain fields, oats were probably known in Egypt thousands of years before our era. Yet they failed to establish themselves as a cultivated crop in the Mediterranean region almost up to the end of classical times, probably owing to the difficulty of developing varieties worth cultivating.

Thus, six of the eight important grains were either not grown at all in the classical world or, like millet, were grown only as a secondary crop and merely in a portion of the region, or, like oats, were introduced only at the end of the period. There remain, therefore, only two grains, barley and wheat, and the struggle between these two for the acreage and consumer is, in fact, our central problem.

It is true that the wheat with which barley had to compete was not everywhere and not throughout the whole period the same type of grain we commonly call wheat, but it was wheat in the broad sense that includes both the naked and hulled subspecies of it.[3] These two types

[3] Naked grain is that in which the kernels fall out of their hulls in threshing; corn and our common wheat are naked, but naked barley and oats also are grown in small

also competed with each other, but this competition was on a higher plane than the one between barley and wheat. Moreover, the rivalry between naked and hulled wheat should probably more correctly be considered not as a competition between different commodities but as a development of the same commodity from a less efficient to a more efficient form.

Natural Conditions in the Mediterranean Region

To compare the agriculture of ancient Rome or Greece with that of Great Britain, Germany, or France is likely to lead one astray because of the peculiarities of the Mediterranean region in climate and soil. This distinctly Mediterranean climate includes a great part of the Iberian Peninsula, Italy south of the Po Valley, all Greece of importance in ancient history, and most of North Africa and the Near East.[4] The major climatic difference is that while in western and central Europe precipitation falls mainly in the summer, in the Mediterranean Basin the summer is dry and the winter is the rainy season. In general, only those grains can be grown in the region without irrigation for which the winter and early spring temperatures are sufficiently high. These are too low for sorghums and, with some exceptions, for millet and corn. Important differences between the Mediterranean region and the other European lands in the Temperate Zone exist also with reference to the growing of small grains. While a large portion of Europe north of the three specified Mediterranean peninsulas permits fall-sowing only of wheat and rye, all small grains, even oats, which are most susceptible to cold, can be grown in all Mediterranean countries as fall-sown crops. North of the peninsulas the competition among the small grains is mainly between fall-sown wheat and rye as against spring-sown barley and oats. In the Mediterranean Basin all these grains compete on an equal basis so far as the growing season is concerned.

Thus, the differences in the seasonality of precipitation between the Mediterranean region and other parts of the Temperate Zone entail important divergencies in the competitive power of the several grains. But such divergencies are also observed within the Mediterranean Basin itself owing to large variations in the total annual precipitation and in its seasonal distribution. The western portions of the south

quantities. In the hulled grains the kernels remain enclosed in their hulls in threshing; common barley and oats are the typical hulled grains, but there are also several subspecies of hulled wheat.

[4] O. J. R. Howarth, *The Mediterranean* (Oxford, 1924), pp. 31-33.

European peninsulas receive much more moisture than the eastern portions because these peninsulas are all mountainous and westerly winds come more frequently than easterly winds during the rainy season. The eastern coast of Greece, for example, receives only around 20 inches annually, while a large portion of its Adriatic coast gets more than 40. The difference in the amount of moisture is smaller in the Italian peninsula, but even there it amounts to 6-7 inches per year. Another important circumstance is that the total precipitation declines, and the summer drought becomes longer, from north to south. The dry spell lasts for only two to three months in Rome, but it continues for nearly half a year in Sicily.

The fact that in Greece the scene of the great historical developments was located on the eastern side of the peninsula, while the reverse was true of Italy, seems not to have received due attention by students of ancient history. Athens, moreover, is located about 4 degrees nearer to the equator than Rome. It receives on an average only 15 inches of moisture per year, while Rome gets about 35 inches and the fall is more evenly distributed over the year. This difference was of paramount importance for the competition between the several grains for acreage and, consequently, for consumers in the two great centers of classical antiquity.

The specific competitive conditions for the several grains in the Mediterranean region due to the climate are to a large extent augmented by peculiarities of the soil. Typically the Mediterranean lands have at best soils of average productivity. Immense stretches of land are occupied by mountains and steep hills, with a large proportion of skeletal soils. Except for those developed on river alluvials, the soils tend to be very shallow, poor in humus, and of small water-holding capacity; they also frequently show a marked deficiency in phosphoric acid. Relatively large proportions of Mediterranean soils are either planosols or saline.[5] The only important advantage that the typical Mediterranean soils possess over the strongly podsolized (bleached) forest soils which are widespread in the northernmost portion of the Temperate Zone and which are among the poorest soils of this zone is that even those Mediterranean soils which are developed from noncalcareous parental material are seldom more than slightly acid. The soils developed on or from limestone—the typical parental material in the Mediterranean region—are, with minor exceptions, alkaline, although some are more

[5] Planosols are soils underlaid near the surface by a cemented or compact layer which cannot be penetrated by water or roots.

alkaline than is good for the crops. The soils of Attica and of certain other Greek areas prominent in ancient history were of the poorest; Sparta had some good soil, but it was inconsiderable.

