PART TEN

The Nation Moves Toward Industrialization

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United States Immigration and Naturalization Service

ALIENS ENTERING ELLIS ISLAND STATION – 1900

MILLIONS OF EUROPEANS SOUGHT OPPORTUNITY IN THE UNITED STATES

Scandinavian farmers settled in the northern states of the Central Plains, and in the region of the Great Lakes. Others, including Finns, went farther west to cut timber in the forests of Washington and Oregon, and to enter the fishing industry of the Pacific Coast. Many families from Sweden, Norway and Denmark settled in Chicago, Minneapolis, and Seattle.

A large number of immigrants from Russia, Poland, Hungary and other countries of eastern Europe were Jews. Being a town people, they remained in the large cities, especially New York. Many Poles, Hungarians, and Bohemians sought jobs in mills and mines. Some of the farmers among them made their new homes on the prairie lands west of the Mississippi River.

Many immigrants from the Mediterranean countries – Italy, France, Portugal, Greece and Spain – settled in the manufacturing states of the North Atlantic Coast. Some found their way to regions in the United States where they could follow the same occupations they had in the old country. French and Italians planted vineyards in the wine-producing states. Portuguese fishermen found employment in the growing fish-canning industry of the Gulf region and the Pacific Coast. Greeks settled largely in cities like New York, Chicago, and Cleveland. Spaniards tended to seek places where their native language was spoken.

Chinese junks crossed the Pacific Ocean to North America before Columbus came, according to historians, and all of the Chinese sailors did not return to their homeland. After the Europeans arrived and claimed the country, not many Orientals were welcomed to settle among them. Asiatic peoples who came first as laborers to work the mines, build the railroads, and plant the crops, remained in the new land. Today, their descendants are citizens of the United States, living mainly in the Pacific region.

Chapter 25

Inventions Contribute to National Growth

MESSAGES BY WIRE

UNDER A FORM of government granting freedom of opportunity, men were able to dream, to experiment, and to produce. Men's dreams and work made this nation a land of invention. According to records in the patent office, inventors were numerous but only a few found fame and fortune. Among them were the inventors in communication.

Samuel F.B. Morse was born in 1791, in a house at the foot of Breed's Hill (where the battle of Bunker Hill actually took place). Though his curiosity about electricity was aroused when he entered college at the age of fourteen, a year later his talent and interest in art led him to decorate a room in his father's house, with a picture of the family. Samuel liked best to paint historical scenes, but no one would buy them. While visiting in the country towns of New Hampshire and Vermont he turned to painting portraits, and these he did sell for $15 apiece. Before long the demand for Samuel's portraits was so great that he could charge as much as $60 for a picture. In 1825 the authorities of New York City commissioned Morse to paint a full-length portrait of Lafayette who was making a triumphal tour of the United States in that year.

While painting and teaching, Morse spent his spare time tinkering with a machine to send electric current along a wire and with an instrument to interrupt the current and make a spark. In this way signs could be made into an alphabet and messages could be transmitted. In fact Morse spent so much time with his invention that his art suffered and he became poor. It was a great disappointment, however, that turned him away from his profession and made him an inventor. Commissions were offered to American artists to paint pictures for panels in the capitol at Washington. Being president of the National Academy of Design, Morse felt he should be engaged as one of the artists to decorate the capitol. He was not among those selected.

From an old canvas frame, the wheels of a clock, three wooden drums, a pencil, some paper, carpet binding, a wooden crank, an electro-magnet, and a few more items, Morse put together his first telegraph instrument. He worked in a room of the University of the City of New York where he was a professor in design.

Not until one of his students, Alfred

Vail, managed to obtain for Morse some money in exchange for a one-fourth interest in the project, was Morse able to build an instrument to place on exhibit and try to prove its worth. Finally, he was able to present his plan in Congress. He asked for an appropriation to build the first telegraph line between Washington and Baltimore. At first the legislators were skeptical and insisted upon proof that messages could be sent over a wire. On the last day of the session on March 3, 1842, five minutes before Congress adjourned, the Senate voted $30,000 to build the first telegraph line. Morse, weary from waiting all day, had gone home at twilight, thinking that all hope was gone. As he came down to breakfast the next morning, the daughter of the Commissioner of Patents arrived to tell him that her father had stayed until Congress closed, and that the telegraph bill was the last one passed. Morse promised the young lady that she would have the honor of sending the first message when the line was opened officially.

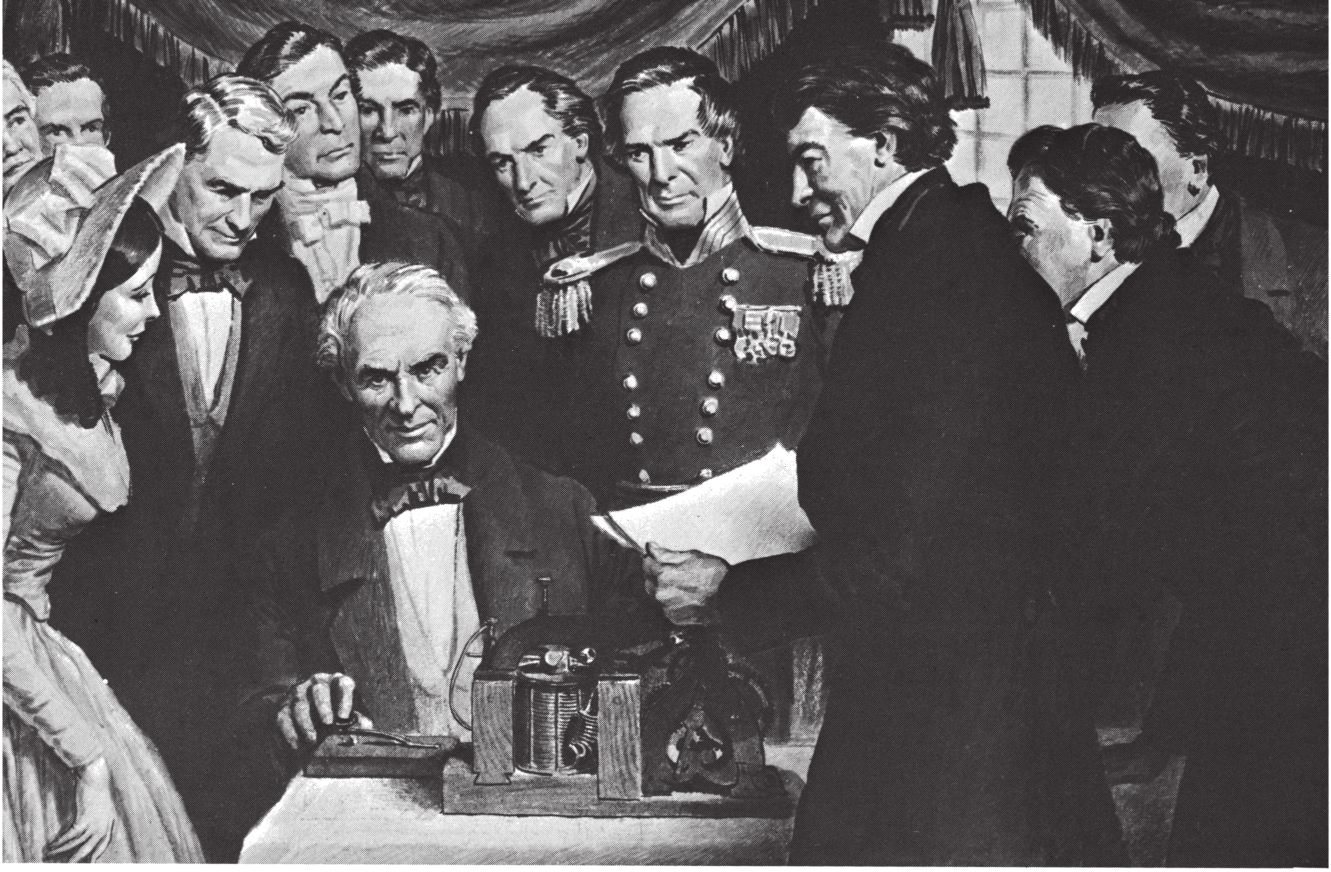
Morse took advantage of the popular interest in the convention of the Whig Party meeting in Baltimore to prove the worth of the telegraph. In a letter to his brother, Sidney, dated May 7, 1844 he wrote:

