iron forming the fuel. The original idea was to withdraw the metal when the carbon was sufficiently reduced. This, however, proved impracticable, except with exceedingly pure iron, although this process has been successfully carried on for many years in Sweden. The least trace of phosphorus impaired the quality of the steel very greatly, and eventually the system was adopted of blowing the metal to the complete exhaustion of the carbon and of then adding a weighed quantity of ferro-manganese or of spiegeleisen, which were practically cast irons containing a large portion of manganese and carbon. By varying the proportions of these materials added, steel of any required percentage of carbon could be produced. As the Bessemer process gradually came into use, it was seen that the manufacture of steel was revolutionized. It was introduced into this country, and Holley, newspaper reporter, mechanical engineer, and metallurgist, found it a fertile subject for his genius, and developed the mechanical features of the process by the introduction of the most perfect hydraulic machinery for operating it. The converter in which the metal is treated is now an egg-shaped vessel, mounted on trunnions, and of size to treat at once from one to fifteen tons of melted iron. Its bottom is full of holes for the blast. It is turned down on its side to receive the charge, the blast is turned on, and it is brought into an upright position for the blow. As the air passes through the melted iron contained in it, a vivid flame issues from its mouth, and the carbon and silicon are burned out of the iron. It is next turned down to receive the carbonizing charge of ferro-manganese or spiegeleisen, and the effect of any phosphorus present is partly overcome by the manganese thus added. The steel, which is as liquid as water under the intense heat, is poured into moulds, and by hammer and roll is worked into any desired shape. The old steel processes treated steel in units of a few pounds weight. The Bessemer process increased the units to many tons.

Something still was wanting; very pure iron had to be used, phosphorus being ruinous. In 1878, only seven years after the visit of the English metallurgists to America to examine the Danks puddling furnace, an announcement was made by a young man, Mr. Sidney Gilchrist Thomas, who stated that by the use of lime he had succeeded in reducing the phosphorus in the Bessemer steel process. After exhaustive experiments the following basic Bessemer process, as it is termed, was evolved, Thomas being associated in the work with his cousin Gilchrist. The Bessemer converter was lined with special bricks consisting largely of lime and of magnesia. After being heated up by a coke fire, a quantity of lime was thrown into the converter and was further heated.

The charge of iron was then introduced and the blow given with a period of some minutes of after-blow or of blast after the carbon was all gone. Spiegeleisen or ferro-manganese was added to give the carbon and the metal was poured. The effect of the after-blow in the presence of the basic material removed the phosphorus almost entirely and proved the greatest advance yet made in the Bessemer process. This brings us down to recent times. Incidentally it may be mentioned that the slag produced in this process is so rich in phosphoric acid that it is used to an enormous extent as a fertilizer.

In 1856 Sir William Siemens explained a steam engine of his invention to the Royal Institution, an invention representing ten years of experimental researches. It was an attempt to apply the regenerative system for saving heat. It was found to be without practical utility, because the high heat destroyed the machinery. A year later his brother Frederick suggested the employment of the system in a furnace. The hint was sufficient. Extensive experiments were at once begun and the Siemens regenerative furnace was the result. It was practically perfected about 1860, and Michael Faraday's last lecture in 1862 was devoted to it. In the Siemens furnace the fuel is burned in a gas producer. By the admission of insufficient air for complete combustion, a combustible gas, termed producer gas, is produced. The gas is admitted to the hearth of the furnace and burned there with heated air, the gas also being heated on the way to the furnace.

The essence of the Siemens invention lies in the way in which this heating is effected. The gas from the producer and the air for its combustion are caused to pass through chambers filled with intensely heated fire brick piled up loosely. The products of combustion before they leave the furnace pass through two other such chambers, thereby heating them. At short intervals, by the manipulation of valves, the course of the gas and of the air is changed, so that the products of combustion go through the chambers which have just been utilized for heating, thereby bringing them up again to a higher temperature, while the chambers already heated are used for the passage of the gas and air. By this process a sort of cumulative effect is produced. A most intense heat can be developed, and the economy effected is very large. Applications of the Siemens or open hearth furnace to making steel at once became obvious. By the Martin process, pig iron and wrought iron were melted together on the hearth, producing a steel of any desired percentage of carbon; by the Siemens process pig iron and iron oxide are used to produce steel on the open hearth, and in the Siemens-Martin process both methods are combined. The product of this operation is the famous open hearth steel.