As a contrast to the at best moderate quality of the bulk of Mediterranean soils, the richness of the soil in areas of more or less recent volcanic eruptions is the more conspicuous. The volcanic soils are very unevenly distributed over the region. The mainland of Greece has practically none, while the area around Rome, especially Campania but also Latium and southern Tuscany, have a great deal.

Thus, a comparison of the natural conditions in the two principal scenes of ancient history, Attica and the area around the city of Rome, shows that the former had rather poor, mostly alkaline soil and little precipitation, while the latter was endowed with large stretches of good and in part proverbially rich soil and a precipitation about twice as great.

Consumers' Preference and Economic Necessity

An authority on ancient civilization, Moritz Voigt, computed that the per capita requirement of land for the production of cereal food increased four and one half times in ancient Rome because of the preference of consumers for naked wheat as against emmer, also a wheat but a hulled one.[6] This estimate is merely an outstanding example of the exaggerated significance regularly assigned to consumers' preference in studies of the economy of the classical world. Similarly, a well-known student of the history of cultivated plants, Johannes Hoops, wrote that the Romans in their later history grew barley chiefly for horse feed, because they did not care to eat it.[7] The statement that the Romans disliked barley is formally correct, but it is misleading, nevertheless, because it implies that there were nations which liked barley and that liking or disliking was the decisive reason why the Romans grew little barley for food. The ancient Greek writers who touched upon the use of wheat and barley for food felt it necessary to stress the superiority of wheat. Medical authorities such as Galen and Dioscorides, dramatists such as Sophocles and Aristophanes, and philosophers such as Aristotle—all were agreed on this point.[8] Yet barley was the staple

[6] "Über die *bina iugera* der ältesten römischen Agrarverfassung", *Rheinisches Museum für Philologie,* New Series, XXIV (1869), 52-71.

[7] *Waldbäume und Kulturpflanzen im germanischen Altertum* (Strasbourg, 1905), p. 373.

[8] Athenaeus, *The Deipnosophists,* trans. by Charles Burton Gulick, III (London and New York, 1928), 43, 109f, 110f, 115c; [Aristotle] *Problems,* XXI, trans. by H. S. Hett

food of the Greek masses all during the classical period. A situation like that in classical Greece still to a large extent prevails in the world. Outside of the Far East wheat is preferred to all other grains as the principal cereal food; yet less wheat is consumed for this purpose than other grains.

Aside from the intensity of preference or objection of consumers, the kind of grain used for food depends on (1) the amount which has to be sacrificed or can be saved by using one grain rather than another, and (2) the extent to which consumers are in a position to afford the sacrifice necessary in choosing between grains. The first item, in turn, may be broken down into two factors: the relative nutritive value of the different grains and their comparative costs.[9] Applying these criteria, let us explain the general competitive relation of wheat and barley in a few words, because the competition between these two grains was the most important one in the classical world.[10]

Wheat of average quality may be conservatively assumed to have a nutritive value of 10 per cent more than barley of average quality in terms of weight and about 35 per cent more in terms of volume.[11] On the other hand, barley is a more prolific crop than wheat and in general costs less to produce. Wheat may outyield barley where it can be grown as a winter crop, while the climate is unsuitable for winter barley, but

(Cambridge, Mass., and London, 1926). Aristotle is not actually the author of the *Problems,* but it is undoubtedly the product of the Peripatetic School.

[9] Relative prices and costs are, of course, not unrelated factors. The amount which consumers are prepared to sacrifice affects ratios between prices, costs, and amounts produced.

[10] For details on competition among grains under contemporary conditions the reader is referred to the writer's *Competition among Grains* (Food Research Institute, Stanford University, 1940).

