The Industrial Giant

Never in the history of the world has any nation seen such rapid expansion in its industry as occurred in the U.S. from 1861 to 1900. How did America become the number one industrial nation in the world?

In order to understand America's rapid rise as an industrial nation, we need to briefly examine the history of the Industrial Revolution.

Many historians say the Industrial Revolution began in the latter part of the 18th century. Others think it began about 1750 and ended around 1850; so let us consider from 1750 to 1850 as the approximate period of the Industrial Revolution.

But what brought about the Industrial Revolution? How did this revolution affect the nations of Europe — and also America?

When the Industrial Revolution began (in the last half of the 1700s), fewer than ten percent of all the people of Europe lived in cities. At that time more than nine out of ten lived in small towns, villages or on farms. But within less than a century the majority had moved to the bigger industrial towns and cities.

The Industrial Revolution began in Britain. But why in Britain? During the early part of the revolution, iron and coal played a very important part. Britain had an easily accessible supply of both, and this proved a big boon to her.

Furthermore, Britain had become the number one colonial power shortly after the mid-1700s. From 1763 (when France ceded to Britain all her colonial possessions in North America) Britain held undisputed title as the world's most powerful colonial nation. This gave Britain a vast market for her manufactured goods, and at the same time, it gave her an unlimited supply of raw materials. In addition, Britain had greater political stability and freedom than most any other country of Europe.

France was weakened by the French Revolution of 1789, and could not devote her full attention to industrialization. In addition to this, much of France's strength went into the manufacture of luxury items — especially for the French Court. But since the wealthy men in Britain controlled Parliament during most of the 1700s they saw to it that every incentive was given to business and commerce. And British industrialists concentrated on manufacturing those items which were more necessary

such as textiles and iron products. Soon Britain was producing these items much more cheaply than any nation on earth.

The British are a very talented and gifted people — evincing unusual inventive ability. This is not to say that the French, Germans, Italians, Russians and others aren't also inventive. But it is a fact that the vast majority of the major discoveries and inventions which furthered industry during the 1700s, 1800s and 1900s were invented by Britons or Americans. This is a simple, indisputable fact.

World's Great Inventions

But why were most of the major inventions during this period invented by Britons or Americans? From the end of the Civil War in 1865 to 1900, the U.S. Patent Office granted over a half million patents. Some call this period America's golden era of inventiveness.

In 1712, a Briton named Thomas Newcomen established the steam engine as a practical machine. (It was an Englishman named Thomas Savery who had invented the steam pump in 1698 — to assist in pumping water out of the mines; and, another Englishman, Edward Somerset, had developed an "atmospheric engine" about 1698.) Later, John Smeaton applied engineering principles to raise the efficiency of Newcomen's atmospheric steam engine to its maximum performance.

But it was James Watt (of Scotland) who really developed the steam engine into an efficient, and wonderfully useful means of power. It was while Watt was repairing a model of the Newcomen engine at the University of Glasgow in 1764-65 that he got the inspiration of how to build a really efficient steam engine. In 1769 he took out his first patent.

But even so, his steam engine might never have come to anything had not a Birmingham industrialist named Matthew Boulton provided him with the capital and business acumen to develop his machine.

Boulton and Watt started manufacturing engines, and by 1786, they were prospering. By 1800, they had manufactured 500 engines for British and American business. The steam engine was now firmly established as an efficient, reliable and relatively inexpensive means of power.

Before the steam engine was developed, power was supplied by wind, water, or by burning wood. And animals also supplied some power — especially for transportation.

But with the steam engine nearly perfected, the way was now opened for a means of inexpensive power to be used in industry — and also in transportation. Without the steam engine, there would either have been no Industrial Revolution, or else it would have developed much more slowly. It is certain that Watt's steam engine played a tremendously important role in furnishing power for that revolution.

The Textile Industry

The industrialization of Britain's textile industry exemplifies how the Industrial Revolution changed other industries during the 1700s and 1800s.

