# *Chapter* 7

## *The Dynamic Logic of Mass Production*

DURING the year 1903 a forty-year-old Detroiter named Henry Ford, having left the employ of the little Detroit Automobile Company with the idea of going into the manufacturing business for himself, designed and built a big and powerful racing car. Why did he do this? He had no great interest in speed; his idea was quite different: he wanted to make a small, light, serviceable vehicle. The reason he built a racing car was that he wanted capital, and to attract capital he had to have a reputation, and in those days when automobiles were thought of as expensive playthings in which the rich could tear noisily along the dusty roads, the way to get a reputation was to build a car that could win races.

Having constructed a car of terrifying power, Ford cast about for a racing driver; and since it would require both strength and reckless daring to control his monster at high speeds—strength because it steered with an unwieldy tiller instead of with a wheel—he hired a professional bicycle racer named Barney Oldfield, and spent a week teaching him to drive a car. Said Oldfield as he climbed into the car for his first race at the Grosse Point track late in 1902, "Well, this chariot may kill me, but they will say afterward that I was going like hell when she took me over the bank."

Oldfield did not go over the bank. He won the race by a wide margin. Ford won his reputation. And it got him enough capital—

$28,000 in cash—to start the Ford Motor Company, of which he became vice-president, general manager, designer, master mechanic, and superintendent.

During the next few years Ford produced, successfully, several varieties of cars and his manufacturing business expanded rapidly. In 1908 he put out what he considered the most satisfactory model to date; he called it Model T. And soon afterward he made a decision which astonished his associates. Let him record it in his own words: "... In 1909 I announced one morning, without any previous warning, that in the future we were going to build only one model, that the model was going to be Model T, and that the chassis would be exactly the same for all cars, and I remarked: 'Any customer can have a car painted any color that he wants so long as it is black.' "

This decision grew naturally out of Ford's experience and temperament. He was a Michigan farmer's son, a gadget-loving Yankee with utilitarian and democratic instincts, uninfected by higher education. As a boy he had been so fascinated with machinery that he had spent endless hours taking watches to pieces and putting them together, and then constructing watches of his own. At the age of sixteen he had seen a "road engine"—a steam engine that could use its steam power to propel itself in an ungainly way from job to job—and had thereupon been fascinated with dreams of horseless carriages, and also of machines that farmers could use to do their hard work for them. Six years later, in 1885, he had seen an Otto gas engine—a European forerunner of the automobile engines of today—and had gone to work on engine design. By the spring of 1893 he had built his first horseless carriage and tried it out on the road. During the next ten years, while he held money-earning jobs, he was forever experimenting in his spare hours, and gradually his ideas developed.

He wanted to build, not a showy car for the well-to-do, but a practical, effort-saving car for ordinary people like himself. He wanted it to be light: few things offended him as did the widespread notion that weight meant strength. He wanted it to be inexpensive; as he said later in his autobiography, "The public should always be wondering how it is possible to give so much for the money." He felt that many manufacturers were mistaken in fixing their attention upon profits,

and that bankers had a bad influence upon manufacturers because they thought about improving profits instead of about improving the product. If the product and the price were right, he thought the profits would take care of themselves. And he believed that if he concentrated on a single model, he could cut the cost of manufacture so sharply that masses of ordinary people would flock to buy it.

As his sales of Model T increased, Ford deliberately dropped the price—and they increased still further. In 1913 he put in his first assembly line, and by the beginning of 1914 he was producing the entire car on the assembly-line principle. Each workman performed a single operation; each element of the car went on a power-driven moving conveyor platform past a series of these workmen, each of whom added or fixed in place some part of it; and these various assembly lines converged upon a main conveyor platform on which the chassis moved to completion.