[11] Unless otherwise specified, all comparisons are in terms of weight. The ancients used measures, and this fact misled many ancient writers in their calculations and, even more frequently, their modern colleagues. Gustave Glotz, one of the best-known students of Greek history, and after him many others, created confusion by assuming that in ancient Greece a two-volume unit of barley was equivalent, or was considered equivalent, in nutritive value to a one-volume unit of wheat. See Glotz, "Le prix des denrées à Délos", *Journal des savants,* New Series, XI (Jan., 1913), 20; Fritz Heichelheim, "Sitos", Pauly's *Real-Encyclopädie der klassischen Altertumswissenschaft,* Supp. VI (rev. ed., Stuttgart, 1935), pp. 819-92, and *Wirtschaftliche Schwankungen der Zeit von Alexander bis Augustus* (Jena, 1930), p. 98; and J. A. O. Larsen, "Roman Greece", in *An Economic Survey of Ancient Rome,* ed. by Tenney Frank and others, Vol. IV (Baltimore, 1938), Part 3, p. 348. But the usual price relationship between barley and wheat was a two-volume unit of barley equal to a one-volume unit of wheat. Since wheat was preferred to barley by the consumers, nobody would have used barley if two units of it were needed to replace one unit of wheat. Yet it was the poor, for whom the saving was particularly important, who were the principal consumers of barley.

even in this case the cost of production of wheat is likely to be higher. Where barley can be grown as a fall-sown crop, as in the Mediterranean region, it probably always yields more than wheat, and its cost is correspondingly less. This advantage of yield in favor of barley varies with soil, climate, and cultivation. On rich, moderately acid soil with considerable precipitation and very intensive cultivation, the excess in yield in favor of fall-sown barley may be as small as 10 to 15 per cent, but on poor soils, especially poor alkaline soils with little precipitation and under extensive cultivation, the additional yield of barley rises to 50 per cent or more. Correspondingly, the cost of producing wheat is larger than that of barley by from 10 to 15 to about 35 per cent.

A comparison of the relationships in nutritive value and costs of production between wheat and barley shows that under conditions least favorable for barley practically no financial sacrifice is involved in using wheat rather than barley for food. Wheat, as indicated, costs 10 to 15 per cent more than barley to produce, but it also has a nutritive value about 10 per cent higher. Under production conditions most favorable for barley, however, the sacrifice which the consumer has to make in choosing wheat is equivalent to about 25 per cent.

It is likewise incorrect, though frequently done, to stress the preference of Greek and Roman consumers for wheat as the only reason for its dominant position in the international grain trade of the classical world. Their preference was probably not greater than that of the other peoples, but their ability to afford wheat was. Moreover, of great importance was the fact that the price difference between wheat and barley in terms of percentages declines with the increase in marketing costs. What on the surface seems to have been greater preference actually was largely the prosaic fact of lesser sacrifice.

Naked Wheat versus Barley

In production. Barley has a shorter growing period than wheat and ripens earlier. Also it needs less water, but the optimum saturation point of the soil with moisture is less for barley than for wheat, and barley is more imperiled by an excess of soil moisture. Barley is most susceptible among grains to excessive soil acidity and least susceptible to soil alkalinity and salinity. It is an early starter and, especially in the case of the more robust six-row varieties, is less in danger of damage by weeds than wheat. Typically both barley and wheat need nutrients in readily available form; but barley varieties which make a fair progress with a small supply of such nutrients have existed since time imme-

morial, while wheat has displayed much less of such adaptability. Barley, on the other hand, needs a milder climate than wheat to be sown in the fall.

A large part of the Mediterranean region meets these specific requirements of barley in an ideal way. There are few, if any, areas in the world where the superiority of barley over wheat in yield is as great as on the very shallow and generally rather poor, alkaline soils of those portions of northern Africa and Palestine that receive little precipitation but grow crops without irrigation. Barley there probably yields as much as 50 per cent or more in excess of wheat. Northward, the lengthening of the rainy season reduces this superiority of barley; and a shift into areas with greater amounts of moisture has the same effect. Nevertheless, on the alkaline soils of eastern Greece and on those of the Aegean islands which receive little moisture, barley may well be expected to yield approximately 40 per cent more than wheat, and on the same soils in Sicily the superiority of barley in yield is hardly less than 30 per cent. But on volcanic soils with a moisture saturation optimal for wheat, barley is unlikely to outyield wheat by more than 15 to 20 per cent, especially if the reaction of the soil is moderately acid.

In ancient times the superiority of barley over wheat in yield may have been somewhat larger than stated above, because improvements in agricultural techniques—except liming, which is seldom important in the Mediterranean region—have since strengthened the competitive position of wheat versus barley. Specifically, naked wheat is likely to have profited more than barley from seed selection and breeding.

Under these conditions it is not at all surprising that barley played a very important role in the grain production of the classical world. It was undoubtedly by far the predominant crop in Greece, most Aegean islands, and large parts of western Asia. Barley, furthermore, was very likely an important crop on the nonvolcanic soils of Africa,[12] Sicily,[13] Sardinia, southern Italy, and in most of Spain. Finally, it oc-

[12] In the Roman sense, *i.e.*, North Africa, excluding Egypt.

