

patent expired. Often, individual patentees and bureaucratic agencies fought over the degree of specificity that was needed in patent applications, with the patentees trying to disclose as little as possible. The dramatic rise in literacy following the invention of movable type printing by Gutenberg made the content of patents application more accessible, though seventeenth- and eighteenth-century verbal descriptions were often vague and general. Nonverbal communication, primarily drawings, also proved an extremely useful agent of technology diffusion. In order to limit the monopolistic powers of patents to their specific fields, courts demanded exact specification of all the applications of an invention. Inventors, on the other hand, feared that listing such details in their patent applications would allow competitors to emulate inventions and destroy inventors' competitive advantage of exclusivity. It was none other than Matthew Bolton and James Watt who used their reputation and resources to combat the general hostility of late eighteenth-century judges to patents, and established the requirement of precise specifications as a *quid pro quo* for the privilege of monopoly.⁶

States had to define who was entitled to such lucrative monopolies. Modern distinctions between invention, discovery, and the acquisition of knowledge by other than mental effort did not exist in the language of the sixteenth and seventeenth centuries. The terms "invention," "discovery," and "first finding out" were used indiscriminately in the patent registration rolls and in the legal literature of the period. Often it was not the inventor *per se* who benefited from a monopoly. Protecting one's patent was technically and financially burdensome. Success depended on the ability to litigate, not on inventive merit. Many inventors who did not have the budget for financing lengthy court battles did not register their patents, opting for nondisclosure over patent exposure. Secrecy was effective less in hiding mechanical innovation than in hiding the cost and profit

margins involved in adopting new machinery. Without these economic data investors had a harder time deciding whether or not it was beneficial to alter the production process.⁷

Success in obtaining state-sanctioned monopoly depended on the ability of would-be patentees to persuade governmental bodies with coercive powers that the innovations they championed were in their exclusive possession and of great value to society and its rulers. Such campaigning required resources that were not at the disposal of all inventors, and many turned to selling and leasing their rights over their patents to others. Keeping innovations secret by not patenting them was a viable alternative only for inventors of processes who could use their monopolized knowledge to increase production and decrease costs without divulging their methods to competitors. Inventors of machines, however, usually had to sell them in order to make a profit, and buyers could analyze the innovations and build their own copies. Even within small communities restrictions on the diffusion of technical knowledge depended on the ability of first users to persuade society to coerce others to respect their monopoly. As critics of capitalism were quick to point out, control of the mode of production was a development of utmost significance in the distribution of political and economic power in the early modern age. In the precapitalist system of production the master owed his dominant role in the production process to his knowledge of the secrets of the craft rather than his ownership of the means of production. Modern industry, however, wrote Karl Marx, "sweeps away by technical means the manufacturing division of labor, under which each man is bound hand and foot for life to a single detail operation. At the same time, the capitalistic form of that industry reproduces this same division of labour in a still more monstrous shape; in the factory proper, by converting the workman into a living appendage of the machine." Owners of patent monopolies sought to restrict the