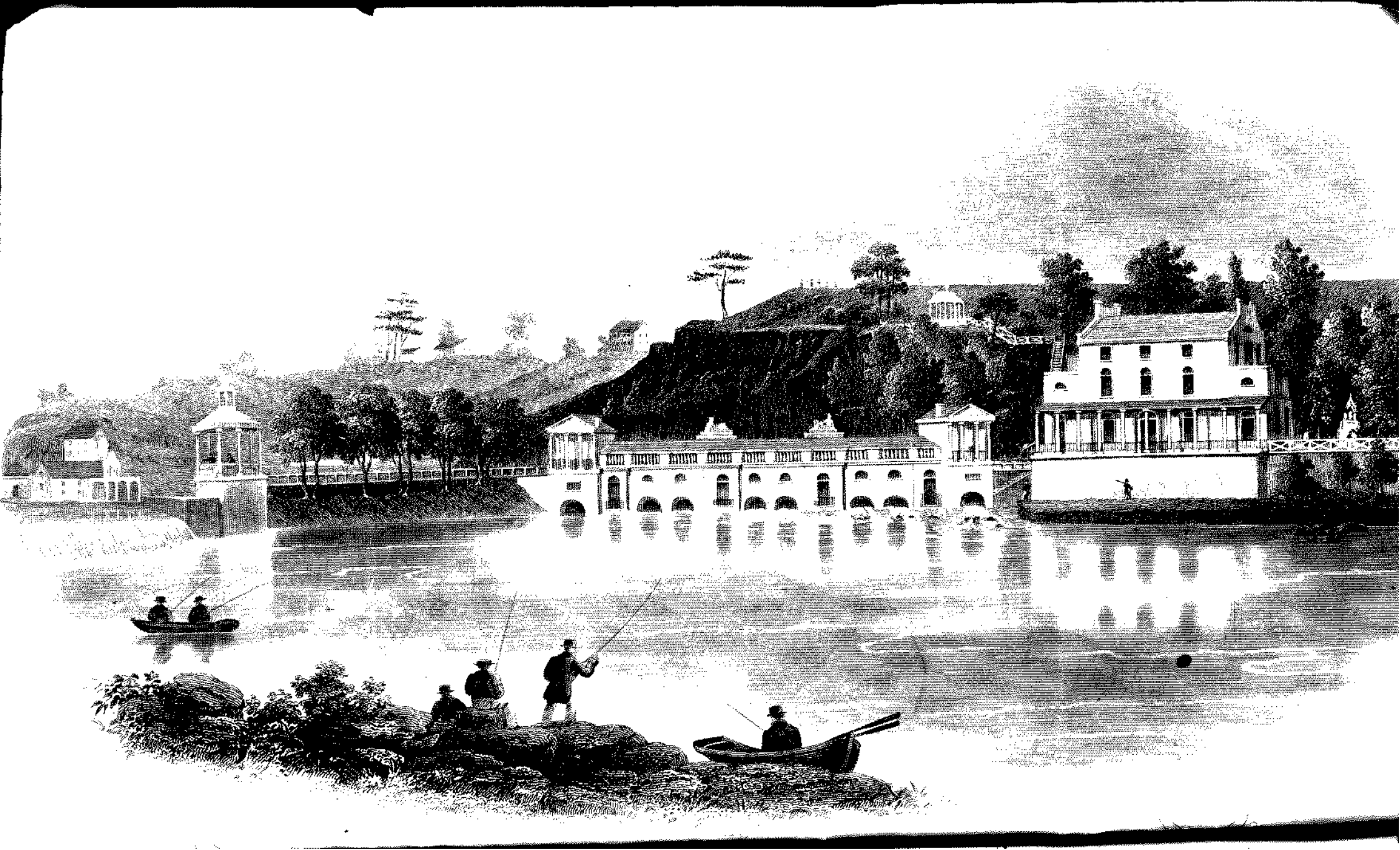

Notes of Steam Engines in the United States about the year 1801, and a description of those in use at the Water Works of the City of Philadelphia.