In principle this method of manufacture was far from new. It depended upon Eli Whitney's great discovery of the principle of interchangeable parts. It owed much to the refinement of that principle by such men as Henry M. Leland, who had shown what close machining could do to make these interchangeable parts fit with absolute precision. Moreover, many a manufacturer had used the assembly-line principle to some extent. Cyrus McCormick, for instance, had done so in his reaper works as far back as the eighteen-fifties; and in particular the packers had used an overhead conveyor to carry slaughtered animals past a series of workers. Ford was indebted, too, to Frederick Winslow Taylor for his studies in "scientific management," the careful planning of manufacturing processes so as to save steps and motions. And Ransom Olds had already put a single type of automobile into quantity production—until his financial backers forced him back into the luxury market. Nevertheless the Ford assembly line, with its subassemblies, was unique as a remorselessly complete application of all these ideas.

When his manufacturing system was complete, in January, 1914, Ford made an announcement which echoed round the world.

At that time the going wage in the automobile industry averaged about $2.40 per nine-hour day. Ford announced that he would pay his men a minimum of $5 per eight-hour day.

The explanation was that he had been paying year-end bonuses to the men, and now, as profits expanded, he thought he should put the profit-sharing on a pay-as-you-go basis. The morale in the plant had been unsatisfactory; he thought this might improve it. And he also felt, however vaguely, that if more Americans got high wages, there would be a market for more industrial products, including of course Ford cars. Because he was afraid that the sudden jump in income might demoralize the spending habits in some families, he made the raise conditional upon their demonstrating that they didn't waste the money—a naïvely paternalistic idea which he later had to modify. But before long he was paying nearly all his workmen the astonishing new wages.

The public reaction to the announcement was terrific. Most businessmen were indignant: Ford was ruining the labor market, he was putting crazy ideas into workmen's heads, he would embarrass companies which couldn't possibly distribute such largess, he was a crude self-advertiser. There was much scoffing of the sort that a Muncie, Indiana, newspaper indulged in many years later: "Henry Ford thinks that wages ought to be higher and goods cheaper. We agree with him, and let us add that it ought to be cooler in the summer and warmer in winter." People with tenderer minds hailed Ford for his generosity and said that he was showing what a noble conscience could achieve in the hitherto unregenerate precincts of industry. Meanwhile the Ford plant was mobbed by applicants for jobs.

What Ford had actually done—in his manufacturing techniques, his deliberate price cutting, and his deliberate wage raising—was to demonstrate with unprecedented directness one of the great principles of modern industrialism: the dynamic logic of mass production. This is the principle that the more goods you produce, the less it costs to produce them; and that the more people are well off, the more they can buy, thus making this lavish and economical production possible.

Every successful manufacturer had followed this principle up to a

point. But few had been able to follow it far; or, if able to, had been able to resist for very long the human temptation to cease expanding their output unduly and then to cash in by charging what the traffic would bear. Very few manufacturers, for that matter, had a single product to sell for which there proved to be an almost inexhaustible market if costs were reduced, or could go on, year after year, turning out this identical product with very little retooling. With these special advantages, Henry Ford—a cranky and self-willed man, in many respects an ignorant and opinionated man, and a merciless competitor, but in his own special way a man of stubborn democratic faith—followed the dynamic logic of mass production all the way, and the results were uncanny.

In 1909-10 his price per car had been $950. It went down to $780, to $690, to $600, to $550, to $490, to $440, to $360; then, after an increase due to the shortages and inflation of World War I, went down again until by 1924 the price of a Ford (without self-starter) was only $290. Meanwhile production had expanded by slow degrees from 18,664 cars all the way to 1,250,000 in 1920-21.

Ford followed the principle without compromise until 1927, when two facts caught up with him. One was that Americans wanted not only cheaper cars, but better ones; rival manufacturers had discovered that if you put out a new and improved model each year, the older ones would become obsolescent, and thus you could turn old customers into new ones; and these brighter and livelier new models had succeeded in making the gaunt and tinny Model T obsolescent indeed. The other fact was that the thirst for new and up-to-date vehicles was automatically producing a flourishing market in second- and third- and fourth-hand cars, at dwindling prices, so that Model T no longer had a monopoly of the bargain hunters' market.