"You will see by the papers that the Telegraph is in successful operation for twenty-two miles, to the junction of the Annapolis road with the Baltimore and Washington road. The nomination of Mr. Frelinghuysen as Vice President was written, sent on, and the receipt acknowledged back in two minutes and one second, a distance of forty-four miles. The news was spread all over Washington one hour and four minutes before the cars containing the news by express arrived."

Later, when the key clicked the choice of the Whig Party for President, the man was Henry Clay whose portrait Morse had painted. Although Henry Clay was the first man whose nomination for President came over a wire, his Democratic opponent, James K. Polk, won the election.

On the twenty-fourth of May in 1844, friends of Morse assembled in the chamber of the Supreme Court in Washington to witness the official test of the new telegraph. Miss Ellsworth, daughter of Morse's friend, was there with the first message, suggested by her mother – WHAT HATH GOD WROUGHT! At the station in Baltimore ten men and one boy sat silently and tensely, awaiting a signal. When the instrument clicked, the operator, Alfred Vail, touched his lips with his fingers and the watchers scarcely breathed. The message came in and Vail touched the key, sending it back to Washington. As the use of the telegraph spread to foreign countries, honors were poured upon Morse, as a benefactor of all mankind.

About two years before the first telegraph line was completed on land, Morse began to experiment with a cable to carry messages under water. On a moonlit night, October 18, 1842, he unreeled nearly two miles of wire, insulated with hemp coated with pitch, tar, and rubber, from lower New York City to a small island. The next morning a notice appeared in a New York paper that Morse would exhibit his telegraph by sending messages under water to a station on Governor's Island. The inventor arrived early to prepare for the event and found seven vessels lying along the line of his submerged cable. In testing the wire he was able to send a signal or two, but the messages suddenly ended. One of the ships in pulling up its anchor caught the



The Western Union Telegraph Company

SAMUEL F.B. MORSE SENDS FIRST PUBLIC TELEGRAM

The inventor asked a few friends to witness the sending of the first public telegram from the Supreme Court Chamber in Washington to Alfred Vail, forty miles away in Baltimore.

The girl is Annie Ellsworth to whom was given the honor of selecting the first official message. With dots and dashes, Morse ticked the words she chose — WHAT HATH GOD WROUGHT. This practical use of electricity was made on May 24, 1844.

cable. Not knowing what the strange line was, sailors pulled in about 200 feet of it and then cut it off, carrying it away with them. The exhibit failed and the crowd jeered. This first attempt, however, stirred the idea of bringing Europe and the Western Hemisphere closer together with telegraph service.

The laying of an Atlantic cable was undertaken by a wealthy New York business man, Cyrus W. Field, who was neither a scientist nor an inventor. Although he was not the first man to dream of laying an underwater cable from one hemisphere to another, he was the first one to make up his mind to do it. In 1856 the Atlantic Telegraph Company was organized "to continue the existing line of the New York, Newfoundland, and London Telegraph Company to Ireland, by making or causing to be made a submarine cable for the Atlantic." Field, himself, subscribed $500,000 of the $1,750,000 that had to be raised before work could begin on laying a cable from Trinity Bay in Newfoundland to Valentia in Ireland. The plan was outlined by Field, to haul the cable on two ships, to meet in midocean where they would splice the cable and then to go in opposite directions. After many breaks and disappointments, the *Agamemnon* headed west toward Newfoundland and the *Niagara* started east toward Ireland. There was great excitement when the cables were pulled ashore at both ends in August of 1858. It was a fleeting triumph. In a few weeks the cable stopped working and all was lost.

Before another effort was prepared, war broke out between the North and the South. However, during the conflict, Field was busy with plans to try again when he could get enough support. In January, 1863 Field wrote in a letter to a friend:

> Some days I have worked from before eight in the morning until after ten at night to obtain subscriptions to the Atlantic Telegraph Company.

By the time the war ended in the spring of 1865, cable had been manufactured and the *Great Eastern* was chartered to lay it across the Atlantic. The English were as enthusiastic about the project of a telegraph line across the ocean as were the Americans. A news report from Valentia Island off the coast of Ireland was printed with the date line of July 24th. It read as follows:

> Before this reaches the public, the *Great Eastern,* if all goes well, will already have laid some 300 miles of the Atlantic cable.

The crew published *The Atlantic Telegraph* on board the cable ship but the paper did not long survive. On the second of August while Field was on watch, the cable broke. Pale but composed, he announced to his working partners, "The cable has parted and gone overboard."

Several days later, he wrote to his family explaining the disaster:

> Spent nine days in grappling; used up all wire, rope; nothing left, so obliged to return to England. Three times cable was caught and hauled up for more than three-quarters of a mile from bed of ocean.