For many hundreds of years before this revolution, spinning had been done in the home, on a simple spinning wheel. In 1738 two Britons, Lewis Paul (a Middlesex inventor) and John Wyatt (a Lichfield mechanic) patented an improved roller-spinning machine, but it was not a very satisfactory machine.

In the 1760s two new machines revolutionized the British textile industry. The *spinning jenny* was invented by James Hargreaves (a Blackburn weaver and carpenter). The *water frame,* or *throstle,* was invented by Sir Richard Arkwright (a former Preston barber).

Then a Lancashire weaver named Samuel Crompton developed the *spinning mule* between 1774 and 1779. This spinning machine combined features of the *spinning jenny* and the *water frame,* and eventually replaced both machines. The introduction of the spinning mule finally ended the home spinning industry.

During the 1740s the first textile mills appeared in Britain. England had 120 mills (several had also been built in Scotland) by the 1780s.

But Britain's weavers couldn't keep up with her spinners. Almost all weaving was done on handlooms until the early 1800s, because no one had been able to solve the problems of mechanical weaving. Finally, a Lancashire clockmaker, John Kay, invented the *flying shuttle* in 1733. This helped the industry, but didn't completely solve Britain's weaving problems.

An Anglican clergyman, Edmund Cartwright, developed a steam-powered loom in the mid-1780s; and John Horrocks (a Lancashire machine manufacturer) built an all-metal loom in 1803. Further improvements were made by other British machine makers during the early 1800s.

Britain had the unbelievable number of 120,000 power looms by 1835, and most of those power looms were used for weaving cotton which she imported primarily from America.

The Steamboat

John Fitch (1743-98) appears to have been the first to perceive the possibility of using steam engines in a *steamboat.* He designed and built a steamboat, and operated it successfully in 1787. He later built several models of steamboats, but his last one was wrecked, and thereafter his backers refused to finance his work any further.

Robert Fulton (1765-1815) is best known for developing the steam-

boat. He formed a partnership with Robert R. Livingston (U.S. minister to France), and the two men launched a steamboat of Fulton's design on the Seine in 1803.

After Fulton and Livingston returned to America, they set about building a newly designed steamboat. This steamboat made its trial runs on August 9, 1807. It was powered by a Boulton and Watt engine. Only eight days later, the historic 150-mile steamboat trip from New York to Albany was made.

Fulton, a clever mechanic with a very fertile imagination, was the real leader in developing a viable steamboat. He used the best ideas he could glean from both Europe and America. It was through his efforts and inspiration that the steamboat was actually developed as a commercially profitable means of transportation.

The development of the steamboat was to have tremendous significance in opening up the North American continent. It proved especially valuable as a means of transportation on the Great Lakes and on America's larger rivers. Before the advent of the steamboat, large barges were used to float American products down the Mississippi to New Orleans. But the barges were too cumbersome to tow back upstream. Therefore, new barges had to be built each time a shipment was transported down the Mississippi. This meant very high shipping charges.

But with the debut of the steamboat, passengers and products could be carried both up and down America's large rivers, reducing costs considerably.

The Cotton Gin

It was during the first half of the Industrial Revolution (from 1750 to 1800) that the *thresher* was invented in Scotland.

Another very important invention was the *cotton gin* — invented by Eli Whitney (U.S.) in 1793. Before the invention of the cotton gin it took one person a whole day to remove the seeds from one pound of cotton lint. This was a slow and laborious task, performed mostly by slaves. England could use more cotton than America could supply at the time.

How did the young Whitney come to invent the gin? He had heard some Southerners discussing the problem of removing the cotton seed from the lint, and he began immediately thinking about a solution. Since he had been a tinkerer, and was quite gifted in mechanical things, his mind naturally turned to a mechanical solution to the problem.