In the meantime, however, Ford's experiment had had what Paul Hoffman has called "multiplier value." For he had advertised a principle which, though more often honored in the breach than in the observance, has a place of some sort in the thinking of every industrial manager today. The continuing discovery and demonstration of this principle has been one of the most powerful forces in the making of

twentieth-century America. For it has had its corollaries: that a nation of men and women secure against exploitation and acute poverty is a nation of delighted buyers of goods, to everybody's profit; that it pays better to produce the same sort of food, clothing, and equipment for people of all income levels, than to produce luxury goods for a few; and that therefore one can make money by lowering class barriers. Thus is Marxism confounded—not by dogma, but by the logic of advanced industrialism itself; or, to put it another way, by capitalism turned to democratic ends.

## II

The great Ford experiment was only one element in the lively industrial development of the United States during the first two decades of the twentieth century. For industry and business in general were expanding and changing as the nation gradually came of age.

It was the golden heyday of railroading. The great network of railroad lines which linked the country together from sea to sea was now virtually complete, and the amount of business which the railroads did swelled hugely. By 1920, for example, they were not only carrying vastly more freight, but were carrying more than twice as many passengers as in 1900, and carrying them longer distances than before, so that the figures for "passenger miles" almost tripled. Shares in the big railroad corporations—New York Central, Pennsylvania, Union Pacific, Northern Pacific, and so on—were the pride, and sometimes the undoing, of investors; rare was the man of means who did not have railroad bonds in his portfolio—while bigger and more powerful locomotives hauled longer and heavier freight and passenger trains from city to city, hooting disdainfully as they crossed dirt roads as yet unpaved for automobile traffic.

It was the heyday of the electric trolley lines, too. Who remembers, now, such bright flowers of the streetcar era as the "Berkshire Hills," the extra-fare interurban trolley car that ran between Great Barrington, Massachusetts, and Bennington, Vermont, for several years after 1908—an elegant white car with buff trim and gold-leaf lettering, with wicker seats inside, and red brocaded curtains, and a Wilton car-

pet, all at the traveler's disposal for an extra fare of fifty cents? And who knows whether any of its proud passengers had any notion that the trolley era was to be short-lived, and that the "Berkshire Hills," like many another relic of that era, would ultimately become a roadside diner?

It was the morning of the electrical age. In 1900 Henry Adams had stood transfixed at the sight of a dynamo at the Paris Exposition, and had seen in it a "symbol of infinity"; during the years thereafter, more and more dynamos—and turbines—were being built, and transmission lines were carrying the magic power far and wide. In 1889, less than 2 per cent of the power used in industry had been electric; by 1919, over 31 per cent of it was. The steel industry grew mightily too as the open-hearth process of steel making supplanted the Bessemer process. By 1920 the output of iron and steel per capita had almost tripled since that memorable day in 1900 when Andrew Carnegie, returning home from a game of golf with Charlie Schwab, had scribbled down on a sheet of paper his terms for the sale of Carnegie Steel to Morgan to form the United States Steel Corporation. Skyscrapers were shooting up in the cities; and although most of the people who craned their necks at the 41-story Singer Building, built in New York in 1908, or the 50-story Metropolitan Tower which closely followed it, or the 60-story Woolworth Building, completed in 1913, probably thought of them as splendid symbols of the American zest for doing bigger and bigger things, they were more especially triumphs of the steel industry that had made their strength and grace possible, and of the electric industry that had made their vital elevator service possible.

If the skyscrapers looked like cathedral towers, the new department stores looked like palaces. And another sort of rival to the old-time individually owned store was multiplying. The chain stores were on their way, paced by the Woolworth five-and-tens and by the A & P, which was operating 200 stores by 1900, 400 by 1912 (when it opened in Newark its first cash-and-carry store), and then—after a terrific spurt of expansion—as many as 11,413 stores by 1924. Here again, at the distribution end of the industrial process, the dynamic

logic of mass production was being demonstrated. For if you could build enough red-fronted stores, with standardized methods and low selling costs, you could attract millions of shoppers, and cut your prices way down by placing huge bulk orders for goods—and still make money.

