Horse power

The millennium of the horse began with a whimper, but went out with a bang.

Vaclav Smil

Horses make superior draught animals. Unlike cattle, their front ends are heavier than their rears (by a ratio of 3:2), an advantage in inertial motion. They can stand without engaging muscles — and hence without additional metabolic cost — by 'locking' their legs with suspensory ligaments and a pair of tendons. And they grow larger and live longer than cattle, and have greater endurance.

Medieval Europe adopted collar harnesses and iron horseshoes just before the end of the first millennium. Ancient throat-and-girth harnesses choked the animal during heavy exertion, and breastband harnesses precluded the optimal transfer of power; fitted and padded collar gave a desirably low traction angle while deploying powerful breast and shoulder muscles without restricting breathing. Iron horseshoes saved hooves from excessive wear and improved traction, and swingletrees, attached to traces to equalize the strain resulting from uneven pulling, made it possible to harness an even or odd number of horses.

By 1000, horses were thus mechanically ready for a bigger role in medieval society — and yet it took them several centuries to displace oxen as the principal draught animals. The Domesday count of 1086 shows that a mere 5 per cent of all demesne draught animals, and about a third of the total on English peasant holdings, were horses. By 1300 they made up nearly half of all draught animals owned by peasants. But it was more than 200 years before they became dominant. The size of the animals, their nutrition, and the ploughs they pulled explain why.

The body weight, and hence power, of draught horses only began to rise after several centuries of breeding the heavy war animals needed to carry armoured knights. And more powerful horses needed at least some concentrates, such as cereal or legume grains, in their diets — not just the roughages (grasses, straws) fed to cattle. Farming had to be intensified to provide this feed for both people and animals. This was a slow process: in England, crop harvests were stagnant for centuries, and average yields only took off in the late eighteenth century.

But even larger, well-fed horses had a tough time with wooden ploughs. The ploughs' heavy soles, wheels and mould-boards generated enormous friction, particularly in wet soils, and without a smooth, curved fitting between the share and the flat mould-board, they were constantly clogged with soil and weeds. Iron mould-boards only crossed from China to Europe in the seventeenth century, and it was not until the rise of the modern steel industry in the mid-nineteenth century that smooth, curved, steel ploughshares replaced cast-iron shares.

Increased body size, improved feed quality and cheap steel transformed draught horses into unrivalled energizers of the early modern world's agriculture. Horses were also essential during the initial stages of industrialization, powering road and canal transport, and turning whims in mining, food processing and numerous manufactures before they were displaced by steam engines.

Heavier draught animals made it possible to cultivate the existing fields more frequently and to convert forests and grasslands to new fields more easily, and freed labour for other activities. Most notably, the post-1850 ploughing-up of America's enormous grasslands could not have proceeded so quickly with oxen. The heaviest nineteenth-century breeds — French percherons, English shires, German rheinlanders — approached and even topped 17 hands and weighed around one tonne. During brief exertions such horses could develop about three horsepower, and they could work steadily at rates well surpassing one horsepower (745 W). These animals needed a lot of feed, but their energy advantage was indisputable: a horse eating 4 kg of oats a day consumed about the same amount of grain as six people — but its power could supplant that of at least ten strong men.

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By the 1890s, American horses, working in teams of more than 30 animals, pulled not just multishare ploughs but also the first grain combines. Such large numbers of animals needed abundant farmland: when the number of farm horses in the United States peaked at 21 million in 1919, at least 20 per cent of the country's farmland was needed to cultivate their feed. By that time internal-combustion engines and electric motors had almost totally displaced draught horses in the cities of industrial countries.

Their eventual replacement in Western farming was inevitable: even the small internal-combustion engines mounted on the first tractors could replace at least ten horses — and claimed no land. By the end of 1960, when three million horses were still left on American farms, the US Department of Agriculture stopped counting draught animals. The millennium of gradually expanding horse power that was so instrumental in the rise of the West ended in a rapid retreat. ■

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Pulling power: better harnesses and ploughs put horses' efforts to more efficient use.