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On the economy of machinery and manufactures

Babbage, Charles

London, 1832

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Chap. VII. Exerting forces too great for human power, and executing operations too delicate for human touch.

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CHAP. VII.

EXERTING FORCES TOO GREAT FOR HUMAN POWER,
AND EXECUTING OPERATIONS TOO DELICATE FOR
HUMAN TOUCH.

(40.) It requires some skill and a considerable apparatus to enable many men to exert their whole force at a given point, and when this number amounts to hundreds or to thousands, additional difficulties present themselves. If ten thousand men were hired to act simultaneously, it would be exceedingly difficult to discover whether each exerted his whole force, and consequently, to be assured that each man did the duty for which he was paid. And if still larger bodies of men or animals were necessary, not only would the difficulty of directing them become greater, but the expense would increase from the necessity of transporting food for their subsistence.

The difficulty of enabling a large number of men to exert their force at the same instant of time has been almost obviated by the use of sound. The whistle of the boatswain occasionally performs this service; and in removing, by manual force, the vast mass of granite, weighing above 1400 tons, on which the equestrian figure of Peter the Great is placed at St. Petersburg, a drummer was always stationed on its summit to give the signal for the united efforts of the workmen.

An interesting discovery was made a few years since, by Champollion, of an ancient Egyptian drawing, in which a multitude of men appeared harnessed to a huge block of stone, on the top of which stood a single individual with his hands raised above his head, apparently in the act of clapping them, for the same purpose of insuring the exertion of their combined force at the same moment of time.

(41.) In all our larger manufactories numerous instances occur of the application of the power of steam to overcome resistances which it would require far greater expense to surmount by means of animal labour. The twisting of the largest cables, the rolling, hammering, and cutting large masses of iron, the draining of our mines, all require enormous exertions of physical force continued for considerable periods of time. Other means are had recourse to when the force required is great, and the space through which it is to act is small. The hydraulic press of Bramah can, by the exertion of one man, produce a pressure of 1500 atmospheres, and with such an instrument a hollow cylinder of wrought iron three inches thick has been burst. In rivetting together the iron plates out of which steam engine boilers are made, it is necessary to produce as close a joint as possible. This is accomplished by using the rivets red hot: while they are in that state the two plates of iron are rivetted together, and the contraction which the rivet undergoes in cooling draws them together with a force which is only limited by the tenacity of the metal of which the rivet itself is made.

(42.) It is not alone in the greater operations of the engineer or the manufacturer, that those vast

powers which man has called into action, in availing himself of the agency of steam, are fully developed. Wherever the individual operation demanding little force for its own performance is to be multiplied in almost endless repetition, commensurate power is required. It is the same "giant arm which twists the largest cable," that spins from the cotton plant an "almost gossamer thread." Obedient to the hand which called into action its resistless powers, it contends with the ocean and the storm, and rides triumphant through dangers and difficulties unattempted by the older modes of navigation. It is the same engine that, in its more regulated action, weaves the canvass it may one day supersede; or, with almost fairy fingers, entwines the meshes of the most delicate fabric that adorns the female form.*

(43.) The Fifth Report of the Select Committee of the House of Commons on the Holyhead Roads furnishes ample proof of the great superiority of steam vessels. The following extracts are taken from the evidence of Captain Rogers, the commander of one of the packets:—

Question. Be so good as to acquaint the committee in "what manner the communication has been kept open between Holyhead and Dublin by steam packets, and what has been the success of the experiment of establishing them on that station.

Answer. We have done every thing that could be done, "by steam boats; and they will go, no doubt, when a sailing vessel will not,—that has been proved.

* The importance and diversified applications of the steam-engine were most ably enforced in the speeches made at a public meeting, held (June 1824) for the purpose of proposing the erection of a monument to the memory of James Watt; these were subsequently printed.

“ *Quest.* Are you not perfectly satisfied, from the experience you have had, that the steam vessel you command is capable of performing what no sailing vessel can do ?

“ *Ans.* Yes.

“ *Quest.* During your passage from Gravesend to the Downs could any square-rigged vessel, from a first-rate down to a sloop of war, have performed the voyage you did in the time you did it in the steam boat ?

“ *Ans.* No ; it was impossible. In the Downs we passed several Indiamen, and 150 sail there that could not move down the Channel ; and at the back of Dungeness we passed 120 more.

“ *Quest.* At the time you performed that voyage, with the weather you have described, from the Downs to Milford, if that weather had continued twelve months would any square-rigged vessel have performed it ?

“ *Ans.* They would have been a long time about it ; probably, would have been weeks instead of days. A sailing vessel would not have beat up to Milford, as we did, in twelve months.”

(44.) The process of printing on silver paper, which is necessary for bank-notes, is attended with some inconvenience, from the necessity of damping the paper previously to taking the impression. It was difficult to do this uniformly ; and in the old process of dipping a parcel of several sheets together into a vessel of water, the outside sheets becoming much more wet than the others were very apt to be torn. A method has been adopted at the Bank of Ireland which obviates this inconvenience. The whole quantity of paper to be damped is placed in a close vessel from which the air is exhausted ; water is then admitted and every leaf is completely wetted ; the paper is then removed to a press, and all the superfluous moisture is squeezed out.