[13] J. Carcopino believed that in the whole of Sicily the yield of barley per acre was, at most, as much as that of wheat in terms of volume or about 17 per cent less in terms of weight ("La Sicile agricole au dernier siècle de la République romaine", *Vierteljahrschrift für Sozial- und Wirtschaftsgeschichte,* IV [1905], 155-56). The price of barley per measured unit in Sicily was only half that of wheat, and, with an equal yield, the return per acre of barley would have been approximately as small. With this price relationship and Carcopino's yield relationship, the Sicilians should not have grown barley—yet they grew a great deal. The price relationship was a fact, but the yield relationship was merely Carcopino's assumption based on the erroneous idea that barley in Sicily returned the amount seeded only as many times as wheat. The yielding power of barley relative to that of wheat is rather commonly underrated by students of classical history, and this leads to

cupied a substantial proportion of the grain acreage irrigated by flooding in Egypt[14] and Babylonia. Moreover, there is reasonable certainty that the losses of barley production in relative importance were not very large during the millennium roughly from 500 B.C. to 500 A.D. They may have occurred mainly in areas growing grain for export or because of the Roman demand for tribute.

In consumption. The consumption of barley for food was considerably smaller in ancient times than its net production. Barley was the principal feed grain not only in areas where natural conditions were particularly favorable for growing it but over the whole Mediterranean region. As a feed barley is worth at least as much as naked wheat, pound for pound; a slight superiority in yield, therefore, sufficed to ensure that no naked wheat was grown for feed. Somewhat more competition in the use for feed was experienced by barley from hulled wheat. Barley gained, therefore, from the rapid disappearance of hulled wheat during the classical period but lost a little owing to the introduction of oats.

The consumption of barley for food, although considerably smaller than its net production, was also large, primarily in areas where barley yielded 25 per cent or more in excess of wheat. Wheat may have become the everyday food of the rich in some of these areas during the period under review, but such consumers mostly constituted a small proportion of the total population. The broad masses consumed much wheat only in those areas favorable for barley production which, like Athens, relied heavily on imports from distant areas. Before the necessity of grain imports had arisen, Athenians were consumers of barley; barley, moreover, also probably regained its former role to a considerable extent as soon as the glorious period of Athens was over. The people living immediately outside the city probably did not consume much wheat even at the time of Athens's glory; they ate what their soil produced, which was mostly barley.[15]

---

an undervaluation of the amounts produced and generally of the part barley played in classical antiquity.

[14] The recently published papyrus 57030 B (A. E. R. Boak, "Some Early Byzantine Tax Records from Egypt", *Harvard Studies in Classical Philology,* LI [1940], 57) may be correctly interpreted as showing that toward the end of the classical period the quantity of barley grown at Karanis, western Egypt, was still not much smaller than that of wheat. The proportion of barley in most other Egyptian areas, it is true, is likely to have been less than at Karanis, but the difference was hardly very large. The common assumption that Egyptian grain production at that time consisted almost exclusively of naked wheat must be wrong.

[15] The self-sufficiency of the Athenian peasant is indicated by Aristophanes in

The stimulus to use barley for food was obviously less strong in areas where the excess in barley yield over wheat was less than 20 to 25 per cent. Moreover, the areas where barley greatly outyielded wheat were those with poor soil and unfavorable climate and, consequently, with low yields of either grain. Some of the areas, however, where the superiority of barley in yield was much less had good soils and more favorable climate and hence obtained relatively high yields of both barley and wheat. Here the greater productivity of the soil made it easier to afford the sacrifice involved in the use of wheat. The volcanic soils of the Roman area and its relatively favorable climatic conditions must have played a considerable part in bringing about the predominant use of wheat for food in Rome even when no imports from distant regions were needed, while the low yields of any grain obtainable in Attica are likely to have contributed to the large food use of barley in that area.

International trade, marketing costs, and price relationship. Naked wheat undoubtedly far predominated in the international grain trade in classical antiquity—but probably to a somewhat lesser extent than is commonly accepted. Owing to the assignment of an excessively great role to preference for wheat, the scanty and mostly ambiguous evidence on the international grain trade in the classical period frequently is interpreted in such a way that practically no place is left in that trade for any grain other than wheat.[16] In such general form the interpretation seems to be incorrect. There was apparently a significant difference between Greece and Rome as grain importers. It is rather likely that Athens imported wheat exclusively or almost exclusively, at least through commercial channels, while barley made up a substantial proportion of the imports of Rome.

