Chapter One
A Wrong Turn

A. Preface: Mumford's Periodization of Technological History

Lewis Mumford, in *Technics and Civilization*, divided the progress of technological development since late medieval times into three considerably overlapping periods (or phases): the eotechnic, paleotechnic, and neotechnic.

The original technological revolution of the late Middle Ages, the eotechnic, was associated with the skilled craftsmen of the free towns, and eventually incorporated the fruits of investigation by the early scientists. It began with agricultural innovations like the horse collar, horseshoe and crop rotation. It achieved great advances in the use of wood and glass, masonry, and paper (the latter including the printing press). The agricultural advances of the early second millennium were further built on by the innovations of market gardeners in the sixteenth and seventeenth centuries—like, for example, raised bed horticulture, composting and intensive soil development, and the hotbeds and greenhouses made possible by advances in cheap production of glass.

In mechanics, in particular, its greatest achievements were clockwork machinery and the intensive application of water and wind power. The first and most important prerequisite of machine production was the transmission of power and control of movement by use of meshed gears. Clockwork, Mumford argued, was “the key-machine of the modern industrial age.” It was

> a new kind of power-machine, in which the source of power and the transmission were of such a nature as to ensure the even flow of energy throughout the works and to make possible regular production and a standardized product. In its relationship to determinable quantities of energy, to standardization, to automatic action, and finally to its own special product, accurate timing, the clock has been the foremost machine in modern technics.... The clock, moreover, served as a model for many other kinds of mechanical works, and the analysis of motion that accompanied the perfection of the clock, with the various types of gearing and transmission that were elaborated, contributed to the success of quite different kinds of machine.[1]

> If power machinery be a criterion, the modern industrial revolution began in the twelfth century and was in full swing by the fifteenth.[2]

With this first and largest hurdle cleared, Renaissance tinkerers like DaVinci quickly turned to the application of clockwork machinery to specific processes.[3] Given the existence of clockwork, the development of machine processes for every imaginable specific task was inevitable. Regardless of the prime mover at one end, or the specific process at the other, clockwork transmission of power was the defining feature of automatic machinery.

> In solving the problems of transmitting and regulating motion, the makers of clockwork helped the general development of fine mechanisms. To quote Usher once more: "The primary development of the fundamental principles of applied mechanics was . . . largely based upon the problems of the clock." Clockmakers, along with blacksmiths and locksmiths, were among the first machinists:
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> Nicholas Forq, the Frenchman who invented the planer in 1751, was a clockmaker: Arkwright, in 1768, had the help of a Warrington clockmaker; it was Huntsman, another clockmaker, desirous of a more finely

1 Lewis Mumford, *Technics and Civilization* (New York: Harcourt, Brace, and Company, 1934), pp. 14-15.
2 Ibid., p. 112.
3 Ibid., p. 68.

tempered steel for the watchspring, who invented the process of producing crucible steel: these are only a few of the more outstanding names. In sum, the clock was the most influential of machines, mechanically as well as socially; and by the middle of the eighteenth century it had become the most perfect: indeed, its inception and its perfection pretty well delimit the eotechnic phase. To this day, it is the pattern of fine automatism.[1]

With the use of clockwork to harness the power of prime movers and transmit it to machine production processes, eotechnic industry proliferated wherever wind or running water was abundant. The heartland of eotechnic industry was the river country of the Rhineland and northern Italy, and the windy areas of the North and Baltic seas.[2]

> Grinding grain and pumping water were not the only operations for which the water-mill was used: it furnished power for pulping rags for paper (Ravensburg: 1290) : it ran the hammering and cutting machines of an ironworks (near Dobrilugk, Lausitz, 1320) : it sawed wood (Augsburg: 1322) : it beat hides in the tannery, it furnished power for spinning silk, it was used in fulling-mills to work up the felts, and it turned the grinding machines of the armorers. The wire-pulling machine invented by Rudolph of Nürnberg in 1400 was worked by water-power. In the mining and metal working operations Dr. Georg Bauer described the great convenience of water-power for pumping purposes in the mine, and suggested that if it could be utilized conveniently, it should be used instead of horses or man-power to turn the underground machinery. As early as the fifteenth century, water-mills were used for crushing ore. The importance of water-power in relation to the iron industries cannot be over-estimated: for by utilizing this power it was possible to make more powerful bellows, attain higher heats, use larger furnaces, and therefore increase the production of iron.
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> The extent of all these operations, compared with those undertaken today in Essen or Gary, was naturally small: but so was the society. The diffusion of power was an aid to the diffusion of population: as long as industrial power was represented directly by the utilization of energy, rather than by financial investment, the balance between the various regions of Europe and between town and country within a region was pretty evenly maintained. It was only with the swift concentration of financial and political power in the sixteenth and seventeenth centuries, that the excessive growth of Antwerp, London, Amsterdam, Paris, Rome, Lyons, Naples, took place.[3]

With the "excessive growth of Antwerp, London, Amsterdam, Paris, Rome, Lyons, Naples," came the triumph of a new form of industry associated with the concentrated power of those cities. The eotechnic phase was supplanted or crowded out in the early modern period by the paleotechnic—or what is referred to, wrongly, in most conventional histories simply as "the Industrial Revolution."

Paleotechnic had its origins in the new centralized state and the industries closely associated with it (most notably mining and armaments), and centered on mining, iron, coal, and steam power. To give some indication of the loci of the paleotechnic institutional complex, the steam engine was first introduced for pumping water out of mines, and its need for fuel in turn reinforced the significance of the coal industry[4]; the first appearance of large-scale factory production was in the armaments industry.[5] The paleotechnic culminated in the "dark satanic mills" of the nineteenth century and the giant corporations of the late nineteenth and early twentieth.

The so-called "Industrial Revolution," in conventional parlance, conflates two distinct phenomena: the development of mechanized processes for specific kinds of production (spinning and weaving, in

1 Ibid., p. 134.
2 Ibid., p. 113.
3 Ibid., pp. 114-115.
4 Ibid., pp. 159, 161.
5 Ibid., p. 90.

particular), and the harnessing of the steam engine as a prime mover. The former was a direct outgrowth of the mechanical science of the eotechnic phase, and would have been fully compatible with production in the small shop if not for the practical issues raised by steam power. The imperative to concentrate machine production in large factories resulted, not from the requirements of machine production as such, but from the need to economize on steam power.