One day he saw a cat sitting by the fence which enclosed a poultry yard. This naughty cat held a paw through the fence, waiting for a chicken to pass. When a chicken strolled past, his paw darted forward like greased lightning — missing the chicken, but retrieving a paw full of feathers.

Young Eli Whitney began to wonder why this principle of friction (used in separating the feathers from the chicken's body) could not be applied to the separation of the lint from the seeds of cotton.

He had previously tried out various shapes of cylinders, pulling knives over them — but nothing seemed to work.

Now, after seeing the cat catch the feathers in its paw, he went back into the workshop to apply this friction principle in his experiments. He used a simple box to begin with. Then he suspended a wooden cylinder that revolved when a handle was cranked. Many evenly spaced spikes were placed on the surface of the wooden cylinder. When the handle was cranked, the cylinder turned and the spikes clawed at the cotton inside the box. It shed the seeds behind the cylinder, but let the lint come frothing out the front of the machine. At last, the world had a cotton gin. Even this simple model could do the work of ten slaves. Before long, his improved cotton gin could do the work of 50 men working by hand.

Whitney made and patented numerous other cotton gins; but when others heard about the principle of the cotton gin, they built their own gins. Even though Whitney applied for patents, he received practically nothing for his invention since there were so many types of gins which others had invented.

The cotton gin proved to be a boon to America and to the world. It made the work of separating the lint from the seeds infinitely easier, and meant that much more cotton could be grown.

Eli Whitney also invented interchangeable parts in 1798 and made mass production possible. His invention of standardized (uniform) parts enabled him to mass produce gins for the U.S.

Food Canning Process

Another very important invention was that of the food canning process. A Frenchman, Nicolas Appert, invented this process during the years 1787-1810. This made it possible to preserve foods for use during the winter and other seaons when those particular fruits or vegetables were not in season. Also, it was much easier and cheaper to transport canned foods.

John Fitch (who is credited with having made the first steamboat) also was one of the first ones to invent and develop the *screw propeller.* John Ericsson (Swedish-U.S.) and others are also credited with this invention during the period of 1796-1837. This was a much more efficient means of propulsion than the old splash paddle wheels which had driven the early steamboats.

The Steam Locomotive

The invention of the *steam locomotive* by Richard Trevithick of Great Britain in 1804 was destined to have a most profound impact on the Industrial Revolution. The first railway was the Stockton to Darlington line, opened in 1826. The line from Manchester to Liverpool was opened five years later. Before long there was a "railway mania" under way in Britain. Many new rail lines were built between 1844 and 1848 — the peak of the rail building craze. By the end of 1848, there were 5,000 miles of railway in operation.

America was also experimenting with steam locomotion on rails as early as 1825. This experimentation continued for several years. But it was the opening of the first few miles of the Baltimore and Ohio and the South Carolina railroads in 1830 which marked the real beginning of the railway era in America. By 1835, more than 200 railway charters had been granted to eleven states. Over one thousand miles of railroad had been opened for operation in the U.S. at that time. Soon railroads would snake their way across the U.S. and meander all over the continent.

The first transcontinental line (the Union Pacific) was completed in 1869 and by 1884 there were three more!

The railroad mileage in America in 1860 — on the eve of the Civil War — was 30,000. But by 1900, the U.S. had 192,000 miles of railway.

In 1875, only ten years after the Civil War ended, the first refrigerated car was on the rails. America's railroads made it possible for her to develop her vast unsettled lands much faster than she could otherwise have done.

America's transcontinental railway lines advertised in Europe for immigrants. Soon the railways were carrying a continual stream of immigrants westward to be settled in the new territories and in the western states. Also, valuable produce, livestock and all sorts of materials were transported quickly, and relatively cheaply by rail. The railway did much to develop America during the last half of the 19th century, and the early part of the twentieth.

Improved Roads

It was two British engineers, John L. McAdam and Thomas Telford (both Scotsmen) who first made important advances in *road construction* during the early 1800s. John McAdam was the originator of the macadam type of road surface, which consists of crushed rock packed into thin layers with tar on top of it. Thomas Telford developed a technique of using large flat stones for road foundations.