Acharnians, trans. by B. B. Rogers (Loeb's Classical Library, London and New York, 1930), ll. 33-36.

[16] Unfortunately, most ancient sources in discussing grain imports and consumption did not specify the grains involved but used the terms σῖτος (Greek) or *frumentum* (Latin). Since the second or third century A.D. these words have generally meant wheat, but previously they had signified cereal grains or food cereal grains in general. Yet it has become almost customary to translate or interpret these terms as having meant naked wheat in all statements of classical writers on imports or exports. See, for example, Ellen Churchill Semple, *The Geography of the Mediterranean Region* (New York, 1931), pp. 368-71. M. I. Rostovtzeff in his basic study of the grains in the Roman Empire, "Frumentum", Pauly's *Real-Encyclopädie,* VII (rev. ed., Stuttgart, 1912), 127, carefully interpreted the word *frumentum* in the correct sense; moreover, aware of the great difficulties involved, he did not feel it wise to raise the question as to the specific grains of which the imported *frumentum* consisted.

But this dominant role of naked wheat in international trade was due not only to the great liking for wheat in deficit areas but also, and perhaps primarily, to the disproportionately high marketing costs of barley and hulled wheat relative to those of naked wheat. The reasons are the great bulk of barley and especially of hulled wheat and the high marketing costs in classical antiquity.

The typical price of barley in areas of surplus production favorable for growing barley—well in line with production costs—was one half of the wheat price in terms of volume. With such a price relationship, and assuming total marketing costs of wheat equal to half the wheat price in the deficit area and marketing costs of barley equivalent to 75 per cent of those of wheat in terms of volume, exactly half of the saving which could be made in the surplus area by eating barley rather than wheat was lost to the consumer in the deficit areas through the disproportionately high marketing costs of barley.[17]

There is sufficient evidence to believe that barley cost about half as much as wheat in terms of measured units in Athens and Delos.[18] It is generally accepted that this same price relationship prevailed in Rome, although no price data are available.[19] As proof the price relationship in Sicily is usually given. But owing to the disproportionately high marketing costs of barley, the very fact that the barley price was half the wheat price in Sicily makes it probable that in Rome the price of barley was more than half that of wheat. There is some supporting evidence, moreover.

One cannot, of course, accept as gospel every word of Pliny the Elder. His statement that wheat was the most prolific grain has caused much mischief in the writings of persons not specialists in agriculture. In another place Pliny compared in detail the conditions of growing barley and wheat—apparently in the area around Rome—and said that the provident agriculturist grows only as much wheat as may be required for his food.[20] But we know that in this area the superiority of

[17] Marketing costs of barley equivalent to 75 per cent of those of wheat in terms of volume are an arbitrary assumption. They might have been slightly more favorable for barley. But the total marketing costs from very distant surplus areas also may have been higher than the price of wheat in the surplus areas; they certainly were higher in the Athenian period.

[18] Auguste Jardé, *Les céréales dans l'antiquité grecque* (Paris, 1925), p. 182: Heichelheim, in Pauly's *Real-Encyclopädie,* Supp. VI, pp. 887-90, and *Wirtschaftliche Schwankungen der Zeit von Alexander bis Augustus,* pp. 128-34.

[19] Frank, "Rome and Italy of the Republic", in *An Economic Survey of Ancient Rome,* I (Baltimore, 1933), 98.

[20] *Naturalis historia,* XVIII, 79 (ed. Teubner).

barley over wheat in yield was relatively moderate. Barley in the Roman area would not have been grown for the market in preference to wheat unless its price was considerably higher than half the wheat price in terms of measured units. At half the wheat price, barley would have been negligible as a cash crop.

A substantial difference in the price relationship between barley and wheat in Greece and Rome seems to have been well in line with the different natural conditions of the two areas. Conditions in Greece were particularly adapted to barley, and a great deal of it was produced there. Domestic production, indeed, far exceeded the quantities needed to satisfy such uses of barley as for feed or porridge, in which the competitive position of barley was strong; much barley must have been pressed into use as the principal cereal food—and hence had to be cheap in relation to wheat. There was no room, therefore, for imports of barley into Greece. Since barley was not imported regularly through commercial channels, the disproportionately high marketing costs of this grain could not have prevented barley in Greece from being as cheap in relation to wheat as in most grain-surplus areas, and cheaper than in Egypt.[21] Greece was deficient in wheat but not in barley.