In London another company was formed by ten men who sat around a table discussing help for Field. When each one put down 10,000 pounds, the Anglo American Telegraph Company took over the task of laying the cable.

Although the new company was formed only on March 1, 1866, the messages were speeding from continent to continent over the underwater telegraph about five months later. On the twenty-seventh of July, the western end of the cable was landed on the shore of Trinity Bay in Newfoundland and the eastern end on the Irish coast. The national rejoicing at the successful completion of the first ocean cable is expressed in a poem by John Greenleaf Whittier. The last stanza expressed the hope that new means of rapid communication would bring the people of the world together to live in peace:

> And one in heart, as one in blood,
> Shall all her peoples be;
> The hands of human brotherhood
> Are clasped beneath the sea.

Both Morse and Field persevered through hardships and disappointments because they believed their work would benefit mankind.

TALKING OVER THE WIRE

ANOTHER MEANS of wire communication developed from the experiments of Alexander Graham Bell who taught deaf children with a method of "invisible speech" evolved by his father. Before migrating to the United States the Bell family of Edinburgh, Scotland had been known as elocutionists (public speakers). Alexander, like his father and grandfather, studied the human voice and taught the deaf to speak. Two well-to-do men, one a leather merchant and the other a lawyer, were so impressed with Bell's lectures, sponsored by the board of education in Boston, that they engaged him as a private tutor for their deaf children, a girl and a boy. With their encouragement Bell opened a school for the deaf in that city.

When not occupied with teaching, Bell was busy experimenting with sound, hoping to discover new ways of helping deaf children to talk and to understand speech. The fathers of his two private pupils took an interest in the young teacher's experiments and provided him with needed supplies for his projects. The grandmother of the small boy invited Bell to live in her roomy house in Salem. Here he could teach the lad in the evening after returning on the train from his school in Boston. Since Bell could not be satisfied away from his experiments, she kindly offered the basement of her house for his use as a laboratory.

As a boy Bell had played the piano and he had wanted to be a musician. He first experimented with transmitting the tones of the scale over a wire – a musical telegraph. Then it occurred to him that the spoken word might be sent over an electrical wire. Since Bell knew little about electricity, his two patrons hired a young mechanic for nine dollars a week to assist him and moved his laboratory to the attic of the electrical shop where the electrician was employed. Here Thomas A. Watson, the assistant, spent his evenings and sometimes most of the night with the inventor.

As the experiments progressed, Bell quit teaching and gave all his time to this endeavor. He rented two rooms in an attic for living quarters and laboratory combined, where he could work privately. In these stuffy upstairs rooms on a hot June day in 1875, a faint sound passed over the wire while Watson was sending in one room and Bell was receiving in the other. Though only a feeble wail, this was the birth of the telephone. After forty weeks spent in improving the invention, Bell spoke over a wire to his helper in the next room on the evening of March 10, 1876.

"Mr. Watson, come here. I want you!" he said.

Bell's voice was clear and natural, but there was such a note of alarm in it that the assistant rushed into the room. He discovered that Bell had spilled some acid on his clothes and was actually calling for help. The damage was soon forgotten, however, in the joy the men experienced talking over the wire.

It was the year when the United States was celebrating the one hundredth anniversary of independence with the Centennial Exposition in Philadelphia. Needing money for food and rent, Bell had returned to teaching deaf children in Boston. When he decided to show his "toy," it was too late to find space in the electrical building. Finally, the telephone was placed on a table under a stairway among the school exhibits from Massachusetts. Hubbard, the lawyer, whose daughter was Bell's pupil and later his wife, secured a patent for the inventor, barely in time to save his telephone. While at the exposition Hubbard sent Bell a telegram notifying him that the judges were scheduled to reach his exhibit on June 25. At the last minute Bell decided to go to Philadelphia although school examinations were at hand. He realized that his telephone would receive scant attention if he were not there to demonstrate it.

It was Sunday when the gates were closed to the general public, but distinguished visitors were admitted. On this day Dom Pedro II, Emperor of Brazil, his Empress, and their retinue were touring the buildings and grounds of the Centennial Exposition. The royal guests examined the products and inventions as eagerly as children and showed their enthusiasm to the judges. Late on the hot, humid Sunday, near closing time, the judges arrived at the exhibit next to Bell's. They announced that one would be the last for that day. As the judges turned to leave, Dom Pedro spied the teacher, whose school for the deaf he had visited in Boston. Greeting Bell with a hearty handshake, the genial emperor inquired why he was there. The inventor showed his instrument, explaining that he could talk with His Majesty over a wire, if he wished. Since Dom Pedro showed much interest in the apparatus, the judges were obliged to do likewise as a matter of courtesy to their royal guest. Aleck hurried to the transmitter, five hundred feet away. While the members of the party passed the receiver from ear to ear, Bell turned elocutionist and recited Hamlet's famous soliloquy, "To be or not to be."

Dom Pedro listened with astonishment.

"It talks!" he exclaimed.

"It is the most marvelous thing I have seen in America," remarked a British scientist.

The "talking wire" became a sensation. Although many inventions are combined in modern telephone equipment, the original idea of Alexander Graham Bell is still a basic principle in transmitting sound over wires. Like the telegraph which sent signals under water, the telephone crossed the oceans to make possible conversation between persons in remote corners of the globe.

SIGNALS THROUGH THE AIR

FEW ACHIEVEMENTS OF SCIENCE thrill people more than a new means of communication. Soon after the first message was sent over a wire by Morse, experimentors began to send messages without wires. Although several inventors made progress, Marconi was the man who made wireless telegraphy operate successfully. Unlike most inventors Guglielmo Marconi was born rich, the son of an Italian father and an Irish mother. As a boy, Guglielmo did not go to schools with other children. He was instructed by a private tutor, whether his family was at home on the country estate at Pontecchio or in the town house at Bologna, Italy.

It was at the Villa Griffone in the country, that Marconi carried on his experiments to send signals through the air. While he worked, the door of his shop on the third floor was locked to all except his mother, to whom he explained his experiments. Even when she did not know what he was talking about, she listened and encouraged him in his efforts.

Sometimes the sons of peasant farmers living on his father's estate were seen burying copper plates in the ground, climbing trees with strange apparatus, and erecting poles in odd places. His two brothers often helped him to string wires through the terraced garden, across the spacious lawn, and down into the chestnut grove. The elder Marconi was a bit perplexed because his youngest son spent so much time in the attic and so little in the family circle.

"What IS he doing?" his father asked his mother one evening.

