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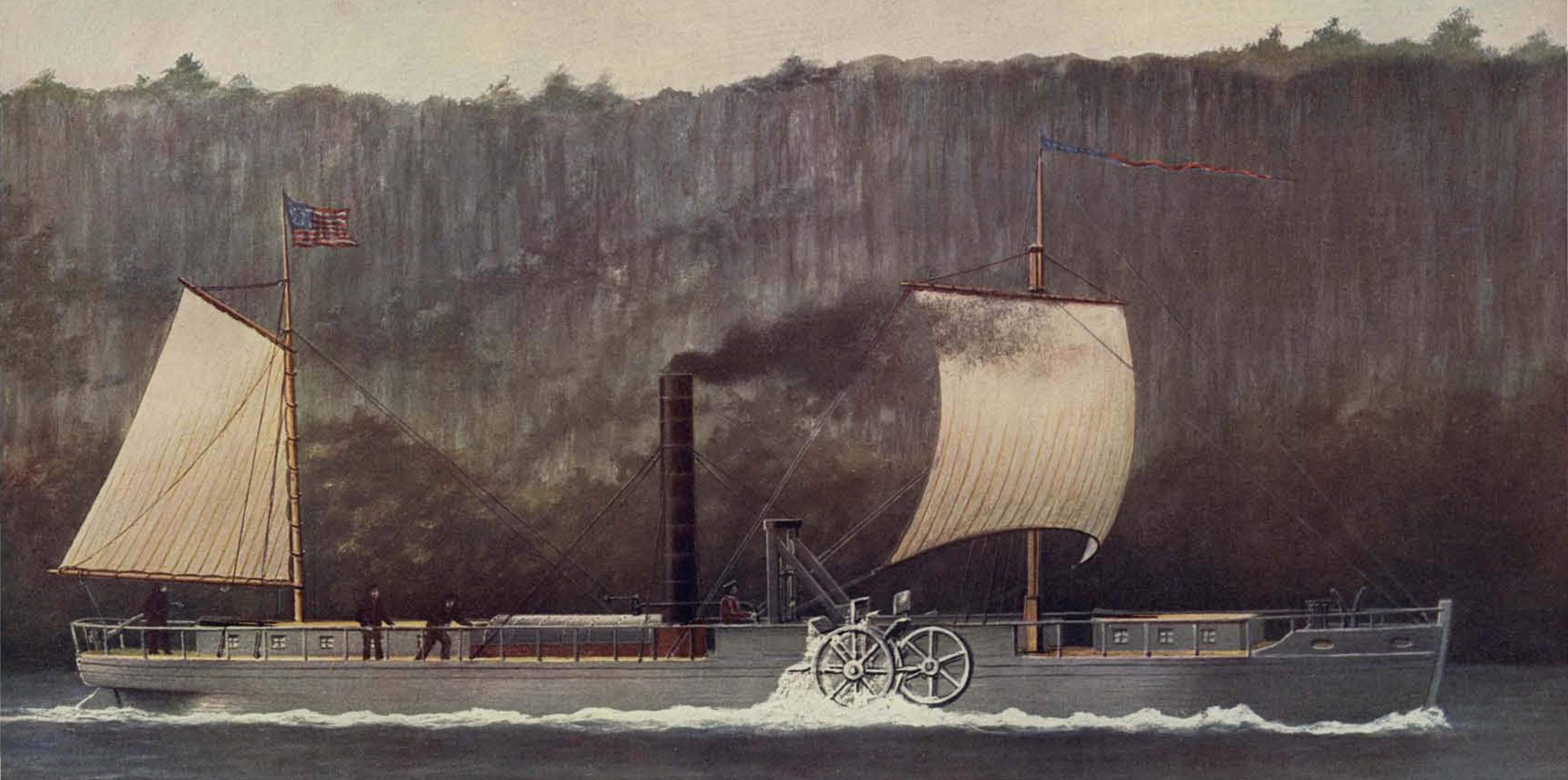

FIRST TRIP OF THE "CLERMONT"

HUDSON-FULTON CELEBRATION

SEPT. 25TH, 1909
VOL. CI. NO. 13

MUNN AND COMPANY, PUBLISHERS
361 BROADWAY, NEW YORK

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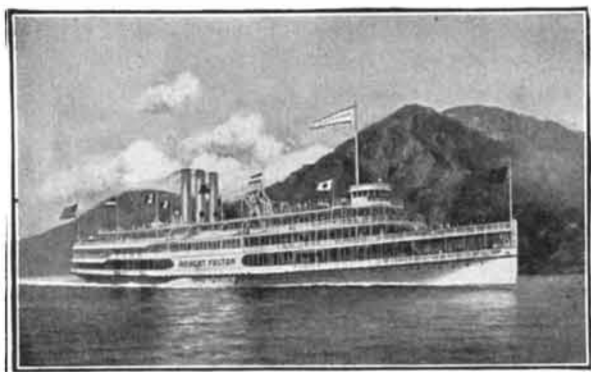

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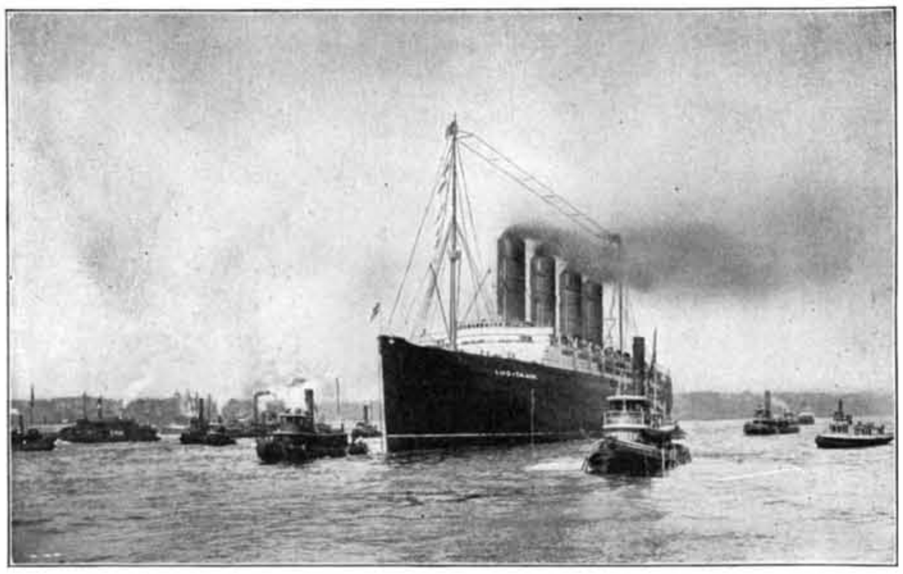

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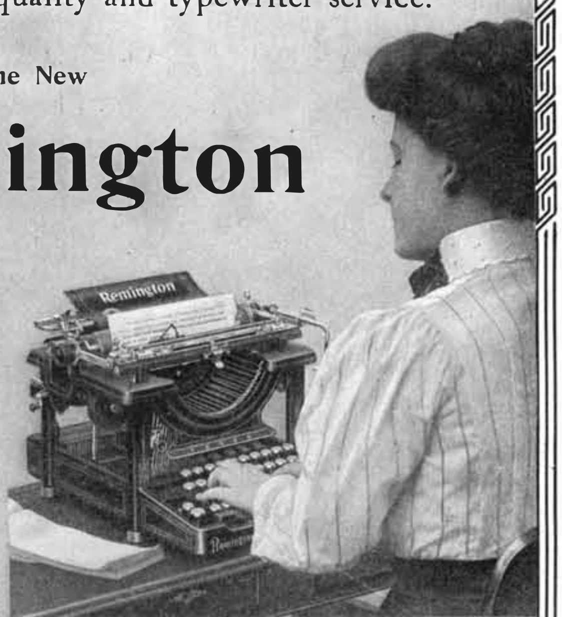

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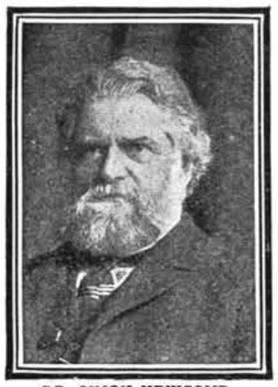
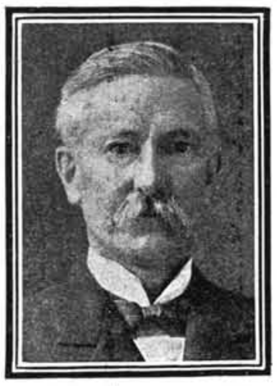

DR. SIMON NEWCOMB. (Department of Astronomy.)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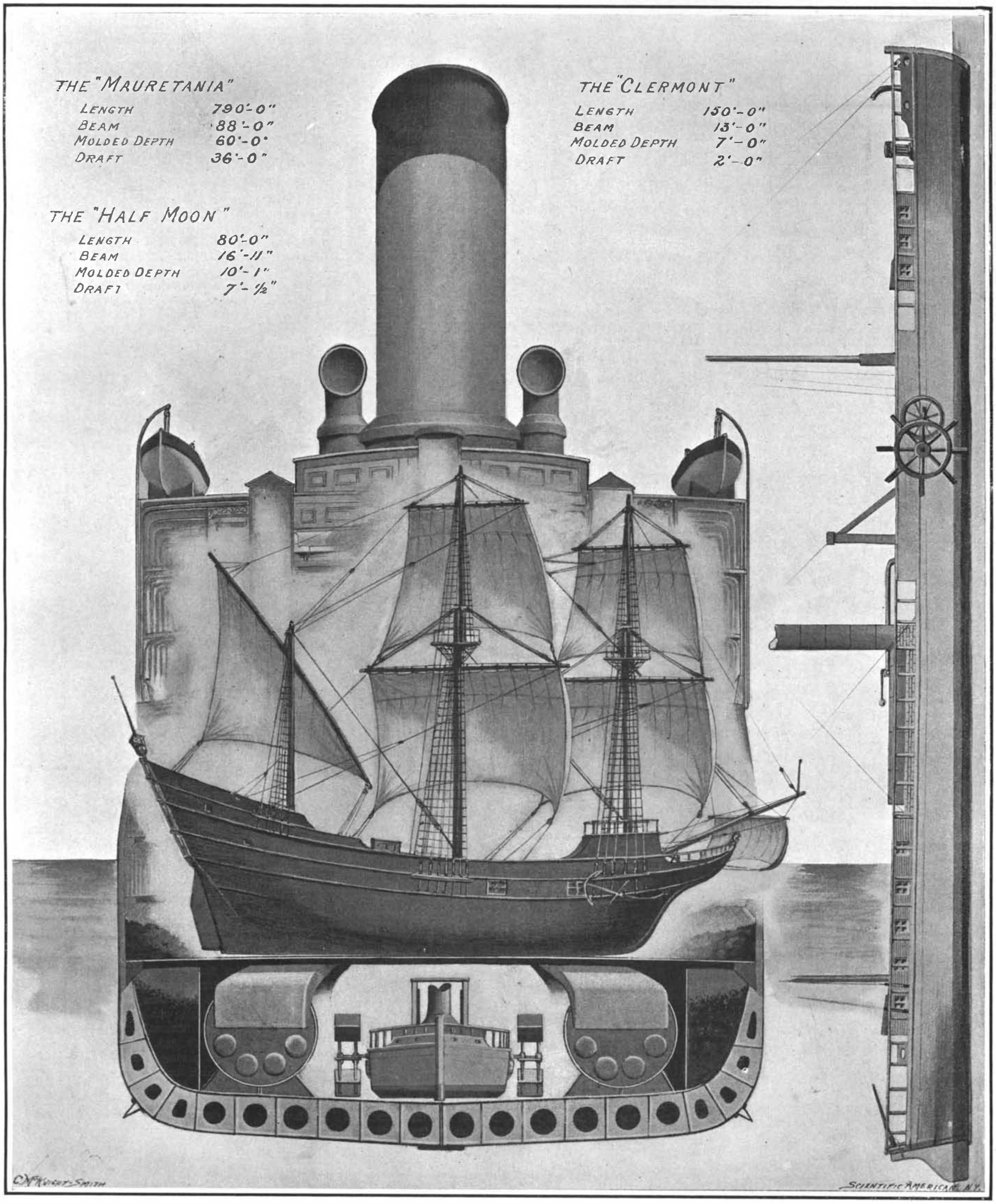
Vol. CI.–No. 13. ESTABLISHED 1845. | NEW YORK, SEPTEMBER 25, 1909. | [10 CENTS A COPY $3.00 A YEAR.



The "Half Moon" of 1609 under favorable circumstances could sail, probably, about 6 knots an hour. The "Clermont" of 1807 made 4¼ knots. The "Mauretania" has crossed the Atlantic in 1909 at an average speed of 26 knots. The "Mauretania" could accommodate five "Clermonts" placed end to end on her boiler and engine room floor; and the "Half Moon" could be placed athwartship on the deck above, with her hull and masts entirely within the ship's structure.

THREE CENTURIES OF NAVIGATION—1609 TO 1909.

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NEW YORK, SATURDAY, SEPTEMBER 25th, 1909.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

THE "WASH" OF AN AEROPLANE.

Those of our readers who have sat in a racing shell, or stood at the wheel of a racing yacht, will remember how troublesome is the "wake" of a competitor, whether it takes the form of the wash of his sculls, or of the disturbance of the air as it sweeps from the leach of the mainsail of a weatherly yacht that is eating out to windward some distance ahead. In the case of two racing yachts that are thrashing it out on the same tack in a struggle to windward, there is a certain relative position of the two, in which the disturbance of the air, caused by its passage over the sails of the leading yacht, will prove exceedingly troublesome to the second boat, especially if she be but a few lengths astern and sailing close to the wake of the other. When this occurs, there is nothing for it but to put about on the other tack, and so get clear of the interference.

With the rapid development of mechanical flight, the remarkable extent of which was shown so clearly in the recent brilliant performances at Rheims, it has become evident that the "wash," or interference, which is inconvenient to a sailing yacht, may become positively disastrous to that yacht of the air, the aeroplane. It was not until the Rheims contests that an opportunity was presented to determine the effect of one aeroplane upon another, when, in meeting or overtaking, they passed in rather close proximity. It is quite possible that the question of interference had never occurred to the aviators at Rheims, but it is certainly a surprising fact that the existence of such interference, and its evidently serious character as shown when several machines were in the air at once, should not have excited more attention, both at the time and in subsequent expert discussions of the Rheims contests.

When such a large body as an aeroplane, spreading several hundred square feet of surface, and weighing from a quarter to half a ton, is driven at fifty miles an hour by propellers that are revolving at from 1,000 to 1,200 revolutions per minute, it is certain to leave in its wake a complicated series of aerial cross currents, whirlpools, and vortices. Now, judging from the description of eyewitnesses of the Rheims races, the behavior of the aeroplanes, when they swept into rather close proximity to one another, indicates that these artificially-created wind storms were present, and that they seriously affected the equilibrium of any aeroplane that came within their influence. The "wash" from propellers, driven, as in the case of Blériot's monoplane, by an 80-horse-power engine, and the air waves set up by the passage of his planes must be very serious indeed; certainly the air will not regain its equilibrium until long after the machine has swept by.

Two notable instances of this interference occurred when several aeroplanes were in the air together. During one race, when Farman was rapidly overhauling opponents who were flying at the same level, he encountered the "wash" of the machines and his own aeroplane was thrown into rather violent oscillation. Before he could pass, it was necessary to make a wide detour to the right or left, or swing up to a higher level into undisturbed air. On another occasion when Latham, flying high, overtook a competitor who was traveling at a lower level it was noticed that his own aeroplane made a sudden dive, as though drawn downward by the suction of the machine below him.

We attach no little importance to a question which must become increasingly serious as the number of flying machines is multiplied, and the favorite lines of travel become populous with these mechanical birds of the air. "Leeway," as the sailors call it, will become even more necessary to the air yacht than it is now to the sailing yacht. Woe to the aviator who, flying low with scant clearance between himself and the ground, is overtaken by some aeronautical scorcher, who sweeps up from behind, and with the characteristic snort of triumph whirls onward, giving him his aerial dust. Happy for him if he recover his rudely-disturbed equilibrium at the expense of a broken wing and not of a broken neck. Perhaps after all we have been a little too "previous" in felicitating ourselves upon the unlimited room that will be afforded for flight through the air; evidently the clearance demanded by our sixty-mile-an-hour aeroplane must be measured by something far wider than the stretch from tip to tip of the planes, or the length from head to tail.

THE RETURN OF HALLEY'S COMET.

The announcement by Prof. Max Wolf that he has discovered Halley's comet will be received with interest and with surprise by every astronomer throughout the world—with interest, because not a little credit redounds to the Heidelberg astronomer, when it is considered how much this honor has been coveted; and with surprise, because the historic comet has made its appearance nearly four months before it was expected.

Halley's comet is unique because it was the first celestial body of its kind which was mathematically subjugated to the law of gravitation, and because its history is to a large extent the history of astronomy. In 1682 a comet was observed by Newton, Halley, and others. On examining the circumstances of its motion, Edmund Halley, who was Newton's intimate friend, and who did perhaps more than any other astronomer of his day to popularize the idea of gravitation, computed its orbit on the supposition that it was parabolic. Comparing his results with the observations of previous comets, for which purpose it was necessary to calculate their orbits from the necessarily imperfect measurements of earlier times, he found that in 1531 and 1607 comets had appeared which followed so nearly the same path that he ventured to assert its identity with them, and to predict its return within a period of about 75 years. Knowing that he would not live to witness the event, because of his advanced age, he left a plea for recognition which reads: "Wherefore, if it should return according to our predictions about the year 1758, impartial posterity will not refuse to acknowledge that this was first discovered by an Englishman."

In the year 1758 the French astronomer Clairaut took up the task of computing the perturbations which the comet would probably have experienced since its last appearance, because of the influence of the two great planets, Jupiter and Saturn. An extremely laborious calculation showed that the comet would have been retarded about 100 days by Saturn and about 518 days by Jupiter; and accordingly he announced to the Academy of Sciences near the end of the year 1758, that the comet might be expected to pass its perihelion about April 13th of the following year, and that owing to various defects in this calculation, there might be an error of a month either way. The comet was actually discovered by an amateur, George Palitzsch, on Christmas day, 1758, thereby justifying Halley's brilliant conjecture, adding a new member to the solar system, and raising the hope (to be later amply fulfilled) that in other cases also the motions of comets might be reduced to rule. Thus at one fell stroke the dreadful divinity that once hedged a comet, the badge of pestilence, of war, and of death, was swept aside for all time.

Since Clairaut's day Halley's comet has been made the subject of much mathematical inquiry. The French astronomer Pontécoulant carried the calculation of the perturbations back to 1531, and recently Messrs. Cowell and Crommelin of Greenwich have traced the comet back beyond the Christian era. The result of these computations has been to prove that Halley's comet undoubtedly appeared in 1066, and was promptly regarded by William the Conqueror as an omen of victory for his English invasion, and that it is the same which is depicted on the Bayeux tapestry. In 1378 and 1456 it appeared again. Constantinople was besieged by the Turks in 1456, and the comet was regarded by the Mohammedans as a favorable sign because of the crescent-shaped tail. Christendom was so alarmed at the simultaneous apparition of the Turk and the comet that a Papal Bull was promulgated against both. In a measure, therefore, the history of Halley's comet is the history of civilization.

The problem of predicting the return of such a body as Halley's comet is one of considerable difficulty. If the sun and comet alone existed in space, the path of the comet could be determined easily. There are also planets to be considered, and these have a marked perturbing effect.

So variable are the features of the comet, that in all the recorded instances of its return the descriptions never quite tally. In 1066 it created universal dread throughout Europe. In 1145, according to the Chinese, it had a tail 10 degrees long. In 1222 it is spoken of as a fine star of the first magnitude with a large tail. In 1456 it occupied a space nearly 70 degrees in length, and spread terror throughout Europe during the month in which it was visible. On the other hand, in 1531 and 1607 it does not appear to have been so conspicuous, for its tail was only 7 degrees long. In 1682 the comet attracted little attention except among astronomers, the tail being 12 to 16 degrees long. This apparent waning of the comet led to the fear that in 1758, the year of its first predicted return, it might be so faint as not to be visible at all. In truth, the tail was not visible until after perihelion, and was then inconspicuous because at its brightest it was seen against bright twilight. In 1835 the comet was visible to the naked eye during the whole of October, and its tail varied from 20 to 30 degrees in length. So marked have been the fluctuations, that there is some question whether the comet will be as magnificent in 1910 as it was in 1546, or whether it will be as insignificant as it was in 1607.

Halley's comet never reappears with clock-like regularity. The change in period from one revolution to the next in some cases has amounted to more than two years. The longest revolution so far recorded was that from 1222 to 1301—79 years and 2 months. The shortest round is the one now being accomplished in a little less than 75 years and 5.5 months. This extreme range of over four years in the orbital period renders necessary the most careful and laborious calculation of the effect of the attraction of all the planets upon the comet. It is indeed marvelous that mathematicians have come so near to predicting the exact date of perihelion at previous appearances. The best calculation hitherto made was that of Pontécoulant, who was only two days out of the way, an achievement which is not likely to be outdone by mathematicians of our time. In 1864 Pontécoulant published the results of his calculation of the present return, and placed it early in May, 1910, a result with which the observations of Cowell and Crommelin agree. Their reservation that possibly the comet may be at perihelion a few weeks sooner is amply justified by Wolf's early discovery. At present the comet is about 250,000,000 miles away from the earth. At the beginning of November its distance should be not more than 165,000,000 miles.

It is certain that if May 10, 1910, is the date of perihelion the comet will be disappointingly near the sun, so that the solar glare will rob it of its principal glories.

THE SELDEN PATENT CASE.

The decision which has been handed down in the United States Circuit Court upholding the Selden patent will be received with mingled surprise and disappointment. We are probably safe in stating that few patent lawyers ever believed in the validity of the patent. If the defendants carry out their intention of appealing, it is not impossible that the decision will be reversed.

The Selden patent was granted on November 5th, 1895, to George B. Selden. Originally filed on May 8th, 1879, its final allowance was postponed until the birth of the automobile industry by delaying the filing of amendments. The chief claim in issue was "the combination with a road locomotive, provided with suitable running gear, including a propelling wheel and steering mechanism, of a liquid hydrocarbon gas engine of the compression type, comprising one or more cylinders, with suitable fuel receptacle, a power shaft connected with and arranged to run faster than the propelling wheel, an intermediate clutch or disconnecting device, and a suitable carriage body adapted to the conveyance of persons or goods, substantially as described." In other words, George Selden claimed all of the essential features of a modern automobile. Every one of the features embodied in this claim was individually old. If they were patentable in combination as a road carriage, was a new result produced? We doubt it. The internal-combustion motor was known before Selden's day. So were power shafts connected with and arranged to run faster than the shafts or wheels which they propelled. So were intermediate clutches or disconnecting devices between shafts running at different speeds.

Thus far, the patent has consumed nine years of litigation, almost half a million dollars, and 60,000 folios of testimony to provide material upon which to base a disappointing decision. The Selden patent expires on November 5th, 1912. It may be doubted whether its validity will be finally settled before it expires, if an appeal is taken.

That the patent was ever respected by the automobile industry is due largely to the fact that it was cheaper to pay the slight royalty demanded by its owners than to contest its validity.

ENGINEERING.

It seems that unless the new cyanamide industry should create a big demand there is a possibility of an overproduction of calcium carbide. It is estimated that the yearly demand is 192,000 tons. According to Mr. Pitaval, the French output last year was 26,000 tons as against a maximum capacity of 50,000 tons. He estimated that the carbide factories of the world have an aggregate of 367,000 horse-power.

According to official Canadian railway statistics for the year 1907, the United States has a population of 381 for each mile of railway, and Canada 289. France has 1,590 for each mile of railway, and the United Kingdom 1,821. In India there are 10,119 people for each mile of railroad. In the United States there are 13.61 square miles of territory for each mile of railway; in Canada 161.8 square miles; in the United Kingdom 5.29 square miles, and in France 8.46 square miles for each mile of railway.

The proposed Forth and Clyde Canal has been criticised in the House of Commons on the ground that its cost of $20,000,000 will be out of all proportion to its subsequent value. Admiral Campbell is reply lays emphasis upon its great strategic value as affording a quick means of transit of warships from the North Sea to the Atlantic, and *vice versa*. In view of the recent construction of a powerful naval base on the Firth of Forth the importance of such a canal outside of its commercial value has been greatly increased.

In view of his classic experiments of twenty years ago and his construction of a gigantic aeroplane, the announcement that Sir Hiram Maxim has built a new biplane cannot fail to arouse much interest in the world of aeronautics. The most valuable feature of his work was the determination of the best form of propeller by means of a whirling arm. Outside of the fact that his new motor (which, together with the rest of the machine, has been built by Messrs. Vickers, Sons & Maxim) is extremely light in proportion to its power, no particulars regarding the machine have been made public.

The proposed method of driving ships by the combination of steam turbine and motors, which at first was received rather coldly, is now beginning to receive the attention to which we consider it to be well entitled. In a recent discussion of the subject in Cassier's Magazine, the advantages of the system for cargo boats are stated as follows: More cargo can be carried; coal consumption is less; there is greater propeller efficiency in rough weather and less propeller racing; and the vessel is not totally disabled if the rudder or a propeller shaft is disabled. The disadvantages are that the first cost of the ship is greater and that a more skillful staff is required.

At the recent meeting of the British Association for the Advancement of Science at Winnipeg, interesting papers were read by Sir John Thornycroft on "Hydroplanes or Skimmers"; by Mr. C. B. Smith on "The City Hydro-Electric Plant" of Winnipeg; by Lieut.-Col. W. P. Anderson, Chief Engineer of the Department of Marine, on "Improvements in the Navigation of the St. Lawrence"; and by Col. G. W. Goethals, chief engineer and chairman of the Isthmian Canal Commission, on "Engineering and Construction Features of the Panama Canal." The latter was considered the most important paper, and will appear in full in the Association's Proceedings, only one paper in each section so appearing.

Two of the largest lighters afloat have recently been launched by Messrs. Rennie of Greenwich, England. They are entirely constructed of steel, 112 feet long, 30 feet beam, and 11 feet 9 inches deep, with a draft when lifting 500 tons of 10 feet. They are divided for 66 feet of their length by a well, on either side of which are six separate water-tight compartments, any or all of which can be quickly flooded for balancing, while they may be expeditiously cleared by a powerful steam pump. The quarters for captain and crew are forward, and boiler and engine room aft. The lighters have been built to the order of the Mersey Dock and Harbor Board, and are intended primarily for raising sunken vessels and similar objects.

The Metropolitan District Railway of London and its associated underground lines are subjected to a destructive wear of the rails which was not present in the days of steam operation. One form of this wear is known as "battering," which results in hollows that develop at distances of from two to three feet apart. It is generally found on the inner rail on curves. Corrugation is a well-known phenomenon on electric roads and constitutes one of the most puzzling features of rail wear under electric traction. This trouble is no doubt largely due to the fact that part of the weight of the motors is carried directly on the axles without the intervention of springs and that the center of gravity of the motor car is much lower than that of the steam locomotive. A partial remedy has been found in the use of high silicon rails, which show an increased life of about 30 per cent over rails of the standard composition.

ELECTRICITY.

An electrolytic process for the production of bleaching solution is used by the Amazon Knitting Mills of Muskegon, Mich., by which the cost of bleaching is said to be less and the results obtained much more uniform.

Japan is falling in with the general movement for the electrification of railways, and the Hachioji-Kafu line of the Japanese middle district railway is to be electrified. Fifteen motor cars have already been ordered from the Osaka Railway Carriage Company.

The Canadian Department of the Interior has recently been estimating the available water power of Dominion streams, and concludes that there is over twenty-six million horse-power in accessible localities, of which only half a million has been hitherto developed. The largest power is on the Hamilton River in Labrador where 9,000,000 horse-power is available, the Canadian part of Niagara Falls coming second.

The Electrical World has an interesting discussion of Prof. Marks's article on the price of electric service. It is pointed out that on account of the difficulty of cheaply storing electrical energy the consumption of any individual user is as important a factor in the cost of serving him as the operating cost, and that it is therefore reasonable for some sort of standing charge based on his estimated or measured demand to be made in addition to a service charge based on operating cost.

Machinery aggregating 10,000 horse-power and other equipment to the total value of $400,000 is now on its way to Dawson City, where Klondike mining operations are expected to be facilitated by the provision of electric power. An English company has taken over the present power station, the only coal mine in the district and the local telephone system. Water power is available for part of the year, but is complicated by floods at one season and drought at another. The present power plant uses wood fuel largely, the local supply of which is becoming exhausted, and considerable economies are expected from use of coal screenings hitherto wasted at the new company's power house, which will be erected at their mine.

The city of Glasgow, Scotland, whose record for an efficient and economical municipal tramway system is well known, has also a remarkably well-conducted electric light and power supply department, according to figures recently received for the past year's working. In spite of a decrease in income of $38,000, due to reduced charges for current, increasing use of economical metallic filament lamp, and general trade depression, an actual increase in available profit balance of $14,000 has been made. The aggregate horse-power sold is 29,500, an increase of 6,000 over the previous year, and 1,232 new consumers have been added. Eighteen million units out of thirty-three sold were for power purposes bringing in on the average 1½ cents per unit.

The experiments, which we described about a year ago, with apparatus for the destruction of harmful moths by means of a combination of electric light and a suction blower, have been repeated with great success at Zittau, in Germany. The beam from a searchlight mounted on the roof of the municipal electric plant is played upon the forest several miles distant and the moths come fluttering up the beam in swarms to where the intake of a powerful suction blower is concealed below massed arc lamps. The moths are drawn in by the suction and exhausted into a wire net cage which is removed as often as filled. As much as 140 pounds weight, representing some 400,000 moths, has been destroyed in this way in one night.

It is not generally known that the disturbances in Persia, reports of which from London have occupied much space in the press of late, pass over the longest telegraph circuit in the world. The telegraph operator at Teheran "speaks" directly to his colleague in London, 4,000 miles away, by wire, automatic repeaters taking the place of operators at ten points on the route. The first repeating station from London is at Lowestoft, where the message is carried forward 200 miles by cable under the North Sea to Emden, Hanover, where it is again automatically repeated; stations at Berlin, Warsaw, Rouno, Odessa, Kertch, Sukhum, Kaleh, Tiflis, and Tauris flash it instantaneously without human intervention, the operator at Teheran being the first to handle it since it left London. The line is continued to India, but in no other place is there so long an automatic circuit.

Mr. George H. Cove of Somerville, Mass., has a solar thermo-battery which is claimed to produce enough current in ten hours' sunlight to supply thirty tungsten lamps for three days. The apparatus consists of a frame of violet glass, like a large window, below which a number of metallic plugs are set in an insulating material. One end of each plug is constantly exposed to the sun while the other is shaded and cool, and the rays permitted to pass by the violet glass set up a reaction in the special alloy used, causing a constant flow of current to the storage batteries.

SCIENCE.

The famous lion of Lucerne appears to be doomed. The entire face of the sandstone rock in which the figure is carved is falling to pieces, and, in spite of every effort on the part of the local authorities, the lion is crumbling away and becoming disfigured.

The Duke of the Abruzzi has made a new record in mountain climbing. The highest ascent hitherto made in the Himalayas, the scene of the Duke's exploit, was by the Norwegians Muradas and Robertsen, who reached a height of 7,300 meters (more than 23,725 feet). The Duke mounted Bright's Peak, which is 7,600 meters (above 24,700 feet) in height. This peak is in the Godwin-Austen group.

Scientists now have placed at their disposal the highest meteorological and astronomical observatory on the American continent. It is situated on the top of Mount Whitney, California, 14,000 feet above sea level. Realizing the value for effective and progressive astronomical and meteorological work of an observatory far above the clouds and free from dust and smoke near great cities, the Smithsonian Institution decided to build a suitable laboratory on Mount Whitney. Now that the observatory is opened it will be used by scientists of the Smithsonian Institution and by others to make observations. The Smithsonian will permit the building to be used by any scientist gratuitously.

We have already made the statement in these columns that the Lick Observatory under W. W. Campbell sent an expedition to the top of Mount Whitney for the purpose of spectroscopically comparing the atmospheres of the moon and Mars, the object being to settle once and for all the mooted question of Martian water. Inasmuch as the moon has an atmosphere which if not non-existent is at least inappreciable, the comparison of its spectrum with that of Mars's atmosphere should prove conclusively whether or not there is any water on Mars. A telegram has been received at Harvard College Observatory from Prof. Campbell in which he states that together with Dr. Albrecht he compared the spectra of Mars and the moon and detected only a little water vapor on Mars. The bands which were measured were of equal intensity and very faint. A reply from Prof. Lowell will naturally be looked for with some interest. It will be remembered that Mr. Slipher of Prof. Lowell's staff has stated that he discovered spectroscopic evidence of water on Mars.