The first steam engine of any considerable size, appears to have been introduced into America, and put to work about the year 1763, at the Schuyler Copper Mine, situate on the river Passaic, New Jersey. All of its principal parts were imported from England, and Mr. Hornblower (the son, it is believed, of the well known steam engineer of that time), come to this country for the purpose of putting up and running the engine.

About the year 1800, the manufacture of the engines for the Philadelphia Water Works was commenced; and as late as the year 1803, we find five steam engines only noticed as being in use in this country, as follows:

Two at the Philadelphia Water Works; one just about being started at the Manhattan Water Works, New York; one in Roosevelt's Saw Mill, New York; one in Boston; and a small engine used by Oliver Evans to grind plaster of Paris, at the corner of Ninth and Market Streets, Philadelphia.

The engines for the Philadelphia Water Works were manufactured by Nicholas Roosevelt, at works established by him near the Schuyler Copper Mine, above referred to.

The following extract from a report made to the Committee on Water Works, by Thomas P. Cope, Esq., who was sent to examine the work upon the engines erecting at the time, will give a good idea of the progress that steam engineering had made to that time, and serve as a measure of the advance made since.

Extract from Report of T. P. Cope, dated July 4, 1800.

"Took passage in the stage for Soho Works, near Newark, New Jersey, on the morning of the 3d of July, 1800, and arrived there about noon of the next day.

"Soho is named after the works of Bolton & Watt, in England, and is situated about three-quarters of a mile northwest of the Passaic, on a small stream called Second River.

"The works consist of, a smith-shop 90x40 feet, with six fires and two air furnaces; next to this is a room 30x20, in which is the fire, for heavy work; four wooden bellows play into a regulator 15x15 feet, with pipes to the forge, and four furnaces for melting and refining copper. Then there is a stone building 20x24, two stories high, with six stampers for preparing loam for the furnaces; next to this is a fitting shop with large lathe and drilling machine, and a water-wheel 20 feet diameter, to bore cannon; next to this is a shop with a water-wheel 30 feet diameter for boring large cylinders; this is now boring a small cylinder for a steamboat, which belongs to Roosevelt, Chancellor Livingston, and others.

"Higher up the stream is the furnaces, 60x50 feet, with two air furnaces capable of melting 40 cwt. of metal each, two blast furnaces for melting and refining copper, with a coal house and pattern shop, with two foot lathes; all are stone buildings; the stream affords a head and fall of 16 to 18 feet.

"The large cylinder for the engine to be used on the banks of the Schuylkill at the water works was cast in two pieces, and united by copper, the joint being secured externally by a strong band of cast-iron, eighteen inches broad, weighing 1,200 pounds. Seven thousand five hundred weight of metal was used for the cylinder; it is six and one-half feet long, and about thirty-eight and one-quarter inches in the bore; about ¾-inches throughout was at first to be cut away; one-half inch has been accomplished; two men are required, one almost lives in the cylinder, with a hammer in hand to keep things in order, and attend to the steelings (cutters), the other attends the frame on which the cylinder rests, which is moved by suitable machinery; these hands are relieved, and the work goes on day and night; one man is also employed to grind the steelings; the work is stopped at dinner time, but this is thought no disadvantage, as to bore constantly the cylinder would become too much heated; the work also stands whilst the steelings are being changed, which required about ten minutes time, and in ten minutes more work they were dull again; I examined some of them and found them worn an eighth of an inch in that time. Three of these steel-

ings (or cutters), about three and one-half inches on the edge, are fixed in the head piece at one time. The head piece is a little less than the diameter of the cylinder, and six inches thick, secured upon a rod of iron eight inches in diameter, which forms the shaft of a water wheel.

"The workmen state that the boring was commenced on the ninth of April, and had been going on ever since, three months, and about six weeks more will be required to finish it.

"The wrought iron for the flue of the boiler over the fire will be imported from England, and is in sheets 38 by 32 inches. That yet made in this country is clumsy stuff of different sizes, the largest being 36 by 18 inches, with rough edges which have to be cut smooth by the purchaser.

Signed (THOS. P. COPE,)

July 4, 1800."