Meanwhile the automobile industry was going through the first and second phases of an evolution that seems to be standard in the industrial world. First was the phase of numerous competition. During these first two decades of the century automobile manufacturers were legion. Hundreds of mechanically-minded men scrabbled for capital and set up their little factories to produce cars: bicycle makers like Pope and Alexander Winton, electric-company employees like Ford, plumbers' supply men like David Dunbar Buick, wagon builders like the associates of Clement Studebaker, axle manufacturers like Harry C. Stutz. Innumerable makes were put on the market, with names that now have nostalgic overtones for people with long memories—Apperson, Briscoe, Stevens-Duryea, Franklin, Chandler, Scripps-Booth, Peerless, Pierce Arrow, Locomobile, Owen Magnetic, and so on endlessly.

And while this proliferation was still going on, the second phase began. Promoters with capital at their disposal—or with a smooth gift for selling stock—went shopping for promising automobile companies in order to merge them into combinations. At the very moment in 1908 when Ford was first putting Model T into production, William C. Durant—a promoter who, unlike Ford, fixed his vaulting mind upon properties and profits rather than upon machines—put together the Buick company and the Olds company and a few others under the management of a New Jersey holding company which he called General Motors, and which—after extreme vicissitudes, during which Durant lost control of it, recaptured it, and then lost control once more, this time to the du Ponts and their allies—was to become one of the giants of the third phase of the industry. This third phase was that in which competition pushed to the wall, one by one, all but a few monster concerns and a few minor rivals.

Meanwhile, too, this same motor industry was beginning to bring out two other products which were to affect the working lives of millions of people—the motor truck, which was destined to be the deadly rival of the railroads, and the tractor. The first crude tractors had been built about 1902. By 1910, production had reached 4,000 a year; by 1920 it had passed 200,000 a year. The mechanization of the American farm and the planting of the grasslands to wheat were getting under way fast.

All this growth and change, so various and so exciting, was accelerated by the development of a rising idea—that of the dignity and importance of national advertising. In the nineties Munsey and McClure had discovered that if you could sell a popular magazine to enough people, and thus attract enough advertisers, you could sell it for less than the cost of printing it, and still make money through your advertising revenue. It was during the next two decades that Cyrus H. K. Curtis and his editors George Horace Lorimer of the *Saturday Evening Post* and Edward Bok of the *Ladies' Home Journal* provided spectacular demonstrations of this journalistic version of the dynamic logic of mass production. What they did is summed up in the figures showing the growth of the *Saturday Evening Post* during those years. In 1902 it sold 314,671 copies per issue, and brought in an advertising revenue of $360,125. By 1922 it was selling 2,187,024 copies per issue—about seven times as many as in 1902—while its advertising revenue had climbed steeply to $28,278,755—over 78 times as much as in 1902!

What do those figures signify? First, that through this five-cent magazine, and others like it, millions of Americans were getting a weekly or monthly inoculation in ways of living and of thinking that were middle-class, or classless American (as opposed to plutocratic or aristocratic or proletarian); and second, that through the same media they were being introduced to the promised delights of the automobiles, spark plugs, tires, typewriters, talking machines, collars, corsets, and breakfast foods that American industry was producing, not for the few, but for the many. The magazine publisher, the copy

writer, the advertising artist, and the advertising agent were all abetting the mass-production principle.

One further word about this principle. It got a tremendous lift from World War I. For during that war—as during World War II—manufacturers suddenly found themselves faced with one overwhelming demand: to make as many guns or shells or ships as possible, and as fast as possible. No need to worry about glutting the market. No need to worry unduly about price. Just concentrate on quantity and speed. The result took people's breath away: the volume of production was terrific. (And incidentally, it brought such fantastic profits, in the absence of any machinery for the renegotiation of contracts, that when the figures were paraded before the public during the nineteen-thirties, many people arrived at the interesting notion that there would be no more wars if it were not for profit-hungry munitions makers.)