The common impression that the soils of the United States are wearing out and that the crop yields are on the decrease is declared to be erroneous by Prof. Milton Whitney, chief of the Bureau of Soils. The results of his investigation will be published in the next bulletin of the Department of Agriculture. In summing up, Prof. Whitney says that a careful study of the data appears to justify two conclusions—first, that the productivity of the newer agricultural soils of the United States is not decreasing. Individual farming deteriorates and soils wear out, but, as a whole, it seems probable that we are now producing more crops per acre than formerly. The cultivation of the land has been more intelligent, the principle of rotation of crops has been better observed, and, in latter years, a more careful use of fertilizers has been made. In addition, we must recognize the increase in farm animals and stock, the improvements in such by selection and breeding and the increased population which is forcing attention to more intensive methods of cultivation.

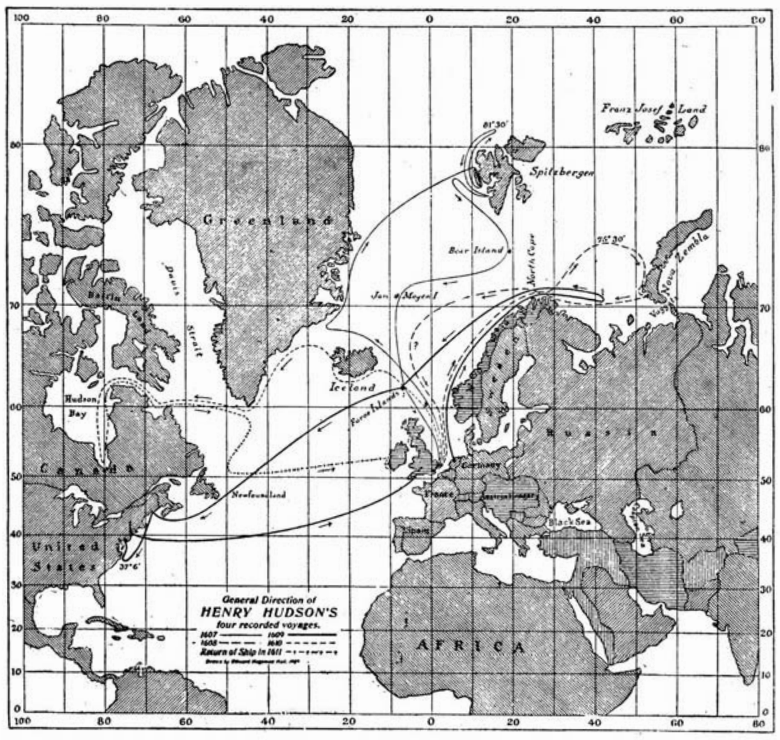
An effective method of freeing the air of rooms from dust and germs is especially desirable for primary schools, children's hospitals, surgical operating rooms and spinning mills. The method hitherto in use consists in supplying a current of air which has previously been purified, more or less completely. Richet has devised a simple method of purifying the air confined in a room by causing it to circulate continuously through an apparatus which retains the dust and microbes. The apparatus is simply an electric fan which revolves in a vertical cylinder and produces a current of nearly 2 cubic feet per second. Water, or some other liquid, drips from a 3-quart vessel, at the rate of 1 quart per hour, upon the blades of the fan, from which it is projected, by centrifugal force, in fine drops to the wall of the cylinder. The impurities of the upward blast of air are caught by the spray, which then trickles down the cylinder to a large basin in which the whole apparatus is set. Richet employed glycerin and soap solution, but the air can be purified very well by a spray of water alone. One hundred thousand microbes, estimated by the usual methods, were thus collected in three hours from the air of the laboratory. The dried organic matter collected in the same interval weighed about 1 grain, and the mineral matter ¼ grain. The same apparatus can evidently be employed for the chemical purification of the air by substituting appropriate solutions—cuprous chloride for the removal of carbon monoxide, potash or soda for carbon dioxide, etc.

HUDSON AND HIS EXPLORATION OF THE HUDSON RIVER.

The name of Hudson has been given to the Hudson River, not by any means because he was its original discoverer, but because he was the first navigator to explore the river throughout its navigable length, and leave behind a detailed account of his voyage. It will therefore be fitting to preface the present record of Hudson's voyage by a brief reference to the discoveries of earlier explorers.

After the return to Spain of the remnant of Magellan's expedition in 1522, it began to be well understood in Europe that a vast ocean must separate the New World and Asia; and the early navigators forthwith began to search for some route by which they could avoid the long journey from Europe to Asia by way of the southern seas, and find a direct route in more northerly latitudes. The explorers sought eagerly for a northwest passage, gradually laying their courses farther and farther up among the ice floes of the Arctic regions. The eastern coast of North America was carefully searched, and the tiny caravels of those days were sailed into the mouths of great rivers, in the hope that they would prove to be straits or channels opening through into the Western Ocean. Among these early explorers was Lucas Vasquez d'Allyon, who tried for a passage by the James River and through Chesapeake Bay in 1524. In 1525 Estevan Gomez sailed down the coast from Labrador to Florida, making a record of Cape Cod, Narranganset Bay, and successively of the mouths of the Connecticut, the Hudson, and the Delaware rivers. Early in 1524 Giovanni da Verazano, who was born in 1480 at Florence, crossed the Atlantic with a single ship and a crew of fifty men. He sighted Cape Fear, N. C., and coasted north to latitude 50 deg. About the last of April, 1524, the "Dauphine," as Verazano's craft was called, arrived off a low point of land, now known as Sandy Hook, where, seeing an inviting harbor, Verazano sailed into the roadstead. The ship's boat was manned and rowed through the Narrows into the Upper Bay, where a hasty survey was made of its islands and inlets, and the mouth of the noble river which flowed into it. He speaks of the river as "a very great river" (*una grandissima riviera*); and the name Grande River was used by some of the leading map-makers of Europe during the sixteenth century. When the Dutch took possession of this part of the country, the name "Groote" was substituted for the Italian term. Henry Hudson was no doubt induced to explore the "Grande River" by a letter from Capt. John Smith, who wrote that it was a strait connecting with the western sea, which in those days was believed to lie not very far from the Atlantic seaboard.

Of Henry Hudson the man we know comparatively little, and that little is comprised within the years 1607 and 1611. He was born in or near London; but of the exact date of his birth there is no certainty. His first appearance is on April 19th, 1607, when, with eleven companions, he is found partaking of Holy Communion in a little church in London, prior to embarking on his first recorded voyage. Our last sight of him is when he passes from view among the mists of Hudson Bay on June 22nd, 1611, turned adrift with a few companions by the mutinous crew of the "Half Moon." No authentic portrait of the man exists. He came of a seafaring family, had a wife and children, and evidently belonged to a prominent family. He made four recorded voyages, the first, second, and fourth under English auspices, and the third under the Dutch. In 1566 Parliament incorporated "The Fellowship of English Merchants for the Discovery of New Trades," which was better known as the Moscovy Company; and it was in their employ that Hudson, on his first voyage, made an effort to reach China by passing between Greenland and Spitzbergen. At latitude 81 deg. 30 min. he was checked by the Arctic ice and returned home. This voyage lasted from April 23rd to September 15th, 1607. The second voyage, in 1608, lasting from April 22nd to August 26th, had the same object in view. This time he endeavored to pass between Spitzbergen and Nova Zembla. After reaching latitude 75 deg. 30 min. he was driven back by the ice. In 1609 he entered the service of the Dutch East India Company, and made the voyage which resulted in the exploration of the Hudson River. His last voyage, made under the auspices of the Moscovy Company, commenced on April 17th, 1610, had for its object a search for a northwestern route to the Pacific Ocean through what is now called Hudson's Strait; and it was here in the following June that Henry Hudson, John Hudson, and seven others, mostly sick and disabled, were set adrift by the mutinous crew in an open boat, with a gun, some powder and shot, an iron pot, some meal, and a chest of carpenter's tools. The ultimate fate of the great explorer, whether he died of starvation or drowning, or was frozen to death, is a matter of pure conjecture.



The voyage of 1609, during which he discovered the Hudson River, is shown by a full black line.

MAP SHOWING HENRY HUDSON'S FOUR RECORDED VOYAGES, 1607-1610.

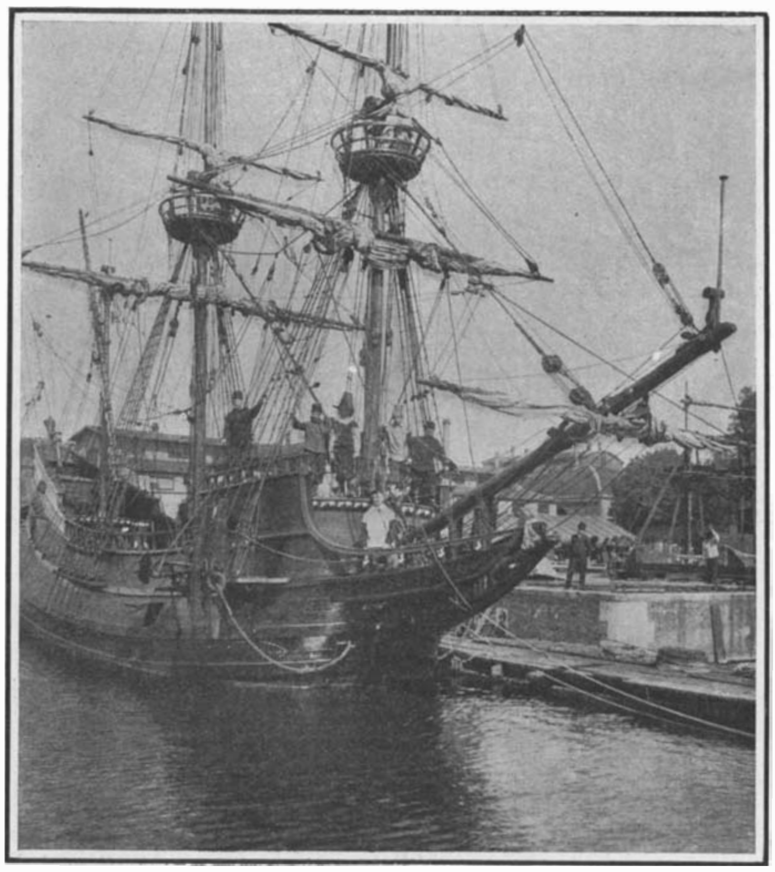
On the 8th of January, 1609, a contract was made between "the Directors of the Dutch India Company of the Chamber of Amsterdam" and "Mr. Henry Hudson, Englishman, assisted by Jodocus Hondius," who was to act as interpreter. In the Dutch copy of the contract preserved at The Hague, Hudson's Christian name is three times spelled "Henry," and he signed the document in the same way; so that in the opinion of the Hudson-Fulton Celebration Commission, "as he was an Englishman, it is a mistake to call him 'Hendrik.'"

The "Half Moon" set sail from Amsterdam April 4th, 1609, with a crew of eighteen Dutch and English sailors. The object of the voyage, as per the contract, was to seek a passage to the north of Nova Zembla, and by an easterly course to reach what is now the Pacific, in the latitude of 60 deg. On May 5th he rounded North Cape, but, baffled by the ice and by the discouragement of his crew, he determined, instead of returning home, to sail direct to the coast of America at the latitude of 40 deg., where he hoped to find a northwest passage by a strait which his friend, Capt. John Smith, in the letter sent to him from Virginia, informed him led into the Western Ocean somewhere between New England and Virginia. On July 18th he cast anchor in a harbor on the coast of Maine. He touched at Cape Cod; sailed to a point one hundred miles south of Chesapeake Bay; and then turned northward again and entered Delaware Bay. Finding the river unnavigable, he ran back to the ocean and sailed up the coast, and on September 2nd was off the New Jersey shore, and anchored probably off what are known as the Navesink Highlands to the south of New York Bay. On the following day the "Half Moon" let go her anchor inside of Sandy Hook. The week was spent in exploring the bay with a shallop, or small boat, and "they found a good entrance between two headlands" (the Narrows) "and thus entered on the 12th of September into as fine a river as can be found."

The log of this voyage was kept by Robert Juet, who was probably the mate of the "Half Moon." It is written in the quaint English of that period, and is entitled "The Third Voyage of Master Henry Hudson, toward Nova Zembla, and at his return, passing from Farre Islands to New-Found Land, and along to Fourtie-Foure Degrees and Ten Minutes, and thence to Cape Cod, and so to Thirty-Three Degrees, and along the coast northward to Fortie-Two Degrees and one Halfe, and up the river neere to Fortie-Three Degrees."

In his passage up the river, Hudson made progress according as wind and tide were favorable, the time from sundown to sunrise being always spent at anchor. On Monday, the 14th, he passed through a "very high and mountainous" country, probably the Highlands. On the following day, mention is evidently made of the Catskills, when the log records that they "came to other mountains which lie from the river side." On Saturday, the 19th, the little ship had reached the northerly limits of its trip, and anchored off what is probably now the northern section of the city of Albany. Further exploration of the river was made in the shallop, in the expectation of finding deeper water beyond the shoals. This was a vain hope, however, and the conviction must finally have come to the heart of the intrepid adventurer that once again he was foiled in his repeated quest for the northwest passage. On Wednesday, the 23rd, the "Half Moon" started on her return trip down the river. On the 29th she was at the northern entrance to the Highlands, having reached "the edge of the mountaines or the northermost of the mountaines." Detained by a heavy gale until October 1st, Hudson weighed anchor on that day and reached Stony Point. Finally, on Friday, the 2nd, the "Half Moon" cast anchor off "a cliffe that looked of the colour of a white greene," which is considered to have been undoubtedly "the green serpentine outcrop" at Castle Point, Hoboken.

Evidently the "Great River" made the same pleasing impression upon Hudson as it has done on the many millions who have voyaged between its banks in the intervening three centuries. Says he: "It is as pleasant a land as one need tread upon. The land is the finest for cultivation that I ever in my life set foot upon." With a few exceptions, he found the native Indians to be friendly disposed. Dressed in skins and with the characteristic decoration of feathers, wearing copper ornaments on their necks and carrying bows and arrows, they smoked large red or yellow copper tobacco pipes. To the little ship they brought tobacco, dried currants, grapes, corn, pumpkins, and beaver and otter skins, which they bartered for knives, hatchets, and trinkets. The country appears to have been quite populous with the Indians, who lived in dome-shaped huts, built of saplings and covered with bark. They existed chiefly on corn, which, together with beans, was dried for their winter use. Fish and birds also formed part of their diet, and mention is made of salmon, mullets, rays, and sturgeon. At the various places where Hudson landed he was usually received amicably and with no little ceremony. It is evident that Hudson's treatment of the Indians was kindly, and the voyagers made a good impression upon the natives, which was destined



The raised superstructure forward contains the quarters for the crew. Below the bowsprit, furled on its yard, is the curious square sail known as the "blind sail." The sailors are dressed in the costume of 1609.

THE REPLICA OF THE "HALF MOON"; PHOTOGRAPH TAKEN JUST BEFORE SHE WAS SHIPPED TO AMERICA.

to have a beneficial and lasting effect on the subsequent history of this State.

It was while at Albany that Henry Hudson decided "to trie some of the chiefe men of the countrey whether they had any treacherie in them"; and accordingly he "tooke them down into the cabin and gave them so much wine and aqua vitae that they were all merrie, and one of them had a wife which sate so modestly, as any one of our countrey women would do in a strange place. In the end one of them was drunke."

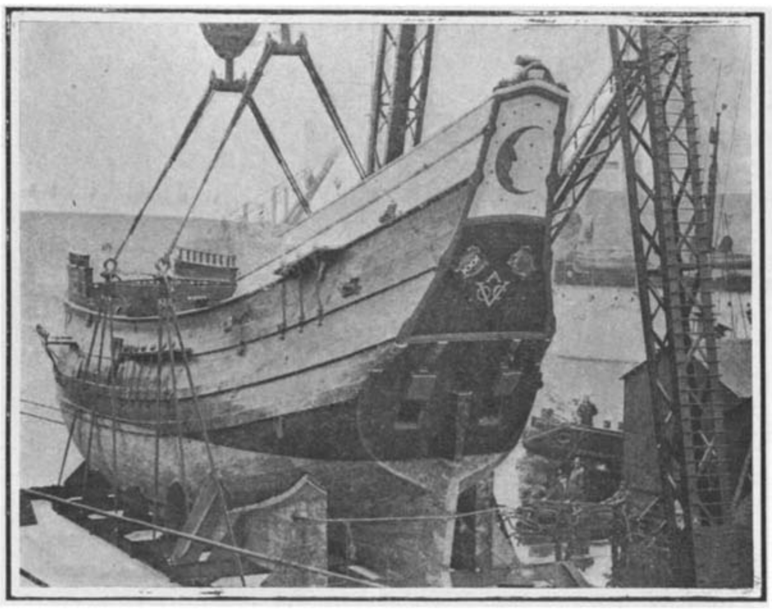
Not always was the intercourse of this convivial character. After the return of the "Half Moon" to the lower harbor, and when John Coleman and four others were exploring in the shallop, they were attacked by the natives, and Coleman was killed. This was on September 6th. Other conflicts occurred on the 9th and the 15th of September, and on October 1st, the log records how an Indian who had climbed up the rudder to the cabin window was caught stealing and shot. The following day the Indians attacked in force, and were driven off with a loss of eight or ten killed. On the 4th of October the "Half Moon" sailed down the harbor and out to sea, and "on the seventh day of November," according to the log, "being Saturday by the grace of God, the 'Half Moon' safely arrived in the range of Dartmouth in Devonshire in the year 1609."

THE "HALF MOON."

When the replica of Henry Hudson's "Half Moon" was lifted by the floating crane at the Brooklyn navy yard from the deck of the "Soestdyk," on which she was brought over from Holland, and lowered into the water, there was a general expression of surprise at her diminutive appearance; for she was actually no larger than a small harbor tug. On rowing over to the craft and going aboard, however, it was at once evident that what she lacked in size, she more than made up in general staunchness and strength of construction. Bluff of bow and high in the poop, as was the fashion in naval architecture of three hundred years ago; built of heavy oak timbers, and planked and decked with the same material, the "Half Moon" was well calculated to stand the buffetings of long deep-sea voyages. Moreover, her underwater model is such, with its long clean run, that, although it must have been slow work beating to windward, it is certain that with the wind free and sheets started the little craft must have been good for say six knots, and possibly—under favorable circumstances—a little more than that. All the same, in view of the diminutive size and exceedingly cramped quarters of the "Half Moon," one is filled with admiration for the daring and resourcefulness of the men who struck boldly to the northwestward in such a cockle shell of a boat, on voyages of many months' duration and in a quest for a northwest passage, which must needs lead them on to dangerous coasts and amid treacherous shoals, of which there was no chart, beacon, or buoy, to give them friendly guidance.

The "Half Moon" must be seen to be appreciated. Of 80 tons displacement, she is only 80 feet in length over all, 63 feet on the waterline, 16 feet 11 inches beam, 10 feet 1 inch molded depth, and 7½ feet draft of water. She was built by a committee of patriotic Dutch citizens, who provided the necessary funds, her plans being drawn from original sketches and documents prepared by the late instructor of shipbuilding in the Dutch navy. In the parade up the Hudson River she will be manned by officers and a crew from the Dutch ship of war "Utrecht," all dressed in the quaint costumes of three hundred years ago. Forward is the raised forecastle, the sleeping place of the crew, provided with five berths. Forward of this and below the bowsprit is the galley, an extraordinarily exposed and wet position, where, says tradition, the sailors were placed for punishment. At the after end of the boat on the main deck was the position for the steersman, whose head projected through the steeply-sloping quarter deck above him and was protected by a curious canopy. In front of the steersman were a compass, a sand glass, and a log glass. Upon the main deck and covered in by the steeply-sloping deck, known as the quarter deck, is the captain's cabin. Under his berth, in an artistically bound chest, are the books which comprised the captain's small library. Upon the diminutive table is a sea chart, a faithful reproduction of the one existing copy, mentioned by Shakespeare, which is in the British Museum. On the table also is a copy of the contract with Hudson for his notable voyage, dated January 8th, 1609. Here also are the primitive dividers and measuring scales for plotting the course. The cabin contains a Jacob's staff, the primitive sextant with which Hudson determined, with a fair amount of accuracy, his latitude. All of these articles are faithfully copied from prototypes in the Netherland Museum. Above the captain's cabin is a smaller one for the accommodation of the mate; and above this is the lofty poop deck.

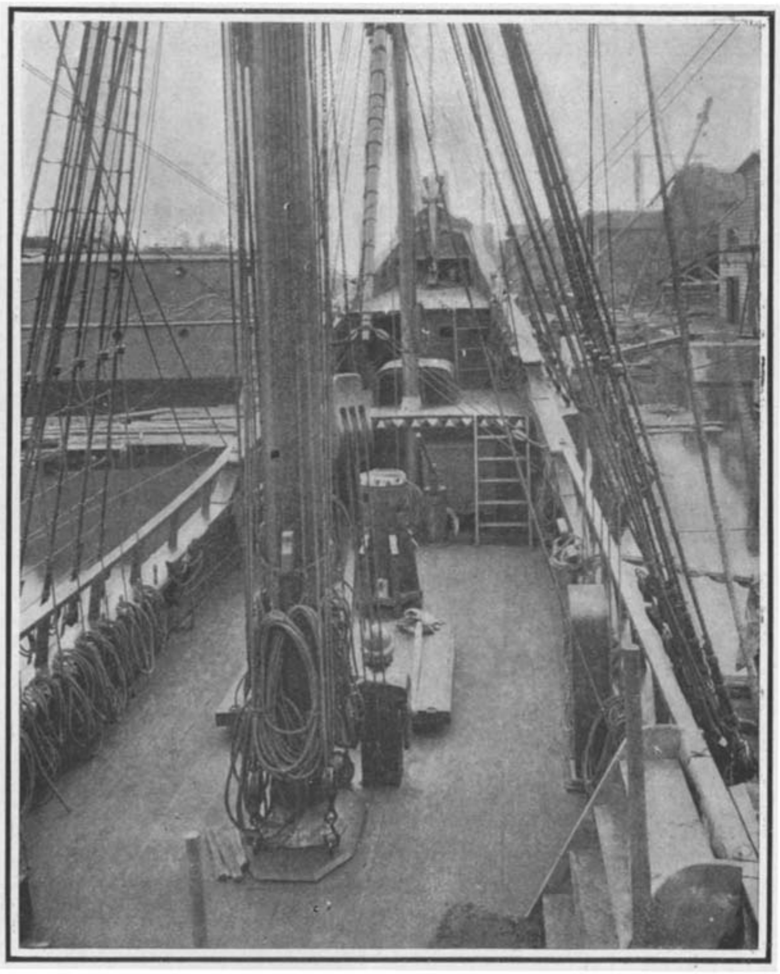
From a naval constructor's point of view, one of the most curious things about the "Half Moon" is the ex-



Note the steel cradle in which the boat was carried on the deck of the "Soestdyk." The transfer was made by the floating crane.

"HALF MOON" BEING LIFTED FROM STEAMSHIP TO DOCK AT THE BROOKLYN NAVY YARD

aggerated, upward slope of the after part of the main deck and of the quarter and poop decks above it, the effect of which was to give great elevation to the poop. Curious indeed to our eyes is this lofty structure; but it must have been an excellent position from which to navigate the ship. About four feet below the main deck is the "tween deck" or the "derdeck," where the head room is so limited that the crew must have at times performed some of their duties on all fours. Here are the two old-fashioned cannon, the primitive kitchen and berth for the cook, a bread room and berth for the steward, and a gunner's room in which the powder was stored. Below is the hold, in which were stored the provisions, drinking water, cable, and cargo. The "Half Moon" carries three masts and a bowsprit. Below the latter is a curious square sail known as the "blind sail." On the foremast are a foresail and a topsail, on the mainmast a mainsail and a main topsail, and on the mizzen is a lateen sail. The shrouds, stays, spars, and in fact the whole of the rigging, standing and running, is exceedingly strong,



View looking aft, showing the lofty poop, containing the steersman's position and the cabins for Hudson and his mate.

DECK VIEW OF THE "HALF MOON."

and well set up. The old Dutch East India Company, whose chief office was in Amsterdam, placed on all its vessels the initial letter of the port from which they sailed. This accounts for the large letter A on the stern of the "Half Moon." Other signs painted on the vessel are a starry heaven, a comet, planets, and a half moon. Below these are the name of the vessel and the arms of Amsterdam and of the company.

THE FOUR PERIODS OF HUDSON RIVER HISTORY.

For the lovers of history, none of the pageants of the Hulson-Fulton Celebration will equal in interest the great parade of Tuesday, September 28th, which will tell the story of the past three hundred years of Hudson River history, in a procession of over half a hundred floats, representing the successive periods of Indian, Dutch, English, and American occupation.

Henry Hudson, during his exploration, found the river occupied by two great branches of the aboriginal Indians, the Algonquins at the mouth and in the lower river, and the powerful league of the Iroquois, or Five Nations, at its head. With a few slight exceptions, Hudson's reception was friendly, and both he and his crew appear to have treated the Indians with consideration. It is certain that such conflicts as occurred were insignificant in comparison with the battle fought between the Canadian Indians under Champlain on the shores of Lake Champlain and a party of Iroquois Indians—a conflict which occurred only a few days before Hudson sailed into New York Harbor. "The contrast between the French and the Dutch and English treatment," says the Hudson-Fulton Commission, "led to the formation of the famous Covenant Chain of friendship between the Indians and the latter, and prevented the French from ever obtaining a permanent foothold in the State of New York."

The Dutch, who succeeded the Indians as owners of what is now New York State, were in 1609 the leading commercial nation of the world, and Amsterdam, from which Hudson set sail, was its leading port. The interest aroused among the early Dutch traders by Hudson's voyage led to the erection, as early as 1613, of traders' huts along the Hudson River. The first permanent settlements were made at Fort Orange (Albany) in 1624, and at New Amsterdam (New York) two years later. The colonial history of New Netherland began with the landing on Manhattan Island of Peter Minuit, as the first Governor-General, in 1626 Under New Netherland was included the territory between the Connecticut and Delaware rivers. The English took possession in 1664; surrendered to the Dutch in 1673; but once more gained possession, this time destined to be permanent, in 1674.

Henceforth New Netherland was to be known as New York, New Amsterdam as New York city, and New Orange as Albany; but the Dutch origin of New York is still commemorated in such names as Brooklyn, Harlem, and Staten Island. Regarding this momentous change, the Commission is of the opinion that the merger of the Dutch and English *régimes* was accomplished more completely and naturally than a change of jurisdiction could have been made between almost any other two nations in the world; for the Dutch were more closely allied to the old Anglo-Saxon stock from which the English are descended than any other living European people. Intense rivals in commerce, England and Holland had worked hand in hand for years for the liberties of Europe, and there were radical bonds of sympathy between them, which contributed materially to the progress of the colony of New York.

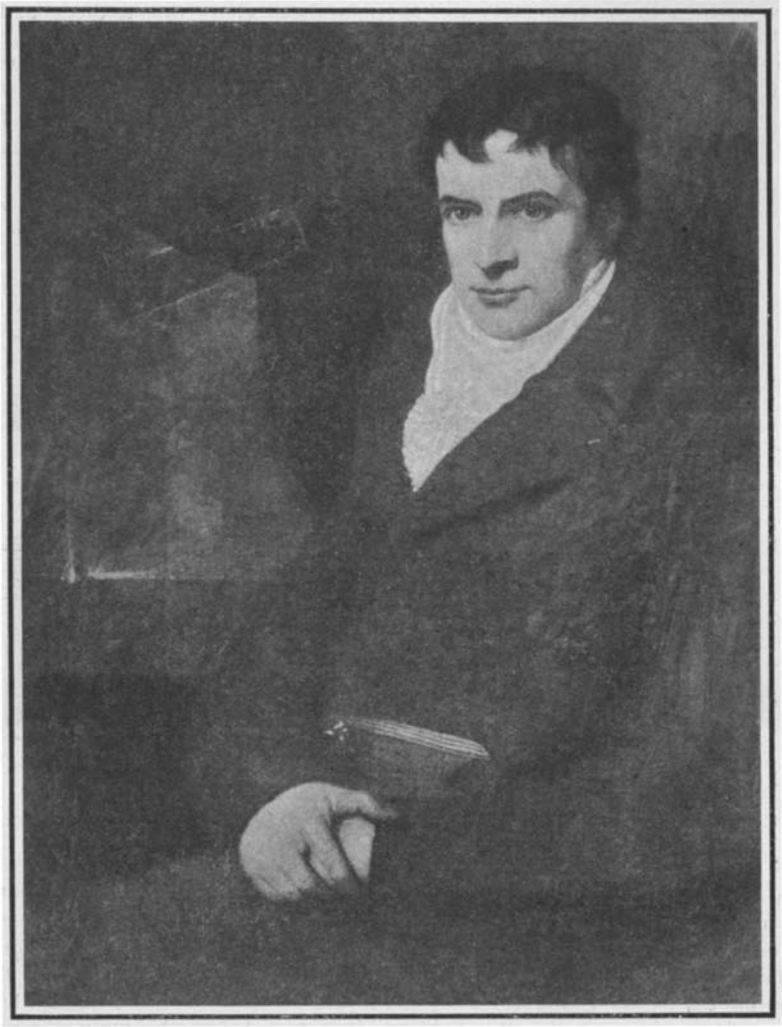
The American or United States period began, of course, with the Declaration of Independence on July 4th, 1776. The geographical position of the Hudson River, which forms part of the great highway of travel from the Atlantic seaboard to the Great Lakes and Canadian territory, rendered it strategically of the very highest importance, and, therefore, the main object of contention between the opposing forces. The British realized that if they could establish complete possession of the Hudson Valley they would cut the colonies in two; and by establishing a route of communication between Canada and New York, they would be able to defeat the colonies in detail. The vast range of incidents connected with the Hudson River Valley has rendered it necessary for the Commission to confine the floats to the representation of events more immediately connected with New York city.

FULTON AND HIS LIFE WORK.

The forthcoming festivities commemorate the first complete exploration of the Hudson River by Henry Hudson and the inauguration by Robert Fulton of successful commercial steamboat navigation on its waters. Hudson was not the first navigator to see the Hudson River, and neither Robert Fulton himself nor the Commission which has organized and carried through the celebration has ever claimed that Fulton was the original inventor of the steamboat. It is rarely that a complete invention leaps full fledged from the brain of any one man. Almost invariably it is the product of the disconnected labors of separate individuals, each of whom contributes his quota to the ultimate result. Three men above all others—Symington on the Forth and Clyde Canal, Fitch on the Delaware, and Fulton on the Hudson River—will be forever associated with the invention of the steamboat; and it is because Robert Fulton combined with his fine engineering sense a large executive and commercial instinct, and was backed by the financial and political influence of Chancellor Livingston, that he was able, not only to put a practical steamship afloat on the Hudson River, but to establish the infant enterprise as a permanent commercial success.

Fulton was born in Little Britain, Lancaster County, Pennsylvania, in 1765. As a boy he showed a decided gift for drawing and mechanics, to which was joined an unusual facility for mathematical calculations. At seventeen years of age he went to Philadelphia to take up the study of portrait and landscape painting and mechanical drawing. In this he must have shown considerable ability; for at the age of twenty-one he had saved sufficient means to purchase a home for his widowed mother, in Washington County. In the following year he went to England to study art under his distinguished compatriot, Sir Benjamin West, who subsequently, in 1792, was elected president of the Royal Academy. That Fulton was an artist of no small attainment is shown by the character of the work which has survived him, and by the fact that his portraits were exhibited at the Royal Academy and at the Society of Arts in Great Britain. His own portrait, painted by his brush, which now hangs in the rooms of the American Society of Mechanical Engineers in New York, is an excellent piece of work, and shows distinctly the influence of the master under whom he studied.