Natural conditions in the area about Rome were much less favorable for barley production than in Greece. The demand for barley which justified its relatively higher price, mainly the demand for use as feed, could not have been met by the small local production. Barley had to be imported. Thus all factors—the character of the demand, justifying a relatively higher price, the relatively higher cost of production in the area about Rome owing to a less favorable yield relationship, and the relatively higher marketing costs of barley brought in from more or less distant producing areas—combined to make barley more expensive in relation to wheat in Rome than in the surplus areas or in Greece. Rome was deficient in both wheat and barley.

Naked Wheat versus Hulled Wheat

Hulled wheat undoubtedly was far more important than naked wheat in the Mediterranean region at the beginning of the classical period but became relatively insignificant, or almost so, by the end of the period. Was the preference of consumers the decisive factor in this shift, or were other factors primarily responsible?

[21] While the typical price relationship in surplus areas was in the ratio of 1:2, barley in Egypt used to fetch 60 per cent of the price of wheat in terms of measured units. See Heichelheim, *Wirtschaftliche Schwankungen der Zeit von Alexander bis Augustus,* pp. 118-22.

Of the three subspecies of hulled wheat, einkorn, emmer, and spelt, only the first two were significant in classical antiquity. Einkorn is a very poor grain qualitatively and also a very poor yielder. Its strength lies in the fact that it makes few demands as to growing conditions. This advantage proved insufficient, however, to offset the disadvantages. In parts of Asia Minor, but nowhere else, einkorn may have been important at the beginning of the period under investigation. By the end of this period, even there it had probably disappeared.

Spelt is a hulled wheat very similar to common and especially to club naked wheats. It produces a fine white flour, particularly adapted for pastry but used also for bread production, although such bread becomes stale more quickly than bread from common wheat. A few decades ago it was rather generally accepted that spelt was the hulled wheat that was widely grown in ancient times. Some authors are still of the same opinion, while others prefer to avoid the disputed problem by using the word spelt in the wider sense in which it includes all three enumerated subspecies of hulled wheat. Numerous excavations in Egypt, the expedition into Abyssinia by Nikolai Vavilov,[22] the investigation of the hulled wheats of Babylonia by Friedrich Hrozný,[23] the studies of Egyptian and other hulled wheats by August Schulz[24] and Gradmann[25]—these and a great deal of other evidence leave no doubt that the hulled wheat widespread in the classical world was emmer rather than spelt. It may be considered definitely proved that emmer was grown in the Mediterranean region millennia before any trace of spelt can be found in the world.[26] Spelt probably never penetrated farther south than the Po Valley, which is outside the region of Mediterranean climate, and perhaps not even as far south as that valley.

[22] N. I. Vavilov and others, *The Wheats of Abyssinia and their Place in the General System of Wheat,* Bulletin of Applied Botany, Genetics, and Plant Breeding, Supp. 51 (Leningrad, 1931).

[23] Friedrich Hrozný, *Das Getreide im alten Babylonien,* Sitzungsberichte der kaiserlichen Akademie der Wissenschaften in Wien, Philosophisch-historische Klasse, Vol. CLXXIII, Abhandlung I (1913).

[24] August Schulz, *Beiträge zur Kenntnis der Geschichte der Spelzweizen im Altertum* (Halle a.d.S., 1918), and *Die Geschichte der kultivierten Getreide* (Halle a.d.S., 1913).

[25] Robert Gradmann, "Dinkel und die Allemannen", *Württembergische Jahrbücher für Statistik und Landeskunde,* 1901, pp. 101-58.

[26] It is very probable that the wheat found in the recent excavations in Fayum by Miss Caton-Thompson consisted exclusively of emmer. G. Caton-Thompson and E. W. Gardner, *The Desert Fayum* (The Royal Anthropological Institute of Great Britain and Ireland, London, 1934), pp. 46-49. The excavated grain is placed in the time somewhat before 5000 B.C. No spelt was found anyhere in the world which could be placed in the time before 2000 B.C.

It is likely that spelt was known in Rome. The farmers in the area about Rome probably tried to grow it, but spelt failed to adapt itself to the Mediterranean climate.

Emmer, a counterpart of durum and poulard among hulled wheats, was the leading crop in Rome, Egypt, Babylonia, and some other areas at the beginning of the classical period. As with durum wheats, emmer is less adapted to the production of bread than common wheat and spelt, but most of them are particularly suitable for porridge and alimentary pastes. Still, it was a kind of bread that emmer was principally used for in Egypt, Babylonia, Asia Minor, and certain other countries, although in Rome it was consumed mainly in the form of porridge.