The tendency of the present day is to produce open hearth and Bessemer steel of low carbon percentage, the metal from the chemist's standpoint being rather wrought iron than steel. It is produced in enormous quantities and the great ships and buildings of our days, the age of steel, are due to four great inventions of which three belong to the last half century. The hot blast for blast furnaces, invented in 1828 by James Neilson, doubled the output of the blast furnace without any extra fuel; in 1855 the Bessemer process was announced and the second of the inventions began to be applied; seven years later, or 1862, may be taken as giving the date of the third invention, the Siemens furnace; and the fourth invention, which we have placed in 1880, is the Gilchrist-Thomas or basic process of making steel from iron containing phosphorus. All other inventions in the metallurgy of iron and steel, ingenious as they were, practical as they were thought to be, with all their promise of great usefulness, sink into comparative obscurity when compared with these four epoch-making inventions which have so inconceivably modified our everyday life.

DISTINGUISHED INVENTORS.

Samuel Finley Breese Morse, the American artist, and the inventor of the electric telegraph, was the son of an American geographer; he was born at Charlestown, Mass., in 1791, and died in New York, April 2, 1872. In 1810 he graduated from Yale College, and in 1811 went to England with Washington Allston to study art under Benjamin West. In 1815 he returned to the United States, and in 1826 he was chosen as the first president of the National Academy of Design, which he was instrumental in founding. He was very fond of discussing electrical matters with his friend Prof. J. Freeman Dana; and while on a voyage from Havre to the United States in 1832, Morse conceived the idea of making not only an electric telegraph, but also an electro-magnetic and chemical recording telegraph, substantially as it now exists. Morse made some drawings on the steamer, which he afterward elaborated, but it was not until 1835 that he first exhibited a telegraph in operation, when he put a half mile of wire in coils around a room. In 1837 he filed a caveat in the Patent Office and also exhibited his new system in the University of New York. He asked Congress for aid to build a line from Baltimore to Washington, but nothing resulted. He went to England, where a patent was refused him. His French patent was worthless. It was not until March 4, 1843, that Congress finally granted $30,000 for his trial line. In 1844 the work was completed and Morse was able to show the practicability of his system of electro-magnetic telegraph. His patents were promptly infringed, and he was quickly engaged in an interminable succession of patent suits. At last these were decided in his favor, and he was able to reap the just reward from his great invention. Honors without number poured in upon him. Foreign nations vied with one another to give him medals or to confer decorations, and in 1858 the representatives of France, Russia, Sweden, Belgium, Holland, Austria and other countries met at Paris to decide on a collective testimonial, and $80,000 was voted to him. It is believed that he had the original idea of submarine telegraphy; he also made the first daguerreotype in the United States.

Elihu Thomson was born in Manchester, England, 1853, and at the age of five came to this country with his parents, who settled in Philadelphia, where he was educated, graduating from the Central High School in 1870. He experimented a great deal during his boyhood in electricity and chemistry, photography and similar subjects. Graduating at the age of seventeen, he spent six months as an analytical chemist in a laboratory, and was then appointed assistant professor of chemistry and physics in the high school, and was promoted to the chair of professor of chemistry and mechanics in 1876. He frequently lectured and continually experimented during this period, in the Artisans' Night Schools, Franklin Institute and elsewhere. He was associated with Prof. Edwin J. Houston in some patents relating to dynamos, and upon these and other inventions based the American Electric Company, since called the Thomson-Houston Electric Company, organized in 1880, and became chief electrician of the company. His invention of electric welding and brazing has been fully described in the columns of the SCIENTIFIC AMERICAN and SUPPLEMENT. His remarkable experiments in alternating current induction have done much to win for him an international renown. The air blast applied to switches and commutators for blowing away destructive arcs is a type of his practical way of reaching results. Like Edison, he holds a great number of patents.