An artist by profession, Fulton was an engineer and inventor at heart. Benjamin West's influence, coupled with his own charm of personality and undoubted social gifts, brought him into touch with many leading men in England, notably the Earl of Stanhope, whose interest in mechanical and physical science is well known. On September 30th, 1793, Fulton wrote to the Earl, offering to make known to him his scheme for moving ships by steam and his plan for an inclined plane for the operation of canals. In the same year, also, he invented a mill for sawing marble and other stone, and actually had one in operation near Torbay, Devonshire. His interest in steam navigation at this time is shown by a letter to Boulton & Watt, dated November 4th, 1794, asking what would be the cost of a steam engine, "which is designed to be placed in a boat." The letter was written from Manchester, where he met young Robert Owen, subsequently known as the distinguished social reformer. Fulton interested Owen in his plans for the more rapid and cheaper excavation of canals, and they became copartners in his inventions. Meanwhile he was writing a "Treatise on Canal Navigation," which appeared in 1796. In 1797 he went to Paris, where he obtained two French patents for panoramas. A lasting evidence of his work in this direction is to be found in the Rue des Panoramas and the Passage des Panoramas in the French capital. Here he lived with the American Minister, Joel Barlow, of whom he painted an excellent portrait now owned by his descendant, Robert Fulton Ludlow of Claverack, N. Y. It was during his residence in Paris that he began to turn his genius for invention almost exclusively to the field with which his name was to be so honorably associated. His first efforts were directed to the invention of means for prosecuting submarine warfare. He invented a system of torpedoes operated by clockwork, and devised methods of attack which were wonderfully similar to those that were used with such disastrous effect in the late Russo-Japanese war. He proposed to float down upon the enemy two such torpedoes tied together by a line, which, being intercepted by an enemy's ship, would swing around, strike her sides, and explode. His most effective work in this field was the construction of a practical submarine or "plunging"



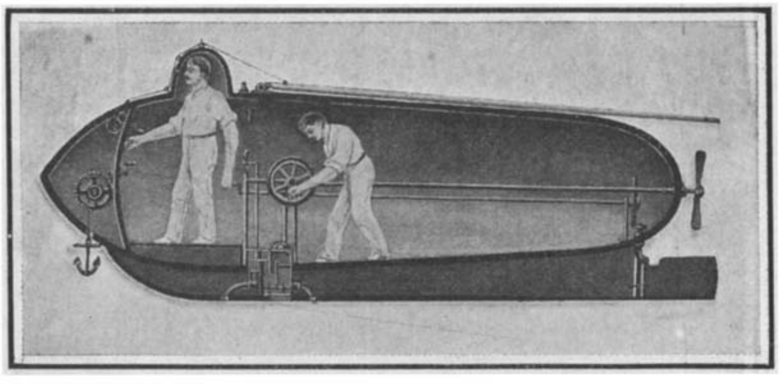
From a painting by Benjamin West in possession of Fulton's grandson, Robert Fulton Ludlow, of Claverack, N. Y.

ROBERT FULTON; 1765-1815.

boat, called the "Nautilus." This vessel, 6 feet in diameter and 20 feet long, was built of iron and copper, and in general outline resembled the modern submarine. It was provided with a sail for surface navi-

THE BRONZE MEDALLION OF ROBERT FULTON ON HIS MONUMENT IN TRINITY CHURCHYARD.

gation, which could be folded back upon the boat when diving. To submerge the boat, water was admitted, which was removed by pumping when it was desired to come to the surface. It was driven by means of a

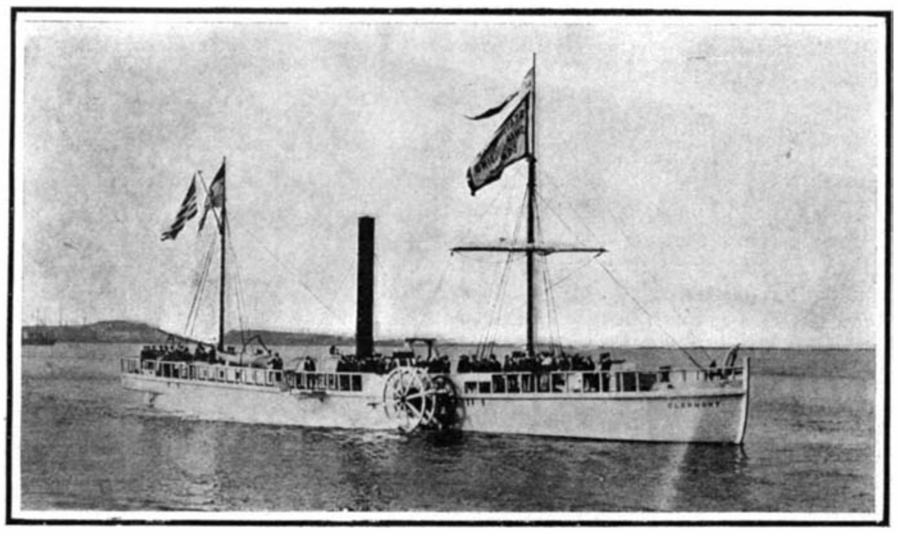


Built of copper and iron; driven by a hand crank and propeller; was submerged by admitting water; air was replenished from a tank of compressed air; remained under water 5 hours with three men aboard. Fulton is the undisputed inventor of the first successful submarine. He antedated the present submarine boat by 100 years and demonstrated by successful tests before officials, first of the French and later of the English navy, the practical character of his vessel.

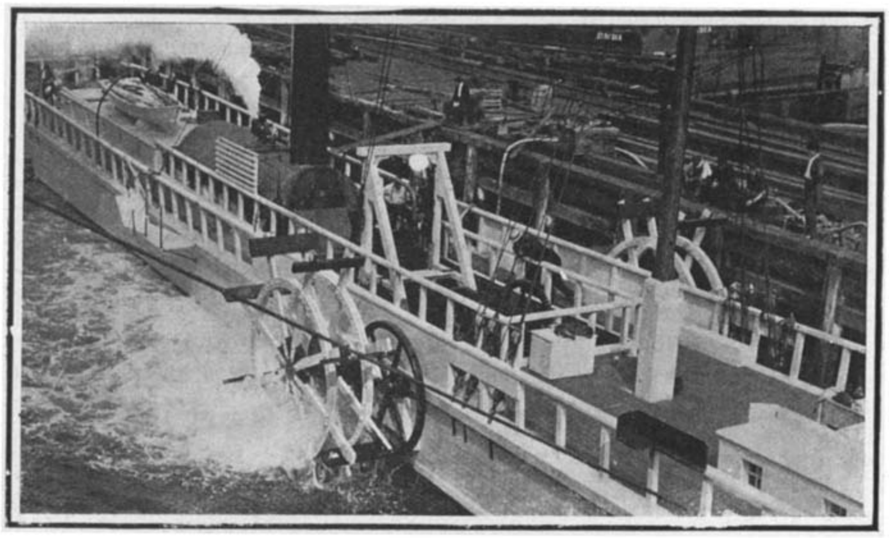
FULTON'S SUBMARINE THE "NAUTILUS."

propeller through a man-operated crank wheel, from which power was transmitted through bevel wheels to a propeller shaft running through the center of the boat. The steering, operation of the pump, and the raising and lowering of the sail, were all accomplished from the interior by the methods shown in the accompanying engraving. Fulton made an exhibition on the Seine, descending with one man, remaining twenty minutes below the water, and coming successfully to the surface. At Brest, in June, 1801, he descended with three men to a depth of twenty-five feet, and remained below for one hour, the air being renewed from a reservoir of air under high pressure. On another occasion he attacked a specified boat in the harbor, attached one of his torpedoes, and blew the boat to pieces. This occurred in August, 1801. The significance of these exploits is enhanced when we bear in mind that the experiments above referred to were made to demonstrate to Napoleon I. the value of Fulton's invention for attack upon the English fleet. His plan was to build steamboats which were to act as tugs to tow the vessels containing Napoleon's army of invasion across the English Channel; and while the steamboats were to afford Napoleon an opportunity to strike a blow upon land with his army, Fulton's system of submarines would enable the French navy to strike an equally telling blow by sea. As the French government failed to accept Fulton's submarine and torpedo inventions, he subsequently returned to England and laid his plans before the British government. Mr. Pitt, the Prime Minister, was favorably impressed, and Fulton was given an opportunity to attack a brig which was anchored off Deal in the English Channel. He launched a torpedo, and by completely destroying the vessel demonstrated to naval and military officers and to a large concourse of spectators the success of his invention. The British government, however, for obvious reasons, did not wish to encourage the development of submarine warfare, for they realized its great potentiality. They offered Fulton a considerable reward if he would suppress his plans forever. This he refused to do, saying to the committee that waited upon him: "I will never consent to let these inventions lie dormant, should my country at any time need them."

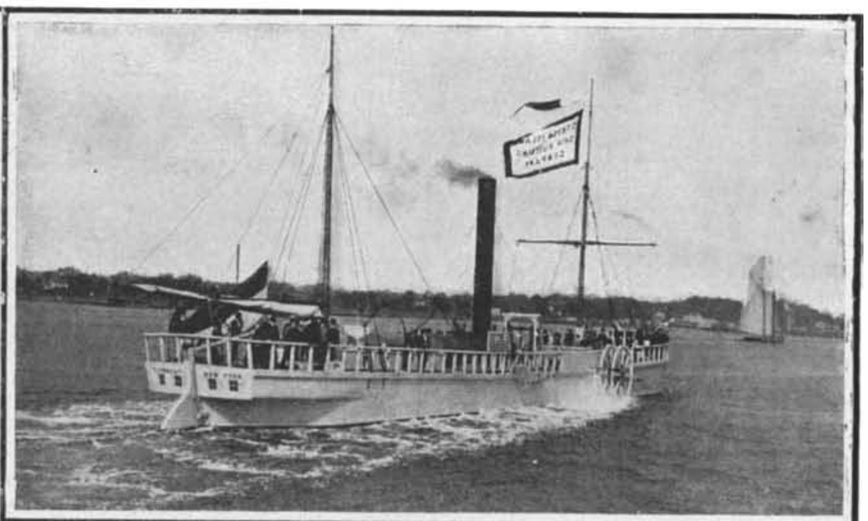
Fulton, again a resident in France, realizing that he had failed to interest either government in his system of submarine warfare, turned to his favorite scheme, and bent his energies to the development of a practical steamboat. He made application to the French government, filing a description and plans of his boat, which have been preserved in the archives of the Conservatoire des Arts et Métiers, Paris. The wide study of what had been done and was then being attempted in the development of the steamboat, with which Fulton prepared himself, is shown in these plans, and the reader is directed to the illustration of the boat, in the chapter on "Steamboats Prior to the Clermont," which appears on page 221. The drawing is especially valuable for the light which it throws upon the "Clermont," of which the original drawings have disappeared. The date of the letter to the French Commission was January 25th, 1803. Fulton built a small boat, in which he placed his boiler and engine; but on the eve of his demonstration before the Commission, during a heavy wind, the craft, unable to carry its burden, broke in two, and the wreck sank to the bottom of the river. The engine, which was presumably the one ordered from Watt, seems to have come through the disaster unharmed; for Fulton immediately built another boat, 66 feet long by 8 feet beam, and in August, 1803, made a fairly successful trial in the presence of members of the Institute and a crowd of onlookers. In spite of this demonstration, Fulton was doomed to disappointment; for the French government failed to take up his invention. But his star was now in the ascendant. The wheel of fortune took a turn in his direction, when Robert R. Livingston was sent to France to act for the United States in the matter of the Louisiana Purchase. This able man, who had himself already given much study to, and made several experiments in, the development of the steamboat, was quick to see the excellence of the Fulton plans, and became from that time on his ardent associate and never-failing backer. "Fulton had genius, and Livingston had the genius to perceive it"; and out of the combination of interests thus formed, there was to emerge four years later that curious but capable little craft, the "Clermont"—practically identical in design, and the lineal descendant of, the boat which steamed successfully on the



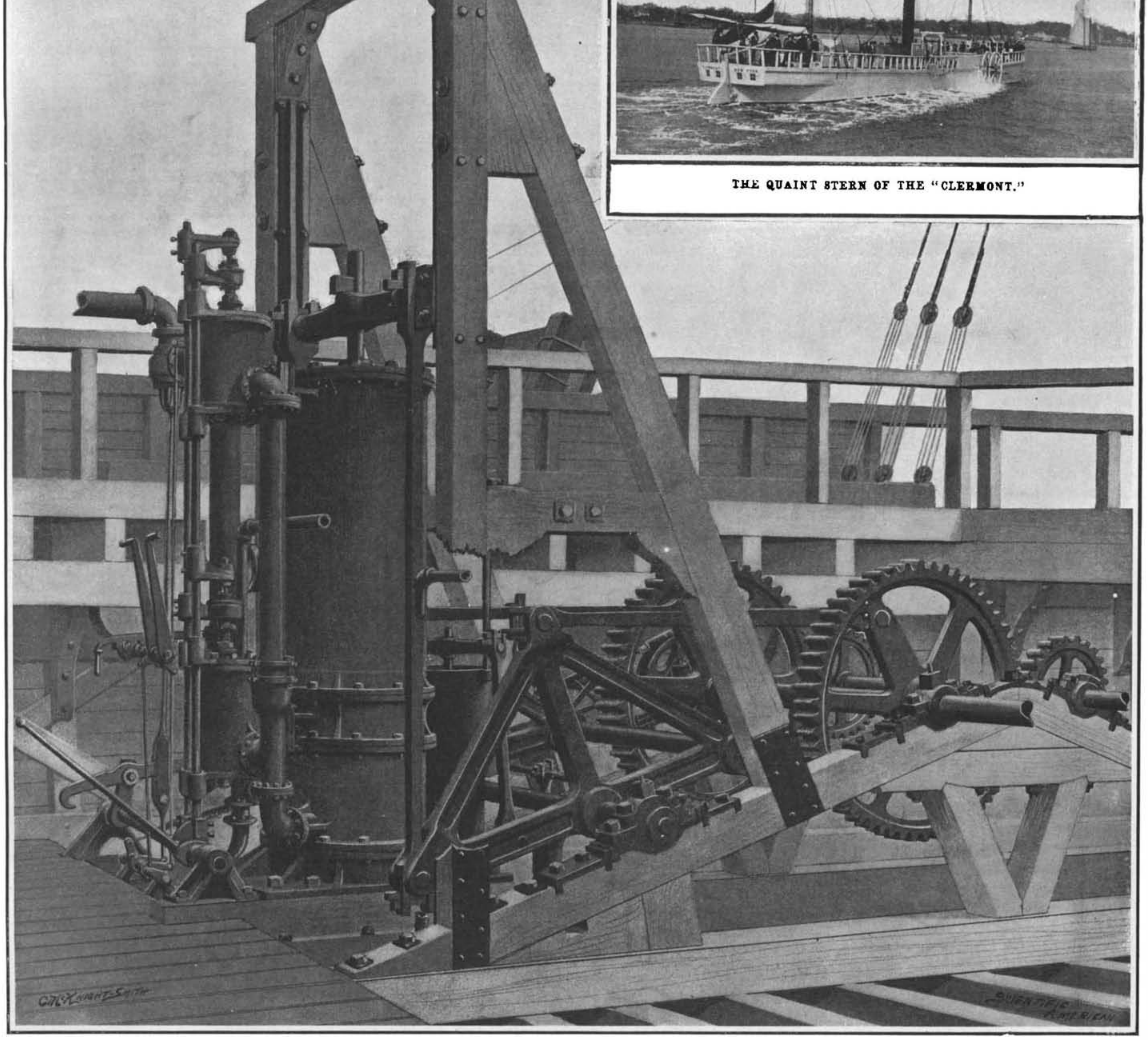
THE "CLERMONT'S" TRIAL TRIP: SEPTEMBER 14TH, 1909.



DECK VIEW, SHOWING FLYWHEELS OUTSIDE HULL.



THE QUAINT STERN OF THE "CLERMONT."



With the exception of the eccentric, valve gear, and starting and stopping mechanism, which were modernized in accordance with government requirements to ensure safe handling during the water parades, this replica is an exact copy of the original of 1807.

The main parts of the engine were built by Watt in England in accordance with Fulton's order of August 6, 1803, which called for "a cylinder of 24-horse-power double effect, the piston making a 4-foot stroke, the valves and movements for opening and shutting them, the air-pump piston and rod, the condenser with its communications to the cylinder, and air pump." The A frame and guides: the cross-head: the bell-crank lever with its connecting rods to cross-head and crank wheels; the crank wheels, paddle wheels and shaft, and the flywheels and shaft with gear for driving the same, were all Fulton's own design; and the arrangement was well adapted for keeping the weight low in his very narrow boat with its small margin of stability. In the original engine the valves were probably operated by a vertical reciprocating rod, carrying pins which engaged the valve-tripping devices.

(Drawn on board the replica of the "Clermont" by the artist of the Scientific American.)

THE ENGINE OF THE "CLERMONT"

river Seine. Preliminary to our description of the "Clermont," it is well to make it clear that Robert Fulton is entirely free from any charge of plagiarism. It has been asserted that, because Fulton inspected the work both of Symington on the Clyde and Fitch on the Delaware, and was familiar with Fitch's plans as left in charge of Aaron Vail, U. S. consul at L'Orient, France, it was from these sources that he derived the design of the "Clermont." Now, while it is true that Fulton was in touch with these men and their work, and probably saw their steamboats in operation, there is nothing in the design of the "Clermont" to indicate that her hull and the general arrangement of her engine were not the design of Fulton himself. On the contrary, there is abundant written evidence that the form of the boat and the connections from the cylinder to the paddle wheels were Fulton's. This is said with due appreciation of the fact that Fulton went to Boulton & Watt at Birmingham, England, for the essential parts of his engine. They were the foremost engine builders of their day; and it was a wise step on Fulton's part to order the cylinder, condenser, and air-pump from a first-class firm. Both Fitch and Symington, it is true, designed and built their own engines throughout; but this fact does not invalidate Fulton's claim to be considered as the naval architect of the "Clermont"—a boat which was quite unlike any other that had been built, and that was so well designed as to prove a thorough commercial success.

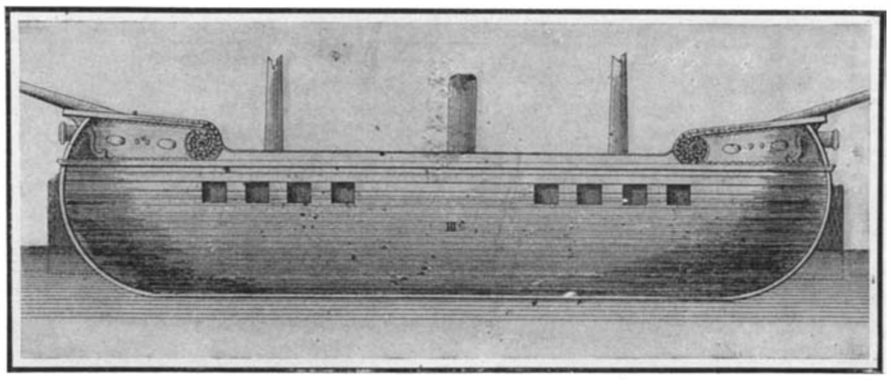
While Fulton was yet in Paris and a few days before the trial of his boat on the Seine, he again wrote to Boulton & Watt, asking them to build him an engine, which he no doubt intended for the boat that he had in mind to build on his forthcoming return to America. On the date of August 6th, 1803, his letter says: "Will you be so good as to make me a cylinder of a 24-horse-power double effect, piston making a 4-foot stroke? Also the piston and piston rod, the Valves and movements for opening and shutting them, the air pump piston and rod, the condenser with its communications to the cylinder and air pump. The bottom of the cylinder cast in form as in the drawing and the dispositions of the parts as near as possible as they stand in the drawing. The other parts can be made at New York. . . . The situation for which this engine is designed and the machinery to be combined with it, will not admit of placing the Condenser under the cylinder as usual." The drawing which accompanied this letter showed the condenser placed forward of the cylinder, and not underneath it, as was the practice in the Boulton & Watt engines. Mr. H. H. Suplee, who has probably given a more thorough study to this phase of the subject than any other investigator, is of the opinion that Fulton wished to place his cylinder directly upon the floor of the boat, in order to keep its weight as low as possible. We are inclined to agree with him; for the original beam of the "Clermont," which was only 13 feet, rendered her laterally very unstable. Furthermore, the boat on the Seine, which doubtless formed the basis of the design of the "Clermont," shows the condenser separate from the cylinder. There can be no doubt, after reading the Boulton & Watt letter, that Fulton had the outlines of the "Clermont" engine clearly in his mind, and its general similarity to the engine of the boat on the Seine is strong evidence that the "Clermont's" engines were, at least as to their general plan and connections, original with Fulton. On the other hand, the drawings which accompanied Fulton's patent of 1809 show the condenser placed beneath the cylinder, a construction which has been followed in the replica of the engine.

In drawing the plans, it was found that, since the replica of the "Clermont" would have a considerable number of people aboard during the festivities, parades, etc., it would be necessary to depart somewhat from the original plans, in order to comply with the requirements of the government inspectors and secure a reliable boat, suitable for the purposes of the Commission. Hence, in the interests of historical accuracy, it is advisable to note that the motive power departs in some respects from Fulton's original design, although in the main it is a faithful reproduction. This is particularly true of the eccentric, valve gear, cut-off, and starting and stopping devices; and it takes only a glance at our drawing to see that these parts belong to a later period, and are practically similar to those now in use on walking-beam engines. In the drawings of the boat on the Seine, the valve gear and the air pump are shown to have been operated by levers and quadrants. Probably Fulton used the "tappets and tappet rod," which were current practice for working the valves in Boulton & Watt engines. Another change is in the boiler, which in the original "Clermont" was built of copper, and carried a pressure of probably not more than three to five pounds above the atmosphere. In the "Clermont" of 1907, the boiler, in order to meet the government requirements, is built of steel, and carries twenty pounds pressure. With these exceptions in mind, the visitor to the "Clermont" may be satisfied, both as regards the hull and the engines, that she looks very much as she did on her first memorable trip up the Hudson. Fulton's design, if we consider the crude condition of the art in those days, is creditable, and it is a noteworthy fact that if we raise the bell-crank lever above the cylinder, we have an engine which is remarkably like the walking-beam engine of the present day. Fulton, however, wished to keep his weights low in the boat; and the plan adopted is admirable for this purpose. Two connecting rods from the crosshead are coupled to a bell-crank A-shaped pair of levers, from the top of each of which a connecting rod transmits the motion to a pair of crank spur wheels upon the inboard ends of the paddle-wheel shafts. In order to carry the engines over the dead centers, Fulton provided a pair of fly-wheels, which were carried upon separate counter-shafts, rotated by means of pinions secured at their inboard ends. The air pump and feed pump are operated through connections from the bell-crank levers, as shown.

About the correctness of the design of the replica of the hull of the "Clermont," there can be no doubt whatever. The plans, drawn by Frank E. Kirby and J. W. Millard, are based upon a letter of Fulton's, which reads: "My first steamboat on the Hudson River was 150 feet long, 13 feet wide, drawing 2 feet of water, bow and stern 60 degrees"; and upon the second enrollment of the "Clermont," on file in the New York Custom House, which describes the vessel as having "one deck, and two masts," and gives her dimensions as 149 feet length, 17 feet 11 inches breadth, and 7 feet depth. The enlargement in beam is due to later changes which were found necessary to increase the vessel's stability. The "Clermont," as originally designed, had therefore a long narrow hull, with parallel sides; a V-shaped bow; and a stern which was V-shaped at and below the waterline, but above the water was carried out with a square overhang. This form was decided upon by Fulton as the result of towing experiments with models which he carried out himself; and he seems to have been of the decided opinion that this was the best form to secure the desired speed. She was provided with a limited amount of sail, of which, at least on her first trip, she seems to have made but little, if any, use. The paddle wheels, 15 feet in diameter, were uncovered, and consequently, if any breeze were blowing, the passengers were pretty well drenched with water.

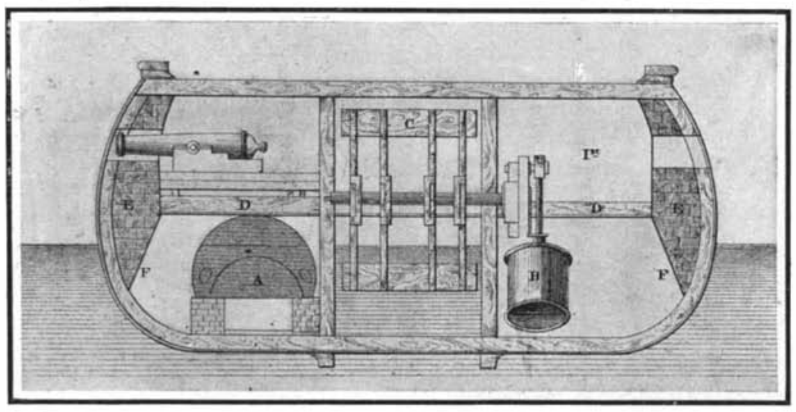
Let it not for a moment be imagined that the public of that day had the least appreciation either of the genius of Fulton or the momentous character of the work he was doing. When, on Monday, August 17th, the little craft cast loose from her moorings near the old State's Prison, which stood on the square now bounded by Washington, West 10th, West, and Charles Streets, many of the thousands that lined the shore of the river had come to deride "Fulton's Folly"; and he made his preparations for the start to the accompaniment of jeers and catcalls. At 1 o'clock the hawser was drawn in, the throttle was opened, and then, amid the curious hush which immediately fell upon the multitude, the side wheels began to turn, and with Fulton at the helm the "Clermont" moved slowly out into midstream and headed north for Albany. Skepticism gave way to approbation and delight, and amid thunders of applause the "Clermont" moved slowly up the river, and was finally lost to sight in the upper reaches of the river. At 1 o'clock on Tuesday the little vessel tied up at Clermont Dock, the landing for Chancellor Livingston's place, having covered the 110 miles from New York against the wind at an average speed of 4.6 miles an hour. Resuming the journey at 9 o'clock on Wednesday morning, the "Clermont" reached Albany, 40 miles distant, at 5 P. M., the running time for the whole distance having been 32 hours, which gave an average speed of a little over 4½ miles per hour.

We have shown in another chapter how phenomenal was the development of steam navigation on the Hudson River as inaugurated by this eventful trip, a development in which Fulton took a leading part. In 1812 he put his first ferryboat in commission, although to Stevens must be given the credit for having started a ferry to Hoboken in the previous year. The boat, which was double-hulled, made her landings at a hinged, floating bridge, to which she was guided by lines of piling. Fulton was thus the originator of our present system of ferryboats. In 1810 we find him before President Madison explaining his models and plans for torpedo warfare. In March, 1814, Congress authorized the construction of a steam war vessel to be built from Fulton's plans. This, the first steam warship in the world, was constructed with a double hull. Its dimensions were: Length 156 feet, breadth 56 feet, depth 20 feet. The paddle wheel, 16 feet in diameter, was driven by an engine, whose cylinder was 48 inches in diameter by 5 feet stroke. As will be seen from our drawing, the sides of the "Demologos," as she was called, were strengthened by massing heavy timbers, until a thickness of five feet was reached. She mounted twenty 32-pounder guns on the gun deck. Fulton, who was present at the launching of the vessel on October 29th, 1814, did not live to see her completed; indeed, it was his devotion to the work of her construction, which led him to spend many hours on her deck in the winter time, when he was troubled with a heavy cold, that brought about his death, which occurred February 23rd, 1815, at his home in what is now Battery Place. He was buried in the Livingston vault on the south side of Trinity Church, and to the northwest of the monument and tablet erected to his memory by the American Society of Mechanical Engineers in 1901.



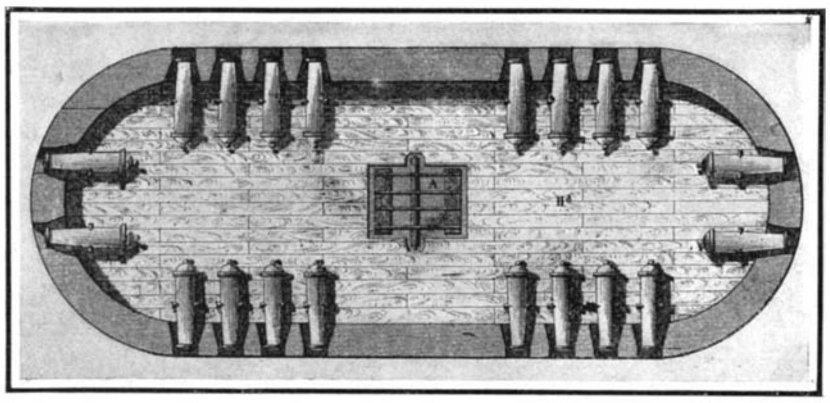
Designed by Fulton for the United States Navy; launched in 1814 and completed shortly after his death. Length, 156 feet; beam, 56 feet; depth, 20 feet; paddle wheel, 16 feet diameter; engine cylinder, 4 feet diameter, 4 feet stroke; speed, 4½ knots.

THE "DEMOLOGOS"; THE FIRST STEAM WARSHIP.



This view shows the engine *B*, driving paddle wheel *C* in a central waterway; the boiler *A*; and the massive wooden side protection *E*, 5 feet in thickness.

MIDSHIP SECTION OF THE "DEMOLOGOS."



The armament consisted of twenty 32-pounder guns. The plans provided also for two 100-pound submarine guns for attacking the enemy below the water-line.

GUN DECK OF THE "DEMOLOGOS."

Correspondence.

THE NUMBER OF OUR ANCESTORS.

To the Editor of the SCIENTIFIC AMERICAN:

The search for truth is said to be often of more benefit than its attainment; and I am glad to see that a solution of the problem is beginning to emerge out of darkness, thanks to Mr. Eckles's letter in your issue of August 21st, although it only lifts a corner of the curtain.

He proves what I have thought all along, that people are far more closely related than is generally supposed, but there is another side to the problem he does not touch.

Consider the five or six distinct races of mankind, and the different nations of the world; such isolated people as the Japanese, Chinese, South Sea Islanders, Eskimo, Thibetans, and many detached tribes of India, Africa, and the other continents and islands. Must there not be thousands, not to say millions, of people living to-day who have not the least commingling of blood in their veins for thousands of years at least?

Suppose we say that there are only twenty different people, a very conservative estimate, and take one from each as totally unrelated to the others for say one thousand years past, and reduce the number of their estimated progenitors (1,094 millions) to 10 per cent to meet Mr. Eckles's blood-relationship (a very generous allowance, as the isolation of groups works both ways, and tends to keep distant communities apart), and we arrive at 2,000 millions living at that date against the 1,500 millions of to-day.

Los Angeles, Cal. A. K. VENNING.

WHAT IS HEAT LIGHTNING?

To the Editor of the SCIENTIFIC AMERICAN:

I note in your issue of August 28th a communication from Mr. A. Graham of Topeka, Kan., regarding the classification of lightning. I had the opportunity several years ago of proving that the so-called "sheet" or "heat" lightning is nothing more or less than a reflection, as he states, of the regular "chain" lightning.

I had a discussion with the man in the telegraph office in a small town on a railroad running directly east and west, regarding what he called "heat" lightning. I maintained that it was lightning flashes so far away or so high in the clouds, that we could neither see the flash itself nor hear the thunder.

During the whole summer we watched the storms very closely; practically all of them came from the west; so we were able, by calling up the operators in the different stations, to tell just what was actually occurring, and in every single instance we could find other operators near us reporting "sheet" lightning, while those at twenty-five, thirty, forty, and even fifty miles off were reporting regular lightning, accompanied with thunder.

It is the writer's opinion, based upon the observation of that summer, that there is but one kind of lightning, viz., that which we see reaching from cloud to cloud or from cloud to earth when the storm is near by. The same kind, in fact, that we can ourselves produce on a miniature scale between points of a spark plug in an automobile engine cylinder. The appearance of so-called "heat" lightning is very easily produced on a cloudy or foggy night, by the jumping of a trolley wheel from its wire, thus making an arc that throws its reflection on the clouds.

Pontiac, Mich. A. R. WELCH.

HOW FINGER AND THUMB MARKS WERE DISCOVERED THROUGH A PHOTOGRAPHIC PROOF.

To the Editor of the SCIENTIFIC AMERICAN:

A few weeks ago a photographic proof upon a piece of gelatine printing-out paper was given to the writer to tone with other photographic prints, in the usual chloride of gold and borax toning baths. No particular attention was paid to this print. It was treated the same as the others, namely, washed well, toned, fixed, and washed well again for half an hour.

The prints were all squeeged upon thoroughly-cleaned ferrotype plates. When the prints were dry they were lifted in the usual way, by inserting the tip of a jack-knife blade at one corner, and pulled off. Every print came off perfectly clean, leaving no impression upon the ferrotype plate, except the proof that had been toned. Upon examining the part where this proof had been dried, it was discovered that quite a number of mixed finger marks were clearly discernible upon the ferrotype plate, although not visible in the print. The explanation appears to be this: Gelatine being a colloid body, the greasy matter, lactic acid, and sodium chloride contained in the perspiration of the skin became impressed and retained upon the gelatine surface, although not sufficiently to become visible to the human eye. Traces of lactate and chloride of silver being formed, became partly washed out previous to toning, and completely dissolved upon fixing, but the greasy matter remained. This too would become more perfectly retained when the gelatine came in contact with water; the result being that the greasy matter, not being affected by any of the chemicals used in toning and fixing, became manifest when the print dried down upon the ferrotype plate, leaving this greasy matter upon the japan, thus giving an admirable clue in the line of detection.

New York, N. Y. A. J. JARMAN.

ELECTRICAL FIREBALLS: WHAT ARE THEY?