By using these new road-building techniques, both Britain and

America were able to speed up road construction, so that roads could be built all over the two countries.

In 1824 Joseph Aspdin of Great Britain invented *Portland cement,* thus assisting in the field of construction. Then Edwin Budding (of Great Britain) invented the *lawn mower* in 1830.

The American, Jacob Perkins, invented *gas refrigeration* in 1834, and the same year, another fellow-American, Cyrus H. McCormick invented the *reaper* which greatly aided farmers in reaping their grain harvests. This was quickly followed by the invention of the *steel plow* by John Deere (U.S.) in 1837.

An American named Charles Goodyear invented *vulcanized rubber* in 1839.

Transportation had now been speeded up, but *communication* was still limited to surface travel until Samuel F. B. Morse (of the U.S.) invented the *electric telegraph* in 1836. The first message flashed from the U.S. capital in Washington to Baltimore, Maryland was: "What hath God wrought!" — quoted from the Bible (Numbers 23:23). Morse also invented the famous Morse code.

In 1842, Crawford W. Long of the U.S. discovered the use of *ether.* This was soon to be of great value as an anesthetic during the terrible Civil War.

Then in 1845, an American, Elias Howe, invented the *sewing machine.* During that same year, Richard M. Hoe, also from the U.S., invented the *rotary printing press.* And Robert W. Thomson of Great Britain invented the *pneumatic tire.*

Of importance to farmers was the *corn picker,* invented by Edmund W. Quincy (U.S.) in 1850. A Frenchman named Ferdinand Carre invented an *ice-making machine* in 1850-55. And another Frenchman, Henry Giffard, invented the *dirigible airship* in 1852. Henry Bessemer of Britain invented the *Bessemer converter* in 1855 — greatly aiding the steel-making industry. Also, in 1855, a German named Robert W. Bunsen, invented the *Bunsen burner.*

The Gas Engine

In 1860, just one year before the Civil War began, a Frenchman invented the *gas engine.* Another Frenchman, Ernest Michaux, invented a *bicycle* with pedals.

During the period of 1861-70 the *electric generator* was invented by Antonio Pacinotti (Italy) and Zenobe T. Gramme (Belgium). This invention was to have tremendous importance on the future of industry.

Alfred Nobel of Sweden invented *dynamite* in 1867. He apparently had no idea that his invention would be put to such terrible purposes as the making of shells and bombs for destruction in war. Also, in 1867, the

typewriter was invented by Christopher L. Sholes, Carlos Glidden and S. W. Soule of the U.S. Then the *air brake* was invented by George Westinghouse (U.S.) in 1868.

One of the most useful of all inventions, the *telephone* was invented by Alexander Graham Bell of the U.S. in 1876. The following year, 1877, Carl Gustaf de Laval (Sweden) invented the *mechanical cream separator* — of great importance to dairy farmers.

One of the most prolific inventors was Thomas A. Edison (U.S.) who invented the *phonograph* in 1877. He was probably the world's foremost, and most prolific, inventor! Anna Baldwin (U.S.) invented the *vacuum milking machine* in the following year, 1878. Charles F. Brush (U.S.) invented the *arc light.* And during the same year, America's master inventor, Thomas A. Edison, invented the *incandescent light.*

The *fountain pen* was invented by Lewis E. Waterman (U.S.) in 1884. Also, that same year George Eastman (U.S.) invented the *photographic roll film* in 1884, and the first "Kodak" camera in 1888.

Television was invented over a long period of time (1884-1930) by numerous inventors from different countries: John L. Baird (Britain), Charles Francis Jenkins, Vladimir Zworykin, Paul G. Nipkow, Philo T. Farnsworth and others.

The First Automobile

The first *gasoline automobile* was invented by Karl Benz and Gottlieb Daimler (both from Germany) in 1885. This invention was destined to greatly transform the lives of hundreds of millions.