Capt. John Ericsson was born in the province of Wermland, Sweden, in 1803, and died in New York in 1889. His father was a mining proprietor, so in his youth he had ample opportunities to watch the operation of machinery. He learned to draw, and entered the corps of Swedish engineers, and at twelve years of age was engaged in the construction of canals. He afterward entered the army and rose to be a captain at seventeen. During this time he made a small heat engine, which was the precursor of the hot air engine which he afterward successfully developed. His inventions in relation to locomotives were also important. Capt. Ericsson early began to make experiments on the screw propulsion of vessels, especially for war vessels, with the arrangement of the screw and all the machinery under the water line. He came to the United States in 1839, and in 1841 he became engaged with Commodore Stockton in building the United States frigate Princeton, said to be the first successful propeller war vessel with all its machinery under the water line. In 1833 he brought out the first practical hot air engine. He was also among the earliest constructors of steam fire engines. During the thirteen years that Capt. Ericsson lived in England he is said to have made forty new inventions. In 1828 he applied on the Victory the principle of condensing steam and returning the water to the boiler, and in 1832 he gave to the Corsair the centrifugal fan blowers, now generally used in American steam vessels. In 1830 he introduced the link motion for reversing steam engines on the locomotives King William and Adelaide, and in 1834 he superheated steam in an engine on the Regent's Canal Basin. Undoubtedly, the greatest of Capt. Ericsson's achievements was the building of the Monitor in 1861. This little iron gunboat, with revolving turrets, was so successful in the historic naval engagement at Hampton Roads in 1862 that it changed the whole course of naval construction throughout the world. Among his later inventions were torpedo boats and sun motors.

Elias Howe, the inventor of the sewing machine, was born at Spencer, Mass., in 1819, and died in Brooklyn, in 1867. He spent his time until 1835 on his father's farm and mill. He then went to Lowell and was employed in a manufactory of cotton machinery. He afterward worked in a machine shop in Boston. Here he developed his invention of the sewing machine. The first of his machines was made in May, 1845. He patented it September 10, 1846. After constructing four machines, he visited England in 1847, and remained there two years. From his return until 1854 he was involved in tedious lawsuits, but at last his rights were acknowledged and the former infringers paid him handsome royalties. He is said to have realized $2,000,000 from his invention.

Nikola Tesla was born at Smiljan, a small place on the Austrian border, and he is now 39 years of age. His education was received at Carlstadt in Croatia; he, too, showed the experimental bent and eventually entered the polytechnic school in Gratz, Austria. Here he studied engineering and devoted his spare time to studying electricity; on graduation he entered the engineering department of the telegraph at Buda-Pesth, and in 1881 took up the electric light and the construction of dynamo machines as his especial work. He is said to have been greatly impressed by the drawbacks incident to the employment of the commutator and collecting brushes on dynamos and motors. His efforts resulted in the production of an alternating system of power transmission, in which these drawbacks were done away with, and which is now universally introduced under the name of the "polyphase system." This work was presented in a lecture before the American Institute of Electrical Engineers, in May, 1888. But his recent work and that which has brought his name more prominently before the world than ever before has been with alternating currents. Employing a dynamo giving 20,000 alternations in a single second, he has produced what may be properly termed the most remarkable experimental results recently attained by electricity. With these alternations used in the production of the most beautiful lighting effects, he succeeded in showing or at least in indicating the possibility of producing light by means of a single or without any conductor whatever. Several striking features were brought out in his experiments in this line. He showed the nature of the brush discharge and demonstrated the necessity of excluding air and gas in general from induction coils and condensers. Many other effects of high frequency currents were pointed out, which have thrown novel light upon electrical phenomena. In recent years he has devoted his attention to the perfection of a method of lighting and other inventions, notably a method of conversion to currents of high frequency and the mechanical oscillators, which were first shown in an experimental lecture before the Scientific Congress at the World's Fair, Chicago, in August, 1893.