Although the paleotechnic incorporated some contributions from the eotechnic period, it was a fundamental departure in direction, and involved the abandonment of a rival path of development. Technology was developed in the interests of the new royal absolutists, mercantilist industry and the factory system that grew out of it, and the new capitalist agriculturists (especially the Whig oligarchy of England); it incorporated only those eotechnic contributions that were compatible with the new tyrannies, and abandoned the rest.

But its successor, the neotechnic, is what concerns us here.

B. The Neotechnic Phase

Much of the centralization of paleotechnic industry resulted, in addition to the authoritarian institutional culture associated with its origins, from the need (which we saw above) to economize on power.

> ….the steam engine tended toward monopoly and concentration.... Twenty-four hour operations, which characterized the mine and the blast furnace, now came into other industries which had heretofore respected the limitations of day and night. Moved by a desire to earn every possible sum on their investments, the textile manufacturers lengthened the working day.... The steam engine was pacemaker. Since the steam engine requires constant care on the part of the stoker and engineer, steam power was more efficient in large units than in small ones: instead of a score of small units, working when required, one large engine was kept in constant motion. Thus steam power fostered the tendency toward large industrial plants already present in the subdivision of the manufacturing process. Great size, forced by the nature of the steam engine, became in turn a symbol of efficiency. The industrial leaders not only accepted concentration and magnitude as a fact of operation, conditioned by the steam engine: they came to believe in it by itself, as a mark of progress. With the big steam engine, the big factory, the big bonanza farm, the big blast furnace, efficiency was supposed to exist in direct ratio to size. Bigger was another way of saying better.
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> [Gigantism] was... abetted by the difficulties of economic power production with small steam engines: so the engineers tended to crowd as many productive units as possible on the same shaft, or within the range of steam pressure through pipes limited enough to avoid excessive condensation losses. The driving of the individual machines in the plant from a single shaft made it necessary to spot the machines along the shafting, without close adjustment to the topographical needs of the work itself....[1]

Steam power meant that machinery had to be concentrated in one place, in order to get the maximum use out of a single prime mover. The typical paleotechnic factory, through the early 20th century, had machines lined up in long rows, "a forest of leather belts one arising from each machine, looping around a long metal shaft running the length of the shop," all dependent on the factory's central power plant.[2]

The neotechnic revolution of the late nineteenth century put an end to all these imperatives.

1 Ibid., p. 224.
2 William Waddell and Norman Bodek, *The Rebirth of American Industry: A Study of Lean Management* (Vancouver, WA: PCS Press, 2005), pp. 119-121.

If the paleotechnic was a “coal-and-iron complex,” in Mumford's terminology, the neotechic was an “electricity-and-alloy complex.”[1] The defining features of the neotechnic were the decentralized production made possible by electricity, and the light weight and ephemeralization (to borrow a term from Buckminster Fuller) made possible by the light metals.

The beginning of the neotechnic period was associated, most importantly, with the invention of the prerequisites for electrical power—the dynamo, the alternator, the storage cell, the electric motor—and the resulting possibility of scaling electrically powered production machinery to the small shop, or even scaling power tools to household production.

Electricity made possible the use of virtually any form of energy, indirectly, as a prime mover for production: combustibles of all kinds, sun, wind, water, even temperature differentials.[2] As it became possible to run free-standing machines with small electric motors, the central rationale for the factory system disappeared. “In general,” as Paul Goodman wrote, “the change from coal and steam to electricity and oil has relaxed one of the greatest causes for concentration of machinery around a single driving shaft.”[3]

The decentralizing potential of small-scale, electrically powered machinery was a common theme among many writers from the late 19th century on. That, and the merging of town and village it made possible, were the central themes of Kropotkin's *Fields, Factories and Workshops*. With electricity "distributed in the houses for bringing into motion small motors of from one-quarter to twelve horse-power," it was possible to produce in small workshops and even homes. Freeing machinery up from a single prime mover ended all limits on the location of machine production. The primary basis for economy of scale, as it existed in the nineteenth century, was the need to economize on horsepower—a justification that vanished when the distribution of electrical power eliminated reliance on a single source of power.[4]

William Morris seems to have made some Kropotkinian technological assumptions in his depiction of a future libertarian communist society in *News From Nowhere*:

> "What building is that?" said I, eagerly; for it was a pleasure to see something a little like what I was used to: "it seems to be a factory."
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> "Yes, he said," "I think I know what you mean, and that's what it is; but we don't call them factories now, but Banded-workshops; that is, places where people collect who want to work together."
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> "I suppose," said I, "power of some sort is used there?"
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> "No, no," said he. "Why should people collect together to use power, when they can have it at the places where they live or hard by, any two or three of them, or any one, for the matter of that?..."[5]

The introduction of electrical power, in short, put small-scale machine production on an equal

1 Mumford, *Technics and Civilization*, p. 110.
2 Ibid., pp. 214, 221.
3 Paul and Percival Goodman, *Communitas: Means of Livelihood and Ways of Life* (New York: Vintage Books, 1947, 1960), p. 156.
4 Peter Kropotkin, *Fields, Factories and Workshops: or Industry Combined with Agriculture and Brain Work with Manual Work* (New York: Greenwood Press, Publishers, 1968 [1898]), pp. 154., 179-180.
5 William Morris, *News From Nowhere: or, An Epoch of Rest* (1890). Marxists.Org online text <http://www.marxists.org/archive/morris/works/1890/nowhere/nowhere.htm>.

footing with machine production in the factory.

> The introduction of the electric motor worked a transformation within the plant itself. For the electric motor created flexibility in the design of the factory: not merely could individual units be placed where they were wanted, and not merely could they be designed for the particular work needed: but the direct drive, which increased the efficiency of the motor, also made it possible to alter the layout of the plant itself as needed. The installation of motors removed the belts which cut off light and lowered efficiency, and opened the way for the rearrangement of machines in functional units without regard for the shafts and aisles of the old-fashioned factory: each unit could work at its own rate of speed, and start and stop to suit its own needs, without power losses through the operation of the plant as a whole.
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> ...[T]he efficiency of small units worked by electric motors utilizing current either from local turbines or from a central power plant has given small-scale industry a new lease on life: on a purely technical basis it can, for the first time since the introduction of the steam engine, compete on even terms with the larger unit. Even domestic production has become possible again through the use of electricity: for if the domestic grain grinder is less efficient, from a purely mechanical standpoint, than the huge flour mills of Minneapolis, it permits a nicer timing of production to need, so that it is no longer necessary to consume bolted white flours because whole wheat flours deteriorate more quickly and spoil if they are ground too long before they are sold and used. To be efficient, the small plant need not remain in continuous operation nor need it produce gigantic quantities of foodstuffs and goods for a distant market: it can respond to local demand and supply; it can operate on an irregular basis, since the overhead for permanent staff and equipment is proportionately smaller; it can take advantage of smaller wastes of time and energy in transportation, and by face to face contact it can cut out the inevitable red-tape of even efficient large organizations.[1]