The engine for which the above described cylinder was being made was that put up at the water works on the Schuylkill, at the foot of Chestnut Street.

The cylinder was 38½ inches diameter and six-feet stroke, and drove a double acting pump 17½ inches in diameter and six feet stroke.

The engine at Centre Square, built about the same time, and at the same place, had a steam cylinder 32 inches diameter and six feet stroke, and worked a double acting pump of 18 inches diameter and six feet stroke, raising the water into tanks about 51 feet high.

In both these engines the lever beams, the arms and shafts of the fly wheels, the bearings upon which the fly wheels were supported, the hot wells, the hot and cold water pumps, the cold water cistern, and even the steam boilers were all made of wood. These latter were rectangular chests, made of white pine planks five inches thick; they were nine feet square inside at the ends, and fourteen feet long in the clear, braced upon the sides, top, and bottom with oak scantling ten inches square, the whole securely bolted together by one and a quarter inch rods passing through the planks. Inside of this chest was placed a fire box twelve feet six inches long, six feet wide, and one foot ten inches deep, with vertical flues, six of fifteen inches diameter and two of twelve inches diameter; through these the water circulated, the fire acting around them and passing

up into an oval flue situated just above the fire box, carried from the back of the boiler to near the front, and returned again to the back where it entered the chimney. This fire box and flues appears to have been at first made entirely of cast-iron; then a wrought-iron fire box was made, the flues still being of cast iron, this not being satisfactory on account of the unequal contraction and expansion of the two metals causing leakage, eventually wrought-iron flues were also put in.

Geat advantage was at the time supposed to be gained by the non-conducting powers of the wood, and also by the vertical flues in the fire box.

By experiments made with the engines when the above described wooden boiler was in use, it was recorded that the engine at Chestnut Street, on the Schuylkill, whilst lifting the water to the height of thirty-nine feet, and running at a speed of sixteen revolutions per minute, raised 1,474,500 ale gallons of 232 cubic inches each, in twenty-four hours, with a consumption of seventy bushels of Virginia coal. And the engine at Centre Square, raising the water fifty-one feet, pumped 962,520 ale gallons in twenty-four hours, with a consumption of fifty-five bushels of the same kind of coal; the pressure of steam, in both cases, being two and one-half pounds to the square inch.

As might be expected, great difficulty was experienced in keeping these boilers steam tight; accordingly, on December 1, 1804, a boiler with cast-iron shell, as well as flues, was put up, and another one, also of cast-iron, but of different form, was put in use March 10, 1806. The second of these, which was erected at the works on the Schuylkill, had semi-circular ends, was seventeen feet long and eight feet wide at the bottom, and nineteen feet long and ten feet wide near the top; the flame passed under the bottom and around the back into oval flues which passed through the boiler, returned and passed around the sides outside the shell.

The first had a semi-circular top, the ends being flat, and was erected at Centre Square. The fire passed under the boiler around heaters of peculiar construction and through one flue of serpentine plan to the front of the boiler; this boiler had two sheets of wrought-iron upon the bottom, just over the fire, all the rest being cast-iron.

These boilers remained in use until the steam works at Fairmount were started September 7, 1815.

At this last named works the boiler used was of cast-iron, the plan of boiler being the same as that of the wooden boiler just used at Centre Square, except that it had a shell with a semi-circular top; made of cast-iron; this was in use; from September 7, 1815, to January 14, 1822, when the use of steam at Fairmount was discontinued and water power works substituted.

The engine at the Schuylkill was started December 22, 1800, and that at Centre Square, January 27, 1801. The contract for them both was made March 21, 1779, the cost to be $30,000. The contractor claimed that they cost him $77,192.

The expense of keeping the engines running in 1809 is reported:

$6,254.36 for the Schuylkill engine.
and 7,552.87 for the Centre Square engine.

$13,807.23 together.

In October, 1807, a new wooden fly wheel shaft was put into the Schuylkill engine, and also that at Centre Square; the latter engine at the same time had a new wooden lever beam made, the old ones being found rotten. This latter engine had a fly wheel of 20 feet diameter substituted for the wheel of 16 feet diameter, first used. Neither of the pumps were originally provided with air chambers; such an appliance was put to the Centre Square engine June, 1810.