To the Editor of the SCIENTIFIC AMERICAN:

This question, that I sent to the English Mechanic and which was published in that journal on July 30th, page 618, letter 576, brought out a number of very interesting answers in subsequent numbers of the same paper, notably in those of August 13th and August 20th; and if your correspondent, Mr. A. A. Graham, who writes the article on "Lightning" in the SCIENTIFIC AMERICAN for August 28th, will take the trouble to read the letters mentioned, in the English Mechanic, he may have occasion to modify his opinion regarding "electrical fireballs."

Mr. Graham says: "The recorded instances of fireballs are so rare and questionable, with no evidence of their electrical nature, that the information is not sufficient to enable one to form even a belief in their occurrence."

While entertaining very much the same belief as Mr. Graham, I received a letter from a very intelligent lady, who is spending the summer in a bungalow situated in the pine woods bordering on Buzzard's Bay, Massachusetts.

She writes as follows: "I was awakened about 2 o'clock by hearing rain, and rose to close the windows. The darkness was appalling. There was a flash of lightning and a loud peal of thunder, and as I got to the window I saw a luminous ball descending, some distance away, and when I looked again some minutes after, there were numerous luminous bodies along the roof of a house about fifty feet away; but these lights were stationary, and I watched them till the first streaks of day."

Of course, we know very well what the immovable lights were. The St. Elmo fire, an electrical appearance, is quite commonly seen on the masts and spars of vessels, and on projecting points of high buildings; but the fireball is a very different affair, and there seems to be abundant evidence of its occurrence, that is, if such scientific men as Arago, Humboldt, Flammarion, and E. B. Dunn of the U. S. Weather Bureau may be considered good authority; and in addition to these, letter 59 in the English Mechanic of August 20th, from Edwin Holmes, a member of the Royal Astronomical Society, who describes a fireball that he witnessed himself, may serve to satisfy Mr. Graham that such things as fireballs are not entirely deceptive appearances; and I would be very glad myself to hear from readers of the SCIENTIFIC AMERICAN what they know about them. J. D. HYATT.

New Rochelle, N. Y.

DOES MUNICIPAL OWNERSHIP PAY?

To the Editor of the SCIENTIFIC AMERICAN:

In your issue of August 21st, second column on page 123, you speak of the effect that the electrifying of the London tramways has had on the passenger receipts of the Great Eastern Railway of England. You make the following statement:

"The Council Tramways are a municipal undertaking, and while giving good service, have been run hitherto at a loss, the deficit being paid out of the rates."

As a matter of fact, the report presented a few months ago by the London County Council on the results of the year 1907-8, showed that the gross receipts were £1,663,000 ($8,315,000), which was a surplus on working of £493,000 ($2,465,000) and a net surplus after payment of interest on capital outlay and providing for the repayment of debt of £45,406 ($227,030). The latter amount was carried to the renewals fund.

There has been such a persistent attempt to deprecate municipal ownership throughout the United States, that it is hard to find justice given the subject. This attempt to mold public opinion through the press has been largely brought about by a "press bureau," maintained for that special purpose. While I am personally of the opinion that municipal ownership in the United States would result in failure (because of the deplorable amount of graft and corruption in the administration of municipal affairs) yet it does seem as though municipal ownership *per se* should be given fair show. ARTHUR J. CRAMP.

Chicago, Ill.

EDITORIAL ADDENDUM TO LETTER.

We appreciate the tone as well as the substance of this correction, and regret that we had not noticed the later report quoted. The note was based on a general impression, which was however correct as to the deficits in administration of the L. C. C. tramways in former years. While we are desirous of treating the question of municipal ownership as impartially as possible, however, we would point out that even in the report mentioned, the net surplus was carried over to renewals fund, with the probability that it would be more than used up in the ensuing year. The only justification of municipal trading, in our opinion, is that it should be carried on at a profit, the profit going to the relief of the rates. Since the above-mentioned surplus was not so used, it can hardly be considered as a profit; besides which, it does not represent interest upon the capital expenditure of the Council at a rate upon which any private corporation could survive.

SUPERSENSITIVENESS OF THE BLIND.

To the Editor of the SCIENTIFIC AMERICAN:

In a recent issue of the SCIENTIFIC AMERICAN, I noticed an article on the supersensitiveness of the blind, in which cases were cited of remarkable acuteness of the remaining four senses. The article in question calls to mind a notable experience I had in New York city in 1896.

It will be recalled by thousands of people that the late Charles Broadway Rouss, the blind merchant of that city, offered one million dollars to anyone who would restore his sight. The offer was sensational and was widely circulated in every civilized nation. Thousands of letters, written in many languages, poured into the big Broadway store suggesting remedies, and the blind merchant was besieged by many offering treatments for the restoration of his sight. Rouss, although blind, was a busy man, always at his desk directing the affairs of his great establishment. He was too busy to take treatments, he declared, and so he selected a substitute whose name was Martin and who was alike blind from atrophy of the optic nerve. He was too poor to pay for treatments and was glad to act as a substitute for the millionaire who agreed to defray his expenses. It was understood that Rouss would undergo any treatment that would benefit Martin.

I made arrangements with Rouss for the treatment of Martin and, accordingly, Martin came to my residence every day for about two months. The treatment was electrical from a primary battery of my own invention. The files of the New York World of July 31st, and Journal (since changed to American) of August 1st, 1896, will show that my treatment of the case became quite sensational. I believed that Martin had made some slight improvement and might regain his sight. I finally gave up the case, however, deciding with all oculists that atrophy of the optic nerve is incurable.

Martin was a native of New York city and had been blind nine years. He was of a fearless and impetuous disposition, and went about over the city without a guide. He passed up, down, and across the great thoroughfares frequently and only a few times collided with a bicycle, which vehicle he detested. I was with him on occasions when I marveled at the perfect freedom with which he walked along the crowded streets, showing not the slightest timidity and requiring no aid whatever from me.

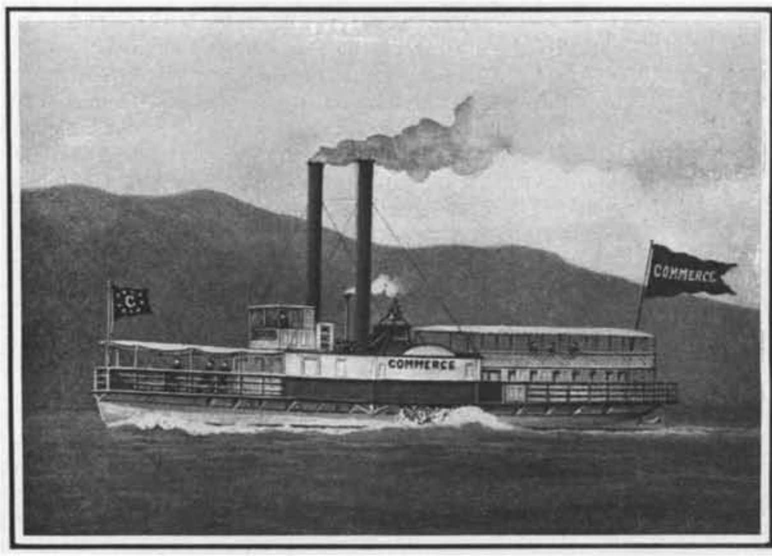
Once I left my residence on 22nd Street near Eighth Avenue with Martin for a walk through the city to Third Avenue and thence down town. In passing he would name with great accuracy the streets and notable buildings. His eyes showed no indication of blindness and no one suspected that he was blind. I was amazed to see him cross Broadway at 14th Street with perfect ease, and imagine my astonishment when he shied around some timbers that had been set up across a sidewalk to prop the wall of a building undergoing repairs. He got off and on street cars without a blunder and made his way across crowded streets without betraying his blindness. He used no cane nor did he feel his way with his hands. Had I not known that he was actually blind I would have believed he was feigning.

I asked him how he knew his way and avoided collisions, and he invariably told me he did not know. He only knew that he cared nothing for his life, and often remarked that he would rather be dead than blind. He seemed to be guided by what I shall term a miraculous instinct superinduced by a subconscious mental condition. I am inclined to the belief, in the absence of a better theory, that he was directed by what Hudson terms "the subjective mind."

Arbuckle, Cal. WALTER W. FELTS.

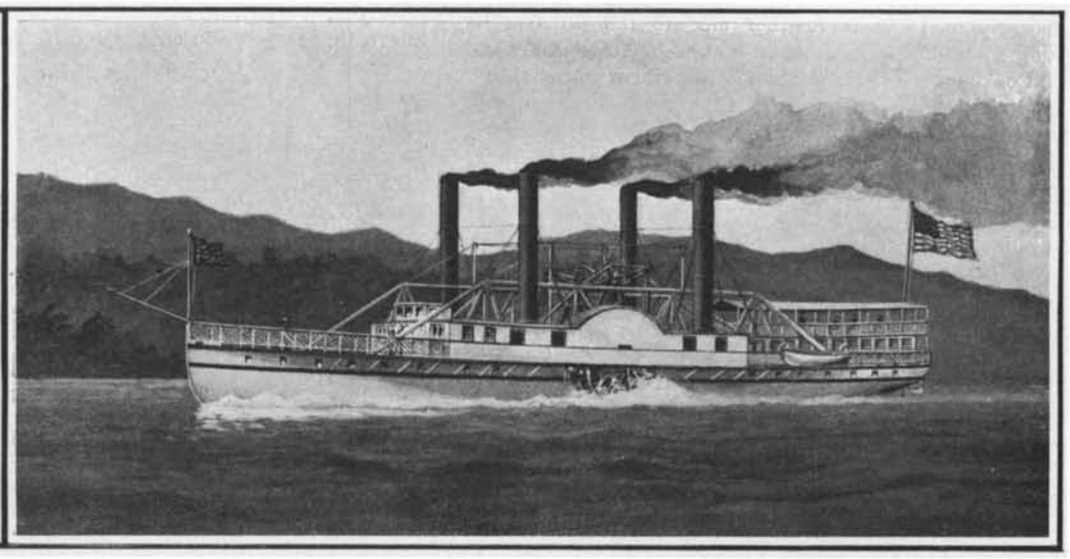
Owing to the careful adjustment and regulation of temperature necessary in bacteriological incubators, a new incubator has recently been built which will be heated by electricity, and which it is expected will thus overcome the difficulties with gas-heated incubators. Incandescent lamps are used in the new heater to maintain the required temperature. A new mercury regulator controls the lamps. The instrument was tested quite recently for a run of forty-five days, and the variations in temperature during this time were practically nothing. The incubator is formed with a triple wall, providing a water jacket and an air space, and is covered with asbestos finished in white enamel.

DEVELOPMENT OF THE HUDSON RIVER STEAMBOAT.



Length, 130 feet; beam, 24 feet; depth, 8½ feet. Engines: Cylinders, 16-inch and 30-inch diameter by 4-foot stroke. Altered in 1852, and renamed "Ontario." Broken up in 1894.

THE "COMMERCE." 1825.



Length, 180 feet; beam, 28 feet; depth, 9 feet. Driven by two engines. Cylinders, 42-inch diameter by 10-foot stroke. Carried two boilers on each guard. In August, 1832, ran from New York to Albany in 9 hours and 49 minutes.

THE "CHAMPLAIN." 1832.

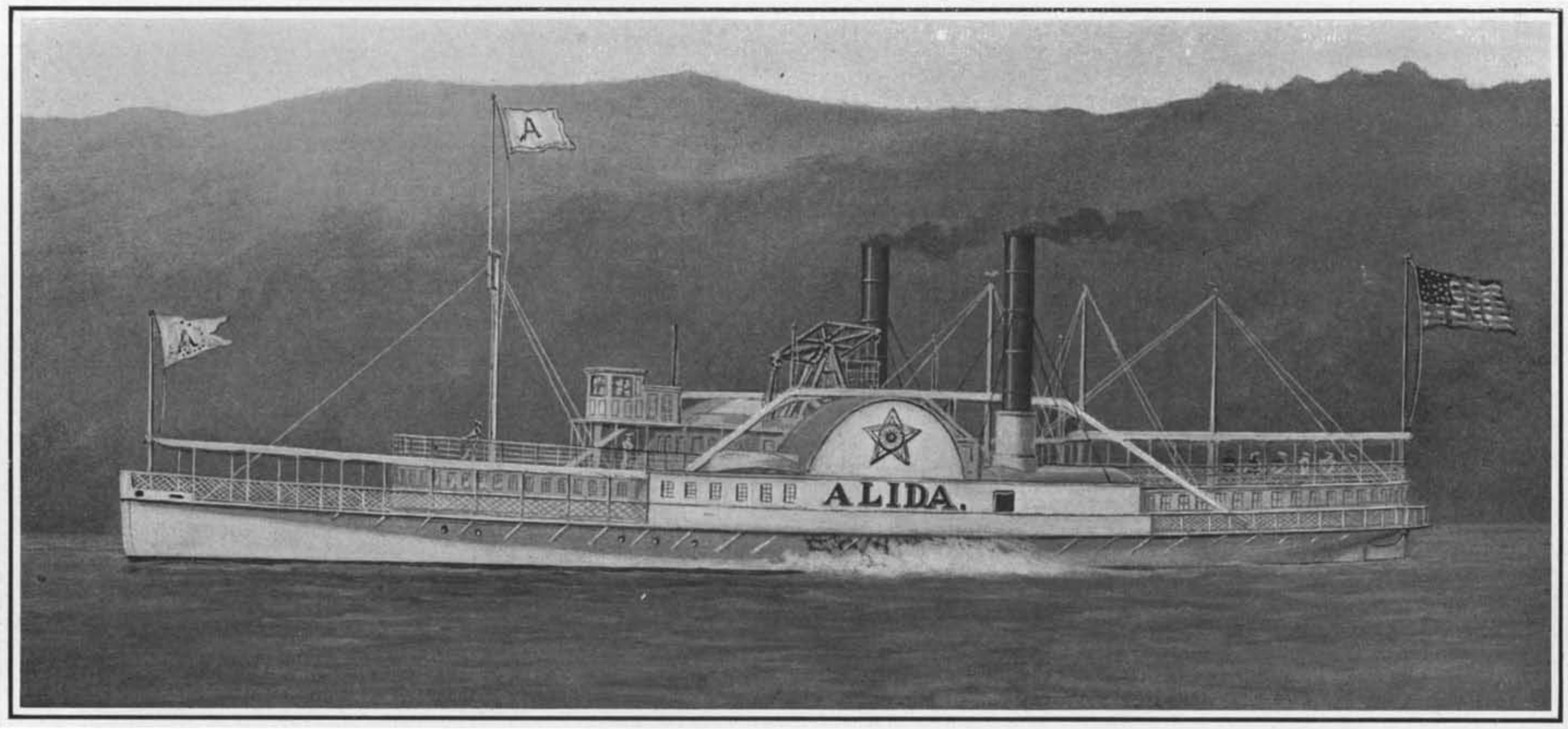
In that broad field of human activity which is covered by the term "engineering," there is probably no product of American design and construction that bears more distinctive national characteristics than the American river steamboat. Also, we venture the assertion that there is no type of passenger vessel plying upon river, lake, or ocean that presents such a perfect picture of graceful lines and contour, or carries such a suggestion of speed as the American river steamboat. That it should show such undisputed beauty is surprising, when we bear in mind that this type of boat has been developed during the past hundred years along lines of the strictest utility, and under the stress of the most severe competition; a competition whose intensity has not been exceeded even in the construction of the competing railroads, which have thrown their elaborate network over the face of the country. Every one of the peculiar characteristics of the river steamboats has been due, not to the mere caprice of the builder, but rather to certain exacting physical conditions of the work which had to be done. The shoal draft, the wide overhanging guards, and even that distinctively American survival (we had almost said anachronism), the walking-beam engine, are instances of "the survival of the fittest" after one hundred years of endeavor to find the best type of boat for this work.

The successful trip of the "Clermont" to Albany in 1807, in the then incredibly brief time of 32 hours, brought the new system of transportation into immediate favor, and the growth of traffic, in spite of the fare of $7 for the single trip, was such as to warrant the construction of four additional steamboats to meet the growing demand. The "Car of Neptune" was built in 1808, the "Paragon" in 1811, the "Firefly" in 1812, and the "Richmond" in 1813-1814. It was not to be expected that so profitable a venture would be allowed to pass unchallenged, and a company was formed at Albany which built two boats to run in opposition to the Fulton line. Fulton and Livingston, however, were granted a perpetual injunction against the opposition company, and the two vessels were turned over to Fulton and broken up. Rendered thus doubly secure in the possession of their exclusive rights in the State of New York, Fulton and Livingston took out additional patents, and settled down to the development of the river carrying trade. Not much is known of the four successors to the "Clermont" mentioned above, beyond the fact that the weakness of construction, which was evident in the "Clermont," was remedied. The rectangular cross section was abandoned; a keel and keelsons were introduced to give the longitudinal stiffness; the flat bottom was abandoned in favor of a dead rise, and the bilge was given the rounded form which characterizes the later vessels.

In 1811 Aaron Ogden, Governor of New Jersey, petitioned the New York Legislature against the Fulton monopoly, but was unsuccessful. He built a steamboat called the "Sea Horse," to run between Elizabethtown, N. J., and New York city, and this vessel is credited by John H. Morrison in his "History of Steam Navigation" with being fitted with an engine that was the pioneer of the American beam engine. Subsequently, Livingston and Fulton gave Ogden permission to run his steamboat on his ferry route for a period of ten years. Out of this arrangement came the litigation, ultimately carried to the United States Supreme Court, by which the steamboat monopoly, which had existed for seventeen years, was broken. One of the most active opponents of the Fulton-Livingston interests was "Commodore" Vanderbilt, who in the early 20's was operating two boats, the "Bellona" and "Stoudinger," from the Battery across the Bay to Elizabethtown, N. J. Robert R. Livingston, Fulton's backer and close associate, died in 1814, and Fulton on February 24th, 1815.

There can be no doubt that the monopoly granted to Fulton served to delay the development both of the steamboat and of river transportation in general. The decision of the Supreme Court in 1824 opened the river to steam navigation by boats propelled "by fire or steam," and forthwith the improvement of the steamboat began to go forward by leaps and bounds. The original North River Company was at once confronted by opposition lines. The Hudson River Line built three boats, the "Constitution," "Constellation," and "Independence," and certain people in Albany set afloat the "De Witt Clinton." The year 1824 is notable for the launching of the first steamboat to carry compound engines, the "Henry Eckford." The cylinders were 12 and 24 inches in diameter, and the stroke 4 feet. The new type of engine gave satisfaction, and it was used in several vessels, including the "Commerce," launched in 1825, of which we present an illustration, and the "Sun" of about the same date. The dimensions of the "Commerce" show the trend of development. She was of less length than the "Clermont," 130 feet as against 150 feet, but of nearly twice the beam, the "Clermont" having been altogether too narrow for stability. Her engines had cylinders 16 and 30 inches in diameter by 4 feet stroke. Altered in 1852 and renamed "Ontario," this remarkable vessel was not finally broken up until the year 1894. The "Sun," whose engines were of the same compound model and of the same dimensions, is credited with having made the trip from New York to Albany in the year 1826 in twelve hours and sixteen minutes, with thirteen landings, so that in the intervening nineteen years since the voyage of the "Clermont," the time of passage had been reduced about two-thirds.

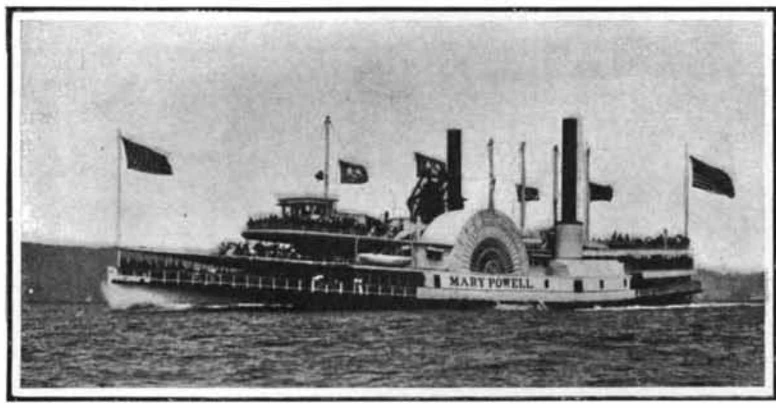
The year 1826 is notable for the fact that John Ste-



Length, 265 feet; beam, 30 feet; depth, 10 feet. Engine, 56-inch diameter by 12-foot stroke. The boilers, as in all the boats of this period, were carried upon the guards, outside of the hull. On May 5, 1848, ran New York to Hudson, 116¼ miles, in 5 hours and 20 minutes at speed of 21.8 miles per hour.

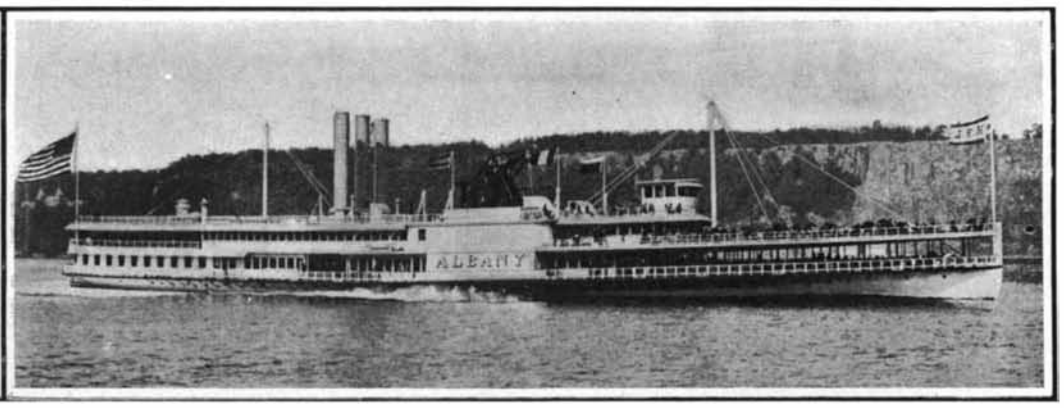
THE "ALIDA." 1847.

vens, the Fulton monopoly having been broken, entered the Hudson River passenger business, and applied his genius to the design of engines and steamboats; and it is doubtful if anyone who worked at the problem in the first half century succeeding Fulton has left a deeper impress. Possessed of a natural gift for engineering, and being a man of wealth and the owner of works of his own, he approached all problems from the scientific standpoint, carrying on careful experimental work before he started the construction of the full-sized engine or boat. To him we owe the present open-skeleton walking beam, with its inclosing wrought-iron strap. In his new "Philadelphia," 1826, he introduced the practice of carrying the boilers outside the boat upon the guards; and in her engine he introduced balanced poppet valves and wrought-iron side pipes. In the following year he introduced (in the "North America") for the first time the familiar truss or "hog frame" for stiffening the hull, a device which has survived in the Hudson River steamboat to the present day.



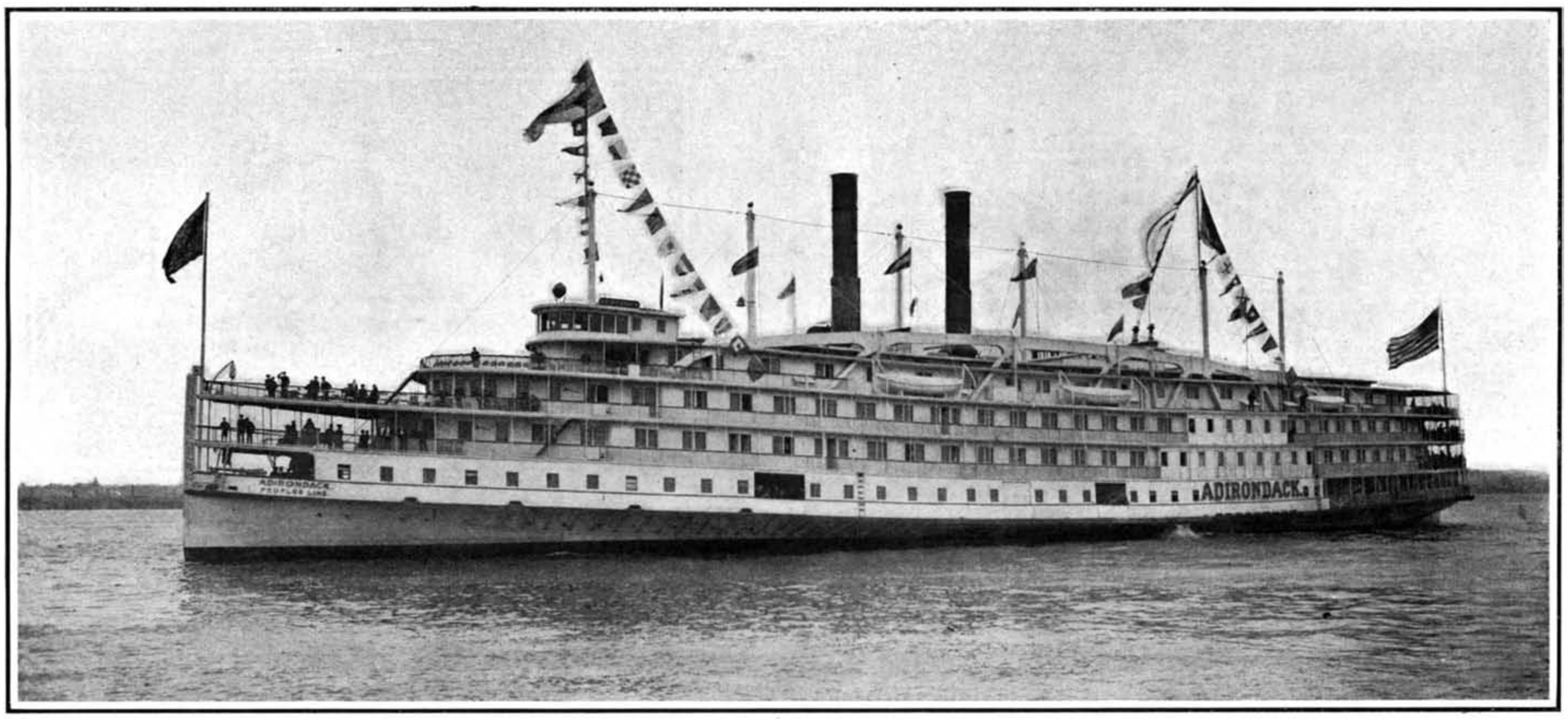
As originally built in 1861: Length was 260 feet; beam, 34¼ feet; depth, 10¼ feet. Engine: Cylinder, 62-inch diameter by 12-foot stroke. Vessel rebuilt in 1875 and 1881. On August 7th, 1874, ran from New York to Poughkeepsie, 74¾ miles, in 3 hours and 19 minutes at speed of 22.54 miles per hour.

THE "MARY POWELL." 1861.



As originally built in 1880: Length, 285 feet; beam, 40 feet; depth, 11½ feet. Cylinder, 75-inch diameter; stroke, 12 feet. Subsequently lengthened to 325 feet. Has feathering paddle-wheels. On October 22d, 1880, ran from 22d Street, New York, to Poughkeepsie, 72⅞ miles, in 3 hours 8 minutes, at speed of 23.26 miles per hour. The "Albany" and the "New York" were the first large Hudson River boats to be built of iron.

THE "ALBANY." 1880.



Length, 412 feet; beam, 50 feet; draft, 8 feet. Beam engine, cylinder, 81-inch diameter, 12-foot stroke. Horse-power, 3,800. Speed, maximum 20¼ miles per hour. Contains 350 staterooms. The dining-room can seat 300 guests. There are four decks for the accommodation of passengers.

THE "ADIRONDACK" FOR NIGHT SERVICE. 1896.

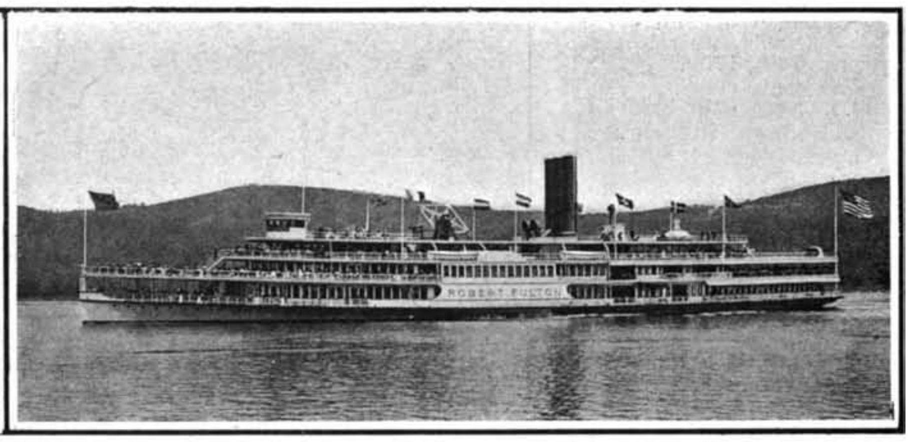
It was at about this time that the practice was followed in some of the steamboats of providing two separate engines, one for each paddle wheel. The "North America," above referred to, had engines of this kind, as did the "Champlain," 1832, which is shown in one of our illustrations. The "Champlain" also illustrates another point of current practice in the possession of four separate boilers, one carried forward and one aft of the wheel house on the guards on each side of the vessel. The "four-pipe boats" with their two oscillating walking beams must have presented an odd appearance to the people of that day, who were accustomed to the one- and the two-pipe practice of the previous years. The next vessel to make a considerable cut in the running time to Albany after the performance of the "Sun" was the "Novelty," which on May 31st, 1832, ran from Albany to New York in nine hours and forty-seven minutes. On August 23rd of the same year, the "Champlain" made the run north in nine hours and forty-nine minutes.

The period from 1830 to 1840 was marked by a truly wonderful development in the speed of the Hudson River steamboat. At that time there were no steam vessels anywhere in the world that could approach these famous craft in speed, and that American shipbuilders and engineers should have gained such a commanding lead over the Old World is to be attributed to the facilities afforded by our magnificent rivers, to the keen competition between the various companies, and to the fact that then as now it is the fastest means of conveyance that wins the popular favor. Two of the swiftest boats of the day were the "Swallow," which was built for the original North River line, and the "Rochester," built in the same year, 1836, for the People's Line, which was started in 1835. The "Swallow," after frequent alterations to engines and hull, with a view to increase of speed, was finally equipped with a cylinder of the huge diameter for those days of 52 inches, and the "Rochester" with one of 50 inches diameter. The particulars of these boats as given by Morrison show to what an advanced stage

(*Continued on page 227.*)

Length, 390 feet; beam, 43 feet; width over guards, 82 feet; draft, 7½ feet. Inclined engine; one 45-inch high pressure, two 70-inch low pressure cylinders, with 7-foot stroke. Steam, 170 pounds. Speed on trial trip, 24.5 miles per hour. Has six decks, four of which comfortably accommodate 5,000 passengers.

THE "HENDRICK HUDSON," 1906. DAY SERVICE.



Length, 348 feet; beam, 42 feet; draft, 7½ feet. Beam engine, cylinder 75-inch diameter by 12-foot stroke. Has feathering paddle wheels. This vessel has the finest underwater body of all the Hudson River boats. Her maximum speed is 23½ knots.

THE "ROBERT FULTON." 1909. DAY SERVICE.

AMERICAN STEAMBOATS PRIOR TO THE "CLERMONT."

It is one of the estimable qualities of Robert Fulton that, in spite of the obvious temptation so to do, consequent upon his brilliant success with the "Clermont," he never claimed the distinction of being the original inventor of the steamboat. He was perfectly familiar with the ingenious work in the development of steam navigation which had been done both in the United States and in Europe during the two decades preceding the successful trip of the "Clermont." He had intimate knowledge of the previous history of the art; he was personally acquainted with the more successful inventors; and, as a guest, had made trips on at least one of the more successful boats. The present celebration, so far as Fulton is concerned, is held in honor of the *successful inauguration of practical commercial steamboat navigation on the Hudson River.* There is glory enough, surely, in this to make a fitting crown for the life work of one man. Were Fulton in our midst to-day, he would be among the first to do justice to the work of his predecessors and contemporaries, in other times and on other waters.

It is impossible, within the limits of the present article, to describe at any length the dozen or more steamboats, big and little, which were built and tried with varying degrees of success in America prior to 1807. We must content ourselves with the following summary (based on Preble's history) of these early efforts, followed by a brief sketch of the remarkable work of Fitch and Stevens.

The first boat successfully propelled by steam in America was one built by John Fitch, which was tried on the Delaware, July 27th, 1786.

The second American steamboat, also built by Fitch, was tried on the Delaware in 1787.

The third boat, built by James Rumsey, and driven by a water jet, was operated at Shepardstown on the Potomac, September 3rd, 1787.

The fourth steamboat, built by Fitch, ran from Philadelphia to Burlington in 1788.