Alexander Graham Bell was born in Edinburgh, Scotland, March 3, 1847, being, therefore, almost the same age as Edison. He was educated at the Edinburgh High School and University. He came to the United States in 1872. His father and grandfather were both language teachers, and the young Bell's attention was directed to language by the course of studies prescribed by his father. The synthesis of artificial speech, by Helmholtz's method, is said to have early engaged his attention, and he resolved to pursue one of the outcomes of his studies, multiple telegraphy, to a practical conclusion. It has been said that all this time the idea of speech transmission was an undercurrent of thought with him, and he has testified that, before 1870, he avowed his belief that we would one day speak by telegraph. Going through all sorts of experiments, he succeeded in inventing the telephone. He lectured on it before the Society of Arts, in Boston, May 25, 1876, exhibited it at the Centennial in Philadelphia, and in August of the same year speech, it was said, was transmitted over a telegraph line. He has received numerous honors, and has written numbers of papers on his other scientific work, such as the photophone. He has also for years studied the subject of speech for the deaf and dumb. After the shooting of President Garfield, Mr. Bell and Mr. Sumner Tainter experimented with the Hughes induction balance to find the bullet in Mr. Garfield, but their attempts proved futile.

Hayward A. Harvey, the inventor of the Harveyized steel armor plate process, passed away August 29, 1893, at his home in Orange N. J. Hayward A. Harvey was born in Jamestown, N. Y., January 17, 1824. His father was General Harvey, the inventor of the gimlet pointed screw, the cam motion, and the toggle joint. Young Harvey entered the office of the New York Screw Company as draughtsman in 1844, he took charge of a wire mill at Somerville, N. J., in 1850, and in 1852 he became connected with the Harvey Steel and Iron Company, of which his father was president. In 1865 Mr. Harvey founded the Continental Screw Company, of Jersey City. The inventions of Mr. Harvey, up to this time, had nearly all been in the direction of automatic machinery; but he afterward devoted his energies to metallurgical processes, and in 1888 he took out his first patent on a process for treating steel. This invention has now made his name familiar all over the civilized world, and has added another word to our language. The new process is, briefly, a method of hardening steel on the surface, or carbonizing it, and raising steel of a low grade to a higher one. The first armor plate treated by the Harvey process was made in 1890. The Harvey Steel Company was organized in 1889, and works were established at Brill's Station, near Newark, on the Pennsylvania Railroad. Various improvements were introduced in the manufacture of armor plates, and to-day Harveyized steel armor plates stand without a rival. The many tests prove conclusively

SOME DISTINGUISHED INVENTORS OF THE LAST HALF CENTURY.

that Harveyized steel plates are the best in the world. The construction of battleships has been modified by the introduction of Harveyized armor, and the new process is being adopted by the principal manufacturers of Europe. Mr. Harvey, in the course of a long and eventful life, had 125 patents granted to him.

Samuel Colt, whose name will ever be identified with the production of the revolver, was born at Hartford, Conn., in 1814, and died there in 1862. In his fourteenth year he ran away from school and went to sea. While on his East India voyage he made a model in wood of a revolving pistol. This was the germ of the great invention. After his return from Calcutta, he studied chemistry in the dye house of his father, and afterward traveled extensively in the United States and Canada, giving lectures on chemistry. He thus gained the means necessary to prosecute his invention of the revolver. In 1835 he visited England and France, taking out patents, and on his return he took out his United States patents. He established a factory at Paterson for the manufacture of his arms. There was, however, little demand for the new weapon, and the company became insolvent. During the Mexican war, in 1847, the manufacture of the revolvers was resumed—first at Whitneyville, Conn., and finally at Hartford. This last establishment was built on a very large scale, and made not only revolvers, but machinery for constructing the same, cartridges, etc. Mr. Colt also invented a submarine battery for the defense of harbors, and also a method of insulating submarine cables. In 1843 he laid a cable from Coney and Fire Islands to the city of New York, which was operated with success.