Between 1914 and 1918 many a man who had only half believed that bigger production brought sharply reduced costs began to dream dreams of an exciting future when he saw what mechanization, unleashed, could accomplish.

## III

During those same years the seeds of future industries were being sown.

On January 10, 1901, Spindletop blew in: Anthony F. Lucas struck oil at Spindletop near Beaumont, Texas. Thus began a new era for the Southwest—and a guarantee that the automobile business, then in its feeble infancy, would have as it grew to maturity an abundant source of power.

On December 17, 1903, on the sands of Kittyhawk on the North Carolina coast, Orville Wright made a twelve-second flight—and then his brother Wilbur made a fifty-nine-second flight—in an airplane they had painstakingly built. Several years went by before the public grasped what the Wrights were doing; people were so convinced that flying was impossible that most of those who saw them flying about Dayton in 1905 decided that what they had seen must be

some trick without significance—somewhat as most people today would regard a demonstration of, let us say, telepathy. Never before or since, in all probability, have the newshawks of America taken longer to apprehend a momentous story. It was not until May, 1908—*nearly four and a half years after the Wrights' first flight*—that experienced reporters were sent to observe what they were doing, experienced editors gave full credence to these reporters' excited dispatches, and the world at last woke up to the fact that human flight had been successfully accomplished—though in the interval the Wrights had flown repeatedly and their longest flight had lasted a full thirty-eight minutes! The seed of the great aviation industry had been sown in 1903; it began to sprout, very belatedly, in 1908.

Wireless telegraphy had been discovered in 1895 by an Italian, Guglielmo Marconi—but its future possibilities were not comprehended in 1900, when Reginald A. Fessenden first transmitted speech by wireless; or in 1904, when Sir John Ambrose Fleming produced the radio detector or Fleming valve; or in 1907, when Dr. Lee De Forest produced the audion; or in 1912, when Edwin H. Armstrong discovered the electric generator circuit by means of which the feeble impulses received by radio could be "fed back" and multiplied many times. For that matter, as late as 1915, when David Sarnoff, assistant traffic manager of the Marconi Wireless Telegraph Company, proposed a "radio music box" and suggested the future possibilities of public broadcasting, he spoke to deaf ears. But the seeds of the radio and television industries had been sown.

In 1903 was produced the first moving picture which told a connected story, *The Great Train Robbery.* About 1905 the first nickelodeons appeared—crude motion-picture theaters, often improvised in vacant stores. And the movies began their slow march to importance as a vehicle of popular entertainment and as an inculcator of the assumptions of the classless American life.

In 1909 Leo H. Baekeland first put on the market a chemically-made substance which he called bakelite. It was not the first plastic—that honor had gone to celluloid, much earlier—but it may justly be called the seed from which the plastics industry grew. And along with

the material which, when first clumsily produced before 1920, was known as "artificial silk," and which later came to be known as rayon, it helped to beget one of the most important concepts of twentieth-century invention: the idea that man could produce materials to order—not simply synthetic imitations of nature, but often materials superior to what nature could produce. Witness the subsequent miracle of nylon.

One might add that in 1911 Willis H. Carrier read a paper on what he called "Rational Psychrometric Formulae," which presented the theory and the practical data on which the air-conditioning industry was later based. And that at the St. Louis Exposition in 1904 there was exhibited an oil engine built in Providence, Rhode Island, after the plans of the great German inventor, Rudolf Diesel. Few people at the time seemed unduly excited by the fact that they had met it at St. Louis, but the Diesel engine, too, had a future.

To understand the America of today one must not only realize how vital to its development was the revolt of the American conscience, which implanted in Americans the idea that you could repair the economic and political machinery of the country, so as to make it work better for the majority, without stopping the machine; one must also realize that the revolt of the American conscience might have caused a mere redistribution of wealth rather than a multiplication of wealth unless the machine had kept on running and a host of men had been tinkering with it, revealing how it could follow the dynamic logic of mass production, and also discovering and inventing new things for it to do in the long and hopeful future.