The fifth steamboat, also built by Fitch, made eight miles an hour over a measured course at Philadelphia in 1789, and in 1790 was placed in regular service on the Delaware as a packet, its sailing dates being advertised in the local press.

The sixth steamboat, a stern-wheeler, built by Capt. Samuel Morey of Connecticut, sailed from Hartford to New York, with Chancellor Livingston and others on board, in 1794.

The seventh steamboat, by Fitch, tried on the old Collect Pond, now the site of the Criminal Court building and City Prison, New York, was driven by both paddle wheels and a screw propeller. Chancellor Livingston was aboard on this trip, and a very crude model of the boat, shown in the accompanying illustration, is now in the keeping of the New York Historical Society.

The eighth boat, by Morey, was tried on the Connecticut River in 1797.

The ninth steamboat was built to plans of Chancellor Livingston by a Mr. Nisbet, and tried at De Koven's Bay, south of Tivoli, in March, 1798.

The tenth steamboat was a model side-wheel vessel built by Fitch and tried on the Ohio in 1798.

The eleventh boat, built and designed conjointly by Nicholas Roosevelt, John Stevens, and Chancellor Livingston, had side chain wheels driven by a steam engine. It was tried successfully in October, 1798, and with the Spanish Minister on board as a guest made three miles an hour.

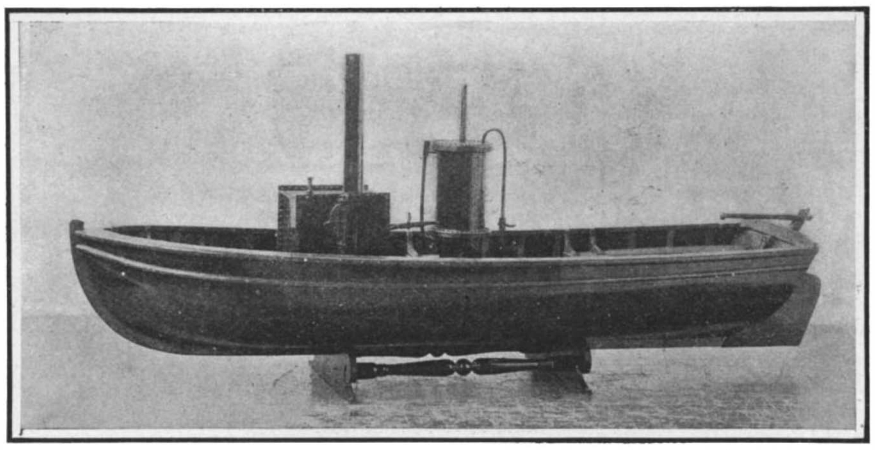
The twelfth steamboat, built by Col. John Stevens, was a 25-foot flat-bottomed boat, which was driven by a screw propeller on the Hudson River at a speed of four miles per hour in 1803 and 1804.

The thirteenth steamboat, built in 1804 by Stevens, was propelled by twin screws at a speed of seven to eight miles per hour, and made several trips on the Hudson River.

The fourteenth steamboat, built by Oliver Evans in 1804, was a large scow, or lighter, driven by a paddle wheel at the stern.

The fifteenth and last steamboat before 1807 to make a trip under her own steam was a large pirouge, with side paddle wheels, called the "Phœnix," built by Stevens in 1806-7, which, being debarred by Fulton's monopoly from navigating on the Hudson, subsequently steamed to Philadelphia by sea, and thus became the first steamship to make an ocean voyage.

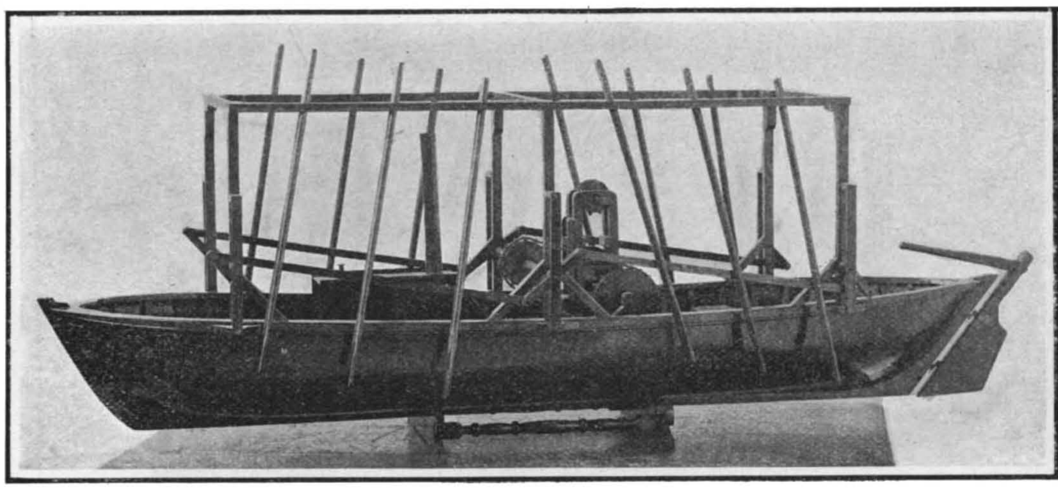
It should be understood that although the above enumeration includes vessels that were actually moved by steam, no claim is made that they were all of a practical character. Of the Americans who turned their attention to the development of the steamboat in the pre-"Clermont" period, two men, in our opinion, stand head and shoulders above their competitors, namely, John Fitch and John Stevens; the first, for the reason that as far back as 1790 he placed on the waters of the Delaware a steamboat which ran on a regular schedule, was advertised extensively in the local papers, and carried freight and passengers at specified fares; the latter, because he was the first to apply the screw propeller as the sole means of propelling a boat; that he used tubular boilers and high-pressure steam; and that he was the first to adopt that system of twin propellers which subsequently became the standard method of propulsion throughout the world.



Rumsey's boat was propelled by a steam engine and pump which drew in water through the bottom and discharged it in a jet at the stern. Made four miles an hour in a short trial on the Potomac; but never reached the stage of practical operation.

(From photograph of the model in the Smithsonian Institution taken especially for the Scientific American.)

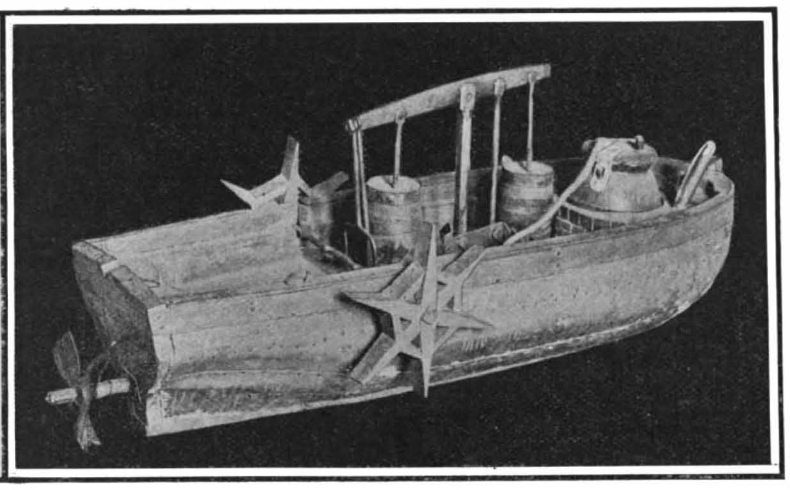
JAMES RUMSEY'S STEAMBOAT OF 1787.



This boat made six miles an hour on the Delaware. It was propelled by vertical paddles, driven in sets of three by side rods operated by a steam engine.

(From photograph of the model in the Smithsonian Institution.)

JOHN FITCH'S STEAMBOAT OF 1787.



This crude model was made from memory in 1852 by a witness of the trials of the boat on the old Collect Pond, New York city.

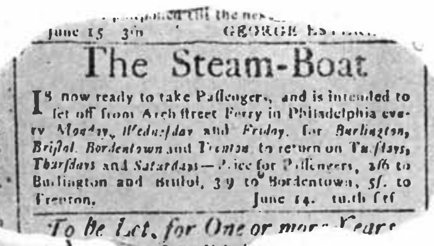
(From photograph of the model at the New York Historical Society.)

JOHN FITCH'S STEAMBOAT OF 1796.

THE
STEAM BOAT
SETS out to-morrow morning at ten o'clock, from Arch-street ferry, in order to take Passengers for Burlington, Bristol, Bordentown, and Trenton, and return next day.
Philad. July 26, 1790.

Gray's Garde

Photograph of advertisement in the "Federal Gazette" of Philadelphia, July 26th, 1790.



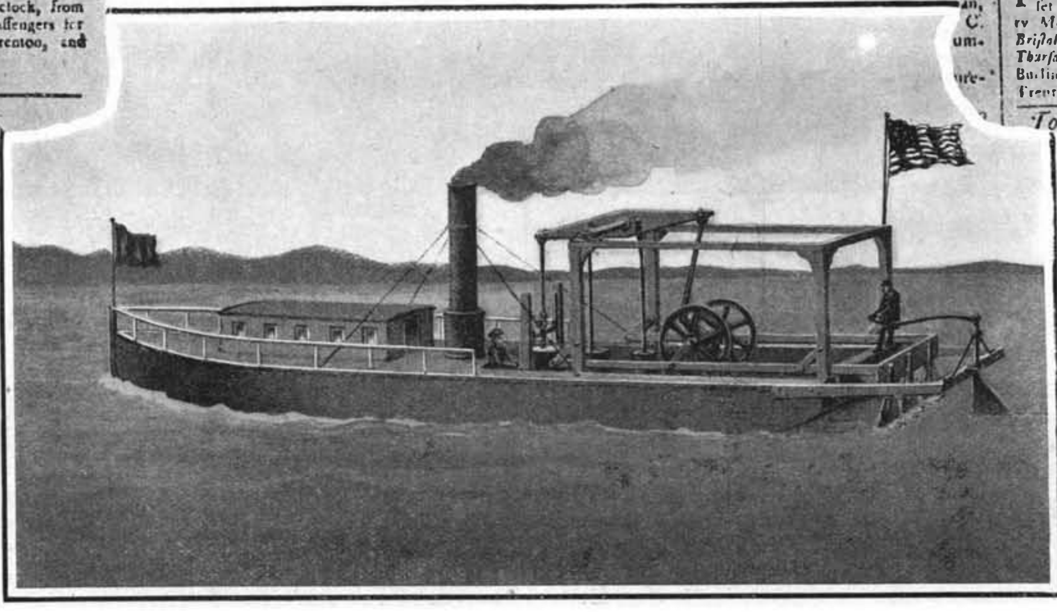
June 15 3tn GEORGE

The Steam-Boat

IS now ready to take Passengers, and is intended to set off from Arch street Ferry in Philadelphia every Monday, Wednesday and Friday, for Burlington, Bristol, Bordentown and Trenton, to return on Tuesdays, Thursdays and Saturdays—Price for Passengers, 2/6 to Burlington and Bristol, 3/9 to Bordentown, 5/. to Trenton. June 14. tu.th f.tf

To Be Let, for One or more Years

Photograph of advertisement in the "Pennsylvania Packet" of Philadelphia of June 14th, 1790.



This boat, 60 feet long, driven by an engine with cylinder 18-inch diameter, designed and built by Fitch, was put in regular service, advertised in the Philadelphia papers, and for three months in 1790 sailed according to schedule between Philadelphia, Trenton, and way points. Its average speed was 7 miles an hour. It was propelled by paddles at the stern.

JOHN FITCH'S STEAMBOAT, WHICH SAILED REGULARLY BETWEEN PHILADELPHIA AND TRENTON IN 1790.

JOHN FITCH.

John Fitch stands out as a splendid type of a large class of ingenious, courageous, but poor inventors, who did so much to promote the industrial development of the country during the early years of the young republic. Born at

Windsor, Conn., on the 21st of January, 1743, in moderate circumstances, he learned the trade of clock making, and at twenty-six years of age moved to New Jersey and then to Philadelphia, where he became a strong partisan on the American side in the dispute between the colonies and Great Britain. He was made lieutenant of a company raised at Trenton, but ultimately he found his sphere of usefulness in the gun factory at Trenton. When Washington crossed the Delaware Fitch moved with the Continental troops to Pennsylvania. In 1780 he was appointed a deputy surveyor, and ultimately struck out westward for the purpose of surveying lands lying beyond the Ohio River. In 1781 he started for Fort Pitt, now Pittsburg. Later he was captured by the Indians, endured severe privations, and was finally carried by them to Canada, where he fell into the hands of the British. After his liberation he again took up the work of surveying the unknown lands of the West; and ultimately, in 1785, turned his attention to his great life-work of inventing a boat to travel by the power of steam. Beyond a natural aptitude for mechanics, Fitch was entirely unfurnished for this difficult task. Although steam-engine building was a recognized trade in England, and had been for many years, there were at this time but three steam engines in the whole of America, and the country was absolutely without suitable means for steam-engine manufacture. In his quaint 500-page manuscript autobiography, now in the Philadelphia Library, Fitch writes: "Although it was not to my credit, I did not know that there was a steam engine on earth when I proposed to gain a force by steam." He read up all the scant literature he could obtain on the subject, formulated his plans, and on September 27th, 1785, presented a drawing and model of his boat to the American Philosophical Society at Philadelphia. The model shows the method of propulsion by an endless chain provided with paddle boards. He endeavored to interest Franklin and Gen. Washington in his plans, neither of whom, however, gave him much encouragement. He formed a company, and on March 18th, 1786, secured from the Legislature of New Jersey the exclusive rights for steam navigation in that State. It was at this time that he associated himself with Henry Voight, a clock-maker of unusual mechanical ingenuity and skill. The task which these men had set themselves was Herculean. There were no machine shops nor the necessary tools for the accurate work required; and through the subsequent years of experimentation they had to feel their way, amid a thousand discouragements of poverty and ignorance, to the final success which crowned their efforts five years later. They first built a model steam engine with a cylinder of one inch diameter, which was too small for a demonstration. Then a new model, with a 3-inch cylinder engine, was erected in a small skiff, and a trial was made with Fitch's endless chain paddle-boards, but without success. Then it occurred to Fitch to move the boat by oars or paddles, working on the side, and moved by cranks operated by the engine. This was tried on the skiff with the 3-inch engine, and on the 27th of July, 1786, the first boat propelled by steam in America made its trial trip successfully on the Delaware. Encouraged by the passage of a law by the State of Delaware in 1787, securing Fitch's right to the invention, fresh advances of money were made by the shareholders, and a boat 12 feet wide and 45 feet long was equipped with an engine having a 12-inch cylinder. After much experimental work with the condensers, this boat, on August 22nd, 1787, was propelled on the Delaware in the presence of practically all the members of the Convention who were then sitting in Philadelphia to frame the Federal Constitution. Certificates of perfect success of this trial were given by Gov. Randolph of Virginia, David Rittenhouse the astronomer, and other notable men. An engraving and description of the boat made from the plans were published in the Columbian Magazine for December, 1786.

Col. Stevens built the first successful steamboat driven entirely by the screw propeller; the first twin propeller boat; and the first steamboat to make an ocean voyage.

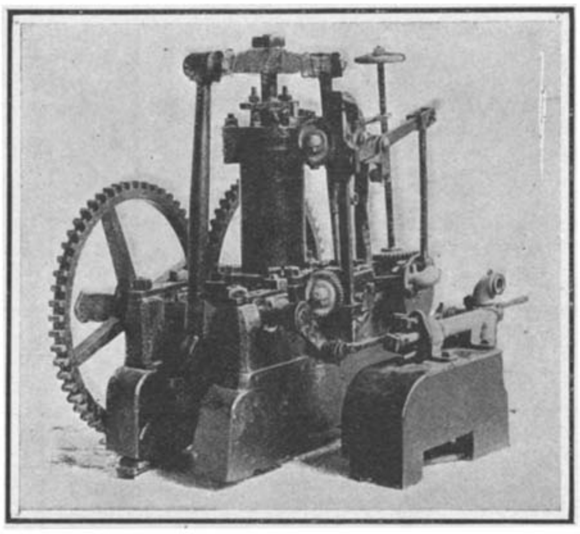
COLONEL JOHN STEVENS; 1749-1838.

The cylinder was double-acting and condensing. Fitch introduced the jet condenser, which he believed to be original with him, although it had been previously invented in Europe. The boat was driven by six pairs of oars, or paddles, which were pivotally connected in sets of three to four horizontal driving bars, operated by cranks on crank disks driven by the engine. Fitch preferred these paddles to the paddle wheel, because he considered that the latter involved a great waste of power, due to the obliquity of the wheels on entering and leaving the water. Fitch's objection to the paddle wheels was theoretically correct; and its inefficiency was not corrected until the invention, half a century later, of the feathering paddle wheel.

The third steamboat built by Fitch was a much larger craft, and was driven by a greatly improved engine. The new boat was 60 feet in length and 8 feet in beam. Its engine, also, had 12-inch cylinder; but as the result of an improved condenser, designed by Fitch, it developed considerably more power than the engine in the preceding boat. Furthermore, it should be mentioned that this was the first steamboat equipped with a tubular boiler, the invention of Voight. The oars, or paddles, were removed from the sides and placed at the stern. Toward the close of July, 1788, she made the trip of twenty miles from Philadelphia to Burlington, and on the 12th of October she made the same trip in three hours and ten minutes with thirty passengers on board. The boat continued in more less experimental operation during 1788 and 1789. The story of the troubles of Fitch and Voight in the endeavor during this time to perfect their engine, as contained in Fitch's autobiography, is of absorbing interest. No less than seven different condensers were tried and rejected. Finally an 18-inch steam cylinder and a jet condenser of Fitch's design were installed, and at last, in the words of Fitch, "On the 16th of April (1790) got our work compleated, and tried our Boat again; and altho the wind blew very fresh at the north east, we reigned Lord High Admirals of the Delaware, and no boat in the River could hold its way with us, but all fell astern, although several sail boats, which were very light, and heavy sails, that brought their gunwales well down to the water, came out to try us."

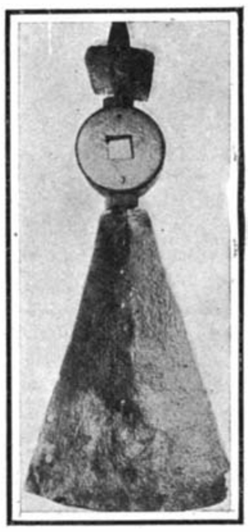
Shortly afterward, Rittenhouse the astronomer, Dr. Ewing, Gen. Irvine, and others were favored with the novel experience of a steam voyage; and now, at last, public journals began to give well-deserved notice to the successful efforts of these indefatigable inventors. The following paragraph was published in the Gazette of the United States, May 15th, 1790, and widely recopied throughout the Union: "Burlington, May 11, 1790. The friends of science and the liberal arts will be gratified in hearing that we were favored, on Sunday last, with a visit from the ingenious Mr. Fitch, accompanied by several gentlemen of taste and knowledge in mechanics, in a steamboat constructed on an improved plan. From these gentlemen we learn that they came from Philadelphia in three hours and a quarter, with a head wind, the tide in their favour. On their return, by accurate observations, they proceeded down the river at the rate of upwards of seven miles an hour." Subsequently, on June 16th, Gov. Thomas Mifflin and nine members of the

(*Continued on page 222.*)



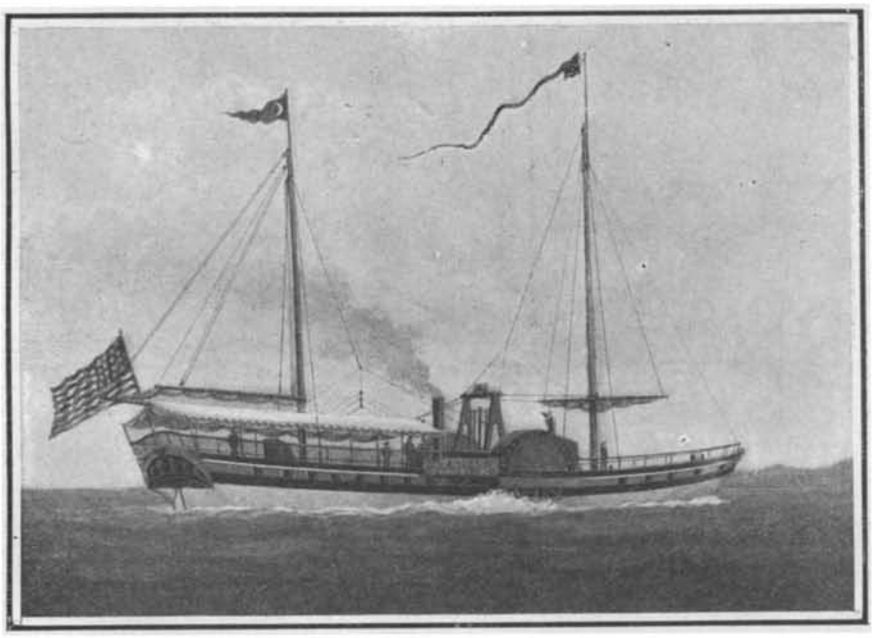
Cylinder, 4½-inch diameter by 9-inch stroke. Two connecting rods to two shafts which are geared together and turn in opposite directions. Valves are two-way cocks, operated by a crank on inboard end of one of the crank shafts.

ENGINES OF STEVENS'S TWIN-SCREW STEAMBOAT OF 1804.



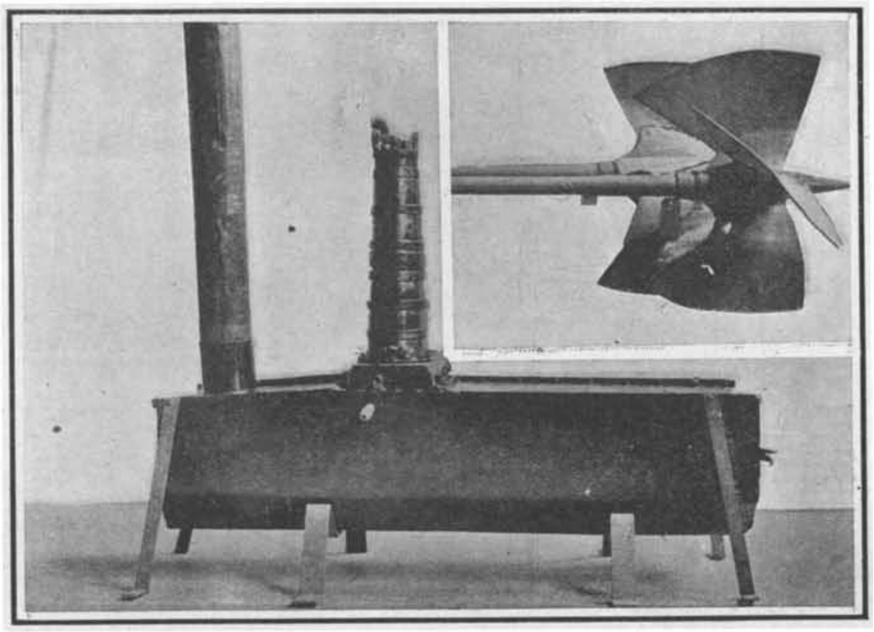
Round shank could be turned in the hub to change pitch.

STEVENS'S ADJUSTABLE PROPELLER BLADES



Debarred by the Livingston-Fulton monopoly from navigating the Hudson, the "Phoenix" went by sea to Philadelphia and was operated on the Delaware. (This was the first steamboat to make an ocean voyage.)

STEVENS'S STEAMBOAT THE "PHOENIX," 1807.



Boiler has 28 tubes 1½-inch diameter and 18 inches long; fourteen projecting from each side of the central rectangular chest. (From photograph by the courtesy of the Smithsonian Institution.)

MULTI-TUBULAR BOILER AND TWIN SCREWS OF THE STEVENS BOAT OF 1804.

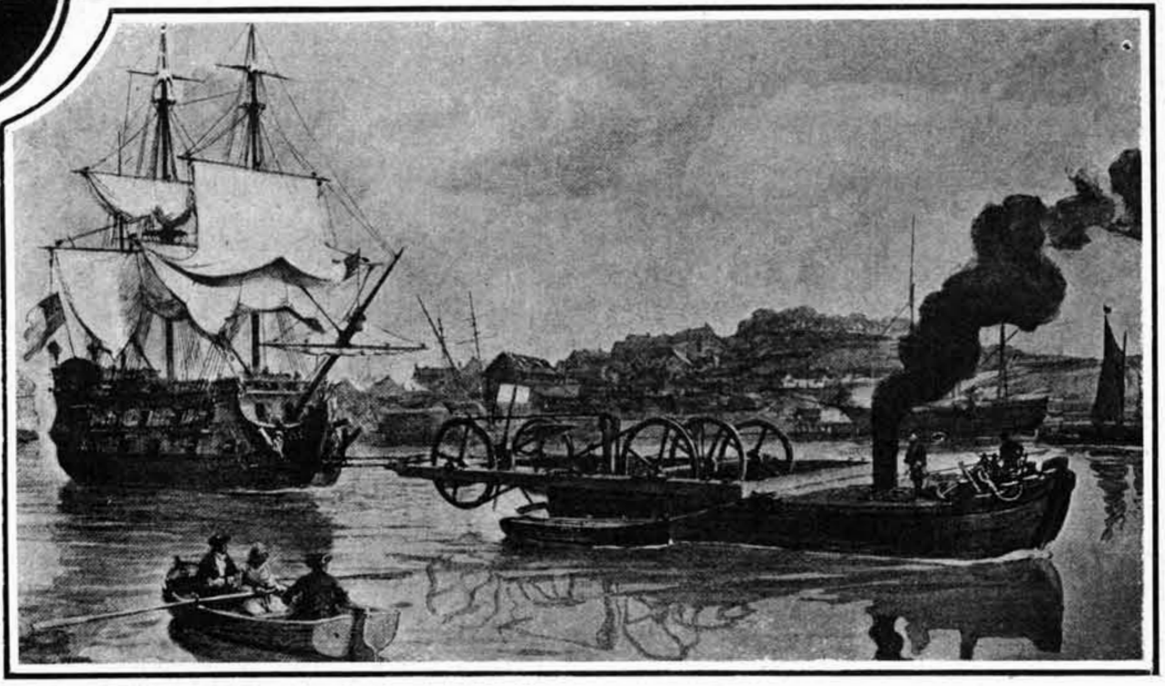


Fig. 1.—JONATHAN HULLS'S PROPOSED BUT NEVER BUILT STEAM TUG. 1737.

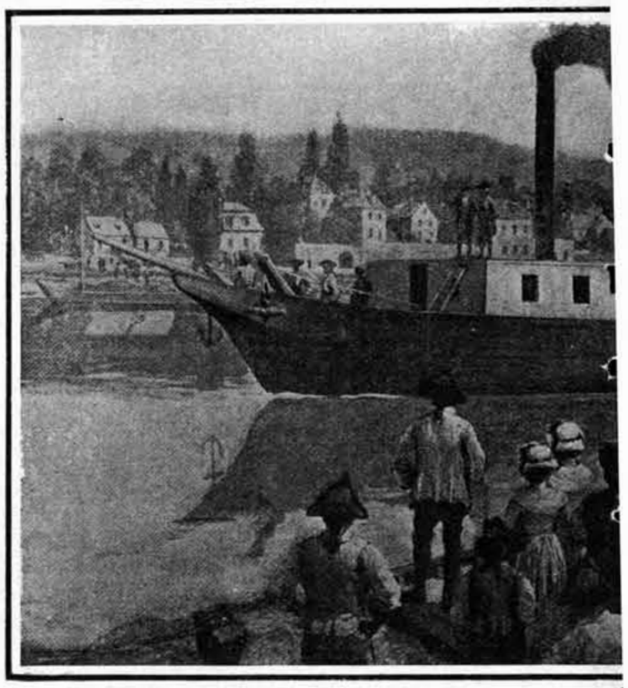


Fig. 2.—THE MARQUIS DE JOUFFROY'S PADDLE STE

FIG. 1.—In 1736 Jonathan Hulls, yeoman, of Campden, Gloucestershire, patented and published a complete description of a practical steam-tug. The tug had a single-acting steam-cylinder, 30 inches in diameter, which in its inward stroke lifted a weight equal to one-half of its effective pull. The energy of this weight in its descent during the return stroke gave the engine a double action and the reciprocating motion of the piston gave continuous rotation by a ratchet gear to a paddle-wheel at the stern.

FIG. 2.—The drawing is based on a sketch at South Kensington Museum taken from a French print published in 1816. In Paris there exists a document declaring that on July 15, 1783, the vessel was propelled by steam for fifteen minutes against the current of the Saone. The boat was 150 feet long with 15 feet beam and 3 feet 2 inches draft. It had two paddle-wheels, turned by a single horizontal steam-cylinder, driving through a ratchet mechanism.

FIG. 3.—Patrick Miller, a wealthy Scotch banker, built a double-hulled boat which he propelled by a paddle-wheel, placed in the channelway between the hulls and operated by men by means of cranks and winches. Symington subsequently (Fig. 5) substituted steam for man power.

FIG. 4.—This vessel, designed by Symington for the Forth and Clyde canal, in March, 1802, towed two 70-ton barges for 19½ miles against a hard wind at the rate of 3½ miles an hour. The horizontal engine, direct-connected from cross-head to paddle-wheel shaft, was many decades ahead of its time. It embodies all the essential features of the modern horizontal engine, and mechanically was a great advance upon the Watt beam engines of that day.

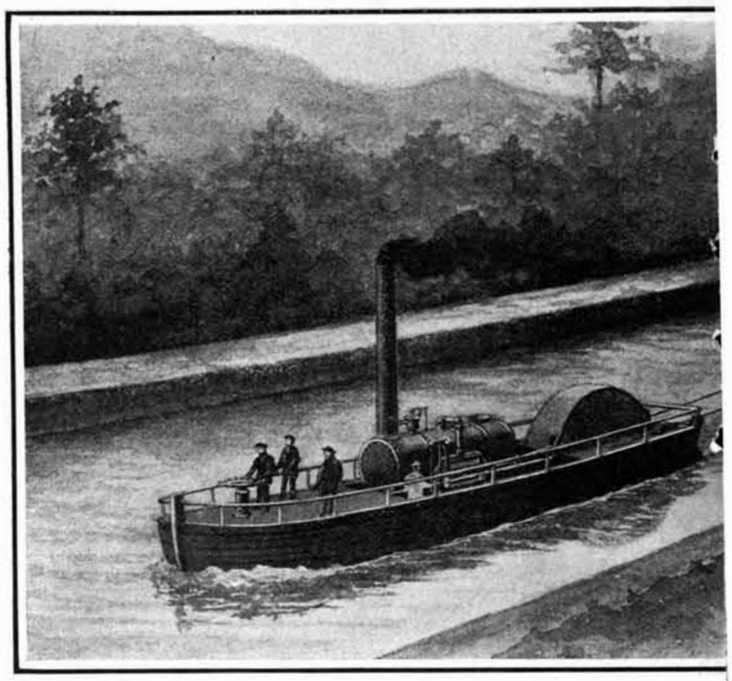


Fig. 4.—WILLIAM SYMINGTON'S STEAMBOAT "CHARLOTTE DUNDA

Fig. 5.—SYMINGTON AND MILLER'S DOUBLE-HULLED STEAM VESSEL. 1788.

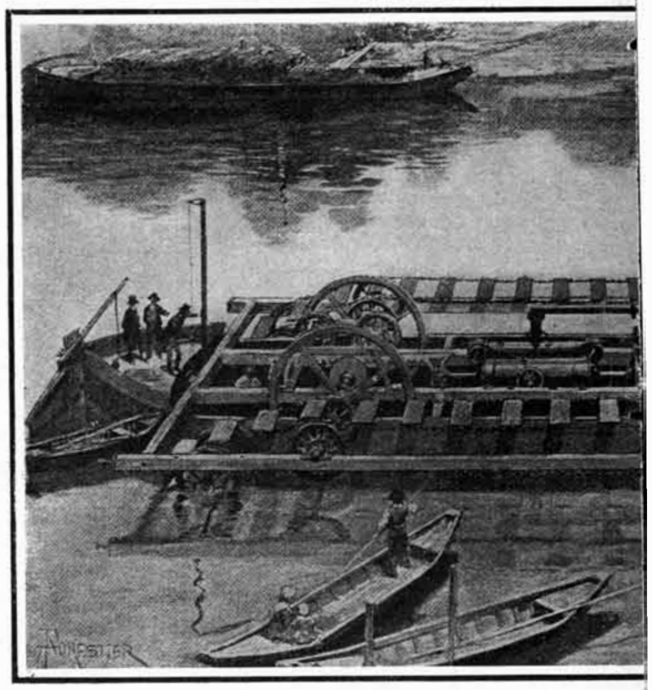


Fig. 6.—DESBLANCS' STEAMBOAT TRIED

EUROPEAN STEAMBOATS PRIO

Figs. 4 and 7 by our own artist; the others by the c

AMBOAT ON THE SAONE. JULY 15TH, 1783.