"His idea," she answered proudly, "is to send signals, even voices, through the air."

One autumn day in 1894, when Marconi was twenty years of age, he invited his parents to his attic workshop to show them the progress he had made on his experiments. He pressed a button and rang a bell on the first floor of the house without the aid of connecting wires. As further proof the father asked his son to remain in the attic and send the Morse signal for the letter "S" to the receiver on the lawn, a distance from the house. When the machine outdoors tapped three dots, he was convinced that Guglielmo's experiments had resulted in wireless telegraphy.

On the twelfth of December in 1901 Marconi and his assistants were huddled in a station on Signal Hill, St. John's, Nova Scotia. Outside the wind was blowing a gale and a man was scarcely able to stand upright. Inside the anxious watchers could barely hear one another speak with the rattle of icy rain on the sheet iron roof. The masts stood against the storm and a kite remained aloft to catch the signal from the Cornish coast of England – if it came that way. The letter "S" was chosen because it is easy to transmit. Marconi sat tensely with an earphone clasped on his head for a long time past the hour set for the test of wireless across the ocean. Finally, he heard three dots – and again. When he was sure, he passed the earphone to his assistants. Although the signals died out from time to time, they were heard quite often on that day and the next, across 1700 miles of water. Later it was agreed among nations that the wireless distress signal for ships at sea would be SOS – three dots, three dashes, three dots.

Wireless telegraphy was one of the marvels at the World's Fair in St. Louis in 1904. It created as much excitement as the telephone when that invention had been exhibited in Philadelphia in 1876. In June of 1910, the United States Radio Act was passed, making it unlawful for any ship carrying more than fifty persons to leave port without wireless equipment and a trained operator, if the vessel was bound for a harbor two hundred miles away. Although wireless had been credited with saving lives at sea before the *Titanic* struck an iceberg in the North Atlantic in April, 1912, the dramatic rescue of 700 persons on that sinking vessel proved the value of Marconi's invention to the entire world. By 1914 the leading maritime nations had laws requiring even cargo vessels to carry wireless apparatus and a licensed operator for the safety of the crew. The outbreak of war in 1914 was flashed around the world by wire.

In that same year a few months before war began, two officers on separate vessels forty-five miles apart held a conversation by radio-telephone. Marconi predicted at the time that the day was near when the human voice would cross the Atlantic on the air waves.

INVENTIONS LIGHTEN LABOR

IN THE SAME YEAR that Samuel F.B. Morse sent his famous message over the first telegraph line, Elias Howe completed a working model of a sewing machine. Being one of eight children in the family of a farmer and miller, Elias began at the age of six to help with chores. He would stick wire teeth through leather straps used for carding cottons. When he was eleven years old, he tried farm work but failed because he was lame and not strong. He returned to his father's mill where he took an interest in machinery, when he was not busy grinding flour. A friend who had visited Lowell, Massachusetts, the first real industrial city in the nation, told Elias about the wonderful machinery he had seen in the mills there. Elias went to Lowell when he was sixteen and found employment in the mills where machines were doing the work of hands. When the Panic of 1837 struck, the mills were forced to cut down production. Elias found new employment in a machine shop in Cambridge, Massachusetts.

Since Howe's earnings were small, and there were three small children to support, his wife did sewing to add a little cash to the family income. Because this labor was poorly paid and his wife sewed late at night, Howe began to work on a machine which she could use to lighten her burden. Although he completed a working model in October of 1844, he lacked the money to buy the metals to make the kind of machine which he could exhibit to prove the worth of his invention. A coal and wood dealer in Cambridge, who had a little money saved, offered to give Howe's family board and room and advance $500 for materials to construct a sewing machine. In exchange the dealer would have half ownership in the patent if Howe succeeded in procuring one. By the middle of May in the following year, 1845, the machine was completed. Before the end of the year Howe secured his first patent and was ready to show his invention to the public.

Then followed years of disappointment. Tailors refused to buy the sewing machine. It would ruin their trade, they said. The more Howe improved it and the better it sewed, the more tailors resisted it. Few persons were willing to invest money to manufacture it. His partner became discouraged and withdrew, leaving Howe to return with his family to his father's house. He moved with his family to England, where he thought he could interest someone in helping him to market his invention. He soon sent his family back home while he stayed on hoping to gain financial help. Failing in this he arrived in Boston to learn that his wife was dying from tuberculosis. This was Howe's dark hour.

After his machine had been copied and manufactured by Englishmen and its value was established, Howe found men willing to advance money to defend his patent and force the manufacturers to pay him royalties. The demand for his sewing machine grew so rapidly, for both home and factory, that his royalties grew in six years from $300 to $200,000. Howe welcomed the inventions of other men to improve his machine and even helped some of them to obtain their patents. The invention of the sewing machine made possible the making of wearing apparel in factories. It gave rise to the garment industry which in turn provided employment for thousands of men and women.