George Henry Corliss was born at Easton, New York, in 1817, and died in Providence, R. I., in 1888. He attended school until he was fourteen, and then became a clerk in a cotton factory; later he spent three years in Castleton Academy, Vt., and finally opened a country store at Greenwich, N. Y. He early showed a leaning toward mechanical pursuits, and in 1844 he moved to Providence, R. I., where, in 1846, he began to make improvements in steam engines. He patented what is now universally known as the "Corliss" engine in 1849. These improvements have revolutionized the construction of the steam engine. By the new devices the governor was connected with the cut-off, preventing waste of steam, and insured uniform speed under the most varying loads. A company was formed in 1856, and they adopted the novel plan of taking the saving in fuel for a given time as their pay. The large Corliss engine was one of the wonders of the Centennial Exposition, and is still in use, driving one of the largest manufacturing plants in the country. Mr. Corliss received many honors and decorations, and amassed a large fortune. He made many other minor inventions.

Thomas Alva Edison was born at Milan, Ohio, in 1847. He began life as a train boy, soon advancing to a newsdealer with assistants. He studied telegraphy and obtained a position as operator at Port Huron. He soon became noted for his speed and accuracy, his messages being taken down in handwriting like copperplate. He soon began to invent, and in 1864 he moved to Memphis and had one of his inventions, an automatic repeater, put into service. He struggled along, inventing and working at his profession, until he went to Boston in 1868, where he was able to open a workshop for developing his inventions. Shortly afterward he was retained by the Western Union Telegraph Company, and started an electrical laboratory at Newark, where he employed 300 men. In 1876 he moved to Menlo Park, New Jersey, and in 1887 left Menlo Park and erected in Orange, New Jersey, what is supposed to be the largest experimental laboratory of its kind in the world. His inventions, which are numbered by hundreds, center largely on electricity, although one of the most wonderful of his achievements is the phonograph. They include inventions in duplex and quadruplex telegraphy, the carbon transmitter telephone, the incandescent lamp, the electric railroad, the electrophone, the motograph for accelerating speed in ocean cabling, the microtasimeter, the odoroscope, the megaphone, the phonoplex telegraph, the pyro-magnetic motor and generator, the magnetic bridge, the electric pen, dynamos and motors, the kinetograph, the magnetic ore separator, and last of all the fluoroscope and the new vacuum light. Taken all in all, the inventions, both from quantity and value, place Mr. Edison in the very front ranks of the inventors of all ages, and it is gratifying to note that he has reaped both honors and rich rewards for his discoveries.

Cyrus Hall McCormick, the inventor of the reaping machine, was born at Walnut Grove, Va., in 1809. He died in Chicago, in 1884. His education was obtained in the common schools; he also helped his father in farm work, and at the age of fifteen had constructed a cradle used in harvesting in the field. At the age of twenty-one he invented two new and valuable plows. As far back as 1816 his father made attempts to construct a reaper, but these attempts only ended in failure, but in 1831 young Cyrus proceeded on a new line, and succeeded in making a success of the new grain harvesting machine which was to bring him fame and fortune. He patented his reaper in 1834, and improvements on it in 1845-47 and in 1858. In 1847 he moved to Chicago, where he built a large plant. He received numerous awards for his invention, which also obtained for him a large fortune. He was elected a corresponding member of the French Academy of Sciences, "as having done more for the cause of agriculture than any other living man." It was estimated in 1859 that his invention saved the country at least $55,000,000 per annum. Of course, with the growth of improvement, this sum has been largely augmented.

AMERICAN SHIPBUILDING.

Though the history of American shipbuilding has been marked by many fluctuations, there had never been a time, from the colonial days of the seventeenth century down to the sudden decline of the middle of the nineteenth century, when it had not been in a more or less healthy condition. The records show that fifty years ago we had entered upon the last and most brilliant era of shipbuilding which the country has ever seen. In the three years, 1843 to 1846, the total yearly tonnage built in the United States had risen from 63,888 to 108,203 tons. In 1850, 279,255 tons were built, and in 1855 the total rose to 583,450 tons. So rapid was the growth that by the year 1860 there was a total of 5,353,868 tons in the merchant marine, 2,379,396 tons of which were engaged in the foreign trade. At this time the total tonnage of the British empire was only slightly greater—5,710,968 tons.