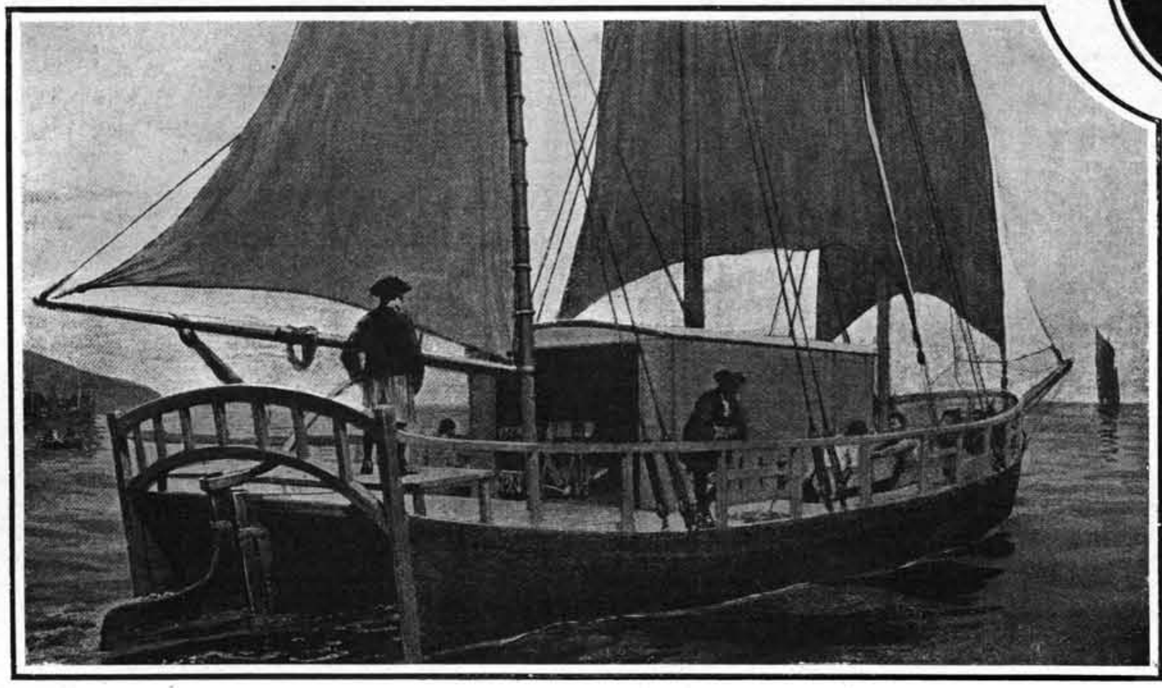
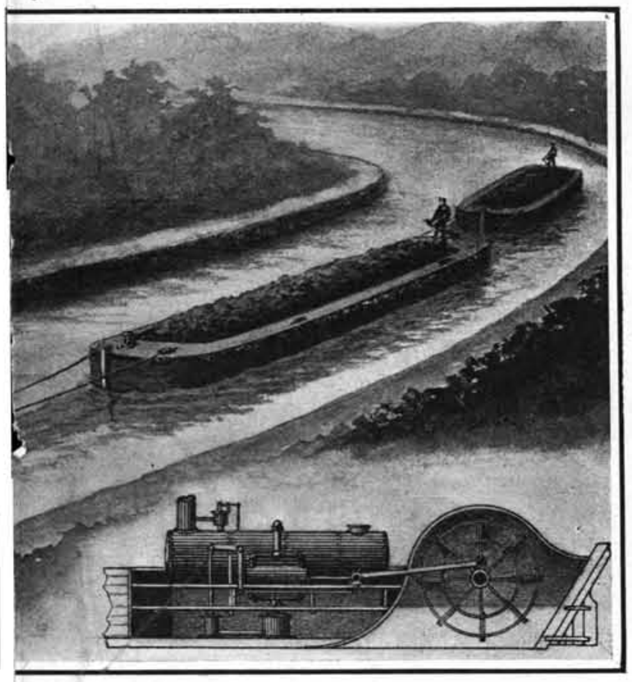


Fig. 3.—PATRICK MILLER'S DOUBLE-HULLED PADDLE BOAT DRIVEN BY MAN POWER. 1786.

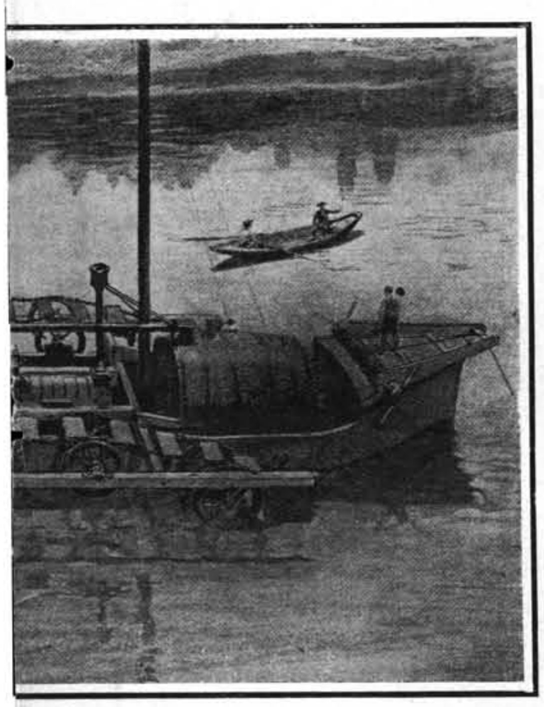


.S" TOWING ON THE FORTH AND CLYDE CANAL. 1802.

FIG. 5.—The engine for this boat was built in 1788 by William Symington for Patrick Miller. It was placed on one deck of a double-hulled pleasure-boat, and the boiler was put on the other deck. The boat ran on Dalswinton Loch at the rate of five miles an hour. The engine had two vertical open-topped cylinders with pistons connected by two chains with a drum turning in opposite directions alternately. Chains from the central drum turned two pulleys attached to the horizontal paddle-shafts, with ratchet teeth round their inner flanges, and these drove the paddle-wheel continuously in one direction.

FIG. 6.—The hull of the vessel was built like a barge. The horizontal motion of the cylinders was converted into circular motion by a ratchet gear acting upon the axle of the fly-wheels. The floats of the paddle were arranged on parallel chains, and traveled like the buckets of a dredger. As the floats of the paddle came out of the water they feathered like an oar.

FIG. 7.—This illustration, drawn from plans filed by Fulton with the French Commission appointed by Napoleon I. to investigate his invention, possesses special interest, because it undoubtedly formed the model on which the engines of the "Clermont" were designed. The engine consisted of an upright cylinder, cross-head, vertical side rods connecting to a bell-crank lever, from which the paddle-wheel crank-shaft was driven by a connecting rod. It made 3½ miles on its trial trip.



ON THE RIVER DOUBS. 1802

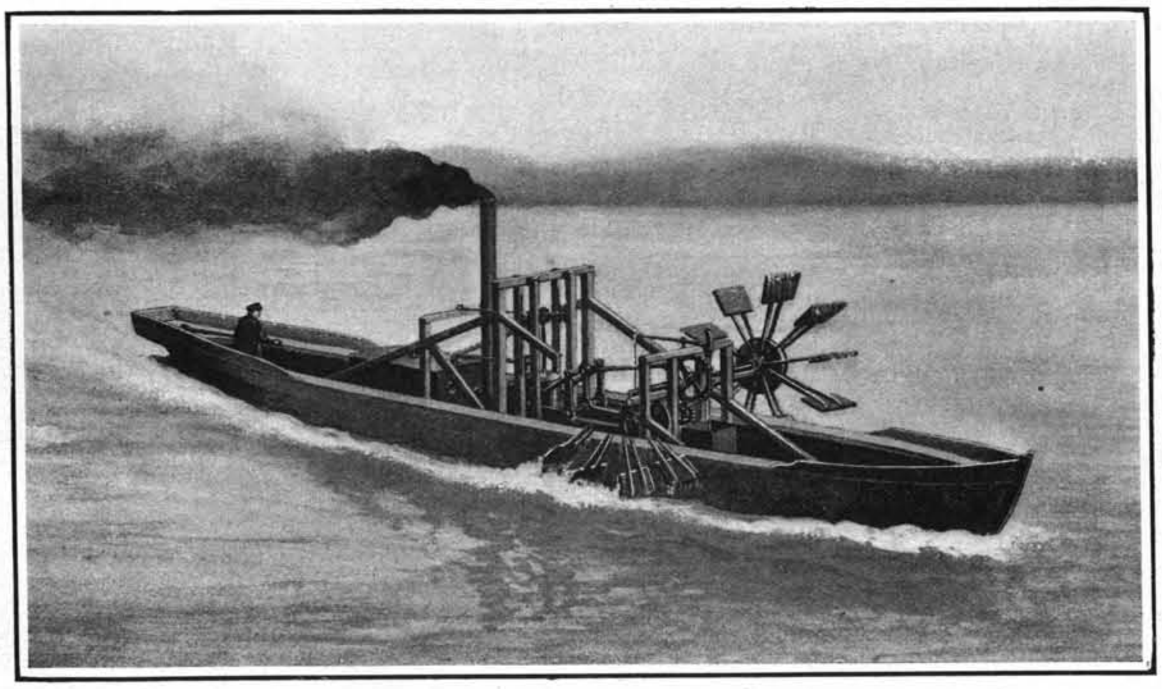


Fig. 7.—FULTON'S STEAMBOAT BUILT AND TRIED ON THE SEINE AT PARIS. JULY, 1803.

)R TO THE "CLERMONT."

ourtesy of the Illustrated London News.

[SEE PAGE 222.]

EUROPEAN STEAMBOATS PRIOR TO THE "CLERMONT."

As in America, so in Europe, the quarter of a century preceding the successful inauguration of steamboat service on the Hudson River was a period of extraordinary interest among inventors in the possibilities of steamboat navigation, during which a great amount of thought and experimental work was devoted to the development of a successful steam-driven vessel. In the present chapter we shall touch lightly upon those inventors who merely drew up plans, took out patents, and made more or less successful models of steamboats; our attention will be devoted more specifically to the clearly-recorded and well-authenticated instances, in which steamboats of useful size were actually propelled by steam.

Following this plan, we may dismiss at once the oft-asserted claim that a vessel of some 200 tons, built by Blasco de Garray, a native of Biscay, was propelled by steam at Barcelona in Spain in the year 1543. Careful search by investigators has revealed two letters, signed by Garray and dated 1543, describing experiments with different vessels, both of them moved by paddle wheels *turned by men*. There is no mention of the use of steam, or anything to indicate that this motive power was contemplated.

The Marquis of Worcester published a book in 1663, in which mention is made of an engine, and of the ability of the inventor to make the vessel which carried it "go against the stream which the more rapid it is the faster it shall advance." His patent, however, contains no suggestion that he had any idea of using steam.

Although the name of no inventor in the early part of the eighteenth century is more closely associated with the design of the steamboat than that of Jonathan Hulls, there is no proof that he ever built and operated one. At the same time, Hulls was a man of unusual intelligence and of considerable mechanical skill. His patent, taken out in 1736, describes the invention as "a machine for carrying ships and vessels out of, or into, any harbor or river against wind and tide." The following year he published a pamphlet in London describing his invention; and it is curious that, like many early experimentalists, he considered that its greatest usefulness would be found in the towing of vessels. The illustration of his boat, given on page 220, was drawn from his very complete description of the mechanism of the boat, and Admiral Preble, of the United States navy, in his work "On the Origin and Development of Steam Navigation," says that "there can be no doubt of his having been the first inventor of an ingenious and practicable mechanism for propelling vessels by a condensing steam engine and by paddle wheels"; and this, be it remembered, was as far back as 1736. Writing over a quarter of a century ago, again the same author says: "The following doggerel is still the burden of a common street ditty among the boys of Campden of Gloucestershire, Hulls's native place:

'Jonathan Hulls,
With his patent skulls,
Invented a machine
To go against wind and stream;
But he, being an ass,
Couldn't bring it to pass,
And so he was ashamed to be seen.' "

Truly, a prophet is not without honor save in his own country.

It is a disputed point whether to Denis Papin, the great French engineer and professor of mathematics at the University of Marburg, is due the credit of being the first to make a steamboat run upon a public waterway. Preble, however, is of the opinion that his correspondence with Leibnitz, which was brought to light during the latter part of the nineteenth century, fully proves that Papin actually constructed a steamboat which he ran upon the river Fulda in 1707. It is certain that he met with the seemingly inevitable ridicule and abuse. Disgusted with the conduct of the Hessians, he determined to go to London in his steam vessel, and descended the Fulda as far as Munden, where the boatmen laid violent hands upon him, and destroyed his little craft.

Next to Papin comes the Marquis de Jouffroy, who in 1781 built a steam vessel 150 feet in length and 15 feet in beam, which, according to a document now in Paris, was propelled by steam for fifteen minutes against the stream.

WILLIAM SYMINGTON.

The credit for the invention and construction of the first steamboat to be successfully applied in Europe to useful navigation is due a Scotch engineer, William Symington, who attacked the problem on original lines, and produced a vessel, the "Charlotte Dundas," which in many respects was half a century in advance of the state of the art. Symington was born in Scotland in 1764. Educated for the church, his taste for mechanical philosophy, he tells us, led him to direct his studies to the exercise of the profession of a civil engineer. He obtained patents for several improvements in the steam engine, and designed a steam carriage, which in 1786 he submitted to several learned and scientific men in Edinburgh. Here he met Patrick Miller of Dalswinton, a wealthy banker, who informed Symington that he had "spent much time in making experiments as to the propelling of vessels upon water by using wheels in place of sails or oars. These wheels he had put in motion, applying the strength of men to the turning of a handle or winch." Symington told Miller that he believed a steam engine might be constructed for the purpose, and he proposed that favorite method with early steamboat inventors, of communicating a rotary motion to the paddle by the alternate action of ratchet wheels. The first experiment was made with a two-cylinder engine, the cylinders being of 4 inches diameter and 18-inch stroke. It was installed on a double-keel vessel, and tried on the Dalswinton estate in 1788, with satisfactory results. The next experiment was upon a larger boat, 60 feet in length, belonging to Miller, which was already equipped with man-operated paddle wheels. In this vessel Symington placed a two-cylinder engine, each cylinder being of 18 inches diameter and 3-foot stroke; and in October, 1789, with Miller and several prominent business men and engineers on board, the boat was driven at a rate of five miles an hour in still water. The engraving on page 220 is based on the original plans of this boat, as given by Symington. At this point, Miller retired from business to devote himself to his estate at Dalswinton; but in the year 1800, Lord Dundas, one of the principal owners of the Clyde Canal, requested Symington to take up his experiments with the steamboat, and spent about $35,000 in this work. With sufficient capital assured to give him a free hand, Symington designed an entirely new boat and engine, called the "Charlotte Dundas." An examination of the drawings of the vessel, as shown on pages 220 and 221 of this issue, proves that Symington was an engineer of decidedly original genius. Even at that early day, his mechanical sense objected to the cumbersome overhead working beam, and in a letter at that period he criticises the cylinder erected in a vertical position and the heavy working beam, and other heavy and complicated apparatus of the old steam engine, and explains how, by changing the position of the cylinder and "by coupling to the end of the piston rod a crank and arm," he "reproduced a rotary motion without the intervention of a lever or beam." In other words, Symington in the engine of the "Charlotte Dundas" originated the modern horizontal reciprocating engine, which was destined to become the predominant type for steamboat, locomotive, and stationary engines, and continued to be such throughout the middle period of the history of the steam engine. The cylinder was double acting, 22 inches in diameter and with a stroke of 4 feet. It was direct-connected to the crankshaft of a paddle wheel at the stern of the boat. The account of the experiment, as given in his own narrative, which has been confirmed by others, is as follows:

"Having previously made various experiments, in March, 1802, at Lock Twenty-two, Lord Dundas, the great patron and steamboat promoter, along with Archibald Spiers, Esq., of Elderslee, and several gentlemen of their acquaintance being on board, the steamboat took in drag two loaded vessels, the 'Active' and 'Euphemia,' of Grangemouth, Gow and Elspine, masters, each upwards of *seventy tons* burden, and with great ease carried them through the long reach of the Forth and Clyde Canal at Port Dundas, a distance of nineteen and a half miles, in six hours, although the whole time it blew a very strong breeze right ahead of us; so much that no other vessel could move to windward in the canal that day but those we had in tow."

Since the object of Lord Dundas in employing Symington was to have him devise some cheaper means of towing canalboats than the existing method by horses, it would look as though the future of the steamboat was assured; but, unfortunately, the other proprietors of the canal objected to the use of steamboats, urging that the waves set up would wash away the canal banks. Therefore, nothing further was done. Subsequently, Symington was introduced by Lord Dundas to the Duke of Bridgewater, who was responsible for the introduction of canals into England. Symington impressed him so favorably that he gave him an order to build eight boats similar to the "Charlotte Dundas" for service on his canals, but the death of the Duke shortly afterward led to the canceling of the order.

Among the many methods of applying the power of the engine to propel the boat that were tried by the early inventors, one of the most popular was to use an endless chain of paddle boards, traveling over wheels or pulleys at each end of the boat, the paddles being submerged as they passed toward the stern, and being carried clear of the water as they returned toward the bow. Of this type was Desblanc's steamboat, which was tried on the river Doubs in 1802. The arrangement of the engine and the chain of paddles is shown very clearly in the engraving on pages 220 and 221. The engine was horizontal, and the reciprocating motion of the piston was converted into rotary motion by means of a ratchet gear acting upon a spur wheel upon the main driving axle.

AMERICAN STEAMBOATS PRIOR TO THE "CLERMONT."

(*Concluded from page 219.*)

Council, after a trip on the Delaware, were so greatly pleased as to present Fitch with a suit of colors for his boat.

The new venture was now ready for commercial exploitation. A schedule of sailing dates and fares was drawn up, and during the following three months there appeared in the local papers twenty-three advertisements announcing the times of sailing. The routes covered were to Trenton, thirty miles; to Burlington, twenty; to Chester, fifteen; and to Wilmington, thirty miles. During these three months "The Steamboat," as she was popularly called, ran in regular passenger service for a total distance of between 2,000 and 3,000 miles. Limitations of space prevent any further quotation of the certificates and eulogies given by prominent men of the day. We present engravings of two of the advertisements of 1790, photographed for the Scientific American from the files of the Pennsylvania Packet and the Federal Gazette, by the courtesy of Mr. Abbott, the curator of the Philadelphia Library.

In view of this crowning success to the labors of Fitch and his associates, the story of the rest of his life is truly tragical. His attempt to build another and larger vessel failed for want of financial support. Had some influential, wealthy, and far-sighted patron come to Fitch's assistance at this time, there can be little doubt that the advent of successful commercial steamboat navigation would have been hastened by twenty years. But it was not to be. Discouraged and embittered by failure to secure recognition and support, Fitch, after an abortive trip to France, wrote an account of his life and experimental work, which he delivered to the librarian of the Philadelphia Library, with instructions that it be not opened for thirty years; and then, retiring to Bardstown, Ky., he ended his unfortunate life by committing suicide.

JOHN STEVENS.

The claim of Col. John Stevens to a foremost position among those who contributed to the early development of the steamboat is based upon his recognition of the value of the screw propeller, of the multitubular boiler, and of high-pressure steam. Like Fitch, Stevens was possessed of great mechanical ability; and to this was added the advantage of wealth and education. His claim to have built the first steam screw propeller boat to navigate the waters of any country we consider to be indisputable.

After some preliminary experiments, as recorded earlier in the present chapter, Mr. Stevens designed an entirely new engine and boiler, differing from anything that had yet been attempted either here or in Europe, and erected it in a 28-foot boat, which made many successful trips at speeds of between seven to eight miles an hour on the Hudson River. The twin screws, engine, and the boiler are still in existence, and are now at the Smithsonian Institution, Washington. The accompanying illustrations are reproductions from photographs of this exhibit made especially for the Scientific American by the courtesy of the curator. The cylinder was of 4½ inches diameter and 9 inches stroke. Motion was transmitted from the overhead crosshead by two connecting rods to a pair of cranks, one on each propeller shaft. The cranks turned in opposite directions (to overcome the tendency of a single propeller to rotate the boat) and the cranks were maintained in their proper rotating position relatively to each other by means of two gear wheels on the propeller shafts. The reaction of the connecting rods against each other served the purpose of a parallel motion and maintained the piston rod in alignment. The valves consisted of two-way cocks, and they were driven by a crank on one of the propeller shafts, through the intermediary of a vertical rack and gear wheels on the spindles of the two-way cocks. The boiler is one form of the multitubular type invented by Col. Stevens. It has 28 copper tubes, 14 projecting from each side of a center rectangular chest.

Contemporary testimony to the successful operation of this boat is given in Stewart's "Anecdotes of the Steam Engine," published in 1829, and in an article by Dr. James Renwick contributed to Tredgold's "Treatise on the Steam Engine," published in London in 1838.

That John Stevens and his son, Robert L. Stevens, are to be credited with having built the first ocean-going steamship is proved by the well-authenticated voyage made by the "Phœnix" from New York to Philadelphia. The engines of the "Phœnix" were designed and built by Stevens. The accompanying illustration of this historic vessel is from a photograph of an old painting at the family home, Castle Point, Hoboken, N. J. Alluding to the above voyage, the late Mr. J. Scott Russell, the builder of the "Great Eastern," said that Mr. Robert L. Stevens was "undoubtedly the pioneer of steam navigation in the open sea."

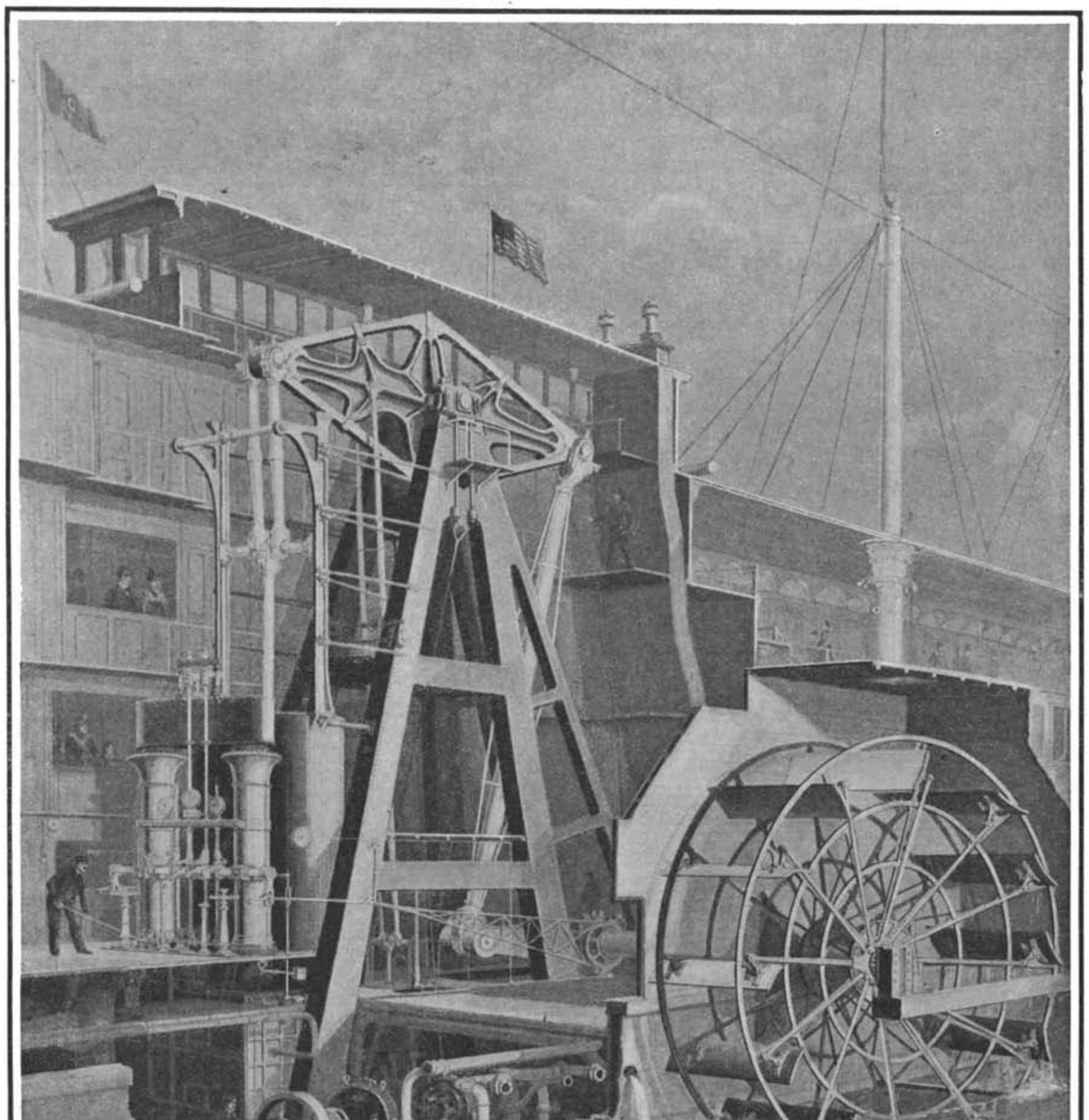
THE AMERICAN WALKING-BEAM ENGINE.

Looked at from the standpoint of the mechanical engineer, the most extraordinary fact in the story of the development of the Hudson River steamboat is the vitality of that early form of steam engine known as the walking-beam type. Although to-day its term of useful life lacks but a year or two of a century, and it is, therefore, actually as old as the Hudson River steamboat itself, and though it represents one of the earliest and crudest methods of changing the reciprocating movement of the piston into the rotary movement of the power shaft, the walking-beam engine is to-day the prevailing type of drive on the Hudson River. Most significant fact of all, when it came to the question of what type of engine to use on the "Robert Fulton," the latest of the Hudson River fliers, built this year, it was decided that, all things considered, the most suitable engine would be one of the kind which was first placed in a Hudson River boat in the year 1811.

In steam engine practice, one hundred years ago, the rocking or walking beam was the favorite method of connection between the piston rod and connecting rod. We are all familiar with the engravings of early stationary engines, particularly those used for pumping in city waterworks, in which a vertical steam cylinder transmitted its power to a cast-iron overhead rocking beam, which was carried upon cast-iron girders supported on cast-iron pillars of elaborate classic design. By the middle of the nineteenth century, this type was being discarded for the simpler horizontal engine; and to-day the few remaining walking-beam stationary engines are regarded with a strictly antiquarian interest.

In the development of the Hudson River steamboat, on the contrary, the beam engine proved to be so ideally adapted to the work, that it has held its place against the multi-cylinder, high-pressure, fast-running engine, with conspicuous success. In the first place, it was an easy engine to build; and, when once the foundries, machine shops, and forges had been built and a force of capable mechanics had become available, its first cost was low. The engine consisted essentially of a single cylinder, a walking beam, a connecting rod, the A-frame, which carried the main bearings of the walking beam, a jet condenser, a hot well whose piston was operated by connecting rods from the walking beam, and feed pumps operated from the same connecting rods as the hot well. Judging from early prints and descriptions, the engine was quickly developed to the identical form which it carries at the present time, the principal change being the substitution, in the past quarter of a century, of surface condensers for the early jet condenser.

The "Clermont," as we have shown elsewhere, transmitted the power from the cylinder to the crankshaft through a bell-crank lever. Subsequently, during the succeeding two decades, use was made of a steeple engine, in which a pair of rocking beams, carried low down in the boat, were used, or the crankshaft was placed immediately below the cylinder, with connecting rods coupled from the piston crosshead to the cranks. This type, however, soon gave way to the present form with an overhead walking beam mounted on a stout timber A-frame, whose footings were bolted to the keelsons of the floor of the boat. The A-frame was built of massive timbers very strongly braced and bolted, and carried at its apex the main bearings of the walking beam. The guides for the crossheads were held in line by rods extending from the guides to the A-frame.



Cylinder, 81-inch diameter by 12-foot stroke. Horse-power, 3,800. Boiler pressure, 55 pounds. The two vertical pipes in front of the cylinder are the "side pipes," one the steam pipe, the other the exhaust. They communicate with transverse steam chests at top and bottom in which are the poppet valves. The latter are operated by two vertical rods, which are lifted by cams on rock shafts, driven by the eccentrics.

ENGINE OF THE "ADIRONDACK."

The boiler of the "Clermont" was made of copper and carried the low pressure of four or five pounds to the square inch. Copper was used because iron plates were not available; but eventually, when reliable boiler plate became available, iron boilers were introduced, and immediately higher steam pressures began to be used. Tubular boilers were introduced in 1830 on the "Novelty," and about the year 1840 wood gave place to anthracite coal. Concurrently with the increase in boiler pressures, a great advance was made in the size and power of the engines. The single cylinder of the "Clermont" was 24 inches diameter by 4 feet stroke. The "Chancellor Livingston" of 1816 had engines 44 inches in diameter by 5 feet stroke. The "Constellation," 1825, used a cylinder 44 inches in diameter by 10 feet stroke, and these remained about the maximum dimensions until the appearance of the "South America," 1840, with cylinders 54 inches in diameter by 11 feet stroke. The keen contest for speed resulted in the construction of engines that were prodigious for those days, and have barely been exceeded at the present time. Thus in 1845 there was built for the "Hendrick Hudson," which was a fine vessel 320 feet long, an engine with a 72-inch cylinder and 11 feet stroke; and two years later T. F. Secor & Co. built for the "New World," one of the fliers of that day, an engine with a 76-inch cylinder and the enormous stroke of 15 feet. Thereafter the stroke was reduced to 12 feet, which was never again exceeded. The largest engine afloat on the Hudson is that of the "C. W. Morse," of 4,000 horse-power, built in 1904 by the W. & A. Fletcher Company, whose cylinder is 82 inches in diameter by 12 feet stroke.

The permanence of the walking-beam engine as the favorite drive for Hudson River steamboats, and its undoubted popularity among the directors of the companies and in the pilot house and the engine room, is largely due to the especial conditions under which the Hudson River service is operated. In the first place, the upper reaches of the Hudson are very shallow during several months of the summer, and it is desirable to keep the draft of the boats as small as possible; conditions to which the broad and shallow but sweetly-modeled river boats lend themselves admirably. The largest vessels for the night service are of over 4,000 tons displacement, and are driven by engines of 4,000 horse-power; yet they draw only about 8 feet of water. It would be a difficult proposition to drive such vessels with screw propellers. Furthermore, the large number of landings which must be made call for a boat with good maneuvering qualities, able to stop and start quickly, and make quick landings at the piers. The paddle-wheel beam-engine boat has proved to be ideal for this purpose. While it is well understood by the engine builders and shipping men of the Hudson River that high boiler pressures, multi-cylinder expansion, and rapidly-running engines are conducive to fuel economy, it is also realized that these economies can be secured only when the engines are continuously in service. Otherwise, the heavy extra capital cost of the more expensive installation is liable to exceed the saving due to coal economy. The Hudson River boats are out of service for about five months of the year; and although a multi-cylinder engine will run under a consumption of from 1.5 to 1.75 pounds of coal per horse-power per hour as against 2.3 pounds for a low-pressure single-cylinder beam engine, the greater first cost of the plant will go far to offset the saving in the coal bill. The cost of upkeep, moreover, of the beam engine is relatively far less. The boilers, built for 50 to 55 pounds pressure, generally carry from 30 to 35 pounds under an easy fire. This means a lessening of boiler repairs, since it is easier on steam pipes, joints, and packings. Moreover, the engine-room force is reduced to a minimum, an engineer and an oiler generally being sufficient to take care of the average Hudson River engine.

The accompanying illustrations of the 3,800-horse-power engines of the "Adirondack" of the night line, the last of the large river steamers to be built of wood, will serve admirably as a reference in connection with the foregoing description of the typical river-boat engine. The "Adirondack," which is 412 feet long, 50 feet beam, and 90 feet over the guards, with four decks above the waterline, and over 400 separate berths for the passengers and crew, was built in 1896. The vessel serves to show the point of size to which these stately river boats have been developed. In the engraving the side of the hull and superstructure has been broken away to show the full height of the engine, which was built by the W. & A. Fletcher Company. The engine foundation consists of heavy steel keelsons. The A-shaped gallows frames are built up of steel plates, the legs, which are of box section, being strongly braced together with struts, which are also of plate steel and box section. The walking beam consists of a strongly-ribbed cast-iron web, belted with a heavy wrought-iron strap; the whole being firmly strapped and keyed together. The cylinder is 81 inches in diameter by 12 feet stroke. The two large vertical pipes seen in front of the cylinder are known as the side pipes; the one on the star-

(*Continued on page 229.*)

THREE HUNDRED YEARS OF NEW YORK.