While the sewing machine was finding

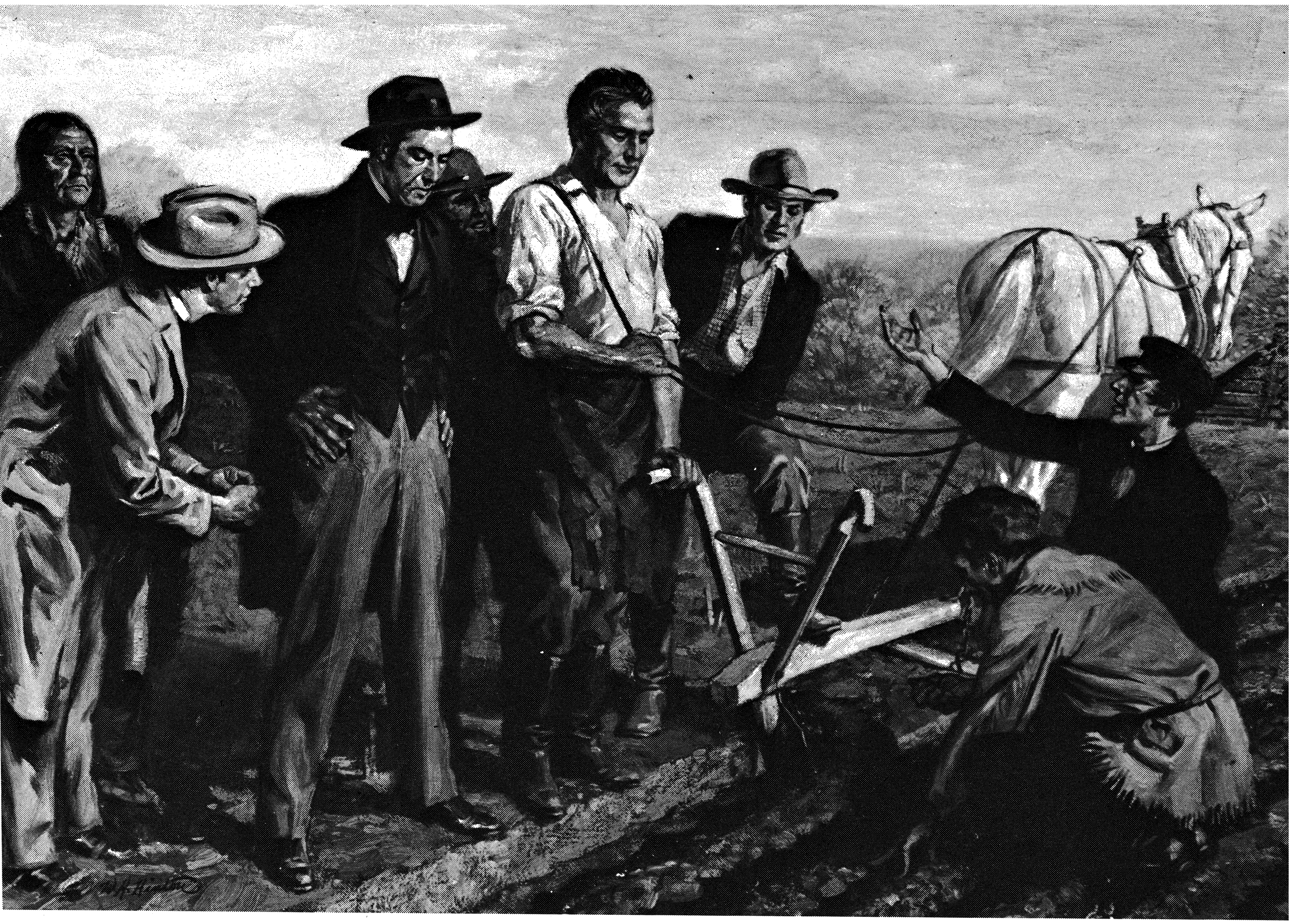
its way into farmer's homes, other labor-saving machines were being invented to lighten the burden of toil in the field. The westward migration created a demand for improved farm tools. In a new country where there was much work to be done and not enough workmen to do it, people were eager for any machinery that saved labor and speeded the production of food. In the New England states hundreds of families were leaving the country to work for wages in the mill towns. The rise of manufacturing in the East increased the demand for flour, corn meal, pork, cheese, and all kinds of farm produce. The simple tools that were good enough on the small, sandy farms of New Hampshire and Vermont became dwarfed and puny implements on the vast prairies of the Middle West.

In 1836 the lure of the West brought to this region a blacksmith, skilled in making shovels, hoes, and pitchforks, and in repairing all kinds of iron tools. He was John Deere. He came from Vermont, having traveled the length of the Erie Canal on a packet boat pulled by mules walking the towpath on the bank of the big ditch. At Buffalo he boarded a lake steamer for the voyage to Chicago. The blacksmith did not linger long in the marshy settlement with about 400 houses and 75 stores which sold clothes, food, and drink to travelers heading west. Deere continued his journey to settle among Vermonters in the frontier village of Grand Detour on the Rock River in northwestern Illinois. In his pocket he had $73.73 with which to go into business.

He built a forge from stones picked up along the river, using clay for mortar. He filled his first order, the repair of a broken shaft in a sawmill nearby. With the nearest blacksmith forty miles away, Deere, from the first, had all the work he could handle. Next door to his shop he built a five-room frame house and sent for his wife and five children. John Deere might have been any one of the thousands of unknown settlers who went west, had he remained a blacksmith and not become an inventor.

While shoeing oxen and mending chains, Deere overheard the farmers talk about their difficulties in plowing through the sticky soil of the prairie. The earth clung to the plow like balled snow, forcing the farmer to spend more time cleaning off the muck than turning furrows in his field. For the prairie they needed a plow that scoured. The blacksmith from Vermont began to fashion such a plow from a broken circular saw he found on the floor of a neighbor's sawmill. It was made of Sheffield steel. This metal was hard to obtain on the frontier. From this scrap of steel he shaped and reshaped the plowshare to cut through the black earth and slice the furrows without muck clinging to the blade.

The day came to make the test in a field while unbelieving farmers trudged behind the inventor. While the farmer, in whose field the trial was made, guided the horse pulling the steel plow, soil curled from the moldboard in a smooth furrow. One furrow was not enough to convince the watchers. Turning the horse, Deere guided his plow down another furrow, just as neat as the first one, proving that he had invented "a plow that scours." Then he gave the plow to the farmer who had furnished the land and the horse for the test. Others had taken a turn and felt the plowshare biting deep into the gummy soil. In the following year, 1838, the blacksmith from Vermont fashioned three steel plows in his spare time. In 1842 he sold nearly a hundred



Deere and Company

JOHN DEERE TESTING HIS PLOW

John Deere, a blacksmith, tested his plow in a field. He proved that he had shaped a steel plowshare that could cut a clean furrow through the sticky soil of the prairie.

implements by allowing settlers to take the plows to their farms to try them out before buying. The inventor of the first steel plow moved to Moline, Illinois, to take advantage of the steamboat traffic and started a factory. Plowmen followed, turning the buffalo range on the western prairie into fields of grain.

Inventions come when a need arises for them. From another blacksmith shop, this time it was in Virginia, came the reaper to cut the grain on the boundless prairie. In 1831 Cyrus Hall McCormick, then twenty-two years of age, completed a working model of a mechanical reaper in the blacksmith shop on his father's farm, Walnut Grove in western Virginia. On a hot July day young McCormick invited his neighbors to Walnut Grove for a demonstration of his wheat-cutting machine, destined to free laborers in the harvest from the sickle and the scythe. Although the grain fell in waves as horses pulled the reaper, the inventor saw the need for improvements before asking for a patent. Like John Deere, who made a plow and set it outside his shop for passersby to see, McCormick built one reaper at a time and sold it to a neighbor. He also believed in field trials to prove the worth of his invention. He, too, went to the Middle West.