Mumford's comments on flour milling also anticipated the significance of small-scale powered machinery in making possible what later became known as “lean production”; its central principle is that overall flow is more important to cost-cutting than maximizing the efficiency of any particular stage in isolation. The modest increases in unit production cost at each separate stage are offset not only by greatly reduced transportation costs, but by avoiding the large eddies in overall production flow (buffer stocks of goods-in-process, warehouses full of goods “sold” to inventory without any orders, etc.) that result when production is not geared to demand.[2]

Neotechnic methods, which could be reproduced anywhere, made possible a society where “the advantages of modern industry [would] be spread, not by transport—as in the nineteenth century—but by local development.” The spread of technical knowledge and standardized methods would make transportation far less important.[3]

Mumford also described, in quite Kropotkinian terms, the “marriage of town and country, of industry and agriculture,” that could result from the application of further refined eotechnic horticultural techniques and the decentralization of manufacturing in the neotechnic age.[4]

Mumford saw the neotechnic phase as a continuation of the principles of the eotechnic, with industrial organization taking the form it would have done if allowed to develop directly from the eotechnic without interruption.

1 Mumford, *Technics and Civilization*, pp. 224-225.
2 In the case of flour, according to Borsodi, the cost of custom-milled flour from a local mill was about half that of flour from a giant mill in Minneapolis, and flour from a small electric household mill was cheaper still. *Prosperity and Security: A Study in Realistic Economics* (New York and London: Harper & Brothers Publishers, 1938), pp. 178-181.
3 Ibid., pp. 388-389.
4 Mumford, *Technics and Civilization*, pp. 258-259.

> The neotechnic, in a sense, is a resumption of the lines of development of the original eotechnic revolution, following the paleotechnic interruption. The neotechnic differs from the paleotechnic phase almost as white differs from black. But on the other hand, it bears the same relation to the eotechnic phase as the adult form does to the baby.
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> ....The first hasty sketches of the fifteenth century were now turned into working drawings: the first guesses were now re-enforced with a technique of verification: the first crude machines were at last carried to perfection in the exquisite mechanical technology of the new age, which gave to motors and turbines properties that had but a century earlier belonged almost exclusively to the clock.[1]

Or as Ralph Borsodi put it, "[t]he steam engine put the water-wheel out of business. But now the gasoline engine and the electric motor have been developed to a point where they are putting the steam engine out of business."

> The modern factory came in with steam. Steam is a source of power that almost necessitates factory production. But electricity does not. It would be poetic justice if electricity drawn from the myriads of long neglected small streams of the country should provide the power for an industrial counter-revolution.[2]

Mumford suggested that, absent the abrupt break created by the new centralized states and their state capitalist clients, the eotechnic might have evolved directly into the neotechnic. Had not the eotechnic been aborted by the paleotechnic, a full-scale modern industrial revolution would still almost certainly have come about "had not a ton of coal been dug in England, and had not a new iron mine been opened."[3]

The amount of work accomplished by wind and water power compared quite favorably with that of the steam-powered industrial revolution. Indeed, the great advances in textile output of the eighteenth century were made with water-powered factories; steam power was adopted only later. The Fourneyron water-turbine, perfected in 1832, was the first prime-mover to exceed the poor 5% or 10% efficiencies of the early steam engine, and was a logical development of earlier water-power technology that would likely have followed much earlier in due course, had not the development of water-power been sidetracked by the paleotechnic revolution.[4]

Had the spoonwheel of the seventeenth century developed more rapidly into Fourneyron's efficient water-turbine, water might have remained the backbone of the power system until electricity had developed sufficiently to give it a wider area of use.[5]

The eotechnic phase survived longest in America, according to Mumford. Had it survived a bit longer, it might have passed directly into the neotechnic. In *The City in History*, he mentioned abortive applications of eotechnic means to decentralized organization, unfortunately forestalled by the paleotechnic revolution, and speculated at greater length on the Kropotkinian direction social evolution might have taken had the eotechnic passed directly into the neotechnic. Of the societies of seventeenth century New England and New Netherlands, he wrote:

> This eotechnic culture was incorporated in a multitude of small towns and villages, connected by a network of canals and dirt roads, supplemented after the middle of the nineteenth century by short line railroads, not yet connected up into a few trunk systems meant only to augment the power of the big cities.

1 Mumford, *Technics and Civilization*, p. 212.
2 Ralph Borsodi, *This Ugly Civilization* (Philadelphia: Porcupine Press, 1929, 1975), p. 65.
3 Mumford, *Technics and Civilization*, p. 118.
4 Ibid., p. 118.
5 Ibid., p. 143.

> With wind and water power for local production needs, this was a balanced economy; and had its balance been maintained, had balance indeed been consciously sought, a new general pattern of urban development might have emerged....
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> In 'Technics and Civilization' I pointed out how the earlier invention of more efficient prime movers, Fourneyron's water turbine and the turbine windmill, could perhaps have provided the coal mine and the iron mine with serious technical competitors that might have kept this decentralized regime long enough in existence to take advantage of the discovery of electricity and the production of the light metals. With the coordinate development of science, this might have led directly into the more humane integration of 'Fields, Factories, and Workshops' that Peter Kropotkin was to outline, once more, in the eighteen-nineties.[1]

Borsodi speculated, along lines similar to Mumford's, on the different direction things might have taken had the eotechnic phase been developed to its full potential without being aborted by the paleotechnic:

> It is impossible to form a sound conclusion as to the value to mankind of this institution which the Arkwrights, the Watts, and the Stephensons had brought into being if we confine ourselves to a comparison of the efficiency of the factory system of production with the efficiency of the processes of production which prevailed before the factory appeared.
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> A very different comparison must be made.
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> We must suppose that the inventive and scientific discoveries of the past two centuries had not been used to destroy the methods of production which prevailed before the factory.
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> We must suppose that an amount of thought and ingenuity precisely equal to that used in developing the factory had been devoted to the development of domestic, custom, and guild production.
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> We must suppose that the primitive domestic spinning wheel had been gradually developed into more and more efficient domestic machines; that primitive looms, churns, cheese presses, candle molds, and primitive productive apparatus of all kinds had been perfected step by step without sacrifice of the characteristic "domesticity" which they possessed.
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> In short, we must suppose that science and invention had devoted itself to making domestic and handicraft production efficient and economical, instead of devoting itself almost exclusively to the development of factory machines and factory production.
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> The factory-dominated civilization of today would never have developed. Factories would not have invaded those fields of manufacture where other methods of production could be utilized. Only the essential factory would have been developed. Instead of great cities, lined with factories and tenements, we should have innumerable small towns filled with the homes and workshops of neighborhood craftsmen. Cities would be political, commercial, educational, and entertainment centers.... Efficient domestic implements and machines developed by centuries of scientific improvement would have eliminated drudgery from the home and the farm.[2]

And, we might add, the home production machinery itself would have been manufactured, not in Sloanist mass-production factories, but mainly in small factories and shops integrating power machinery into craft production.

1 Lewis Mumford, *The City in History: Its Transformations, and Its Prospects* (New York: Harcourt, Brace, & World, Inc., 1961), pp. 333-34.
2 Borsodi, *This Ugly Civilization*, pp. 60-61.

C. A Funny Thing Happened on the Way to the Neotechnic Revolution

The natural course of things, according to Borsodi, was that the "process of shifting production from the home and neighborhood to the distantly located factory" would have peaked with "the perfection of the reciprocating steam-engine," and then leveled off until the invention of the electric motor reversed the process and enabled families and local producers to utilize the powered machinery previously restricted to the factory.[1] But it didn't happen that way. Instead, electricity was incorporated into manufacturing in an utterly perverse way.

Michael Piore and Charles Sabel described a fork in the road, based on which of two possible alternative ways were chosen for incorporating electrical power into manufacturing. The first, more in keeping with the unique potential of the new technology, was to integrate electrically powered machinery into small-scale craft production: "a combination of craft skill and flexible equipment," or "mechanized craft production."

> Its foundation was the idea that machines and processes could augment the craftsman's skill, allowing the worker to embody his or her knowledge in ever more varied products: the more flexible the machine, the more widely applicable the process, the more it expanded the craftsman's capacity for productive expression.

The other was to adapt electrical machinery to the preexisting framework of paleotechnic industrial organization—in other words, what was to become twentieth century mass-production industry. This latter alternative entailed breaking the production process down into its separate steps, and then substituting extremely expensive and specialized machinery for human skill. "The more specialized the machine—the faster it worked and the less specialized its operator needed to be—the greater its contribution to cutting production costs.[2]

The first path, unfortunately, was for the most part the one not taken; it has been followed only in isolated enclaves, particularly in assorted industrial districts in Europe. The most famous current example is Italy's Emilia-Romagna region, which we will examine in a later chapter.

The second, mass-production model became the dominant form of industrial organization. Neotechnic advances like electrically powered machinery, which offered the potential for decentralized production and were ideally suited to a fundamentally different kind of society, have so far been integrated into the framework of mass production industry.

Mumford argued that the neotechnic advances, rather than being used to their full potential as the basis for a new kind of economy, were instead incorporated into a paleotechnic framework. Neotechnic had not "displaced the older regime" with "speed and decisiveness," and had not yet "developed its own form and organization."

> Emerging from the paleotechnic order, the neotechnic institutions have nevertheless in many cases compromised with it, given way before it, lost their identity by reason of the weight of vested interests that continued to support the obsolete instruments and the anti-social aims of the middle industrial era. *Paleotechnic ideals still largely dominate the industry and the politics of the Western World*.... To the extent that neotechnic industry has failed to transform the coal-and-iron complex, to the extent that it has failed to secure an adequate foundation for its humaner technology in the community as a whole, to the extent that it

1 Borsodi, Prosperity and Security, p. 182.
2 Michael S. Piore and Charles F. Sabel, *The Second Industrial Divide: Possibilities for Prosperity* (New York: HarperCollins, 1984), pp. 4-6, 19.

has lent its heightened powers to the miner, the financier, the militarist, the possibilities of disruption and chaos have increased.[1]

> True: the industrial world produced during the nineteenth century is either technologically obsolete or socially dead. But unfortunately, its maggoty corpse has produced organisms which in turn may debilitate or possibly kill the new order that should take its place: perhaps leave it a hopeless cripple.[2]

> The new machines followed, not their own pattern, but the pattern laid down by previous economic and technical structures.[3]

> The fact is that in the great industrial areas of Western Europe and America..., the paleotechnic phase is still intact and all its essential characteristics are uppermost, even though many of the machines it uses are neotechnic ones or have been made over—as in the electrification of railroad systems—by neotechnic methods. In this persistence of paleotechnics... we continue to worship the twin deities, Mammon and Moloch....[4]

> We have merely used our new machines and energies to further processes which were begun under the auspices of capitalist and military enterprise: we have not yet utilized them to conquer these forms of enterprise and subdue them to more vital and humane purposes....[5]

> Not alone have the older forms of technics served to constrain the development of the neotechnic economy: but the new inventions and devices have been frequently used to maintain, renew, stabilize the structure of the old social order....[6]

> The present pseudomorph is, socially and technically, third-rate. It has only a fraction of the efficiency that the neotechnic civilization as a whole may possess, provided it finally produces its own institutional forms and controls and directions and patterns. At present, instead of finding these forms, we have applied our skill and invention in such a manner as to give a fresh lease of life to many of the obsolete capitalist and militarist institutions of the older period. Paleotechnic purposes with neotechnic means: that is the most obvious characteristic of the present order.[7]

Mumford used Spengler's idea of the "cultural pseudomorph" to illustrate the process: “...in geology... a rock may retain its structure after certain elements have been leached out of it and been replaced by an entirely different kind of material. Since the apparent structure of the old rock remains, the new product is called a pseudomorph.”