Motion pictures were invented (1889-1896) by Thomas A. Edison, Charles Francis Jenkins, William Friese-Greene, Thomas Armat, Louis and Auguste Lumiere and others.

Why the Anglo-American Monopoly

The vast majority of the inventions covered during this period were invented either by *Americans* or *Britons.* The French were next, then the Germans.

Why were so many important inventions invented by American and British inventors?

This was due in great measure to the fact that these nations had a stable political and economic climate in which to work. Also, America and Britain had access to vast resources which gave them a tremendous advantage. In addition to these advantages, some believe that these British descended peoples have an unusual degree of innate inventive ability.

How did America become number one? How could this nation

which had a population of only two and a half million in 1776, and little industry, become the world's number one industrial power?

Firstly, America undoubtedly received, to use President Lincoln's words, "the fairest portion of the earth" and "the choicest blessings of heaven." She had been blessed with good, fertile land, and also with an abundance of minerals, water and other natural resources. Then the sheer size of the nation is also a great advantage.

Secondly, America's peoples have always been a dynamic, and aggressive people; and they have always wanted to get ahead in life. It has never been their desire to stand still — to stagnate!

Thirdly, America's political and religious institutions have encouraged freedom of thought, speech, and the press. This free flow of ideas has given a boost to inventiveness. This has inspired the American peoples to want to work hard in order to preserve these precious liberties for posterity.

America's Industrial Revolution

The first industrialization (outside the continent of Europe) occurred in Britain's North American colonies. The colonies developed a wide range of industries, but it was *shipbuilding* that first became the most important. When the Revolutionary War broke out, about one third of all of Britain's ships were being built in America.

The manufacture of *iron* was also a major industry in the colonies before 1776, and some iron was even exported to Britain. After the Revolutionary War, a small arms industry sprang up in the U.S. By the early 1800s, machines and machine tools could produce standard parts which were required for mass production.

But the Industrial Revolution didn't really get going in the United States until the 1800s. Industrialization increased very rapidly throughout the eastern U.S., beginning in th 1830s.

It was during the 1830s that two remarkable future industrial giants were born — Andrew Carnegie and John D. Rockefeller. These two men would later become multi-millionnaires. Both rose from rags to riches, and played an important part in America's dynamic development in the nineteenth century.

Andrew Carnegie

Andrew Carnegie was born in Dunfermline, Scotland in 1835. When young Andrew was 13 years old, his family moved to America.

Andrew's family settled in Allegheny City, Pennsylvania (now a suburb of Pittsburgh). The young Andrew worked as bobbin boy in a

cotton factory for only $1.20 a week. When Andrew was 17, he became a telegraph operator.

Then Carnegie got a job as a railroad clerk in the office of the Pennsylvania Railroad. By hard work, he was able to work his way up and became a train dispatcher. Eventually he was promoted to division manager — when only 24 years old.

The young Carnegie had already purchased stock in the Woodruff Sleeping Car Company — the forerunner of the Pullman Company.

Carnegie rendered valuable service organizing the telegraph department of the Union Army during the Civil War. During the war he also entered the iron business (in 1864), but he didn't begin making steel for several years.

After seeing the merits of the Bessemer process, Carnegie built the Edgar Thomson works in Braddock, Pennsylvania so he could make Bessemer steel. He later established other steel plants, and eventually merged all his steel interests into the giant Carnegie Steel Company. It became one of the mightiest industrial enterprises in America. In 1901, Carnegie sold it to U.S. Steel Corporation.

In Carnegie's famous essay, "The Gospel of Wealth," which was published in 1889, he expounded his view that the life of a rich man should be divided into two periods: 1) the period of acquiring his wealth and 2) the period of distributing his riches in such a way that any surplus would be used for the general welfare. When Carnegie reached middle age, he had become one of the richest men in the world, but he gave away most of his wealth for the benefit of humanity. Overall, he is estimated to have given away about $350 million. He gave millions of dollars to schools and universities, and thousands of communities were provided libraries. If the local authorities would donate the land, and keep the library up, he would build and equip it.