It was inevitable that an enterprising country, with a 3,000 mile Atlantic seaboard flanked by great forests of timber that was excellently adapted to shipbuilding, should create a powerful merchant fleet; and the rapid decline which took place at this time is primarily to be ascribed, not to any decadence of the maritime spirit, but to the substitution of iron for wood in the construction of ships; though the collapse was undoubtedly hastened by the outbreak and course of the civil war.

As long as wood was the material of construction the American shipwright more than held his own against the world; but the change from wood to iron came a little too early for the undeveloped condition of the mineral resources of the United States, and we suffered accordingly. In 1855 there were built 381 ships and barks and 126 brigs; in 1870, only 73 ships and barks and 27 brigs; in 1880, but 23 ships and barks and 2 brigs; and in 1895, 1 ship. Of steam vessels we built in 1846 some 46,359 tons; 147,499 tons in 1864, and 69,753 tons in 1895. The above figures, it is true, do not include schooners and sloops, nor the large fleet of canal boats and barges, of which there were 445 built in 1895, with a total tonnage of about 41,000 tons.

In addition to the two causes of decline above mentioned, it must be remembered that the past thirty years has been a period of unparalleled agricultural, mining and manufacturing activity. If the nation has neglected its merchant marine, it has been largely for the reason that it was fully occupied with the development of the internal resources of the country. The discovery of the gold fields of California; the rapid extension of the railroads, and the opening up of the unoccupied farming lands of the West; the development of the mineral wealth of the country, and the rapid growth of the iron industries, have proved a strong counter attraction that has temporarily weaned the heart of the nation away from its old-time love of the sea. Now that the tide of emigration has touched the remotest bounds of the country, and the extent of its resources has been well ascertained, we may look for something of a reaction in the direction of maritime enterprise—indeed, the reaction has already begun.

The teachings of history regarding the relation of the navy to the merchant marine have frequently shown how intimately the interests of the two are associated. A large merchant fleet requires a strong navy for its protection, and a strong navy can never exist without a large merchant marine, from which, in the sudden emergency of war, it can recruit its seamen.

We think that, when the history of American shipbuilding comes to be written, it will be agreed that two of its red letter days occurred on July 23 and 26, 1883, when the celebrated firm of John Roach & Sons, of Chester, Pa., signed the contract for the construction of the Atlanta, the Boston and the Chicago, and the Dolphin, ships which were to prove the forerunners of a completely new and up-to-date navy. The policy which was thus commenced has encouraged our shipbuilders and engineering firms to lay down extensive and costly modern plants, suitable for the building of the most approved modern ships and engines. So utterly stagnant was the shipbuilding industry that it needed some powerful stimulant to arouse it. The prospect of securing contracts for warships, as they shall from time to time be built, has not only encouraged the existing yards to enlarge their plants, but has called others into existence; until to-day we have several firms which are qualified to undertake the construction of the largest merchant steamers, and, as the performance of the St. Paul and St. Louis has clearly shown, to rival the best work of the European builders.

The last census showed that there were in all 1,000 shipbuilding plants in the United States, though, of course, many of these are comparatively insignificant. The important yards are located on the seaboard and on the great lakes, the latter locality having witnessed of late years the growth of a really magnificent steam fleet.