The reaper was not well suited to the rolling landscape of western Virginia but the machine performed successfully on the level lands of the western prairie. For a factory site McCormick selected the fast-growing village of Chicago which had less than one hundred inhabitants in 1832. It grew from three to four thousand only three years later. A news item of May 16, 1835, stated:

> Chicago has one of the finest harbors on Lake Michigan, 20 to 25 feet of water in front of the town. The town will command the trade of the Illinois River and the Mississippi by means of the canal, and the west and east by the navigation of the lakes. It is destined to be the New Orleans of the west.

When McCormick moved to Chicago in 1847, the population of the town was 17,000. The place was uninviting. Broken plank roads threaded through the swampy townsite, few streets were paved, and the houses were small. The canal was about to be opened. Immigrants were flocking into the village, arriving by the hundreds on the lake steamers from Buffalo. Chicago was a place of opportunity, located in the heart of fertile lands awaiting the reaper for development. In a small brick factory a new industry was established in 1848. Thirty-three men were employed and ten of these were blacksmiths. The output was 778 reapers, but twice as many were built in 1849, the year of the California gold rush. When people were leaving their farms to try their luck in mining gold, McCormick advertised his reaper as a labor-saving machine that would save the harvest of grain that might be lost for lack of men to swing the scythes. The mechanical reaper had a large share in making the central part of the United States one of the great wheat regions of the world. This invention was merely the beginning of labor-saving machines for use on the farm.

RUBBER PUT THE NATION ON WHEELS

WHILE JOHN DEERE was forging steel plows and Cyrus McCormick was building reapers, Charles Goodyear was seeking a way to "cure" India rubber. In time, Goodyear's experiments put tractors in the fields to pull disc plows and harvester-threshers which developed from the early inventions of Deere and McCormick. Today the treads of rubber tires trace a geometric pattern along the moist, black furrows on many farms.

Indians living along the Amazon River in South America tapped certain trees in the forests to obtain sap from which they made bottles and rough shoes. Hence, the gummy substance came to be called Indian rubber or India rubber. In 1823 a Boston merchant bought five hundred pairs of rubber shoes, made by the natives of Para, and sold them. The Portuguese settlers in Brazil, for some time, had been manufacturing waterproof shoes, boots, hats, and cloaks from rubber to afford comfort during the rainy season. However, the rubber shoes were not practical in a climate with extremes of heat and cold. The rubber hardened in winter and melted in summer.

A struggle, lasting twenty-five years,

began in 1834 when a hardware merchant in Philadelphia, out of curiosity, bought a life-preserver made of the substance. The storekeeper was Charles Goodyear, then in his thirty-fifth year and in poor health. He moved to Massachusetts to use the abandoned works of an India rubber company in Roxbury, where he succeeded in making articles with such a smooth, dry surface that he secured an order from the Government for a hundred and fifty rubber mail bags. The handles began to fall off before delivery as coloring matter had caused the gum to decompose.

While Goodyear was describing the merits of sulfur-cured India rubber to a few relatives and friends on a winter evening, a piece accidentally fell from his hand onto a red hot stove. It shrivelled like leather but did not dissolve. He nailed the sample outdoors in the cold. When it was still flexible the next morning, Goodyear knew that he had made a discovery. This happened in Woburn, Massachusetts, where the inventor had moved to use another factory for his experiments. Five years later, in 1844, Goodyear patented his process for vulcanizing rubber and started a factory in Naugatuck, Connecticut.

Like many other inventors he had difficulty holding his patent and was sued in the courts. Six years after patenting his process, shoe manufacturers depending upon it paid Daniel Webster, the famous lawyer and brilliant orator, the sum of $25,000 to defend the rights of Goodyear to his patent for vulcanizing rubber. Goodyear was cheated out of the fortune which might have been won by his discovery. He was not a good business man. During his lifetime he served jail sentences for debt and still a debtor, he died in July of 1860, leaving his great discovery for mankind.

Although factories sprang up in many towns to make garments, life preservers, and numerous articles from rubber, the product did not become a big factor in the business world until it was used in the field of transportation. First, wheels of carriages, buggies, and bicycles were fitted with rubber tires, but it was the automobile that built the big rubber industry.

While travelers were still depending upon vehicles drawn by animals, inventors were experimenting with the horseless carriage, propelled by steam. Although some steam cars were built in the United States and other countries, the real automobile waited for gasoline, rubber, and roads.

Shortly after Goodyear vulcanized rubber in 1839, an Englishman patented the principle of the pneumatic tire. Gasoline was developed soon after the Drake well in Titusville, Pennsylvania, began pumping oil in 1859. It took some years to discover its use for motor fuel. The first application for a patent on a gasoline motor to propel a road vehicle was filed in 1879. However, to the bicycle goes the credit for road improvement which prepared the way for the horseless carriage. The bicycle was a social vehicle and every town had its cycle club. On Sunday afternoons parties of cyclists pedaled miles into the country to enjoy the great outdoors. Rubber tires for bicycles and carriage wheels started the tire industry in a small way, by establishing plants that were in operation when the demand arrived for automobile tires. Cyclists wanted smooth tracks for their wheels and worked for the improvement of roads. The bicycle made highways more important to more people than ever before and a roadminded public welcomed the advent of the automobile.

Charles E. Duryea of Springfield, Massachusetts is credited with building the first American-made gasoline car that actually ran. He won the first automobile race held in this country on Thanksgiving Day, 1895, in Chicago. Many mechanics were tinkering with horseless carriages in backyard shops. One of these was Henry Ford, who awakened his neighbors on a rainy April night in 1893 as he drove his noisy, chugging gasoline buggy through the deserted streets of Detroit. Not until Ford acquired a special permit from the mayor was he allowed to drive freely about the city. The horse owners objected to the contraption which frightened their animals and caused accidents. At the time, Henry Ford claimed "the distinction of being the only licensed chauffeur in America."

It was March of 1898 before the first automobile was sold commercially, when a mechanical engineer from Carbon, Pennsylvania, bought a car from the Winton Motor Carriage Company in Cleveland. At that date only one automobile was completed, but three more cars were in production. These small beginnings at the dawn of the twentieth century marked the rise of the fastest-growing industry yet launched in the world. The rubber industry that furnished tires kept pace with the output of cars. Rubber put the nation on wheels, although rails and ships continued to share the responsibility of transportation.

INVENTORS IMPROVE RAIL AND WATER TRANSPORTATION

JOHN ERICSSON, though born in Sweden, is usually listed among American inventors because he lived in this country for so many years and rendered such outstanding services to the nation. Although he invented many improvements for railroads, he is best known for screw-propellers on steamboats.