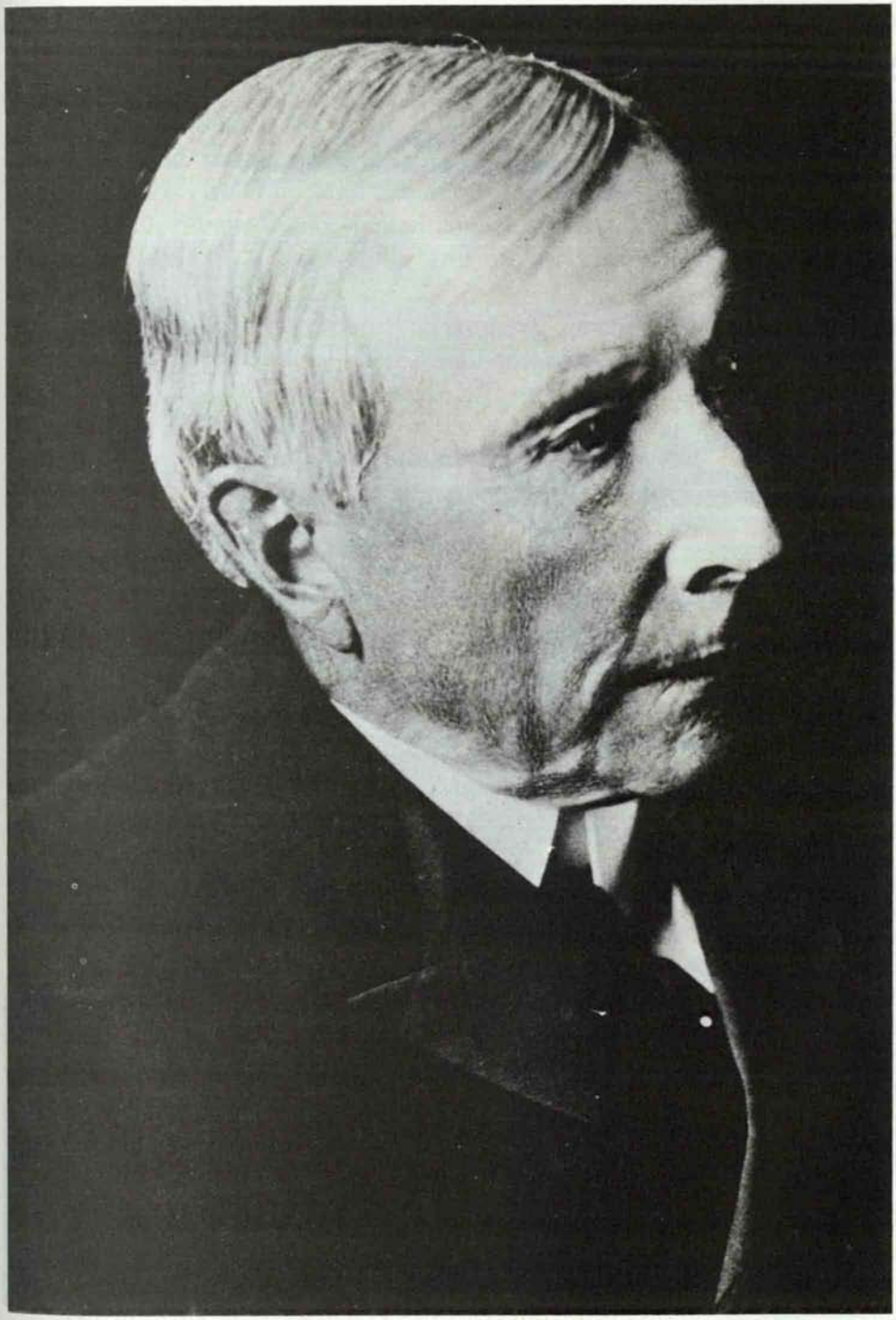
Many have criticized Carnegie, but no one can say that he didn't give much of his vast wealth to benefit mankind — both before and after his death. When he died in 1919, he was 84 years old.