> A similar metamorphosis is possible in culture: new forces, activities, institutions, instead of crystallizing independently into their own appropriate forms, may creep into the structure of an existing civilization.... As a civilization, we have not yet entered the neotechnic phase.... [W]e are still living, in Matthew Arnold's words, between two worlds, one dead, the other powerless to be born.[8]

For Mumford, Soviet Russia was a mirror image of the capitalist West in shoehorning neotechnic technology into a paleotechnic institutional framework. Despite the neotechnic promise of Lenin's “electrification plus Soviet power,” the Soviet aesthetic ideal was that of the Western mass-production factory: “the worship of size and crude mechanical power, and the introduction of a militarist

1 Mumford, *Technics and Civilization*, pp. 212-13.
2 Ibid., p. 215.
3 Ibid., p. 236.
4 Ibid., p. 264.
5 Ibid., p. 265.
6 Ibid., p. 266.
7 Ibid., p. 267.
8 Ibid., p. 265.

technique in both government and industry....”[1] That Lenin's vision of “communism” entailed a wholesale borrowing of the mass-production model, under state ownership, is suggested for his infatuation with Taylorism and his suppression of worker self-management in the factories. The Stalinist fetish for gigantism, with its boasts of having the biggest factory, power plant, etc. in the world, followed as a matter of course.

How were existing institutional interests able to thwart the revolutionary potential of electrical power, and divert neotechnic technologies into paleotechnic channels? The answer is that the state tipped the balance.

The state played a central role in the triumph of mass-production industry in the United States.

The state's subsidies to long-distance transportation were first and most important. There never would have been large manufacturing firms producing for a national market, had not the federal government first created a national market with the national railroad network. A high-volume national transportation system was an indispensable prerequisite for big business.

We quoted Mumford's observation above, that the neotechnic revolution offered to substitute industrialization by local economic development for reliance on long-distance transport. State policies, however, tipped the balance in the other direction: they artificially shifted the competitive advantage toward industrial concentration and long-distance distribution.

Alfred Chandler, the chief apostle of the large mass-production corporation, himself admitted as much: all the advantages he claimed for mass production *presupposed* a high-volume, high-speed, high-turnover distribution system on a national scale, without regard to whether the costs of the latter exceeded the alleged benefits of the former..

> ...[M]odern business enterprise appeared for the first time in history when the volume of economic activities reached a level that made administrative coordination more efficient and more profitable than market coordination.[2]

> ...[The rise of administrative coordination first] occurred in only a few sectors or industries where technological innovation and market growth created high-speed and high-volume throughput.[3]

William Lazonick, a disciple of Chandler, described the process as obtaining "a large market share in order to transform the high fixed costs into low unit costs....”[4]

The railroad and telegraph, "so essential to high-volume production and distribution," were in Chandler's view what made possible this steady flow of goods through the distribution pipeline.[5]

The primacy of such state-subsidized infrastructure is indicated by the very structure of Chandler's book. He begins with the railroads and telegraph system, themselves the first modern, multi-unit enterprises.[6] And in subsequent chapters, he recounts the successive evolution of a national wholesale

1 Ibid., p. 264.
2 Alfred D. Chandler, Jr., *The Visible Hand: The Managerial Revolution in American Business* (Cambridge and London: The Belknap Press of Harvard University Press, 1977), p. 8.
3 Ibid., p. 11.
4 William Lazonick, *Business Organization and the Myth of the Market Economy* (Cambridge, 1991), pp. 198-226.
5 Chandler, *The Visible Hand*, p. 79.
6 Ibid., pp. 79, 96-121.

network piggybacking on the centralized transportation system, followed by a national retail system, and only then by large-scale manufacturing for the national market. A national long-distance transportation system led to mass distribution, which in turn led to mass production.

> The revolution in the processes of distribution and production rested in large part on the new transportation and communications infrastructure. Modern mass production and mass distribution depend on the speed, volume, and regularity in the movement of goods and messages made possible by the coming of the railroad, telegraph and steamship.[1]
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> The coming of mass distribution and the rise of the modern mass marketers represented an organizational revolution made possible by the new speed and regularity of transportation and communication.[2]
>
> ...The new methods of transportation and communication, by permitting a large and steady flow of raw materials into and finished products out of a factory, made possible unprecedented levels of production. The realization of this potential required, however, the invention of new machinery and processes.[3]

In other words, the so-called "internal economies of scale" in manufacturing could come about only when the offsetting external diseconomies of long-distance distribution were artificially nullified by corporate welfare. Such “economies” can only occur given an artificial set of circumstances which permit the reduced unit costs of expensive, product-specific machinery to be considered in isolation, because the indirect costs entailed are all externalized on society. And if the real costs of long-distance shipping, high-pressure marketing, etc., do in fact exceed the savings from faster and more specialized machinery, then the “efficiency” is a false one.

It's an example of what Ivan Illich called “counterproductivity”: the adoption of a technology beyond the point, not only of diminishing returns, but of *negative* returns. Illich also used the term “second watershed” to describe the same concept: e.g., in the case of medicine, the first watershed included such basic things as public sanitation, the extermination of rats, water purification, and the adoption of antibiotics; the second watershed was the adoption of skill- and capital-intensive methods to the point that iatrogenic (hospital- or doctor-induced) illness exceeded the health benefits. In other areas, the introduction of motorized transportation, beyond a certain point, produces artificial distance between things and generates congestion faster than it can be relieved.[4]

Where Illich went wrong was in seeing counterproductivity as inevitable, if adoption of technologies wasn't restrained by regulation. In fact, when all costs and benefits of a technology are internalized by the adopter, adoption beyond the point of counterproductivity will not occur. Adoption beyond the point of counterproductivity is profitable only when the costs are externalized on society or on the taxpayer, and the benefits are appropriated by a privileged class.

As Chandler himself admitted, the greater "efficiency" of national wholesale organizations lay in their "even more effective exploitation of the existing railroad and telegraph systems."[5] That is, they were more efficient parasites. But the "efficiencies" of a parasite are usually of a zero-sum nature.

1 Ibid., p. 209.
2 Ibid., p. 235.
3 Ibid., p. 240.
4 Ivan Illich, “The Three Dimensions of Public Opinion,” in *The Mirror of the Past: Lectures and Addresses, 1978-1990* (New York and London: Marion Boyars, 1992), p. 84; *Tools for Conviviality* (New York, Evanston, San Francisco, London: Harper & Row, 1973), pp. xxii-xxiii, 1-2, 3, 6-7, 84-85; *Disabling Professions* (New York and London: Marion Boyars, 1977), p. 28.
5 Chandler, *The Visible Hand*, p. 215.

