

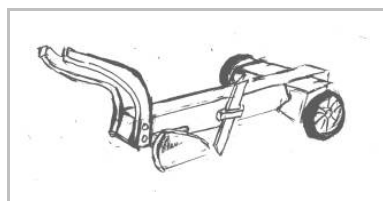
The Plow and the Expansion of Agriculture



Until very recently agriculture has been the basic form of technology. In antiquity its production of surplus was very low: it is a safe guess that well over nine-tenths of the population had to work the soil to support a tiny fraction of humanity engaged in other occupations. Clearly, anything which increased productivity was of major importance. In late Roman times there were efforts, particularly in the northern provinces, to improve agriculture, but no coherent new system of cultivation emerged. By the middle of the 6th century, however, some of the Slavic peasants were using a novel kind of

plow very efficient for heavy fertile alluvial soils which were hard to handle with the older, two-ox scratch-plow designed for light soils. The older plow had merely dug the surface of the soil; in order to turn over the soil for planting, it was necessary to cross-plow, that is, to plow the soil twice, the second plowing being at right angles to the first. The new heavier plow had wheels, a vertical blade (colter) to cut the line of the furrow, a horizontal plowshare, and a mould board to turn over the sod. Its friction with the dirt was so great that it had to be pulled, at least on newly cleared land or in sticky soil, by eight oxen. It attacked the earth so violently that the cross-plowing required by the scratch-plow was unnecessary, and squarish fields gave way to long strip-fields. Since the mould board normally turned the sod to the right and the fields were plowed clockwise, the strips tended to become low ridges favorable to field drainage in the wet climate of Northern Europe. Since few peasants owned eight oxen, co-operative plowing became usual. Likewise, since the fencing of long strip-fields was impractical, villages using the heavy plow divided the arable land into fenced “open fields” embracing many strips which, even though individually owned, had to be cultivated, planted, and harvested on a unified plan. The adoption of the new plow therefore helps to explain the communal pattern of manorial life in Northern Europe. [73]

Starting, it would seem, with the Slavs, the new plow and its related agrarian system spread among the Germans by the early 8th century, and were presumably taken to Britain in the late 9th century by invading Norsemen. Wherever these methods went, their ability to use the heavier and more productive river-bottom soils led to a vast cutting of forests and reclaiming of marshes for agricultural purposes: the face of Northern Europe was changed.



Paralleling and interlocking with the new pattern of cereal-growing was an improved type of cattle-raising. The Romans had not integrated stock-farming closely with agriculture, but had simply pastured their cattle. Proof of this is the scarcity of Roman scythes. Scythes had been used chiefly for cutting grass for hay, which implies an intensive rearing of cattle and sheep, largely in

barns, and a concentration of their manure for later systematic fertilization of fields. In the Frankish age, scythes became common, and at the end of the 8th century Charlemagne tried to rename July “Haying Month.” In addition to the haying, after the harvest the village herd was turned into the open fields to browse on the stubble, incidentally leaving their droppings to fatten the next crop. Thus the northern medieval peasants worked out a new system of food production more balanced and efficient than anything earlier.

By the later 8th century they had taken another stride, at least in the region between the Loire and the Rhine rivers which was the heart of the Carolingian Empire. Land had normally been left fallow half the time to renew its fertility: the cultivated half of the arable was planted in the autumn with wheat, barley, or rye and harvested in the early summer. But now this “two-field” rotation began to give way to a “three-field” system in which only a third of the land was left fallow. In the autumn another third was planted as

before; but in the early spring the remaining third was planted in oats, barley, and legumes to be harvested the later summer. The peas and beans were particularly important, both because their nitrogen-fixing ability strengthened the soil under the burden of this more intensive rotation, and also because they furnished an increased quantity of vegetable proteins for human consumption.

Since the new spring planting required summer rains, it was generally feasible only north of the Alps and the Loire River. Where it could be adopted, however, it was so advantageous that it does much to account for the great vitality of the North in the age of Charlemagne. By providing two sets of crops and two harvests, the three-field rotation much reduced the risk of crop failure and famine. By distributing the work of plowing better over the year, it enabled the plow team to accomplish more. Depending on whether the fallow were plowed once or twice (to turn under the green manure), a community of peasants, with any wasteland to reclaim, by shifting from the two-field to the three-field rotation could increase their production by either one-third or one-half.

The surplus of oats which could be grown in the spring planting of the three-field system is related to another major change in northern agriculture. In antiquity, oxen were adequately harnessed by means of yokes, but the yoke applied to horses is extraordinarily inefficient, both because it strangles the animal as soon as he tries to pull and because the point of traction at the withers is so high that the horse cannot throw his weight into the task of pulling. About 800 A.D. the modern horse harness appeared in the Carolingian realm, consisting of a rigid, padded collar resting on the horse's shoulders and permitting him to breathe, and lateral traces or shafts placed so that the point of traction is effective. With this new harness a team of horses could pull four or five times the load they could draw with a yoke harness.

Hitherto the horse had been valued for its speed; the new harness made horse-power available in conjunction with that speed. The first evidence of habitual plowing with horses, who worked perhaps twice as fast as oxen, comes from Norway in the late 9th century. By 1100, horses were customarily drawing plows, at least in favored regions, all the way from the English Channel to the Ukraine, and throughout the later Middle Ages the horse steadily displaced the ox for farm labor. But this occurred only in Northern Europe, where the three-field rotation made possible, in the spring planting, the surplus of oats needed to feed many horses. The Mediterranean peasants could not shift from oxen to the more efficient horses because, for climatic reasons, they could not produce enough oats.



The early Middle Ages then, witnessed, in Northern Europe, an agricultural revolution unparalleled since the first invention of tillage. Its elements — the heavy plow, open fields, three-field rotation, and horse harness — accumulated and consolidated into a new agrarian system from the 6th through the 9th century. More than anything else the increased surplus of food which it produced accounts for the permanent shift, in Carolingian times, of the focus of European culture away from the Mediterranean to the great plains between the Loire and the Elbe rivers. It accounts for the steady increase of population until the late 13th century, when, because no further agricultural innovations had been introduced, the point of diminishing returns was reached and overcrowding began to worsen the living conditions of the peasantry and undercut the boom in the general economy of Europe which had prevailed from the end of the Viking invasions, c.1000, until c.1300. During these three centuries, the surplus of food permitted an unprecedented growth of cities and an accumulation of capital best symbolized by the enormous Gothic cathedrals which towered over them and which were the pride of the burgher capitalists who created the basic economic and political patterns of the modern West.

— From Lynn White, Jr., “Technology in the Middle Ages.” Melvin Kranzberg and Carroll W. Pursell, Jr., eds., *Technology in Western Civilization*, vol. 1 (Oxford University Press, 1967), pp. 66-79.