John D. Rockefeller

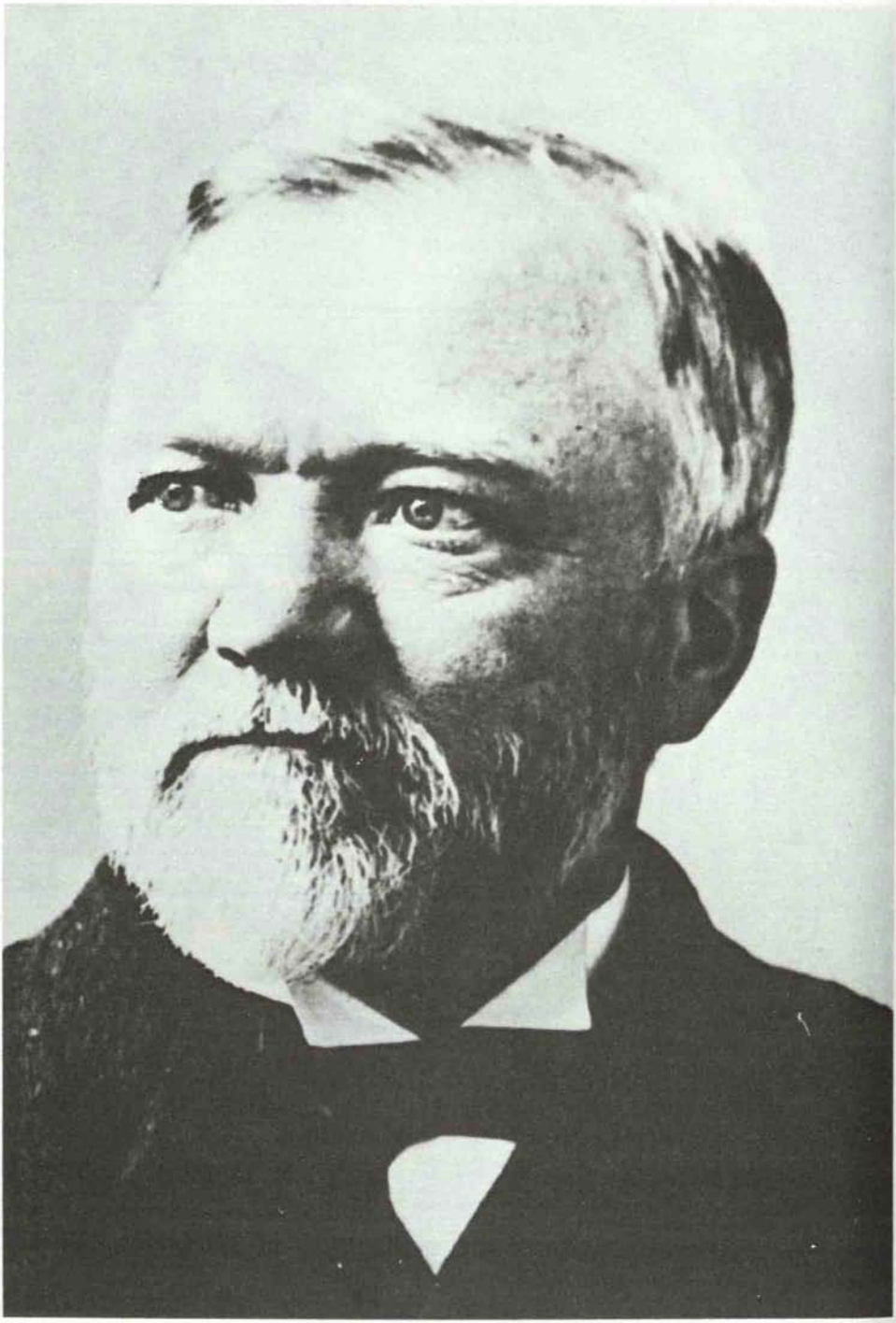
John D. Rockefeller (1839-1937) was born only two years after Andrew Carnegie. Carnegie had made much of his fortune in steel, but Rockefeller would make most of his in the oil industry.