Captain Ericsson's name is linked with the sea and ships. At the time that Ericsson was working to improve water transportation, Abraham Lincoln was trying his hand at inventing. He actually secured a patent in 1849 for an apparatus to float river vessels over sand bars and other obstructions. Steamboats on the inland rivers were Lincoln's concern, and ocean-going vessels were Ericsson's major interest.

The Yankees, who excelled in building wooden vessels, had developed the fastest sailing ships afloat – the tall, slender and graceful clippers. These speedy merchant vessels, the pride of the seas, pulled down the curtain on the golden age of the American merchant marine. Although the steamship was gaining in popularity, owners of shipping companies in the United States clung to the sturdy sailing ships that had made money for them. Seamen have an affection for sails and the challenge of wind and weather that is not easily transferred to a steam engine that turns a propeller. However, it was after the War Between the States, and the sea battle between Ericsson's *Monitor* and the iron-plated *Merrimac,* that the death bell was sounded for wooden vessels and yards of wind-filled canvas. Shipbuilding began to decline when manufacturing turned the nation's interest to railroading for inland transportation. Following the War Between the States, after a century of colorful Yankee traders, the United States veered away from the sea. American cargoes were carried in foreign ships more and more, although the diminishing merchant marine still bravely carried the Stars and Stripes into ports all over the world.

During the canal era inland transportation was by water wherever possible, since barge freight was cheaper than wagon freight. Towns and cities grew up along the navigable rivers, lakes, and the canals between them. Not until the coming of the railroads in the 1830's did settlements grow and prosper away from the rivers. The frontier moved westward with the railroads. Any country, though rich in soil, timber, and minerals, is practically worthless without transportation. Since the opening of new territory depended largely upon rails, inventions to improve railroading were welcomed. They came as the need arose for them.

As more and more freight was hauled and trains grew longer, brakes became more important. When a long train was suddenly halted, cars bumped one another so hard that, sometimes, cattle were knocked down and trampled and the shipment was ruined. A vital improvement for railroads had its origin in a wreck. George Westinghouse was riding on a passenger train enroute to Troy, New York, when his trip was delayed by a collision ahead. One freight had rammed another because the engineer of the second train had not been able to stop quickly

GEORGE WESTINGHOUSE – INVENTOR

At the age of 15, George Westinghouse was experimenting with his rotary steam engine. For this invention, he received his first patent.

Westinghouse Air Brake Company

enough to avoid an accident. In the early days of railroading, brakemen ran from car to car on top, turning hand wheels to set the brakes. This procedure took considerable time. Viewing the damage done to merchandise, scattered and broken by the impact, Westinghouse realized the need for a brake that could be operated readily by the engineer in the cab of the locomotive. Not long afterwards he invented one which worked by compressed air.

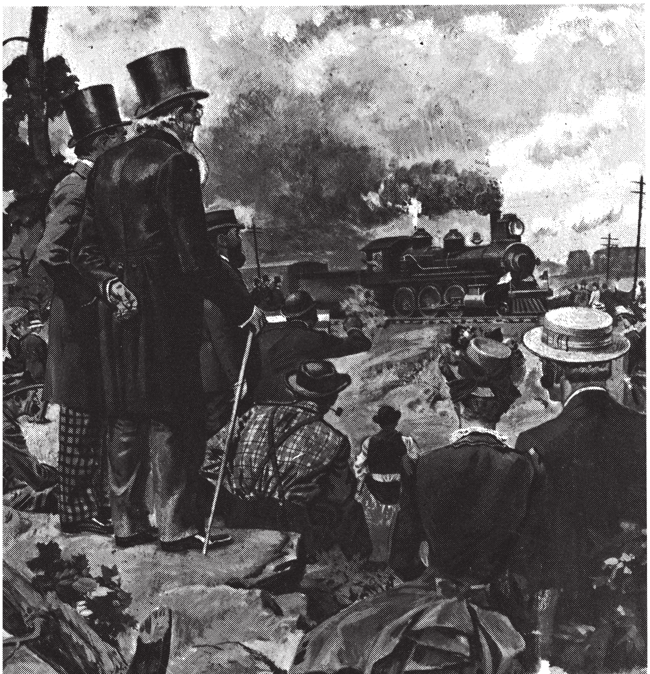
At first railroaders showed little interest in this invention. Finally, an alert superintendent of one line persuaded his directors to equip one train with the new air brake and test it. Westinghouse and the railroad officials boarded the train for the trial run between Steubenville, Ohio, and Pittsburgh, Pennsylvania. During the trip the engineer decided to gain some speed before he tested the brake. He waited for a straight stretch of road. Emerging from Grant's Hill tunnel at thirty miles an hour, he sighted a wagon crossing the track not far ahead. As the frightened driver lashed the team with a whip to clear the track quickly, the horses reared. With all his strength the engineer applied the brake. The train rolled to a full stop within four feet of the driver and a life was saved. Although the officials had skinned knees from the sudden bump, the air brake needed no further testing than this incident. A few months later, a group of far seeing railroad men met in Pittsburgh and organized a company to manufacture the safety device. They named the twenty-four year old inventor president of the Westinghouse Air Brake Company. Westinghouse patented his air brake in 1869.

CROWD AT BURLINGTON TRIALS – 1887 – BURLINGTON, IOWA

Although Westinghouse patented his air brake in 1869, all railroads did not accept it. So many inventors were working on brakes for trains that railroad officials held tests every few years. These races were exciting. People came for miles to check the time it took to stop a train at high speed after the brake was applied.

In the trials held in Burlington, Iowa the air brake won again. This invention, with improvements through the years, came into general use on railroads.

Westinghouse Air Brake Company



Railroading has traveled far since Peter Cooper's engine ran a race with a horse in 1830 and lost it. The following year the first mail was carried on a railroad train in South Carolina. In 1858 the first sleeping car, named Pullman after the inventor, added comfort to long journeys by rail. The cars were elegant with red plush seats, paneled wood, gleaming mirrors, linen damask, and silver-plated cuspidors.

An item of news in a Denver paper, dated June 18, 1870, mentions the first train to that city on the Great Plains:

> Nearly every tall building in Denver had someone on its roof yesterday looking at the inbound engine. It was first seen on Wednesday evening, June 15, from the roof of the First National Bank building by some officers of the road. Many in Denver have never seen an engine.

The Diesel engine, named for its German inventor, was developed by Alexander Winton, a Scotch immigrant, for use on ships. Winton first became famous as a builder of bicycles, then of the first automobile sold commercially. Later, Winton built Diesel electric-driven power plants for the United States Navy. The nation's first Diesel electric-powered streamlined train went into service between Denver and Chicago in 1934. Diesel engines have also been developed for trucks hauling freight. For mountain country some railroad operators prefer electric engines.