When Henry Hudson approached the opening of the upper bay he did not at first know that he was nearing the river which was afterward to bear his name. He believed that it was an arm of the sea, in fact, that it was the northwest passage to India, that *Ignis Fatuus* of so many of the old navigators. He lay in the lower bay for more than a week before he anchored in New York Harbor proper. He found the neighborhood well peopled by Indians who lived in villages of fairly regular construction. They were mild and inoffensive, as savages go, and they were quite willing to trade their tobacco and pelts for the beads and knives of the white men.

Hudson at last discovered that he was at the estuary of a great river, up which he sailed, consuming three weeks, until he reached the head of navigation at Albany. Early in October, Hudson turned the prow of the "Half Moon" homeward, bringing the news of a discovery which was of the greatest possible interest among the Dutch merchants. A number of trading and exploring expeditions started out and made the trip with considerable profit to themselves.

It was at last decided to establish permanent posts at the head of the river and at New York. The main fort was built near the mouth of the Mohawk River, and a few trading huts were built at the south end of Manhattan Island, and it is from this small beginning that we are enabled to trace the industrial beginning of the city of New York.

A monopoly of the fur trade was given to the New Netherlands Company, which erected a trading post at New York. The monopoly, which was a valuable one, was extended from year to year, until 1621, when the Great West India Company was chartered. It was under its auspices that the first real and permanent settlement in New York was made.

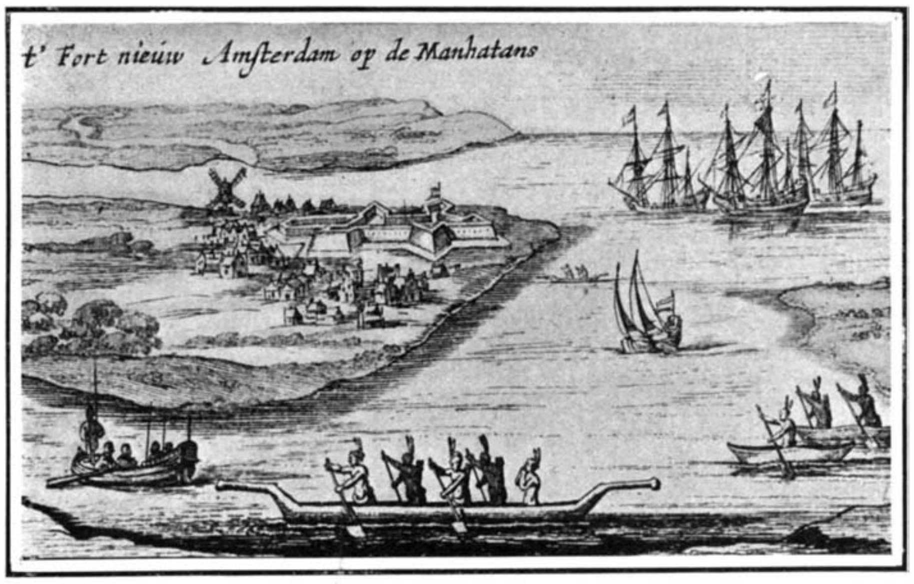
The city of New York has been very fortunate in the preservation of the early records of its settlement. The early history of Rome, London, and even Paris, is lost in obscurity, while other cities, such as Berlin and St. Petersburg, have no history of any importance, and still look painfully new and as though they were planned with the aid of the T-square and drawing pen. From these records we learn that the original block house with its palisades gave way to Fort Amsterdam, around which clustered the small cabins of the first settlers. Some idea of the early appearance of the settlement is obtained from a view in Hartgers' "Beschrijvinghe' van Virginia," a copy of which we present herewith. This is the earliest known view of New York, and the little book in which it was published is of the greatest rarity. To obtain a correct idea of the topography, it is necessary to view the plan in a mirror, as it is reversed. It was probably obtained with the aid of a camera obscura from some point on the Long Island shore and was never restored to its proper position. Although the print is on a small scale, it gives considerable detail, the number of buildings shown being about thirty or thirty-five. In the fort were situated the Governor's house, the chapel, barracks for the soldiers, magazines, and other necessary buildings.

There does not appear to have been any attempt to found a substantial colony until 1621, when the Dutch West India Company came into existence. It was admirably organized and they established a strongly garrisoned colony which was the nucleus of a colonial government which was in control of a vast territory which stretched from Virginia to New England. The municipality itself, however, was of almost microscopic proportions, for in 1628 we find that the inhabitants numbered only 270, but the fort was constantly increased in strength until it became a fortress of no mean magnitude for the size of the place. In 1626, Peter Minuit purchased the whole of Manhattan Island for trinkets, the aggregate value of which was $24. It would perhaps be interesting to figure up how much the interest at 6 per cent, compounded at regular intervals, would be on the $24 for the period since the purchase.

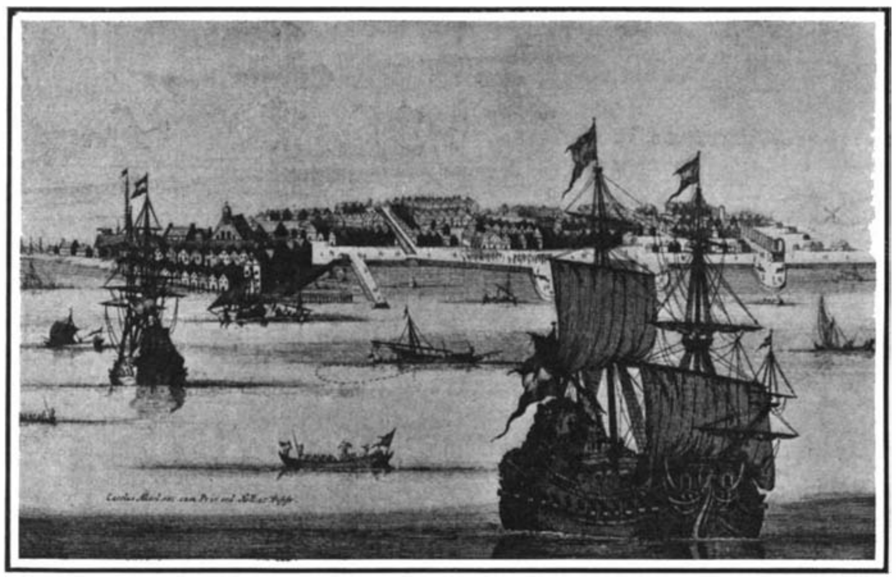
In 1653, when a foray of New Englanders was expected, a stockade or palisade was erected across the island from east to west, thus fortifying the outskirts of the inclosure. This was at the point where we now have a teeming center of finance — Wall Street. Strange to say, this wall prevented the natural expansion of the city for over half a century and always tended to create that congestion which still remains so overwhelmingly strong. Every old and important city in Europe has been cramped within a stone girdle of fortifications, and long after the necessity for this has vanished the habit of congestion remains.

The present crowded tangle of streets at the southern termination of Manhattan Island is entirely attributable to the customs of the Dutch dwellers. There was little attempt made to lay out broad or convenient streets. The foot-paths and lanes became the future streets, and no better example can be adduced than this, that the early pre-arrangement of the south never obtained in northern lands. One of the earliest streets was nearly parallel with the present Pearl Street and the other with Broadway, while "Dock" Street led to the shipping quays.

After a long and rather interesting occupancy by the Dutch, the flag of Great Britain was raised on September 8, 1664, and Fort Amsterdam forthwith became Fort James. There was little or no dislike of the conquerors, who made a peaceful invasion without striking a blow. England's policy was not so liberal in those days as in her present handling of colonial matters. Still, however, the Dutch hardly knew that the form of government was being changed, so that now the isolated trading post became a national colonial dependency. Under the old *régime* there was no home pride among the commercial owners, but the new conditions put a different aspect on the situation, and

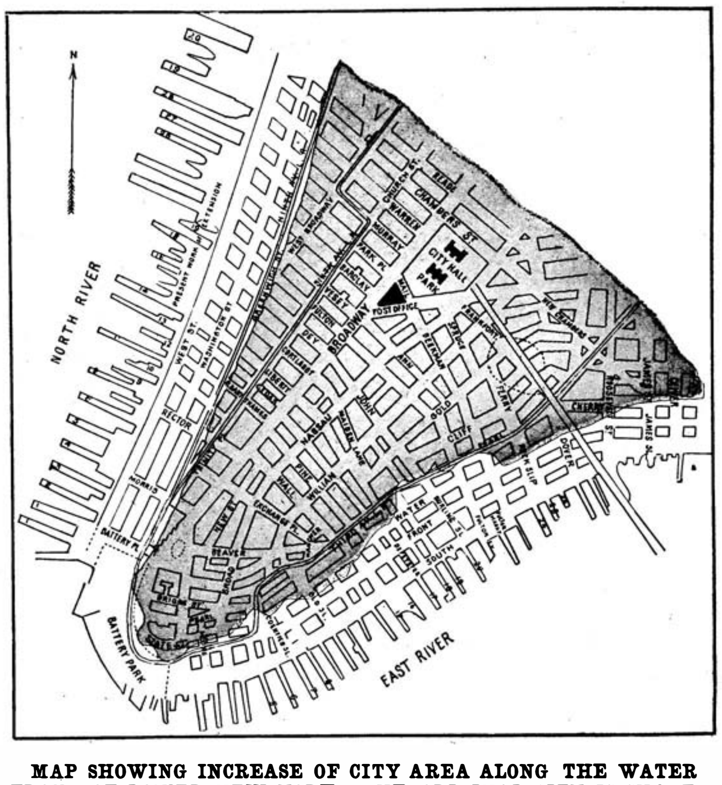


EARLIEST KNOWN PRINT OF NEW YORK CITY ENTITLED: "FORT NIEUW AMSTERDAM OP DE MANHATANS," PUBLISHED IN 1651.— POPULATION ABOUT 300.

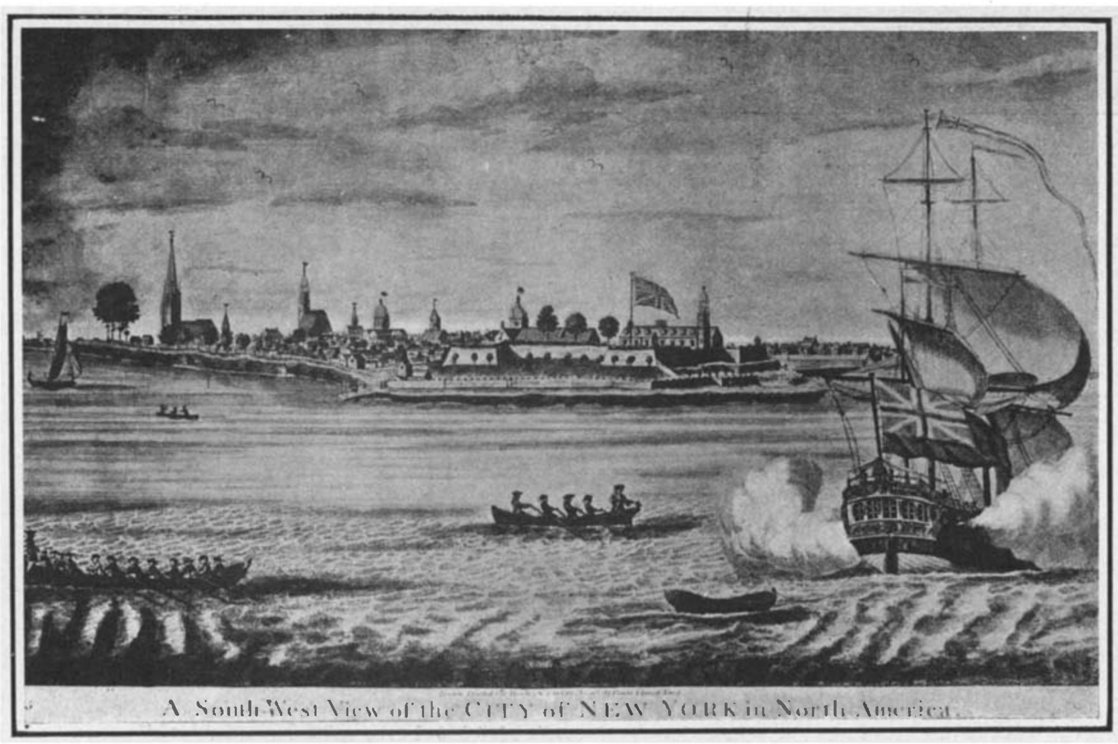


NEW YORK IN 1673.

Buildings have been erected within the fortified enclosure; streets have been laid out leading to wharves. The population in 1664 had grown to 1,500 and in 1686 it was 4,337.



MAP SHOWING INCREASE OF CITY AREA ALONG THE WATER FRONT OF LOWER NEW YORK. THE ORIGINAL CITY IS SHADED.



NEW YORK UNDER BRITISH DOMINION JUST BEFORE THE REVOLUTION.

Among the landmarks are Trinity Church, the old Dutch Church, and Fort George. The population in 1771 was 21,863.

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THREE HUNDRED YEARS LATER—THE SKYLINE OF THE HUDSON RIVER SHORE FROM CITY HALL TO THE BATTERY WITH THE SINGER BUILDING OUTSTRIPPING ALL IN HEIGHT.

the inhabitants began to grow fond of their new surroundings and government.

In 1783, when New York was evacuated by the British troops, the condition of the city was most deplorable. The streets, which had been paved and partly graded before the war, had been suffered to lapse into idle wastes again. The wharves had rotted, and all the public and many of the private buildings had fallen into a state of semi-ruin. The population had decreased and the city was practically wrecked. Under the inspiration of the new government the inhabitants revived the city within three years, so that the former population was regained and commerce quickly returned.

We have before noted the crookedness of the streets in the lower part of the city, especially below the stockade at Wall Street. At the beginning of the nineteenth century nearly all of Manhattan Island, down as far as Fourteenth Street, was practically a virgin territory which could be treated in any way which seemed conducive to the public good. It was thought to be wise to make a plan which would be so comprehensive that the growth of the city would be provided for for a couple of centuries or more, so that an act of the Assembly was passed on April 13, 1807, and a commission of well-intentioned but blundering men was appointed—men who were of great importance for the time—as "Commissioners of Streets and Roads in the City of New York." They were given much power, and had they not been so mediocre in their attainments, the results would have been far different. They were allowed four years in which to prepare their plans and fix posts at suitable points. In 1811, they made their reports and their maps were filed, which created the city from Houston Street to Washington Heights substantially as it exists to-day. Without doubt their labors were most arduous, as a survey involving the placing of "1,549 marble monumental stones and 98 iron bolts" proves. The commissioners had the opportunity to create a most beautiful city instead of the commonplace utilitarian arrangement from which the citizens are now suffering. These worthy men left undone the things which they should have done, and did the things which they should not have done. They decided that the beautiful forest growths should be cut down, that the hills should be leveled, streams were bridged over and filled in, and upon the plan thus produced they decided that the city should be built with the aid of the T-square and triangle. As Mr. Janvier says, "The commissioners, in their stolid way, unquestionably gave their very best thought to the work confided to their indiscretion; they even, by their own showing, rose to the height of considering the claims of what they believed to be the beautiful before they decided upon giving place to the useful alone." In regard to parks, these excellently dull gentlemen had their own views. They thought that the large arms of the sea which embraced Manhattan Island and furnished all the variety required. They would not stipulate for a space to be devoted to parks, although they thought that a space should be set aside sufficient for a reservoir. They also felt the need for a space for military exercises, so that the "Parade Ground," which extended from Twenty-third to Thirty-fourth Streets, and from Fourth to Seventh Avenues, was provided. We have the remains of the "Parade Ground" in Madison Square, and the whole space includes some of the choicest business locations in the entire city. Union Square was a union of the many roads which centered at that point for the transfer of traffic, and may be regarded as a "geographical accident." They provided streets which reached as far as 155th Street northward, reaching from the Hudson to the East and Harlem Rivers. The plan of New York, as we find it to-day, is stupidly commonplace, and it has cost millions to give even a semblance of variety to the work of these worthy gentlemen. Among the mistakes which the commissioners made was to provide one-third less to the square mile for longitudinal streets than they did for cross streets. They did not seem to realize that they were dealing with a long and narrow island whereon the traffic would always be in a longitudinal direction, but we are now feeling the stern necessity for increased facilities for north and south travel.

In 1805, the free school system was founded. Prior to that time schooling was largely a matter of private enterprise. Each church had its own school and there were also numerous private schools kept by teachers who were remunerated for their services. The first public school was opened in 1806. A number of scientific and literary societies were founded in New York at the beginning of the nineteenth century.

Before the days of the steamship and the railroad, was the era of the fast "clipper," like those which ran from Baltimore and which were famous for their great size and speed. So fast were they that for many years after steamers were built they maintained a nearly equal fight against their more formidable rivals. Fast vessels made the trip to England in fourteen days. It seems extraordinary that the United States, that during the first half of the nineteenth century brought the art of shipbuilding to such a high plane, should be so neglectful of her ocean commerce in the last half of the century. The more recent events connected with New York city are outlined in the chronology which follows, and which has been especially compiled for this issue:

When we look at the impressive picture of the sky line from the City Hall to the Battery there is one point which is of surpassing interest—how was it possible to secure enough ground to permit of the erection of such vast structures?—as we know that the original territory comprised in this part of Manhattan Island in the days of Peter Minuit was not so great. When Manhattan Island was first purchased from the Indians, there was doubtless little thought that it would ever be necessary to increase the area of the seemingly large island. From the beginning, however, we find examples of made land, of docks being built, of ponds being filled up, and a general tendency to increase the superficial area. In former times the island was very much narrower than at the present time, although the general shape was the same. The old maps show the lower part of the island extending in width barely from Broadway to the present Pearl Street.

Since olden times, filling has gone on along the city edge for generation after generation, until many blocks have been added, and the island has been increased by the addition of area on its outer periphery, precisely in the place where the addition counts the most. Originally, the junction of Pearl Street and Maiden Lane marked the entrance of a wide canal, and another wide canal ran up Broad Street, beginning at Front Street and extending nearly to Wall Street. These facts indicate the narrow limits of the old city.

The rapid currents of the Hudson and East Rivers, especially the latter, had to be guarded against, and as early as 1654 it was resolved to drive planks into the shore, and to make uniform sheet piles between Broad Street and the City Hall, for the lower part of the city, and many other ordinances touching on the subject of the water front were passed.

The map gives us a good idea of the enlargement of the city area. It is only within modern times that the limit of enlargement has been fixed, and bulkhead and wharfhead lines located to determine the extent to which filling and dock building operations may be carried out. The map in the shaded portions shows the original limits of the lower end of the island, while in outline are given the additions up to the present time. Along the water front on this ground which has been reclaimed from the rivers, are built many lofty and heavy structures which are very noticeable in our view of the skyline of New York.

THE POPULATION OF NEW YORK AT VARIOUS PERIODS.

1628.	Under Dutch rule	270
1656.	" " "	1,000
1664.	British Dominion	1,500
1703.	" "	4,375
1731.	" "	8,622
1749.	" "	13,294
1771.	" "	21,863
1790.	United States government	30,022
1800.	" " "	60,489
1810.	" " "	96,873
1820.	" " "	123,706
1840.	" " "	312,710
1860.	" " "	805,658
1880.	" " "	1,206,299
1890.	" " "	1,515,301
1900.	Greater New York	3,437,202
1905.	" " "	4,013,781
1910.	Estimated	4,810,000

EVENTS IN THE HISTORY OF NEW YORK ARRANGED CHRONOLOGICALLY.

1609. The arrival of Henry Hudson on the "Half Moon."
1613. A trading-post was established on Manhattan Island by Dutch merchants.
1621. The Dutch West India Company was chartered.
1626. Peter Minuit buys Manhattan Island of the Indians for $24.
1635. Fort Amsterdam completed.
1652. The first city charter granted.
1653. A palisade was built along "Wall" Street.
1656. First city survey.
1658. The streets were paved with stone and guarded by watchmen.
1664. The Dutch dominion surrenders to English rule.
1693. Printing press set up by William Bradford.
1696. Building of first Trinity Church.
1697. Streets were lighted.
1699. City Hall built in Wall Street.
1707. Broadway was paved from Bowling Green to Trinity Church.
1725. New York Gazette established by William Bradford.
1730. Stage line to Philadelphia opened.
1731. Fire department was organized.
1763. Jersey City ferry was established.
1766. St. Paul's Church was built.
1774. The Hoboken ferry was established.
1776. Battle of Harlem Heights. Washington occupies New York.
1783. Washington bids farewell to his officers.
1789. Meeting of the First Congress. New York was the federal capital. Washington was inaugurated.
1790. First laying of sidewalks.
1807. First voyage of the "Clermont." St. John's chapel built.
1811. The Commissioners of Streets and Roads in the city of New York finished laying out the present city.
1812. City Hall finished.
1814. Steam ferryboats were put in operation.
1817. Erie Canal was begun, and first line of packet ships established.
1819. The first ocean steamship "Savannah" was built.
1825. Gas was introduced, and Erie Canal was completed.
1833. The New York Sun was founded.
1835. Founding of the New York Herald.
1836. The Erie Railroad was begun.
1841. The New York Tribune was founded.
1842. Old Croton Aqueduct was opened.
1845. SCIENTIFIC AMERICAN was established.
1846. Electric telegraph line was opened between New York and Philadelphia.
1848. Founding of Collins Line of steamships.
1851. New York Times founded.
1853. World's Fair.
1856. The site of Central Park purchased.
1857. Cooper Institute founded.
1858. Opening of Atlantic cable.
1860. New York World founded.
1862. Building of the "Monitor."
1870. Old Brooklyn Bridge begun.
1873. The city crosses the Harlem.
1877. Founding of the American Museum of Natural History.
1880. Completion of elevated railway system.
1883. First East River bridge opened.
1898. Greater New York created by annexation.
1901. Unveiling of the Fulton monument in Trinity churchyard.
1903. Opening of Williamsburg Bridge.
1904. Subway opened.
1908. Opening of the Brooklyn tunnel. Opening of the Hudson and Manhattan Railway tunnel, northern tubes.
1909. Opening of Queensborough Bridge. Opening of the southern tubes, Hudson and Manhattan tunnels. Opening of the Pennsylvania tunnels. Completion of the Metropolitan Life Insurance Building. Rapid approach to completion of great Pennsylvania and New York Central terminals in New York city. Hudson-Fulton Celebration.

Aeroplane Flights During the Hudson-Fulton Celebration.

For the first time since the invention of the aeroplane New York will be given an opportunity to witness sensational flights by the leaders in aviation. These flights will be made by Wilbur H. Wright and Glenn H. Curtiss with their respective biplane machines. Up to the time of our going to press, Mr. Wright had not stated just what feats he would try to accomplish after he has made his initial flights during the present week above Governor's Island. Sheds have been erected upon the island for the machines of both aviators. Mr. Curtiss, who arrived from Italy last Monday after having won the Brescia Grand Prix 31-mile race in 49 minutes, 23 1/5 seconds, has signed a contract to fly up the Hudson from Governor's Island to Grant's Tomb and back, and Wilbur Wright will doubtless make fully as remarkable flights, above the waters of the lower bay. In one of these Mr. Wright will probably remain an hour or more in the air. Mr. Charles F. Willard, who, as mentioned in our last issue, has been making flights above Lake Ontario, will perhaps make flights with the Aeronautic Society's Curtiss biplane. There is also a possibility that a new monoplane, built by a member of the Society, may make flights. An elaborate system of signaling has been arranged, whereby the people will be quickly notified when flights are to be made.

America Boiled Down.

In the year of our Lord nineteen hundred and nine, we find the United States the most progressive country of the world. Its growth has been more than remarkable, and one who wants to boast of his country need only secure a copy of the "Statistical Abstract," a document issued each year by the Department of Commerce and Labor.

This particular publication, originated some thirty years ago in the Bureau of Statistics under the direction of John Sherman, then Secretary of the Treasury, and which in its first issue was a thin pamphlet, has grown to be now an unwieldy volume crammed from cover to cover with masses of figures. At a glance such a document would seem very dry for summer reading, but after one has delved into it, the comparison in the growth or decrease of everything is fascinating.

To-day the population of the United States is in round numbers 88,000,000. Last fall 14,887,133 individuals lined up at the polls to cast a vote for a Presidential nominee. And the last figures obtainable show that six thousand four hundred and sixty-six millions of letters and postal cards were sent through the mails. The table does not state whether the greater quantity of this fabulous number were post cards or not. At any rate, the quantity is two-thirds as much as the combined postal business of Great Britain, Germany, France, and Austria-Hungary, and twice as great as any one of them, notwithstanding the fact that France has the reputation of being one of the greatest letter-writing countries. The people, however, had a great many things to say quickly; and becoming fidgety over the "slowness" of the mail facilities, used slightly over one hundred million telegraph blanks, in order to relieve their nerve tension and get quick results.

Of the 88,000,000 of population, practically one-third are domiciled in the thirteen original States, another third in the States created from the territory ceded to the common union by those States, and the remaining third in the area added by purchase or annexation.

It is interesting to observe that our total continental area, including Alaska, is about equal to that of all Europe; that while the area conceded to the thirteen original States by the peace treaty of 1783 was 828,000 square miles, their present area is but 326,000 square miles, forming in part or in whole thirteen other States, while the remaining twenty-four States and Territories were created from territory added by purchase.

Uncle Sam has some resources left. There is just 754,000,000 acres of land still left in his keeping, though it may be mentioned that all of it is not very desirable. Almost half of this acreage is in Alaska, and much of it in the Rockies. He also has other resources besides vacant lands. In his charge there are 52,827 water wheels to be kept turning, but there is plenty of power for that purpose, for he is credited with having 5,360,000 horse-power from streams with which to keep them moving.

The estimated coal supply of the country is 3,125,708,000,000 tons, and during the last year almost a half a billion tons were mined. The iron-ore supply of the United States is nearly five billions of tons, 52,000,000 tons being the amount mined for the last year reported. The wealth of the country in 1850, according to the figures available, was $7,000,000,000, speaking in round numbers; in 1890 it was $65,000,000,000, and the last figures show it to have jumped to $107,500,000,000. The last report shows that the wealth production of farms amounted to $7,412,000,000, alone more than the wealth of the country half a century ago.

There has been a steady decrease in the negro population since the year 1810, the percentage in that year being 19.03. In 1850 it was 15.68 per cent of the total population; in 1860, 14.12 per cent, and so on. Last year the percentage was 11.59.

Out of his $107,500,000,000, Uncle Sam spent during the last year just $197,000,000 for school teachers. The United States imported one and a half billions of dollars' worth of products, according to the latest figures, but half that amount was raw material for manufacturing. The exports amounted to nearly two billions of dollars, about forty per cent of which represented manufactured goods.

This mass of boiled-down information presents a picture of conditions in the United States which is extremely interesting, not merely to the economist and student, but to those interested in the growth of the country.

The Current Supplement.

The current SUPPLEMENT, No. 1760, opens with an excellent illustrated article on a German automobile fire engine, which has been adopted by the German city of Frankfort-on-the-Main. The recent improvements in the internal-combustion engine are reviewed by H. E. Wimperis. Among the economies practised in machine shops, foundries, and metal-working establishments of various kinds, few are more suggestive than the use of magnetic separators. The principal applications of these, as thus far developed, will be found excellently outlined in an article entitled "Magnetic Separators for Various Uses." Prof. A. F. Ganz's admirable summary of recent electrical progress in the artificial lighting field is concluded. Efforts have been made from time to time in the past to produce the Egyptian types of cotton in America. The latest of these efforts is described by Charles Richards Dodge. Ernest Rutherford's brilliant paper entitled "Visualizing the Atom" is concluded. Though Nature evidently meant the vertebrates to be a tooth-bearing race, her design has by no means been rigidly adhered to, as many creatures of very different orders have been permitted, so to speak, to adopt various substitutes therefor. Mr. W. P. Pycraft interestingly describes these various substitutes. Dr. D. T. Macdougal's paper on "Aridity and Evolution" is concluded.

Prime Minister Asquith recently announced in the House of Commons that the British government would recommend a Parliament grant of $100,000 to Lieut. E. H. Shackleton, in order to defray the expense of his recent expedition. If the appropriation is made, Lieut. Shackleton will be out of debt. When he returned from his expedition, he found that he owed $215,000. With the assistance of his friends he succeeded in paying all but $70,000, which last sum he hoped to earn by writing, and by lecturing in the United States.

DEVELOPMENT OF THE HUDSON RIVER STEAMBOAT.

(*Concluded from page 217.*)

the development of the river steamboat had been carried at that early date. Both boats had return-flue iron boilers, and when pushed to their highest speed would burn from twenty-three to twenty-five cords of wood per trip. The rivalry between the two became so great that finally a formal race from New York to Albany was decided upon, and on November 8th, 1836, they started abreast of each other at 4 P. M. with everything tuned to the highest pitch. The "Rochester" reached Van Wies Point, 140 miles from New York, in eight hours and fifty-seven minutes, and the "Swallow" five minutes later. Some interesting details are given by David Stevenson in an English work, "Engineering in North America," published in 1838, of a trip which he made on the "Rochester" in 1837, when the distance to Albany was made in ten hours and forty minutes. The steam pressure, according to this authority, was 45 pounds, and the steam was cut off at half stroke. Speaking of the remarkable speed of American steamboats at this time, he says the vessels "navigating the Hudson River and Long Island Sound perform their voyages safely and regularly at a speed which far surpasses that of any European steamer hitherto built." A good description was given during this period by a German vistor of a trip made in 1838 on the "North America." He gives the length of the vessel as 200 feet, her beam as 26 feet, and describes her as having two decks, the lower of which was about three feet above the water. There were separate cabins for men and women, that for the men being used also as the dining room. He writes: "There were 320 passengers on board, each of whom slept in a berth, and as sufficient room appeared still to remain, one may imagine how colossal this floating palace must be." He paid three dollars, or two cents per mile, for the passage. In "less elegant" steamboats the fare was one dollar, and in some boats as low as fifty cents.

The inventive and original mind of Robert L. Stevens was shown in the design of the "Rainbow," an experimental vessel of very narrow beam, the breadth of which compared to her length was as 1 to 14. She was driven by a pair of inclined condensing engines, one forward and one aft of the wheel, with cylinders 36 inches by 10 feet, coupled to a common crankpin. Her boilers, strapped at every 10 inches with bar iron, 1¼ by 6 inches, carried the enormous pressure for those days of 80 to 100 pounds per square inch. The hollow wheel shaft, made of ⅝-inch boiler iron, was 3 feet in diameter. She did not make the high speed expected, and was subsequently used for towing.

The contests of speed which characterized that period were accompanied by rate wars, in which passengers were carried over the full course at rates which at one time dropped as low as twelve cents; and it is recorded that on one occasion rather than see an opposition boat carrying a full passenger list, a rival steamboat offered twelve cents apiece to the public for the privilege of taking them; the deficit being subsequently made up when the ship was under way by the simple expedient of raising the price of meals by 300 per cent.

As evidence of the high state of development to which the steamboat had been carried by the middle of the century, we quote the case of that handsome steamer "Aiida," built in 1847 by William Brown of New York. This craft, of which we present an excellent illustration, was 265 feet long, 30 feet broad, and 7 feet deep. She was driven by a steam engine with cylinders 56 inches diameter by 12 feet stroke. From the very first she proved to be a "flyer"; and on May 8th she made the trip of 145 miles from Albany to New York, with six landings, in seven hours and fifty-six minutes. She was not, however, the first boat to bring the time below eight hours, that distinction belonging to the "South America," which on April 19th, 1843, covered the distance in the extraordinary time of seven hours and twenty-six minutes. This trip, however, was made without any landings, and the vessel was favored by a heavy freshet in the river, which not only gave deep water over the shoals, but set up a swift current in the vessel's favor.

It is impossible, within the limits of the present article, to follow in detail the development of the famous steamboats on this famous river. There was a steady increase in size, though the speed, having been carried to the high point of between twenty-one and twenty-two miles an hour, was destined to remain stationary. We can do no more than mention two celebrated boats, the "New World," of the People's Line, with wheels 45 feet in diameter and a piston of 15 feet stroke, and the "Francis Skiddy," with 40-foot wheels and a 14-foot stroke of piston, two vessels which had many struggles for supremacy during the ensuing decade.

We pass on to the year 1852, when in consequence of the many deplorable accidents which occurred, due to the too frequent bursting of boilers, Congress passed a law for the inspection of vessels, which put an end to the perilous practice of steamboat racing. The stories which have come down to us of the reckless way in which engineers would "bottle up their boilers" when racing with a rival boat are astonishing, but nevertheless well verified. Morrison, a most careful historian, credits the statement of an engineer that, on being pressed by his captain to pass another boat, he "prepared for the contest by tying the safety-valve lever, drawing the pointer from the mercury gage, plugging up the mouth of the tube, and urging the fires under the boilers." He passed the other boat, but we are not surprised to learn that it was his opinion that although ordinarily he carried thirty pounds, the pressure during the contest must have risen to fifty or sixty pounds to the inch.