Like Carnegie, Rockefeller's story is one of rags-to-riches. He was born the son of a peddler who lived in Richford, New York. His family decided to move to Cleveland, Ohio when young John was only 14 years old.

First, young Rockefeller worked as a clerk in a small produce firm.



Andrew Carnegie made much of his fortune in the steel industry. When he died, he gave multiple millions to help build libraries, schools and various foundations. —



John D. Rockefeller's vast fortune was made in his extensive oil holdings. He gave much of his wealth to philanthropic institutions. — *American Stock Photo*

He later formed a partnership in a grain commission house, and plowed back the profits from the business into an *oil* venture when he was only 23 years old.

The oil industry was just in its infancy at the time, but much confusion and chaos reigned in the business. Rockefeller set out to organize the oil industry, and accomplished his goal in just 15 years.

In 1859, Edwin Drake drilled America's first commercially successful oil well. In 1863, Rockefeller and his associates began organizing a vast oil industry.

Rockefeller used the name "Standard" as the name for his second refinery, and when he organized his oil company in 1870, he called it the Standard Oil Company. By 1882, the Standard Oil Company controlled 95 percent of the oil refining industry in the U.S. — as well as manufacturing, transportation, iron, lumber and other subsidiaries. Rockefeller's company soon owned all the main refineries in Pittsburgh, Philadelphia, New York and Cleveland.

Rockefeller began building tank cars and distribution systems. But his shrewd dealings with the railroads (involving *rebates* and other types of privileges (which were not illegal at the time) caused his competitors to grumble. His competitive methods caused much criticism which led the courts in Ohio to dissolve his company in 1899. The Ohio court held his trust to be in violation of the Sherman Anti-Trust Act.

Then, in 1911, the Supreme Court also declared his Standard Oil Company of New Jersey to be illegal.

Rockefeller's immense wealth and his vast power provoked much of the antitrust agitation at the turn of the century.

World's Richest Man

At one time, Rockefeller was the world's richest man. Like Carnegie, he gave away much of his wealth before his death. He is reputed to have given away $530,000,000 — over half a billion dollars!.

Both Carnegie and Rockefeller lived during America's period of rapid industrial expansion. Railways were being flung across America, and an energetic building program was in progress all over America. This took money, steel, oil and brains.

Rockefeller worked closely with the *railroads* which were controlled by such men as Jay Gould, Cornelius Vanderbilt, James J. Hill and Edward H. Harriman.

During this same period, Philip Armour and Gustavus Swift developed colossal *meat-packing* businesses. Meyer Guggenheim controlled much of the copper interests. J. P. Morgan was one of the world's greatest *financiers*.

The "Giant of Technology"

In less than fifty years from the Civil War America had become the world's "giant of technology." By 1900, she produced twice as many goods as Britain. And Britain had been the world's leading industrial nation since the mid-1700s.

But there were a number of growing pains during this period of rapid expansion. In spite of the fact that America was considered the land of "milk and honey," most of the common people had to scratch hard — especially many of the small farmers — in order to make a decent living. As the big American *trusts* got bigger, and began to squeeze the little man more and more, the U.S. government finally had to step in to correct numerous flagrant abuses. In response to corporate power, *labor unions* rose up to champion the cause of the working man (especially those employed by industry), to make sure that he didn't have to work too long hours, to guarantee reasonably healthful working conditions, and also a decent wage.