Chandler also admitted, perhaps inadvertently, that the "more efficient" new production methods were adopted almost as an afterthought, given the artificially large market areas and subsidized distribution:

> ...the nature of the market was more important than the methods of production in determining the size and defining the activities of the modern industrial corporation.[1]

And finally, Chandler admitted that the new mass-production industry was not more efficient at producing in response to autonomous market demand. He himself helpfully pointed out, as we shall see in the next chapter, that the first large industrialists only integrated mass-production with mass-distribution because they were forced to: "They did so because existing marketers were unable to sell and distribute products in the volume they were produced."[2]

Despite all this, Chandler—astonishingly—minimized the role of the state in creating the system he so admired:

> The rise of modern business enterprise in American industry between the 1880s and World War I was little affected by public policy, capital markets, or entrepreneurial talents because it was part of a more fundamental economic development. Modern business enterprise... was the organizational response to fundamental changes in processes of production and distribution made possible by the availability of new sources of energy and by the increasing application of scientific knowledge to industrial technology. The coming of the railroad and telegraph and the perfection of new high-volume processes... made possible a historically unprecedented volume of production.[3]

"The coming of the railroad"? In Chandler's language, the railroads seem to be an inevitable force of nature rather than the result of deliberate actions by policy makers.

We can't let Chandler get by without challenging his implicit assumption (shared by many technocratic liberals) that paleotechnic industry was more efficient than the decentralized, small-scale production methods of Kropotkin and Borsodi. The possibility never occurred to him that massive state intervention, at the same time as it enabled the revolutions in corporate size and capital-intensiveness, might also have tipped the balance between alternative forms of production technology.

First, the national railroad system simply never would have come into existence on such a scale, with a centralized network of trunk lines of such capacity, had not the state rammed the project through.

Piore and Sabel describe the enormous capital outlays, and the enormous transaction costs to be overcome, in creating a national railroad system. Not only the startup costs of actual physical capital, but those of securing rights of way, were "huge":

> It is unlikely that railroads would have been built as quickly and extensively as they were but for the availability of massive government subsidies.

Other transaction costs overcome by government, in creating the railroad system, included the revision of tort and contract law (e.g., to exempt common carriers from liability for many kinds of physical

1 Ibid., p. 363.
2 Ibid., p. 287.
3 Ibid., p. 376.

damage caused by their operation).[1]

According to Matthew Josephson, for ten years or more before 1861, "the railroads, especially in the West, were 'land companies' which acquired their principal raw material through pure grants in return for their promise to build, and whose directors... did a rushing land business in farm lands and town sites at rising prices." For example, under the terms of the Pacific Railroad bill, the Union Pacific (which built from the Mississippi westward) was granted twelve million acres of land and $27 million worth of thirty-year government bonds. The Central Pacific (built from the West Coast eastward) received nine million acres and $24 million worth of bonds.[2]

The federal railroad land grants, according to Murray Rothbard, included fifteen mile tracts of land on either side of the actual right of way. As the railroads were completed, this land skyrocketed in value. And as new towns were built along the railroad routes, every house and business was built on land sold by the railroads. The tracts included valuable timber land, as well.[3]

Theodore Judah, chief engineer for what became the Central Pacific, assured potential investors "that it could be done—*if government aid were obtained*. For the cost would be terrible." Collis Huntington, the leading promoter for the project, engaged in a sordid combination of strategically placed bribes and appeals to communities' fears of being bypassed, in order to extort grants of "rights of way, terminal and harbor sites, and... stock or bond subscriptions ranging from $150,000 to $1,000,000" from a long string of local governments that included San Francisco, Stockton, and Sacramento.[4]

Absent the land grants and government purchases of railroad bonds, the railroads would likely have developed instead along the initial lines described by Mumford: many local rail networks linking communities into local industrial economies. The regional and national interlinkages of local networks, when they did occur, would have been far fewer and far smaller in capacity. The comparative costs of local and national distribution, accordingly, would have been quite different. In a nation of hundreds of local industrial economies, with long-distance rail transport much more costly than at present, the natural pattern of industrialization would have been to integrate small-scale power machinery into flexible manufacturing for local markets.

Instead, the state artificially aggregated the demand for manufactured goods into a single national market, and artificially lowered the costs of distribution for those serving that market. In effect, it created an artificial ecosystem to which large-scale, mass-production industry was best "adapted."

The first organisms to adapt themselves to this artificial ecosystem, as recounted by Chandler, were the national wholesale and retail networks, with their dependence on high turnover and dependability. Then, piggybacked on them, were the large manufacturers serving the national market. But they were only "more efficient" in terms of their more efficient exploitation of an artificial environment which itself was characterized by the concealment and externalization of costs. With all the concealed and externalized costs fully subsumed into the price of mass-produced goods, rather than shifted onto society or the taxpayer, it is likely that the overall cost of goods produced flexibly on general-purpose machinery for local markets would have been less than that of mass-produced goods.

1 Piore and Sabel, pp. 66-67.

2 Matthew Josephson, *The Robber Barons: The Great American Capitalists 1861-1901* (New York: Harcourt, Brace & World, Inc., 1934, 1962), pp. 77-78.

3 Murray N. Rothbard, *Power and Market: Government and the Economy* (Menlo Park, Calif.: Institute for Humane Studies, Inc., 1970), p. 70.

4 Josephson, pp. 83-84.

Besides almost single-handedly creating the artificially unified and cheap national market without which national manufacturers could not have existed, the railroad companies also actively promoted the concentration of industry through their rate policies. Piore and Sabel argue that "the railroads' policy of favoring their largest customers, through rebates," was a central factor in the rise of the large corporation. Once in place, the railroads—being a high fixed-cost industry—had

> a tremendous incentive to use their capacity in a continuous, stable way. This incentive meant, in turn, that they had an interest in stabilizing the output of their principal customers—an interest that extended to protecting their customers from competitors who were served by other railroads. It is therefore not surprising that the railroads promoted merger schemes that had this effect, nor that they favored the resulting corporations or trusts with rebates.