It is probable that the Hudson River boat which has attained the most world-wide popularity is the "Mary Powell," of the Day Line, which, built in 1861, has been in continuous service ever since, and is to-day one of the most popular boats on the river. Her original dimensions were 260 feet length, 34½ feet beam, and 10¼ feet depth. Her model is particularly sweet, with a long, sharp entrance and a very easy run. Her fastest run was made from New York to Poughkeepsie, 73¾ miles, in three hours and thirty-nine minutes, including the time lost in six landings. Deducting this time, her average speed, while running under full power, was 22.54 miles per hour. Her present captain, A. E. Anderson, a son of her previous owner and captain, informs us that during her long life of nearly half a century she has been rebuilt three times and lengthened 40 feet. The lines of the original boat, however, have been religiously preserved. Her present length is 300 feet. Her original engines had one cylinder, 62 inches by 12 feet, which was replaced by a cylinder 72 inches by 12 feet stroke in 1874. Steam is supplied by two return-flue tubular boilers, and she uses a working pressure of thirty-five pounds, under which she makes the eighteen miles per hour necessary to make her scheduled time. Under the forty-five pounds which she is allowed, this wonderful old craft is still good for twenty miles an hour. The hull of the "Mary Powell" was built by M. S. Allison of Jersey City, and her present machinery by the W. & A. Fletcher Company of Hoboken.

Another wooden vessel famous in her day was the "St. John," 1864, the cylinder of whose engine was 85 inches in diameter with the exaggerated stroke of 15 feet.

The year 1880 was signalized by the appearance of the first iron steamboat, the "Albany," the second being the "New York," 1886. These, with two exceptions, are probably the fastest large passenger steamers plying on American inland waters to-day. With their long, unbroken lines, graceful sheer, and triple buff-colored smokestacks, they present as beautiful a marine picture as one would wish to see. Both vessels, after being some time in service, were lengthened by the addition of 30 feet, and as thus altered their dimensions are: "Albany," 325 feet length by 40 feet beam; and "New York," 341 feet length by 40 feet beam; the breadth of both vessels over the guards being 76 feet. The engines are of the typical walking-beam type, with cylinders 76 inches diameter by 12 feet stroke. They were allowed fifty pounds pressure, but thirty-five pounds is sufficient to enable them to attain their schedule speed of about eighteen miles an hour. The "Albany" holds the blue ribbon of the Hudson River. On October 22nd, on her way up to Albany for winter quarters, she was given an engineer's trial for speed. Leaving 22nd Street at 11:01 A. M., she reached Poughkeepsie dock at 2:09 P. M., thus covering 72⅞ miles in three hours and eight minutes, at a speed of 23.26 miles per hour. On May 28th, 1903, the sister boat, the "New York," made the same trip at an average speed of 23.21 miles per hour.

In 1906 the Hudson River Day Line placed in service the handsome steel passenger steamer "Hendrick Hudson," which measures 390 feet over all, 43 feet breadth of hull, 82 feet over the guards, and draws from 7½ to 8 feet of water. The vessel was designed by F. E. Kirby of Detroit and J. W. Millard of New York, who were subsequently engaged by the Hudson-Fulton Commission to design the replica of the "Clermont." Including that in the hold, the vessel has six decks, four of which are available for passenger accommodation. These decks are unusually spacious, and they can accommodate, without crowding, five thousand passengers. The dining room has accommodations for 262 persons. The vessel is driven by an inclined, double-expansion paddle-wheel engine, with a 45-inch high-pressure and two 70-inch low-pressure cylinders acting on three cranks, the common stroke being 7 feet. Steam is furnished at 170 pounds pressure by eight boilers. The paddle wheels in this vessel, as in the "New York" and "Albany," are of feathering type. On her trial trip, made over the measured course on the Hudson, she made 24.5 miles per hour, or about one mile an hour more than the high speed credited to the "New York" and "Albany." The latest addition to the Day Line boats is the "Robert Fulton," built to replace the "New York," which was burned while in her winter quarters. The "Robert Fulton" is 348 feet in length, 42 feet beam, and 76 feet in width over the guards. She was built by the New York Shipbuilding Company of Camden, N. J., and was launched in the record time of two months and ten days after the keel was laid. The hull, which is built of steel, is considered by the company to possess the finest model of any of the large steel vessels of the Day Line. She embodies the best features of the model of the "Mary Powell" and other fast boats, and her appearance on the year of the centennial anniversary of Fulton's great work is very timely. Her maximum speed is 23½ miles an hour. Our illustrations include one of the "Adirondack," which may be taken as typical of the fine fleet of steamers owned by the People's Line, which makes the night trip between New York and Albany. These boats differ from the Day Line steamers in their larger size, more moderate speed, and the towering superstructure for the accommodation of the many tiers of staterooms. The "Adirondack" is 412 feet in length, 50 feet in beam, and draws 8 feet of water. Being a wooden vessel, she is strengthened by the two big suspension trusses which are such a characteristic of the American river steamer. She has 350 staterooms. Her engines, of

3,800 maximum horse-power, can drive her at a speed of 20½ miles an hour. The maximum in size and accommodations is reached in the "C. W. Morse," of the People's Line, which is 427 feet over all, 90 feet over the guards, and contains 450 staterooms. The dining room will accommodate at one time 300 people. She is driven by a walking-beam engine with a cylinder 81 inches in diameter by 12 feet stroke, and her maxium speed is 20½ miles per hour.

In the above necessarily brief story of the development of the Hudson River steamboat, we have endeavored to bring out the salient points of the increase in size, speed, and accommodation of one of the most remarkable and successful types of vessel in the world to-day. It would be well in closing to refer to the phenomenal speeds which were achieved by these vessels over half a century ago, and draw attention to the fact that their record passages were usually made when wind and tide were favorable. The swiftest of the present-day boats would undoubtedly exceed the earlier speeds, though by no very great margin; and it must be remembered that, under existing conditions, they are run under a fixed schedule, generally under a reduced steam pressure, and are operated at several miles less speed than the maximum of which they are capable.

THE AMERICAN WALKING-BEAM ENGINE.

(*Concluded from page 223.*)

board side being the steam pipe, and the other the exhaust. Each of these pipes carries a separate rocking shaft, which is operated by its own eccentric. The motion of each rocking shaft is communicated to two vertical lifting rods, which operate the valves by means of two cams called "wipers." The eccentric rods are formed with hooks at their outer ends, which engage a pin in the arms of the rocking shafts. They are thrown out of gear by means of the slotted vertical rods through which the eccentric rods work, one of which will be seen in the engraving. These vertical rods are known as strippers, and they are operated by the levers which will be noticed attached to the rocking shaft on the steam pipe. When it is desired to start or reverse the engine, the eccentrics are thrown out of gear, and the valves are worked by a steam starting and reversing engine, which is controlled by the vertical lever seen near the steam pipe. If it is desired, the valves can be operated by the vertical starting bar shown in the engraving.

The handwheel on the small vertical standard in front of the exhaust pipe opens the steam valve for the starting engine, and the wheels which are seen on the other two standards are for operating the injection valve and for turning the surface condenser into a jet condenser, if at any time it should be desired to do so. The surface condenser is located in front of the steam cylinder and below the main deck. Behind the steam cylinder and also below the main deck is the air pump, which is operated by connecting rods from the walking beam. The gear shown attached to the front face of the gallows frame, above the cylinder, is a hand winch, for lifting the cylinder head.

The paddle wheels are of what is known as the vertical or feathering type, in which the buckets are made to enter and leave the water in a nearly perpendicular position. The old type, with fixed radial buckets, is extravagant and uncomfortable; extravagant because it wastes power in forcing water downward when the buckets strike, and lifting it when they leave the water; and uncomfortable because it sets up a violent vibration throughout the whole vessel. The feathering paddle wheel is smoother and more efficient in its action, and its efficiency is from 12 to 15 per cent greater than the older type. Its construction is as follows: Bolted to heavy timbers just above the guards is a large pin carrying a loose flanged ring, to which are pivotally attached a set of connecting rods. At their outer ends these rods are pivotally connected to rocking arms fastened to the back of the buckets, the buckets themselves being pivotally attached to the rigid spokes of the paddle wheel. The pin and loose ring are placed eccentrically to the crankshaft, and the ring is rotated in its proper relation to the paddle wheel by attaching one of the connecting rods rigidly to it. The eccentricity of the ring is so adjusted that the buckets shall always enter and leave the water in a perpendicular position, thus securing a true feathering action. The wheels are 30 feet in diameter.

Steam is supplied by four steam boilers, of the lobster-return flue type, each 11 feet wide, 9 feet 3 inches diameter of shell, and 33 feet long, with steam domes 87 inches diameter and 10 feet 6 inches high. Forced draft is supplied by two large Dimpfel blowers, driven by independent engines. The steam pressure is 55 pounds to the square inch, and the total horse-power is 3,800.

RECENTLY PATENTED INVENTIONS.

Pertaining to Apparel.

ADJUSTABLE PATTERN.—M. Bogushefsky, New York, N. Y. This invention consists in the construction and combination of parts, whereby the different edges of the pattern may be moved outwardly or inwardly substantially in parallelism, without varying the relative proportions or the general shape of the pattern. Attachments are employed for varying the style of the garment, rendering one pattern useful for cutting different forms of garments.

PNEUMATIC HEEL-CUSHION.—W. L. Gordon, Deal, N. J. The cushion is such as worn at the heel of the shoe on the inside in order to cushion the heel in walking. The cushion has an improved form which increases its elasticity in action, and a further object is to provide improved means for holding the cushion in position.

Electrical Devices.

TELPHER SYSTEM.—B. T. Hitch, Allen, Md. In this case the invention relates to telpher systems and is particularly applicable to rural mail delivering routes in which the delivery points are relatively far apart. It may be used also as a parcel delivering system or for any purpose in which the rapid transportation of light matter is desirable.

HEAD-GEAR FOR SUPPORTING LIGHTS.—D. E. Taylor, Willimantic, Conn. The gear is for use by surgeons, dentists, and opticians, and supports an electric light and delivers the rays directly upon the object under inspection. The main feature involves a spring metal band, adapted to extend over the head from the front to the back, and be retained in position by resilient engagement with the forehead and back of the head.

Of Interest to Farmers.

BEEHIVE.—P. Weaver, Fort Worth, Texas. The object among others here is to provide a hive of concrete or cement whose walls will be thick enough to exclude heat and cold, and whose interior will be large enough to receive any desired form of honey frames and which will afford at its entrance ventilating means, cleaning out means, and means for the passage of the bees into and out of the hive.

PEA-HULLER.—W. L. Hay, Franklin, Tenn. The intention of this inventor is to provide a device of comparatively simple construction in which the hulling of picked peas or of peas on the vines may be accomplished by merely shifting the concave and feeding the peas through the device in the direction most suitable for their proper treatment.

DEVICE FOR TEACHING MILKING.—P. J. DeVries, Hull, Iowa. The purpose of the improvement is to provide a device that simulates the udder and teats of a cow pendent therefrom, together with other details that afford means for practising the removal of water from the artificial udder by a proper compression of the teats, and thus acquire the art of milking quickly and safely.

Of General Interest.

SOLDER FOR ALUMINIUM.—J. F. Guggenbuhl, 22 Rue de Bagnoles, Paris, France. This solder is not easily broken and it readily resists the action of acid and water. It may be used for soldering pieces of pure aluminium or of the alloys thereof, or for soldering aluminium upon copper, zinc, steel and other metals, regardless of the general shape and thickness of the parts.

BUTTER AND LARD CUTTER.—C. H. Carlson, Iron Mountain, Mich. The invention is an improvement in self measuring lard and butter scoops for use in taking lard or butter out of barrels, tubs, or other receptacle. The blades may be made of different sizes to measure different quantities of the material, and the blades or other portions of the device may be of any suitable metal or material.

DISPLAY-STAND.—J. Towle, Oremont, Ga. The invention pertains to stands for postal cards and similar articles, and more particularly to one having a number of leaves or partitions movably supported upon a suitable standard, and having the surfaces perforated to permit clips for holding the cards or other articles to be inserted at a number of points and in different positions.

METHOD FOR PROTECTING GROWING PLANTS AND VEGETABLES.—E. R. Drake, De Land, Fla. In this case the improved method of growing plants consists, first, in protecting the plant-bed on its several sides, but leaving the same open and exposed above; next, when the plants have grown to a considerable height, raising the protecting parts correspondingly, and also shading the plants along the sides and overhead.

Railways and Their Accessories.

SEAL.—R. A. Edgar, Iola, Kan. The device is especially intended for sealing railway cars and the like, and the initials of the railroad or the firm using the seal may be embossed on the annular space between the dished portion and the periphery of the disks. The leaden seal may be impressed with the station number or other suitable designation showing where the seal is placed.

RAILWAY-TIE AND RAIL-CLAMP.—W. C. Neel, Lakin, Kan. The aim of the invention is to produce a tie, having an improved form, and particularly adapted to be constructed of metal. A further object is to produce a clamp to be used in connection with a metal tie, and which will operate effectively to hold the rail in position without the use of spikes or similar fastening devices.

CAR-DOOR OPERATOR.—F. F. Unckrich and C. L. Seeley, Galion, Ohio. The invention relates more particularly to a car having a plurality of doors, a controlling member, operable from various points of the car for simultaneously opening and closing the doors, and connections between the members and the doors, parts of the connections being adapted to be inoperably disposed so that the controlling member can be rendered inoperative with respect to any one of the doors.

Pertaining to Recreation.

PUZZLE.—R. D. Clover, Weston, Colo. The present object is to provide a puzzle with an outer run way and inner run way surrounding goals, with gates in the run ways and goals, so disposed that considerable skill is required to roll balls from the run ways through the gates and inner run ways to dispose the balls in the respective goals.

GAME APPARATUS.—W. H. Cornford, Mornington, Victoria, Australia. The invention consists in the construction and arrangement of parts constituting a game apparatus. A board or table is provided upon which are placed miniature forts, men, castles, and numerous objects. Toy shooters are provided fitted with spring mechanism adapted to project peas, shots, or pellets through ports from the four corners of the board against the forts, men, and flags.

Pertaining to Vehicles.

DETACHABLE RIM FOR PNEUMATIC OR OTHER TIRES.—M. A. Lemercier, 112 Rue de Richelieu, Paris, France. In this patent the invention has reference to a detachable rim which allows a complete pneumatic tire fully inflated, or a solid India rubber tire, mounted on said detachable rim to be attached to or detached from the wheel of a vehicle with great rapidity.

CASING FOR PNEUMATIC TIRES.—J. H. Seiberling, Jonesboro, Ind. The casing is arranged to permit its convenient or ready application on either single clench or double clench style of wooden rim, it being provided for this purpose with separable abutting edges and single exterior locking ribs arranged at equal distances from the edges, the portion of the casing extending from the base of each rib to the corresponding edge gradually diminishing in thickness and forming a pliable non-clenching closing flange.

VEHICLE-WHEEL.—W. L. Howard, Trenton, N. J. The invention relates more particularly to the mechanism for rigidly locking the rim in place yet permitting of its ready removal. It is particularly adapted for vehicle wheels having pneumatic tires carried by the rims, the object being to facilitate the removal of the rim and tire and the substitution of a new rim and tire in case of puncture or other injury.

SPEED-GAGE.—O. D. Munn and J. K. Brachvogel, New York, N. Y. The invention is particularly useful in connection with devices intended for measuring the speed of railroad trains, automobiles, and the like. An object is to provide a gage by means of which the speed of moving bodies can be measured with accuracy, and which is insensitive to shocks and concussions. A circulating fluid medium is employed, which is sensitive to extremely slight changes in the degree of velocity of the moving body.

Note.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

INDEX OF INVENTIONS

For which Letters Patent of the United States were Issued for the Week Ending September 7, 1909,

AND EACH BEARING THAT DATE

[See note at end of list about copies of these patents.]

Gas meter. H. Chrisman ... 933,159
Gas purifying apparatus. W. McArthur ... 933,097
Gas scrubber. G. Gray ... 933,430
Gas storing tank, acetylene, P. C. Avery ... 933,152
Gases, apparatus for separating mixed, C. J. A. Fiesse ... 933,243
Gases electrically, treating, I. Moscicki ... 933,094
Gate, Sprague & Mulroyan ... 933,594
Gate, J. E. Smith ... 933,677
Gearing, W. J. Schoonover ... 933,672
Glass cutting machine. A. L. Milentz ... 933,481
Glove, mitten or the like, A. G. Hoegren ... 933,449
Governor speed regulator, De Dion & Bouton. 933,367
Grab, safety, W. Remsnyder ... 933,583
Grading pulverulent materials, apparatus for, S. Cooper ... 933,532
Grain bin, G. M. Boll ... 933,617
Gun, breech loading gas actuated, S. N. McClean ... 933,098
Gun lock, J. Stauber ... 933,135
Gun sight attachment, H. Korrodi ... 933,469
Hair comb, J. Swanberg ... 933,274
Harrow, J. Mattern ... 933,719
Hat baking oven, C. F. Bennett ... 933,413
Hat fastening, lady's, Morris & Marks ... 933,679
Hat holder. T. M. Coleman ... 933,063
Hats, article holder for, G. Leopold ... 933,473
Hatch operating mechanism, H. M. Gleason ... 933,070
Head rest, E. C. Leahy ... 933,471
Headlight, C. L. Betts ... 933,614
Heel cushion, pneumatic. W. L. Gordon ... 933,551
Heel spring, T. Dee ... 933,422
Hinge. J. H. Kaufman ... 933,648
Hoisting mechanism, G. A. Armington ... 933,356
Horse boot, M. Weiss ... 933,508
Hose nozzle, garden, J. G. Kasjens ... 933,464
Hose rack, H. Gibbs ... 933,069
Hot air heater, R. L. Short ... 933,128
Hydrant, reel operated, W. J. Clay ... 933,290
Hydrocarbon burner, G. E. Whitney ... 933,684
Ice shaver, A. M. Preston ... 933,488
Ice shaving machine, G. S. Blakeslee ... 933,154
Ingot mold, automatic stripping, Morie & Magnanelli ... 933,658
Inhaler, E. Carabias ... 933,360
Internal combustion rotary engine, W. G. Macomber ... 933,316
Ironing machine, A. Kreuter ... 933,256
Ironing table, Pride & Davenport ... 933,390
Ironing table and sleeve board, combined folding, T. C. Krings ... 933,568
Jar cap or closure, E. D. Schmitt ... 933,347
Jars and the like, closure for, A. Schram ... 933,122
Jars, machine for applying metal caps or closures to, E. D. Schmitt ... 933,120
Keg, metallic beer, K. A. Zimmerer ... 933,520
Kettle safety filling device, tea, G. T. Bohan. 933,052
Key. See Telegraph key.
Knife cleaner, P. H. Lachicotte ... 933,313
Knitted fabric, ribbed, R. W. Scott ... 933,673
Knitting machine, circular automatic stocking, J. D. Hemphill ... 933,443
Knotter, cord, J. A. Sharp ... 933,126
Lacing hook setting machines, spacing mechanism for, W. F. Fraser ... 933,298
Ladle construction. G. P. Jones ... 933,732
Lamp, F. A. Curtis ... 933,162
Lamp, J. R. McKay ... 933,385
Lamp attachment for vehicles, G. S. Sherman ... 933,350
Lamp, baker's oven. C. Robson ... 933,113
Lamp bulbs, locking device for incandescent electric, L. Davis ... 933,296
Lamp, gas, Humphrey & Wright ... 933,177
Lamp, incandescent electric. Farkas & Jaeger 933,539
Lamp, inverted, P. B. Johnson ... 933,734
Lamp, inverted gas arc, S. W. Hyatt ... 933,252
Lamp, inverted incandescent gas, A. J. Hofmann ... 933,176
Lamp shade holder, W. V. R. Seltzer ... 933,125
Lamps, means for igniting and controlling vehicle, A. A. Clark ... 933,694
Lamps, weatherproof socket for electric, G. W. Goodridge ... 933,644
Lap robe holder, H. F. Tyrell ... 933,405
Last. Loewer & Kittlinger ... 933,087
Latch, automatic switch, W. S. Weston ... 933,511
Leaf spring, W. J. Harrison ... 933,441
Leather and making the same, artificial. L. V. Guilleteau-Chapnt ... 933,645
Lens mounting, W. R. Uhlemann ... 933,502
Letter and document distributer, F. Bristow. 933,156
Life saving mattress, H. Schonboe ... 933,671
Lifting jack. F. L. Gormley ... 933,704, 933,705
Lights, head gear for supporting, D. E. Taylor ... 933,499
Link mesh, W. J. Bailey ... 933,411
Linotype machine attachment, A. F. Welling. 933,509
Liquid selling machine, automatic, A. Meinert 933,478
Liquids from closed receptacles, device for drawing, G. H. Crease-Williams ... 933,161
Lock and fastener, J. Robertson ... 933,586
Lock and key for same, A. Gogmin ... 933,703
Locomotives, device for preventing hold-ups on, C. J. Johnson ... 933,565
Log handling mechanism. C. E. Cleveland ... 933,231
Logging means, lead block for, S. J. & P. W. Davis ... 933,533
Loom, H. Le Doux ... 933,187
Loom picker mechanism, B. Trimble ... 933,403
Loom shuttle, J. Lacroix ... 933,376
Loom, weft replenishing, E. H. Ryon ... 933,492
Loom, weft replenishing, G. B. Ambler ... 933,613
Looms, spooler for pile fabric, F. A. Whitmore ... 933,213
Mail bag pick up mechanism, B. R. Simmons ... 933,273
Mail clip, J. Klein ... 933,311
Malt house, J. F. Dornfeld ... 933,165
Manure spreader, D. K. Wilson ... 933,515
Match, duplex, J. Roche ... 933,393
Match unloading and boxer, Sterba & Birch ... 933,727
Mattress supporter, J. Wilkins ... 933,215
Measuring device, liquid, A. Bruce ... 933,528
Metal box, F. O. Buschbaum ... 933,229
Metal cutting tools, rolled metal bar for, E. J. Poole ... 933,338
Metal pieces, uniting, C. F. Jacobs ... 933,459
Metal, treating molten, H. W. Partin ... 933,576
Metal wheel, A. E. Noble ... 933,102
Metals or steels of all qualities, metallurgic process to produce, L. H. Baraduc-Muller. 933,357
Metallic product, G. F. Allen ... 933,612
Metallic receptacles, machine for manufacturing, F. Olejnik ... 933,575
Milk cooler, Lindgren & Mattson ... 933,653
Milking, device for teaching, P. J. De Vries ... 933,535
Milking machine, R. Kennedy ... 933,466
Molding machine, W. E. McCleary ... 933,485
Mowers, gathering and dropping device for, C. A. Rice ... 933,391
Multiple effect receiver. G. T. Voorhees ... 933,682
Music leaf turner, A. H. Osterman ... 933,334
Musical instrument, double scale pneumatic, T. Danquard ... 933,366
Mute, K. Fujita ... 933,244
Nursery chair, P. S. Chaudler ... 933,624
Nut device, lock, J. S. Conradi, et al ... 933,420
Nut lock, C. Starzman ... 933,595
Oil burner, R. P. Selsor ... 933,674
Operating table for osteopathic treatment, W. O. Galbreath ... 933,170
Ore separating machine, dry, Bonson & McLaughlin ... 933,053
Ore separating process, M. Ruthenburg ... 933,491
Ore washer and concentrator, A. Dieu ... 933,633
Ores, treating, Lockwood & Samuel ... 933,717
Oscillation device, G. W. Pickard ... 933,263
Package, B. F. G. Linnell ... 933,189
Packing box or case, D. J. Cable ... 933,287
Pail holder, milk, Fitch & Chamberlin ... 933,542
Paint can, R. Henke, Jr. ... 933,444
Pan handle, dish, C. F. Pfalzgraf ... 933,487
Paper bottle making machine, C. F. Jenkins ... 933,460
Paper cutting machine. G. M. Farnham ... 933,540
Paper machine pulp feeding device, E. F. Millard ... 933,656
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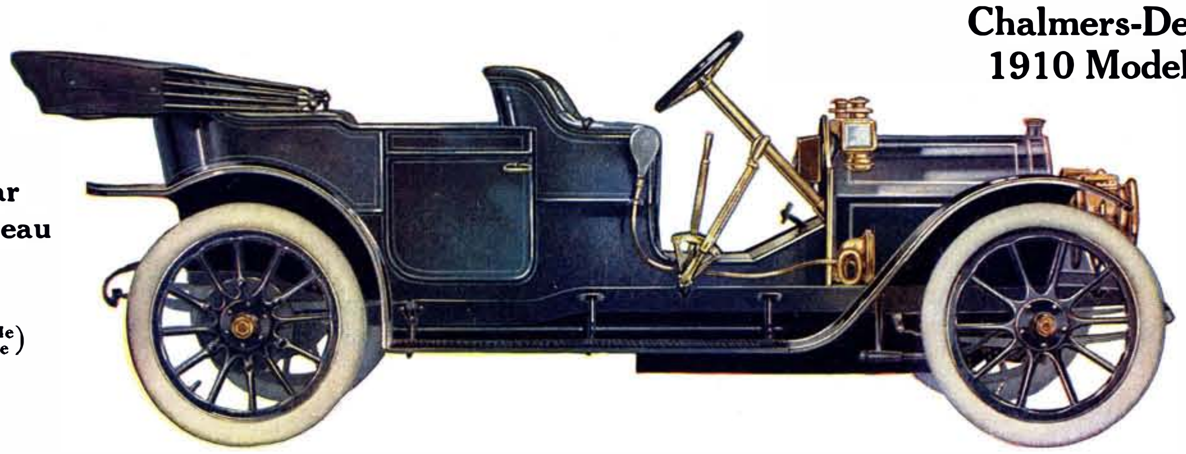
Water tube boiler, vertical, E. C. Fisher..... 933,541
Watering tank, A. N. Eaton 933,066
Weatherproof composition, H. Gallinowsky... 933,171
Weeder, C. F. Billau 933,227
Weeding and transplanting implement, hand, H. L. Hughes 933,304
Weighing device, O. B. Wright 933,608
Welding and bonding rails and other metal pieces, C. F. Jacobs 933,456
Wheel. See Metal wheel.
Whip socket, A. R. Tuttle 933,140
Whips or like articles, case for, N. F. Alston 933,044
Wind shield, J. H. Sprague 933,496
Wind wheel, H. Schmit 933,394
Winding machine, thread, M. Metz 933,092
Window screen, roller, Gibson & Bevier...... 933,245
Window shelf, F. H. Gnekow 933,643
Window ventilator, W. H. Dean 933,421
Wire coiling and weaving machine, M. B. Lloyd 933,476
Wire fabric, interlocking hook for, G. B. Smith 933,130
Wire fabric, making coiled, M. B. Lloyd...... 933,475
Wire frames, making, G. K. Rix 933,342
Wood, coloring, W. A. Hall 933,435
Wood, coloring or transforming, W. A. Hall. 933,436
Wood, transforming, W. A. Hall 933,437
Wrench, W. H. Munro 933,096
Wrench, T. H. Knott 933,649
Yarn or thread into carriers, machine or mechanism for drawing, Whitmore & Dougherty 933,214
Zinc ores, treating, F. T. Snyder 933,133

A printed copy of the specification and drawing of any patent in the foregoing list, or any patent in print issued since 1863, will be furnished from this office for 10 cents, provided the name and number of the patent desired and the date be given. Address Munn & Co., Inc., 361 Broadway, New York.

Canadian patents may now be obtained by the inventors for any of the inventions named in the foregoing list. For terms and further particulars address Munn & Co., Inc., 361 Broadway, New York.

Chalmers-Detroit "30"
1910 Model—$1500

Made as
Touring Car
Pony Tonneau
Roadster
Limousine
Coupe (Inside Drive)
Landaulet



Note How Much We Now Give For the Money

In June, 1908, when our "30" came out, it was generally said that we would not for long give such a car for the money.

We half thought so ourselves. Materials then were exceedingly low—far lower than now. And we feared their advance would compel our advance, for our profit was but nine per cent.

But you buyers took our whole output—2,500 cars. And you left us, at the end of the season, with unfilled orders for $1,200,000.

So we built a new factory, and increased our capacity to 4,000 cars—our output for 1910. And this whole output, by the way, was contracted by dealers before the first car was delivered.

The Cut in Cost

This new model involved no mechanical changes, so the tools of last year would serve. That meant a heavy saving.

The 1,500 extra cars would involve no added fixed expense.

When we divided out cost by 4,000, instead of 2,500 as last year, we found the cost per car greatly lessened. Then we figured what to do with the saving.

There is no way to improve the mechanical features. They were perfect last year, as thousands of owners know.

So we increased the wheel base to 115 inches. We increased the wheels to 34 inches. We added a little more power.

We made the tonneau more roomy, and the hood correspondingly longer and higher. We gave to the car its present beautiful lines.

We put every cent of our saving into beauty, size and room. Our profit remains nine per cent.

So this is the "30" you get this season for the same price—$1500.

Saving on Extras

Then we decided to sell our extras on a profit as small as our cars.

This season we fit our "30" with a Bosch magneto, a Prest-O-Lite gas tank, and two Atwood-Castle new style gas lamps—all for $100 extra. These extras at regular prices would cost $175.

We will fit our "30" with a Lenox mohair top —a $125 top—for $75.

So this 1910 model, when fully equipped, costs less than the car of last year.

Reasons for Success

The story of the Chalmers-Detroit "30" is like a tale from Arabian Nights.

Think of outselling our mammoth output the first season by more than 800 cars.

Think of a car which, from its inception, took the topmost place in its class.

The reasons are these:

The car was Mr. Coffin's creation. He spent two years in designing it—made two trips to Europe. And every man in motordom knows that Mr. Coffin's designs are successful.

The car was sold by us on a margin of nine per cent, so it was utterly impossible for any rival to give any more for the money.

The car made endurance records, early in the year, such as no other car at any price ever equaled.

It made a long-distance speed record exceeding 55 miles per hour.

It made that famous path-finding trip between Denver and Mexico City, plowing its way through oceans of sand.

Then it won the Indiana Trophy—the greatest event of the year. One of our stock cars won the cup, though every rival, save one, sold at a higher price.

Cost of Upkeep

The popularity of our "30" is largely due to its amazing low cost of upkeep. One of these cars, in a New York Economy Test, went 25.7 miles on one gallon of gasoline.

For the year ending June 1, owners paid us for repairs exactly $2.44 per car.

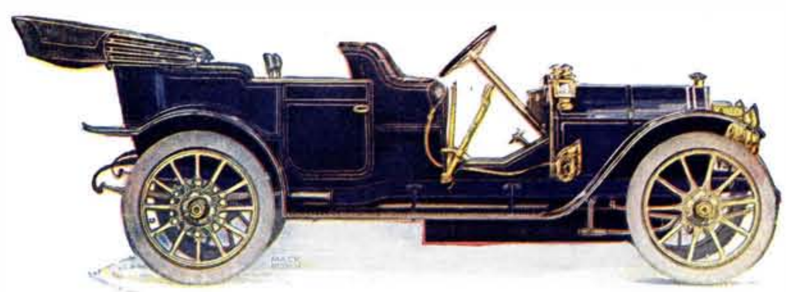
Motor car owners who have learned by experience now seek the car with such records for upkeep.

All Models Ready Now

Our 1910 models are now on the market. To get one now means several months' use before 1910 begins.

And it is also getting the car that you want. For this season, like last season, there are bound to be hundreds of the dissapointed.

Please send now for our catalog showing every new style and feature.



Chalmers-Detroit "Forty"—1910 Model—$2,750

Made as Touring Car, Pony Tonneau, Roadster

Our 1910 "Forty" has a 122-inch wheel base—ten inches longer than last year. It becomes a 7-passenger car. The wheels are now 36 inches. The upholstering is hand-buffed leather.

We fit our "Forty" with a Bosch magneto, gas tank and gas lamps free. We will fit it with a $150 mohair top—the best top we can buy—for $125. The two extra seats, if wanted, cost but $75 extra.

This car has a four years' record such as no other car ever had.

It has won more important events—in hill-climbing, reliability and speed—than any car at any price.

Now we have given it lines which no car can excel. We have brought it to 7-passenger size. We have given it all the power that any service requires. We have made it as beautiful as a car can be made.

If you can think of a reason for paying more than this price, we can prove that the reason is wrong. No car at any price goes farther than this, save in higher cost of upkeep.

When you write for our catalog, we will tell you what neighbors own our "Forty". Please judge it by what they say.

Send us this coupon now.

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Detroit, Mich.
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