

conclusions, and obtained important results for the correction of compasses.

A narrative of high adventure concludes the book, describing how in 1816 his command, the *Esk*, was hove down at the ice edge to repair a broken keel. It is typical of Scoresby that, no sooner on board again, he could so far detach himself as to make some ingenious calculations showing that the men had pumped 15,690 tons of water from the ship during those nine fearful days.

ROBERT CLARKE

AN AMERICAN BRUNEL

Charles Ellet, Jr

The Engineer as Individualist, 1810–1862. By Gene D. Lewis. Pp. viii+220. (University of Illinois Press: Urbana and London, April 1969.) 71s 6d.

ONLY a very few people in England will have heard of the subject of this biography and even in his own country the name of this pioneer civil engineer is comparatively little known. Yet in 1857 a contemporary of Charles Ellet called him the "American Brunel" and it is true that remarkable parallels may be drawn between these two highly individualistic engineers who were almost exact contemporaries (I. K. Brunel lived from 1806 to 1859). It is in this and in the contrasting conditions that the two men had to meet in their two countries that the chief interest of this book lies for English readers.

In the early nineteenth century, though English engineers excelled in practice, France led the world in engineering theory and instruction. Both men benefited from French influence and example. Brunel completed his education in Paris while the young Ellet, with no paternal aid, determined to visit Europe in 1830 where he attended lectures at the celebrated *École des Ponts et Chaussées*.

Both men were remarkable for their versatility and tireless energy. Moreover, both men insisted on complete responsibility for every task they undertook and would brook no interference from either management or Government. This uncompromising attitude characterized the great pioneer English engineers of the eighteenth century, but in the rapidly evolving nineteenth century engineering world a new type of engineer was emerging. This was the salaried professional, expert in a narrow field and willing to work as a team with other experts under administrative control. Consequently the individualism of Brunel and Ellet encountered a growing antagonism which was exacerbated by their own self-confident arrogance. The fact that they so often proved to be right did not help to mend matters.

Ellet emerges from this book as the less attractive character because, unlike Brunel, he seems to have been without the saving grace of a sense of humour. He also seems to have lacked Brunel's originality of mind and the tenacity with which the latter saw his projects through to a conclusion despite all opposition. Thus, although Ellet was responsible for introducing to America the long-span cable suspension bridge and was engineer of a number of important canal and railway construction projects, having done the pioneer work he withdrew from them as a result of disputes, leaving them to be completed by others. Here, however, the comparison may be unfair to Ellet for, as Professor Lewis points out, political and social conditions in pre-Civil War America, unlike those prevailing after that war, were unpropitious for large-scale engineering projects. In England, the situation was precisely the opposite.

Charles Ellet lost his life in the Civil War as a result of a wound received when captaining a steam ram of his own design in a naval action on the Mississippi. Perhaps the most remarkable example of his genius and foresight was his report on the causes of flooding on the Mississippi and

Ohio rivers in which he recommended as a remedy the construction of reservoirs near the headwaters to hold back the water at time of flood. It fell on deaf ears. Many years later the Tennessee Valley Authority would demonstrate the validity of his proposals.

We should be grateful to Professor Lewis for his diligence in rescuing from obscurity this thought-provoking life story of a great American engineer.

L. T. C. ROLT

RUMFORD ON HEAT

Collected Works of Count Rumford

Edited by Sanborn C. Brown. Vol. 1: *The Nature of Heat.* Pp. x+507. (Belknap Press of Harvard University Press: Cambridge, Mass.; Oxford University Press: London, March 1969.) 95s.

THE great creative periods in the history of science abound in personalities whose activity, besides contributing to the discovery of timeless features of the world's fabric, reveals the specific preoccupations of their time, which inspired and oriented their endeavours. They either belong to a class of society striving for economic and political power, or are associated with such a class in a menial position, and more or less consciously regard science as a remarkably efficient instrument in the service of their particular interests, which they more or less candidly identify with those of mankind. As typical examples one thinks of the Italian mathematicians and engineers of the sixteenth and seventeenth centuries, numbering such colourful individuals as Tartaglia, Cardano or Galileo; or of the circle of *virtuosi* assembled in the Royal Society in Newton's time, among whom Newton himself, Hooke, Flamsteed, Halley stand before us not only as the protagonists of a new way of looking at nature, but as men with their all too human passions and ambitions. No period, however, is richer in this respect than that which corresponds to the initial phase of the industrial revolution among the tradesmen of the British kingdom (including the American territories) in the late eighteenth and beginning nineteenth centuries; and in the array of extraordinary characters who have left their mark in the expansion of the field of chemistry and physics that accompanied the expansion of industry, Rumford appears, not perhaps as the greatest, but certainly as the most picturesque.

Indeed, were it not for his investigations on the nature of heat, he would rather pass for one of those restless, egotistic inventors, always on the lookout for new practical problems on which to exercise their fertile imagination, and busily advocating schemes of improvement and reform; as such, he must be credited for the energy and generosity he displayed in the various employments of his adventurous career. Among his somewhat dilettantish and repetitive writings, a number of papers bearing on the nature of heat stand out as masterly examples of the happiest combination of experimental work and theoretical induction; the experiments on the production of heat by friction, from which he concluded the kinetic nature of heat, have gained the supreme consecration of figuring for ever in every elementary textbook; the others, though less famous, form an imposing body of entirely original research, and have not played a lesser historical role in putting on a firm empirical basis the main properties and modes of propagation of heat.

The only collected edition of Rumford's papers so far available was the one published in four volumes between 1870 and 1875 by the American Academy of Arts and Sciences in Boston. Whatever its undeniable merits, it was far from satisfactory, and it is therefore gratifying that the new issue, the first volume of which is the object of this review, is not a simple reprint of the original, but entails a thorough-going rearrangement of the material, as well as amendments and additions wherever needed.