"Indeed, seen in this light, the rise of the American corporation can be interpreted more as the result of complex alliances among Gilded Age robber barons than as a first solution to the problem of market stabilization faced by a mass-production economy."[1] According to Josephson,

> while the tillers of the soil felt themselves subject to extortion, they saw also that certain interests among those who handled the grain or cattle they produced, the elevators, millers and stockyards, or those from whom they purchased their necessities, the refiners of oil, the great merchant-houses, were encouraged by the railroads to combine against the consumer. In the hearings before the Hepburn Committee in 1879 it was revealed that the New York Central, like railways all over the country, had some 6,000 secret rebate agreements, such as it had made with the South Improvement Company....[2]
>
> ...[T]he secret tactics of the rebate gave certain producing groups (as in petroleum, beef, steel) those advantages which permitted them to outstrip competitors and soon to conduct their business upon as large a scale as the railways themselves.[3]
>
> ...Upon the refined oil [Rockefeller] shipped from Cleveland he received a rebate of 50 cents a barrel, giving him an advantage of 25 per cent over his competitors.[4]
>
> In the meantime the political representatives whom the disabused settlers sent forth to Washington or to the state legislatures seemed not only helpless to aid them, but were seen after a time riding about the country wherever they listed by virtue of free passes generously distributed to them.[5]

The railroads also captured the state legislatures and railroad commissions.[6]

Among certain Objectivists and vulgar libertarians of the Right, this is commonly transformed into a morality play in which men of innovative genius built large businesses through sheer effort and entrepreneurship, and the power of superior efficiency. These heroic John Galts then charged rates based on the new railroad's benefits to customers, and were forced into political lobbying only as a matter of self-defense against government extortion. This is a lie.

What happened was nothing to do with a free market, unless one belongs to the right-wing strain of libertarianism for which "free market" equates to "beneficial to big business." It was, rather, a case of

1 Piore and Sabel, pp. 66-67.
2 Josephson, pp. 250-251.
3 Ibid., p. 253.
4 Ibid., p. 265.
5 Ibid., p. 251.
6 Ibid., p. 252.

the government intervening to create an industry almost from scratch, and by the same act putting it in a commanding height from which it could extort monopoly profits from the public. The closest modern analogy is the drug companies, which use unlimited patent monopolies granted by the state to charge extortionate prices for drugs developed entirely or almost entirely with government research funds. But then the Randroids and vulgar libertarians are also fond of Big Pharma.

Of course, the railroads were only the first of many centralizing infrastructure projects. The process continued through the twentieth century, with the development of the subsidized highway system and the civil aviation system. But unlike the railroads, whose chief significance was their role in creating the national market in the first place, civil aviation and the automobile-industrial complex were arguably most important as sinks for surplus capital and output. They will be treated in the next chapter, accordingly, as examples of a phenomenon described by Paul Baran and Paul Sweezy in *Monopoly Capitalism*: government creation of new industries to absorb the surplus resulting from corporate capitalism's chronic tendencies toward overinvestment and overproduction.

Second, the American legal framework was transformed in the mid-nineteenth century in ways that made a more hospitable environment for large corporations operating on a national scale. Among the changes were the rise of a general federal commercial law, general incorporation laws, and the status of the corporation as a person under the Fourteenth Amendment. The functional significance of these changes on a national scale was analogous to the later effect, on a global scale, of the Bretton Woods agencies and the GATT process: a centralized legal order was created, prerequisite for their stable functioning, coextensive with the market areas of large corporations.

The federalization of the legal regime is associated, in particular, with the recognition of a general body of federal commercial law in *Swift v. Tyson* (1842), and with the application of the Fourteenth Amendment to corporate persons in *Santa Clara County v. Southern Pacific Railroad Company* (1886).

The Santa Clara decision was followed by an era of federal judicial activism, in which state laws were overturned on the basis of "substantive due process." The role of the federal courts in the national economy was similar to the global role of the contemporary World Trade Organization, with higher tribunals empowered to override the laws of local jurisdictions which were injurious to corporate interests.

In the federal courts, the "due process" and "equal protection" rights of corporations as "juristic persons" have been made the basis of protections against legal action aimed at protecting the older common law rights of flesh and blood persons. For example local ordinances to protect groundwater and local populations against toxic pollution and contagion from hog farms, to protect property owners from undermining and land subsidance caused by coal extraction—surely indistinguishable in practice from the tort liability provisions of any just market anarchy's libertarian law code—have been overturned as violations of the "equal protection" rights of hog factory farms and mining companies.

Still another component of the corporate legal revolution was the increased ease, under general incorporation laws, of forming limited liability corporations with permanent entity status apart (severally or collectively) from the shareholders.

Arguably, as Robert Hessen and others have made a case, corporate entity status and limited liability against creditors could be achieved entirely through private contract. Whether or not that is so, the government has tilted the playing field decisively toward the corporate form by providing a ready-made and automatic procedure for incorporation. In so doing, it has made the corporation the standard or default form of organization, reduced the transaction costs of establishing it relative to what would prevail were it negotiated entirely from scratch, and thereby reduced the bargaining power of other parties in negotiating the terms on which it operates.

Third, not only did the government indirectly promote the concentration and cartelization of industry through the railroads it had created, but it did so directly through patent law. As we shall see in the next chapter, mass-production requires large business organizations capable of exercising sufficient power over their external environment to guarantee the consumption of their output. Patents promoted the stable control of markets by oligopoly firms through the control, exchange and pooling of patents.

According to David Noble, two essentially new science-based industries (those that “grew out of the soil of scientific rather than traditional craft knowledge”) emerged in the late 19th century: the electrical and chemical industries.[1]

In the electric industry, General Electric had its origins first in a merger between Edison Electric (which controlled all of Edison's electrical patents) and the Sprague Electric Railway and Motor Company, and then in an 1892 merger between Edison General Electric and Thomas-Houston—both of them motivated primarily by patent considerations. In the latter case, in particular, Edison General Electric and Thomas-Houston each needed patents owned by the others and could not “develop lighting, railway or power equipment without fear of infringement suits and injunctions.”[2] From the 1890s on, the electrical industry was dominated by two large firms: GE and Westinghouse, both of which owed their market shares largely to patent control. In addition to the patents which they originally owned, they acquired control over patents (and hence over much of the electrical manufacturing market) through “acquisition of the patent rights of individual inventors, acquisition of competing firms, mergers with competitors, and the systematic and strategic development of their own patentable inventions. As GE and Westinghouse together secured a deadlock on the electrical industry through patent acquisition, competition between them became increasingly intense and disruptive. By 1896 the litigation cost from some three hundred pending patent suits was enormous, and the two companies agreed to form a joint Board of Patent Control. General Electric and Westinghouse pooled their patents, with GE handling 62.5% of the combined business.[3]

The structure of the telephone industry had similar origins, with the Bell Patent Association forming “the nucleus of the first Bell industrial organization” (and eventually of AT&T) The National Bell Telephone Company, from the 1880s on, fought vigorously to “occupy the field” (in the words of general manager Theodore N. Vail) through patent control. As Vail described the process, the company surrounded itself

> with everything that would protect the business, that is the knowledge of the business, all the auxiliary apparatus; a thousand and one little patents and inventions with which to do the business which was necessary, that is what we wanted to control and get possession of.

