under its nose. Technology is only an instrument and man does not always know how to use it.

Concluding remarks

Let us return to Europe at the end of the eighteenth century to formulate two connected remarks: the first on the subject of energy resources as a whole, the second on the machinery available.

1) We can accurately classify available sources of energy in descending order of importance: first, animal traction; 14 million horses, 24 million oxen, each animal representing a quarter horse-power – that is roughly 10 million horse-power; next, wood, possibly equivalent to 4 or 5 million horse-power; then water-wheels, between 1.5 million and 3 million horse-power; then man-power (50 million workers), representing 900,000 horse-power; finally, sails, at most 233,000 horse-power, without counting the war fleet. This is obviously a far cry from the present-day energy supply, but that is not the point I wish to make. The interest of this incomplete calculation (in which, it should be pointed out, we have counted neither windmills, nor river boats, nor charcoal, nor even coal) is that it shows incontestably that the two principal sources of energy were draught-animals and wood combustion (windmills, which were not as numerous as watermills, cannot have represented more than a third or a quarter of the power of the water under control). If the mill was not more developed, it was partly for technical reasons (the widespread use of wood rather than metal) but chiefly because in the places where the mills were sited, there was no use for any greater energy supply, and at this time energy could not be transported. Lack of energy was the major handicap of ancien régime economies. The average watermill gave five times the yield of a hand mill operated by two men – and that was itself a revolution; but the first steam-driven mill would do five times the work of a watermill.

2) However, a preliminary stage was reached before the industrial revolution. The harnessing of horses, the flames from burning wood, rudimentary engines utilizing wind and river currents, plus an increased number of men at work, all provoked a certain amount of growth in Europe from the fifteenth to the eighteenth century, a slow increase in strength, power and practical understanding. Increasingly active progress in the 1730s and 1740s was built upon this gradual advance. There was thus an often imperceptible or unrecognized industrial pre-revolution in an accumulation of discoveries and technical advances, some of them spectacular, others almost invisible: various types of gear-wheels, jacks, articulated transmission belts, the 'ingenious system of reciprocating movement', the fly-wheel that regularized any momentum, rolling mills, more and more complicated machinery for the mines. And there were so many other innovations: looms for knitting and manufacturing ribbons, chemical processes.

It was during the second half of the eighteenth century that the first attempts
were made to adapt lathes, borers and drilling machines [tools which had long been known] to industrial use.' It was the mechanization of weaving and spinning processes at the same time that launched the English economy. Nevertheless what was lacking before these imagined or realized machines could be fully employed was a surplus of easily mobilized - and that means easily transportable - energy. But the machinery existed and was constantly being perfected. It is revealing to see how European travellers unfailingly comment on the contrast between the primitive machinery in use in India and China, and the quality and refinement of its products. 'One is amazed at the simplicity of the instruments used to make the finest silks in China,' writes one visitor, and his words are echoed in almost identical terms by another writing about the famous cotton muslins of India.

With the coming of steam, the pace of the West increased as if by magic. But the magic can be explained: it had been prepared and made possible in advance. To paraphrase a historian (Pierre Léon), first came evolution (a slow rise) and then revolution (an acceleration): two connected movements.

Men the eighteenth century would certainly have said of it...