Whether a wheat is naked or hulled does not matter to the ultimate consumer so long as he himself does not have to remove the hull, and it does not matter much even in the latter case. Not long ago spelt was the principal bread-grain crop of southwestern Germany. There was no discrimination against it to speak of on the part of the consumer, hull-free spelt selling for practically the same price as naked wheat. It is true that the production of spelt went down rapidly in the last decades, but the consumer and his preference had nothing to do with this. Spelt, less exacting as to growing conditions than naked wheat, was produced so long as, in terms of hull-free kernels, it yielded sufficiently more to repay the cost of removing the almost worthless hull and the additional cost of transportation and storage. The large reduction in the prices of commercial fertilizer and other technical achievements of modern times made it possible to produce as much or more naked wheat as hull-free spelt from the same area, and this, of course, meant the end of spelt.

A similar although not identical development occurred with emmer in classical times. The development was not quite the same because the objection of the consumers may have played a slight role in the downfall of emmer. As previously stated, emmer is not well adapted to bread production, and the improvements in baking techniques in the classical period made the preference for the consumption of grain in the form of bread even more pronounced. More marked also became the preference for the types of wheat most adapted to breadmaking. That this was a minor factor, however, is evident from the fact that the naked wheats which replaced emmer were mainly or exclusively poulard and durum wheats rather than common or club wheats.

As in the case of spelt, the principal reason for the replacement of emmer by naked wheat must be sought in production conditions. The

fact that emmer rather than naked wheat was primarily grown in the beginning of the classical period puts it beyond reasonable doubt that then emmer yielded materially more, in terms of hull-free kernels, than naked wheat. Except in very limited areas, it now yields materially less.[27] Although, according to Voigt, the shift from the consumption of emmer to that of naked wheat involved an increase in the area needed for the production of the cereal food of the Roman population by about 350 per cent, one can be certain that even a 10 per cent increase was not needed. Moreover, it seems probable that the replacement of emmer by naked wheat did not become rapid until farmers learned to produce from the same area as much naked wheat as hull-free emmer or even more. This time did not come for spelt, in the area where it proved adaptable, before the end of the nineteenth century; it arrived for emmer almost two thousand years earlier.

The relatively higher marketing costs on hulled wheat may have contributed to its rapid replacement by naked wheat during the classical period. Hulled wheat is an even bulkier grain than barley, and its price is lower per unit of volume than that of either barley or naked wheat. The burden of additional marketing costs is, therefore, even more effective in precluding transportation of emmer over long distances than in the case of barley. Unless hulled wheat was shipped with the hulls removed before shipment, its bulkiness must have practically excluded it from the international trade. This factor, however, could have been only a minor one among those responsible for the declining importance of this grain. The total grain exports of Egypt, for example, probably amounted to less than 15 per cent of its grain production. Even if the Egyptian exports consisted exclusively of naked wheat and barley, there would have been plenty of room left for a large emmer production unless emmer had been overtaken by naked wheat in yielding power.

While naked wheat almost pushed hulled wheat out of existence during the classical period, it is a grave mistake when Heichelheim repeatedly designates emmer as an inferior grain and places barley with naked wheat as a superior grain.[28] If men had not succeeded in developing varieties of naked wheat which yield not less of hull-less

[27] Carrado Barbagallo, "La produzione media relativa dei cereali e della vite nella Grecia, nella Sicilia, e nell' Italia antica", *Rivista di storia antica,* New Series, VIII (1904), 477-504, who used the present-day relationship in yield between naked wheat and emmer in computing the yield of emmer in classical Greece, would have great difficulty in explaining why any emmer was grown in Greece or elsewhere at that time.

[28] Heichelheim, in Pauly's *Real-Encyclopädie,* Supp. VI, p. 848; "Roman Syria", in *An Economic Survey of Ancient Rome,* IV, 129.

kernels than emmer or spelt, all the conquests of naked wheat would have gone not to barley or other coarse grain but to hulled wheat. Rice, a hulled grain, dominates the Oriental world even more than naked wheat dominates the Occidental world.

Durum and Poulard versus Common Wheat

Durum and poulard wheat dominated in wheat production of the Mediterranean region in classical antiquity almost to the exclusion of the other subspecies of naked wheat. No common or spelt wheat apparently was ever discovered in Egypt.[29] Πυρός δεμιδαλίτης, the type of wheat almost exclusively grown in Greece, and several other wheats of classical antiquity, are definitely identified as durum.[30] *Triticum* in the narrow sense, one of the two principal wheats of the area around Rome, and some other wheats most probably were poulard wheats. Sicilian, African, and Spanish wheats also are likely to have been mainly durum with poulard making up the rest. The production of common or club wheat seems to have been almost limited to central and especially northern Italy (*siligo* of the Romans) and to northern Greece (σιτανίας).