To achieve this, the company early on established an engineering department

> whose business it was to study the patents, study the development and study these devices that either were originated by our own people or came in to us from the outside. Then early in 1879 we started our patent

1 David F. Noble, *America by Design: Science, Technology, and the Rise of Corporate Capitalism* (New York: Alfred A. Knopf, 1977), p. 5.
2 Ibid., p. 9.
3 Ibid., pp. 9-10.

> department, whose business was entirely to study the question of patents that came out with a view to acquiring them, because... we recognized that if we did not control these devices, somebody else would.[1]

This approach strengthened the company's position of control over the market not only during the seventeen year period of the main patents, but (as Frederick Fish put it in an address to the American Institute of Electrical Engineers) during the subsequent seventeen years of

> each and every one of the patents taken out on subsidiary methods and devices invented during the progress of commercial development. [Therefore] one of the first steps taken was to organize a corps of inventive engineers to perfect and improve the telephone system in all directions ...that by securing accessory inventions, possession of the field might be retained as far as possible and for as long a time as possible.[2]

This method, preemptive occupation of the market through strategic patent acquisition and control, was also used by GE and Westinghouse.

Even with the intensified competition resulting from the expiration of the original Bell patents in 1894, and before government favoritism in the grants of rights-of-way and regulated monopoly status, the legacy effect of AT&T's control of the secondary patents was sufficient to secure it half the telephone market thirteen years later, in 1907.[3] AT&T, anticipating the expiration of its original patents, had (to quote Vail again) "surrounded the business with all the auxiliary protection that was possible." For example, the company in 1900 purchased Michael Pupin's patent on loading coils and in 1907 acquired exclusive domestic rights for Cooper-Hewitt's patents on the mercury-arc repeater—essential technologies underlying AT&T's monopoly on long-distance telephony.[4]

By the time the FCC was formed in 1935, the Bell System had acquired patents to "some of the most important inventions in telephony and radio," and "through various radio-patent pool agreements in the 1920s... had effectively consolidated its position relative to the other giants in the industry." In so doing, according to an FCC investigation, AT&T had gained control of "the exploitation of potentially competitive and emerging forms of communication" and "pre-empt[ed] for itself new frontiers of technology for exploitation in the future...."[5]

The radio-patent pools included AT&T, GE and Westinghouse, RCA (itself formed as a subsidiary of GE after the latter acquired American Marconi), and American Marconi.[6] Alfred Chandler's history of the origins of the consumer electronics industry is little more than an extended account of which patents were held, and subsequently acquired, by which companies.[7] This should give us some indication, by the way, of what he meant by "organizational capability," a term of his that will come under more scrutiny in the next chapter. In an age where the required capital outlays for actual physical plant and equipment are rapidly diminishing in many forms of manufacturing, one of the chief functions of "intellectual property" is to create artificial "comparative advantage" by giving a particular firm a monopoly on technologies and techniques, and prevent their diffusion throughout the market.

The American chemical industry, in its modern form, was made possible by the Justice Department's seizure of German chemical patents in WWI. Until the war, some 98% of patent

1 Ibid., pp. 11-12.
2 Ibid., p. 12.
3 Ibid., p. 12.
4 Ibid., p. 91.
5 Ibid., p. 92.
6 Ibid., pp. 93-94.
7 Alfred Chandler, Jr., *Inventing the Electronic Century* (New York: The Free Press, 2001).

applications in chemical industry came from German firms, and were never worked in the U.S. As a result the American chemical industry was technically second-rate, largely limited to final processing of intermediate goods imported from Germany. Attorney General A. Mitchell Palmer, as "Alien Property Custodian" during the war, held the patents in trust and licensed 735 of them to American firms; Du Pont alone received three hundred.[1]

More generally, patents are an effective tool for cartelizing markets in industry at large. They were used in the automobile and steel industries among others, according to Noble.[2] In a 1906 article, mechanical engineer and patent lawyer Edwin Prindle described patents as "the best and most effective means of controlling competition."

> Patents are the only legal form of absolute monopoly. In a recent court decision the court said, "within his domain, the patentee is czar.... cries of restraint of trade and impairment of the freedom of sales are unavailing, because for the promotion of the useful arts the constitution and statutes authorize this very monopoly."
>
> The power which a patentee has to dictate the conditions under which his monopoly may be exercised has been used to form trade agreements throughout practically entire industries, and if the purpose of the combination is primarily to secure benefit from the patent monopoly, the combination is legitimate. Under such combinations there can be effective agreements as to prices to be maintained...; the output for each member of the combination can be specified and enforced... and many other benefits which were sought to be secured by trade combinations made by simple agreements can be added. Such trade combinations under patents are the only valid and enforceable trade combinations that can be made in the United States.[3]

And unlike purely private cartels, which tend toward defection and instability, patent control cartels—being based on a state-granted privilege—carry a credible and effective punishment for defection.

Through their "Napoleonic concept of industrial warfare, with inventions and patents as the soldiers of fortune," and through "the research arm of the 'patent offensive,'" manufacturing corporations were able to secure stable control of markets in their respective industries.[4]

These were the conditions present at the outset of the mass production revolution, in which the development of the corporate industrial economy began. In the absence of these necessary preconditions, there simply would not have been a single national market or large industrial corporations serving it. Rather than being adopted into the framework of the paleotechnic factory system, the introduction of electrical machinery would likely have followed its natural course and lived up to its unique potential: powered machinery would have been incorporated into small-scale production for local markets, and the national economy would have developed as "a hundred Emilia-Romagnas."

But these were only the necessary conditions at the outset. As we shall see in the next chapter, the growth of big government continued to parallel that of big business, introducing newer and larger-scale forms of political intervention to address the corporate economy's increasing tendencies toward destabilization, and to insulate the giant corporation from the market forces that would otherwise have destroyed it.

1 Noble, *America by Design*, p. 16.
2 Ibid., p. 91.
3 Ibid., p. 89.
4 Ibid., p. 95.