The history of the Pacific fleet dates from the year 1849, when the Union Iron Works had its beginning in a small forge at San Francisco. In 1865 the name of the firm was changed to Prescott Scott & Company, and in 1885, when the fine yard in South San Francisco was opened, the firm became known as the Union Iron Works. This new yard and works is one of the most complete of its kind in the world. The buildings, which are of brick, cover an area of four acres, the total area of the covered works being nine acres. One of the most notable features is the hydraulic dry dock, with an area of 30,450 square feet, which we hope to illustrate in a later issue. The works are underlaid throughout with hydraulic mains, which supply the various lifting, forging, shearing and riveting machines. The Union Iron Works give employment to 1,500 men, and they have turned out some of the most successful ships of the new navy, including the Charleston, San Francisco, Monterey, Olympia and Oregon, in addition to many fine ships for the merchant service. To this firm, aided by the various smaller yards scattered along the coast, must be given the credit of a fleet on the Pacific Ocean which comprises some 1,520 American vessels, aggregating 456,359 tons.

Coming across to the Atlantic seaboard, we should take note in passing of the Iowa Iron Works, Dubuque, Iowa, where the steel torpedo boat Ericsson, of 120 tons and 24 knots speed, was built. There is a world of suggestiveness in the fact that this destructive little craft was built and engined thousands of miles up the Mississippi, and dispatched to the Atlantic by way of New Orleans.

Turning northward to the great lakes, we find that American shipbuilding has advanced by leaps and bounds, and that here, in its inland seas, it has to record a growth of which it may justly be proud. In 1895 our lake shipping comprised 3,342 vessels, with a total tonnage of 1,241,459 tons, two-thirds of this tonnage consisting of steam vessels. The Commissioner of Navigation estimates that the carrying power of this fleet is 2,666,261 tons, in which case our merchant fleet on the lakes alone is larger than that of France, and second only to England and Germany. It only requires a full-sized ship canal to enable the splendid shipyards that fringe the lakes to lend their aid to building up a deep sea fleet that shall be second to none in the world.

Passing on to the New England coast, renowned for its famous yards in the days of the wooden sailing ships, we find a compact and very complete plant at the Bath Iron Works, Bath, Maine. It covers a large area on the banks of the Kennebec River, twelve miles from its mouth. Several vessels for the new navy, including the ram Katahdin, have been launched from its slips. City Point Works, Boston, Mass., and the Herreshoff Manufacturing Company, of Bristol, R. I., have contributed to the list of our merchant and naval fleets, and the latter firm have immortalized themselves in the international yachting world by the production of such craft as Vigilant and Defender. Mention must be made also of the Columbian Iron Works, Baltimore, Md., N. F. Palmer & Company, of Chester, Pa., of Harlan & Hollingsworth, of Wilmington, Del., and many other yards that are contributing to our increasing fleet of deep sea and river craft.

One of the clearest evidences of the faith of American capitalists in the revival of our maritime interests is to be found in the extensive and costly plant of the Newport News Shipbuilding and Dry Dock Company. This concern, like the town from which it is named, has been built up within a very few years. Its extensive shops, dry docks, and building ways have been carefully laid out after a thorough inspection of the great shipbuilding yards of the world. It has turned out some fine ships for the merchant service, and taken an active share in the construction of the new navy, the gunboats Wilmington, Nashville and Helena, which have been constructed in this yard, being just about to be turned over to the government. Here also are being built the Kentucky and Kearsarge, first-class battleships of 11,525 tons, an illustration of which, as they will appear when completed, will be found on another page.

The plant comprises sixteen buildings, which include four shops 100 by 300 feet, and a blacksmith's shop 120 by 208 feet in size. There are four piers ranging from 60 by 350 feet to 60 by 900 feet in size. The plant includes eight ship ways from 400 to 500 feet long, and an outfitting basin 500 feet by 900 feet. There is also a dry dock 600 feet long, with a depth of 25 feet over the sill. Over 3,000 men find employment in the various departments.

There is no shipbuilding concern in America that has contributed so largely to the upbuilding of our modern navy and the merchant marine as the William Cramp & Sons Ship and Engine Building Company, of Philadelphia, Pa. The foundation of this justly famous concern dates from the year 1830, when Mr. William Cramp, then a young man of 23 years, opened a small shipyard at the foot of Otis Street, Philadelphia. That was the age of wood and canvas, and for forty years William Cramp continued to build sailing ships for home and foreign service. In 1871-72 the es-