This dominance of durum and poulard wheat in production existed in spite of the fact that common wheat was greatly preferred by the consumers. According to Pliny,[31] *siligo,* a more or less branless flour from *siligo* wheat, interpreted here as common or club wheat, cost 56 asses per modius, while *similago,* a similar flour from *triticum* in the narrow sense, interpreted as durum or poulard wheat, cost 48 asses.

Poulard wheat indeed is a very poor-quality naked wheat, the poorest except for Polish wheat, which perhaps was never grown extensively in any part of the world. The kernels of most emmers and spelts also are superior in quality to poulard wheat. So far as this is used for food, it is more adapted for alimentary pastes or starch than bread. Durum is a better wheat than poulard, producing excellent macaroni, but most of it is not well adapted for making bread.

As in the case of barley and hulled wheat, the principal reason for growing poulard and durum rather than common or club wheat in antiquity has to be sought in production conditions. Poulard wheat is, and even more was, the highest yielding subspecies of naked wheat. Durum likewise yielded materially more than common wheat.

[29] This is also true of the most recent excavations in Karanis. Botanical and Zoological Reports, I. Cereals, *Karanis: Reports,* University of Michigan Studies, Humanistic Series, XXV (Ann Arbor, 1933), 87-88.

[30] See J. and Ch. Cotte, *Étude sur les blés de l'antiquité classique* (Paris, 1913), p. 93.

[31] Pliny, as cited in n. 20 above, XVIII, 90.

Some time after the classical period, perhaps partly during it, poulard wheat was replaced by other wheats. In the Mediterranean region it was replaced partly by common or club wheat, but another and much larger part was replaced by durum—a subspecies also little adapted to bread production. Although durum, like poulard, may have given way in part to common wheat since classical antiquity, it still commands a dominant position in the Mediterranean region. In Tunis, for example, about three fourths of the wheat produced is durum. Many areas grow many times as much durum as is needed for macaroni; the preference for this has little to do with the growing of durum. Many consumers still cannot afford the sacrifice needed for having their bread made from common rather than durum wheat. With the improvement in agricultural techniques, however, the advantage of durum in yield tends to decline, and with this disappears the foundation on which its dominance in production rests.

Conclusion

Bread made of wheat has been recognized in the Western world as superior to preparations from other grains for use as the principal cereal food. To make the shift to wheat in western and central Europe possible, it was necessary to make usable for wheat large stretches of poor, very acid, formerly forested soils, naturally adapted only to rye, oats, and buckwheat. Hence, the shift to naked wheat is regarded there with considerable justification as a cultural achievement of a high order —from both the consumption and production points of view.

The large gains of naked wheat in consumption and production in the classical world were less significant. They were primarily at the expense of emmer. The type of food consumed was little affected by the shift from emmer to naked wheat, because the shift was almost exclusively to subspecies of naked wheat very similar qualitatively to emmer. In production, too, the shift from emmer to naked wheat can hardly be considered as great an achievement as the adaptation of the poor, strongly acid, "rye" soils to wheat growing. The shift from emmer to wheat was not, indeed, a shift from one grain to another or even from one type of grain to another type of the same grain, but from a less efficient form of the same kind of grain to a more efficient form.

Wheat in the Mediterranean region in ancient times did not encounter the competition of rye and corn, the two grains which have since proved its strongest rivals for the role of the principal cereal food in the Occidental world. Rye, the only grain other than wheat from

which raised bread can be made and which therefore appeals most strongly to consumers among the coarse grains, is unadapted to the Mediterranean region. Corn, probably the best food grain among the underprivileged, *i.e.,* except wheat, rye, and rice, also is not at its best in the Mediterranean region because it needs artificial irrigation; it was, moreover, totally unknown in ancient times.

Besides emmer the only other serious adversary of naked wheat in the Mediterranean region was barley. So far as a shift from barley to wheat occurred, it caused almost as significant changes in the type of food consumed as those usually brought about by a shift from corn to wheat, and the changes were approximately as significant as those resulting through a shift from rye to wheat. But the shift from barley to naked wheat in consumption was much less quantitatively than the shift from emmer. Moreover, only part of the shift was due to preference for wheat. Another part was brought about by the development of an international grain trade in which the bulkiness of barley deprived it of a large portion of its advantage over wheat in cost to the consumer at the place of destination.

The victory of naked wheat in the classical world, we conclude, was attained not so much by the strength of wheat as by the weakness of its rivals.

N. Jasny.

Washington, D. C.