The engine and pump first put in at Fairmount, which was started to supply the City September 7, 1815, was almost similar to those at Schuylkill and Centre Square Works, except that the lever beam and fly wheel arms and shafts were made of cast-iron. They were all on the Bolton and Watt style of that period, with poppet valves worked by hand gear and tappets.

The dimensions of this engine were: steam cylinder 43⅛ inch diameter, and six feet stroke; lever beam, cast in two leaves, was 23 feet 9 inches long, between centres; the pump was double acting, 20 inches diameter and 6 feet stroke; the water was raised 102 feet above low tide; the boiler, as before stated, was cast-iron.

The castings for the engine were made by Samuel Richards, at Weymouth Furnace, and at a foundry then situated within a fourth of a mile of Fairmount. The price paid was for the cylinder castings $160 per ton; for lever beam $120; for fly wheel and shaft

$100, and for the cast-iron boiler plates $90 per ton; the weight of the latter was 16 tons 12 hundredweight and 39 pounds.

The founder reported that the castings of the cylinder (which had to be cast with the nozzles for the side pipes separate) took all the metal that the "Eagle Works" would hold, viz., thirty-five hundredweight.

This engine, with steam at 2½ pounds above the atmosphere, raised 2,116,382 United States gallons, with the consumption of seven cords of oak wood; the run was for twenty-four hours, but after the first eight hours it was found difficult to keep the steam up to 2½ pounds pressure, and the engine finally stopped for want of steam; the chimney flue was afterward enlarged, and then steam was carried up to 4 pounds to the square inch; the engine cost $54,341.

At this works Oliver Evans erected the first large high pressure engine made by him. It had a steam cylinder 20 inches diameter and five feet stroke, with a rotating steam valve, worked by bevel gear wheels, driven from the main shaft; it had a double acting pump 20 inches diameter and 5 feet stroke; the beam was made of wood, and was suspended at one end upon vibrating standards, the piston rod being attached to the other end of the beam.

The boilers were wrought-iron, 27 feet long, 27 inches diameter, and four in number, upon which steam was at times raised to 220 pounds to the square inch; they were twice burst, three men being killed by the explosion, first time June 20, 1818, and again October 12, 1821.

On the 15th of May, 1817, this engine was submitted to contract test; she run twenty-three and a-half hours; filled the reservoir 9 feet 5 inches deep, being equal to 3,666,021 United States gallons, maintained steam from 194 to 200 pounds to the square inch, and burned 13 cords of oak wook, running at a speed of 22 revolutions per minute.

The use of both these engiues was discontinued January 14, 1822; they remained standing in the building until May 10, 1832, when they were sold and soon after removed.

The distributing pipes used with the Centre Square Works, and for several years after the use of steam was abandoned there, were made of spruce pine logs, and varied in diameter from 3 to 6 inches, inside.

As Philadelphia was the first works in the country to adopt cast-iron as a material for water-pipe, a plate, which will explain itself, is appended hereto. (Jan 1879)

It shows the standard sizes adopted at that time, as established by Frederick Graff, Sr., then Chief Engineer of the Water Works, and also shows the old stops used with the wooden logs, which it will be seen is in general arrangement precisely like the "globe valves" of the present day, for which numerous patents have been granted.

And also the fire-plugs and stop-cocks designed by Mr. Graff in 1803 and 1822; no fire-plug or stop has been invented since (to my knowledge) that does not contain the general principle, and almost the mechanical form, of these early hydraulic appliances.

The first of the large water mains were cast at the charcoal blast furnaces of Mr. Samuel Richards; one of the very earliest of them is to be seen in the section of the American Society of Civil Engineers, at the Centennial Exhibition, and not only seems to show the advance made in such castings at the time, but also the durability of water-pipes in the soil of our City, and with the water supplied from the River Schuylkill.

FRED. GRAFF.

Philadelphia, June 8, 1876.