In a short time, the coal-burning steam locomotives, puffing smoke and cinders, lost out in competition with the powerful Diesels. The old work horses of the railroad era were driven from the tracks to the lonely pastures of museums as relics of the past.

THOMAS EDISON – INVENTIVE GENIUS

THE NAME OF Thomas Alva Edison, with more than a thousand patents to his credit, is linked inseparably with the electro-industrial progress of the push button age. When Edison was twelve, he was a newsboy on the Grand Trunk Railway running between Port Huron and Detroit. He became interested in telegraphy and secured his first employment as a telegraph operator at Port Huron when he was fifteen years old. He was soon experimenting during spare time in his office and invented his first successful telegraph instrument. He was discharged from the office in Louisville, Kentucky, when acid from one of his experiments dripped through the floor and ruined fine furniture in the private office of a bank official on the floor below. Edison landed in New York, penniless, in 1870. He walked the streets for three weeks before he found a job as a telegraph operator by repairing an instrument that no one else had been able to put in working order.

From New York he went to Menlo Park, New Jersey, where he established a laboratory and began work on varied inventions that came into his mind. By this time many men had discovered his genius and were willing to offer financial help. Edison foretold in 1878, the many uses that would be made of his inventions, such as:

> Letter writing and all kinds of dictation without the aid of a stenographer – Reproduction of music – Preservation of language by exact reproduction of the manner of pronunciation – The family record, a registry of sayings.

Being an expert telegrapher, himself, he invented devices to improve wire communications, including the telephone. In August of 1879 Edison attended a meeting of the American Association for the Advancement of Science in Saratoga, New York. The following report was published in the *Popular Science Monthly:*

> An exhibition of Edison's electro-chemical telephonic receiver was given before the Association in the Town Hall. Mr. Edison was present and he offered an explanation of his new instrument. Apparently it is simply a small box provided with a crank, and looking like a coffee mill . . . . The instrument exhibited was only an experimental model; nevertheless, it transmitted messages which were heard by the whole audience, numbering 1500 persons.

Henry Ford Museum, Edison Institute

CELEBRATING FIFTY YEARS OF ELECTRIC LIGHTING

Thomas Alva Edison and his assistant repeated their original experiment in the same setting on the fiftieth anniversary of the inventor's electric light.

At the time, Edison was trying to produce a steady light with electricity, and to do it so cheaply that it could compete with gas for illumination. After costly experiments using platinum for a filament, the inventor began the search for a cheaper material. He tried almost anything at hand, including cotton sewing thread. He sealed a piece of carbonized thread in a glass bulb, after pumping out the air, and turned on a current of electricity. A steady light glowed without a flicker. How long would it burn? Edison and a few of his assistants kept vigil for forty hours and the lamp was still burning. Edison increased the current to see what would happen. The light flared brighter and then suddenly blinked out at two o'clock on October 21, 1879.

Two weeks later Edison filed application for a patent on an electric lamp with a paper filament, carbonized pasteboard baked in an oven. The scientists were skeptical. The public was curious. A reporter from a New York paper went down to Menlo Park to see for himself. The inventor was always news because readers expected almost any startling device to follow the phonograph, the wonder of the day. Edison promptly invited the public to Menlo Park on New Year's Eve to watch the old year out in the glow of electric lights. The invitation was a scoop for the reporter who made the most of it by whetting the curiosity of his readers. On December 21, he wrote, teasingly:

> Edison's electric light, incredible as it may appear, is produced from a little piece of paper – a tiny strip of paper that a breath would blow away. Through this little strip of paper is passed an electric current. The result is a bright, beautiful light, like the mellow sunset of an Italian autumn.

The public did not wait until New Year's Eve. To accommodate the crowds, the railroad ran special trains from New York City to Menlo Park, where Edison staged a nightly demonstration of his lamps. On December 29, the reporter continued his story, describing the crowds:

> All came with one passion – the electric light and its maker. They are of all classes, these visitors, of different degrees of wealth and importance in the community and varying degrees of scientific ignorance . . . . In the office the lights were all electric. In the library upstairs it was the same. Such volleys of questions as were pouring out! The visitors have been around to see the

engine, the generators, the regulators . . . .
Satisfied about the electric light, they have asked about the tasimeter, the microphone, the phonograph and a dozen other things, as though they wanted to improve every instant before the train starts. At last they go in twos and threes down the hill to the railroad track, and it is all "wonderful! marvelous! wonderful! wonderful!" among them till the train takes them away and Menlo Park is left to itself.

New Year's Eve arrived. Snow was gently falling as trains pulled into the little depot. Eager guests hurried up the lighted lane to enter the buildings. Farmers came in wagons from the countryside and sightseeing parties arrived in carriages from nearby towns. Many guests were well-dressed. Edison wore his working clothes. The inventor was busy explaining how he regulated the supply of current at the central station, stopping now and then to inspect the apparatus. An electric motor pumped water and operated a sewing machine to the delight of the visitors.

NEW YEAR'S EVE PARTY AT MENLO PARK, NEW JERSEY

To greet the new year of 1880, Edison invited the public to his laboratories in Menlo Park to see an exhibition of electric lighting.

Henry Ford Museum, Edison Institute

Edison told his guests that electric motors would change the pattern of living in both the home and the mill. Edison had a keen sense of the value of publicity. In a dramatic way his New Year's party for 1880 announced to the public that the age of electric power was dawning. People came to see for themselves and were convinced by the "Wizard of Menlo Park."

Although water, steam, and gasoline operated machinery, electric energy was largely responsible for the age of power. Electricity helped to take the drudgery out of labor in this industrial nation and gave man more time to improve his education.

New inventions in printing increased the number of books, magazines, and newspapers. In 1825, at the age of fifteen, Richard M. Hoe went to work in his father's printing business in New York City. Printing with a flat-bed model in the press was too slow for him. He set type on a revolving cylinder to print with greater speed. Hoe's invention developed into the rotary or "lightning press," patented in 1846. The rotary press has made possible the printing of so many sheets of paper in a short time that the daily newspaper has become a necessity in American life. Books, also, could be printed at a price more people could afford to pay, and book shelves in homes, schools, and libraries added volumes for learning and pleasure.

New inventions create new industries and new markets. As factories grew in number and production of goods and services increased, more money was needed for investment and more workmen were needed to fill jobs. Emigrants came by the thousands from other countries to find employment and opportunity in the United States and other nations of the Americas.