IMPROVEMENT OF POTOMAC FLATS, WASHINGTON.

The improvement of the river front of the city of Washington, D. C., popularly known as the Potomac Flats Improvement, was intended to accomplish two objects: First, to improve navigation, for which annually the government has for years been expending a large sum of money; and second, to fill up a large area of marsh land, which was overgrown with a dense growth of grass. The marshes were what are known as the Flats. There were many acres of these marshes bordering on the river bank, which were exposed at low and covered at high tide. One of the largest sewers of the city discharged its contents on these flats, and being exposed daily to the rays of the sun, when the tide was low, rendered a large section of the city almost uninhabitable. The Executive Mansion itself was only about 2,500 feet from the flats, which became such a public nuisance that what had been one of the most desirable sections of the city became the most undesirable for residence.

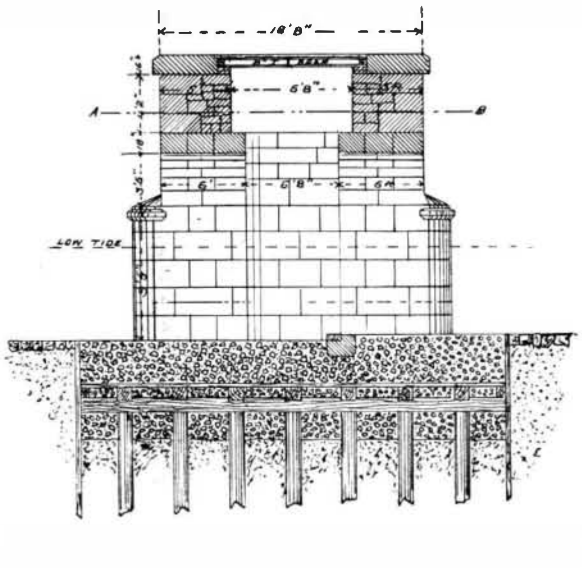
In 1881 the Senate appointed a committee to investigate the case. The direct result of this investigation was an appropriation by Congress of $400,000 to begin the work of improvement. Since then successive appropriations have been made at intervals of two years, and the amount expended up to the present time has been $1,624,798. The estimated cost of the entire work was $2,716,365, and notwithstanding the unbusinesslike methods of Congress in appropriating insufficient sums to prosecute the work vigorously, and the damage it has consequently sustained from freshets, the work has been brought to that advanced state that it could yet be completed within the estimates. Considering the magnitude of the work, and the fact that the estimates were regarded as low, this is justly regarded as a satisfactory exhibit.

The total area of land reclaimed is in round numbers 621 acres. The material with which the fill was made was taken from the river channels, and thus accomplished the double purpose of improving the navigation and reclamation of the flats.

The question of the disposal of dredgings taken from rivers to improve navigation is becoming a serious one. The old dumping grounds are rapidly becoming filled up, and even when others are found at a long distance from the place to be improved, there is great danger of the material being swept back into some other channel, and thus create a new obstruction where none before existed. In many places satisfactory dumping grounds cannot be found at all; in others the vested rights of adjacent owners of land forbid it.

The work of taking the material from the bed of the river was done in different ways. At first the channels were dredged in the ordinary way, with clamshell and dipper dredges, the material being loaded into scows and then conveyed to a basin located at a convenient point, from which it was again taken up and loaded on railroad cars, which conveyed it to the place of deposit on the flats. The tracks in this case were carried on trestle work, made by driving piles in the flats on the area to be filled, and capping them with heavy timbers. The tracks were raised to a sufficient height to cause the material, when dropped from the cars, to fall with such force that it spread out laterally to a distance of several hundred feet, and when it did not spread itself, a pump was used to level it down. This method of deposit had several disadvantages. It was expensive. The amount of material that could be dropped at any particular point depended altogether on its character. Soft mud spread out well, but sandy or gravelly stuff did not. The material had to be lifted through a considerable vertical height no less than three times—a wasteful expenditure of energy.

Another method was to dredge the material from the river by means of a centrifugal pump, and force it ashore through pipes carried on scows or pontoons. This work we show at the top of our front page, the material being delivered under pressure to a considerable distance. The boat shown in the illustration is 110 feet long; beam of boat, 50 feet. The rotary centrifugal pump is 8 feet in diameter, and 21 inches discharge. Two engines are required to run the pump, each 22 inch cylinder and 24 inch stroke, making



VERTICAL SECTION
ON "C D".
GATE REMOVED.

RESERVOIR OUTLET—VERTICAL SECTION.

150 revolutions per minute; steam 90 pounds to the inch. Two locomotive boilers, each 60 inch diameter, 25 feet long. Two engines to run the plows, each 10×20, running 120 revolutions per minute, discharging through 4,200 feet in length of 20 inch discharge pipe.

This pump has a capacity of 10 cubic yards per minute in stiff blue clay and a greater capacity in other material. Three of these hydraulic dredges were put on the work at various times. The material dredged in this way when deposited on the flats spread itself out in low conical heaps and gave good grades. When the material was very soft it spread out quite flat. This method of dredging proved economical and advantageous, but it was necessary to prepare the place of deposit by constructing embankments around it. As these embankments became in fact a part of the fill and were cheaply constructed, the hydraulic method of dredging was very satisfactory. The centrifugal pump dredge was known as the McNee dredge, and has been used on other important work, giving good satisfaction. As it deepens the channel and deposits the material at any distance required up to one mile at one operation, it is by far the cheapest method that has been employed. Many of these dredges are now in use in different sections of the country. They are owned and operated by the Hydraulic Dredging and Improvement Company, of Philadelphia, Pa.

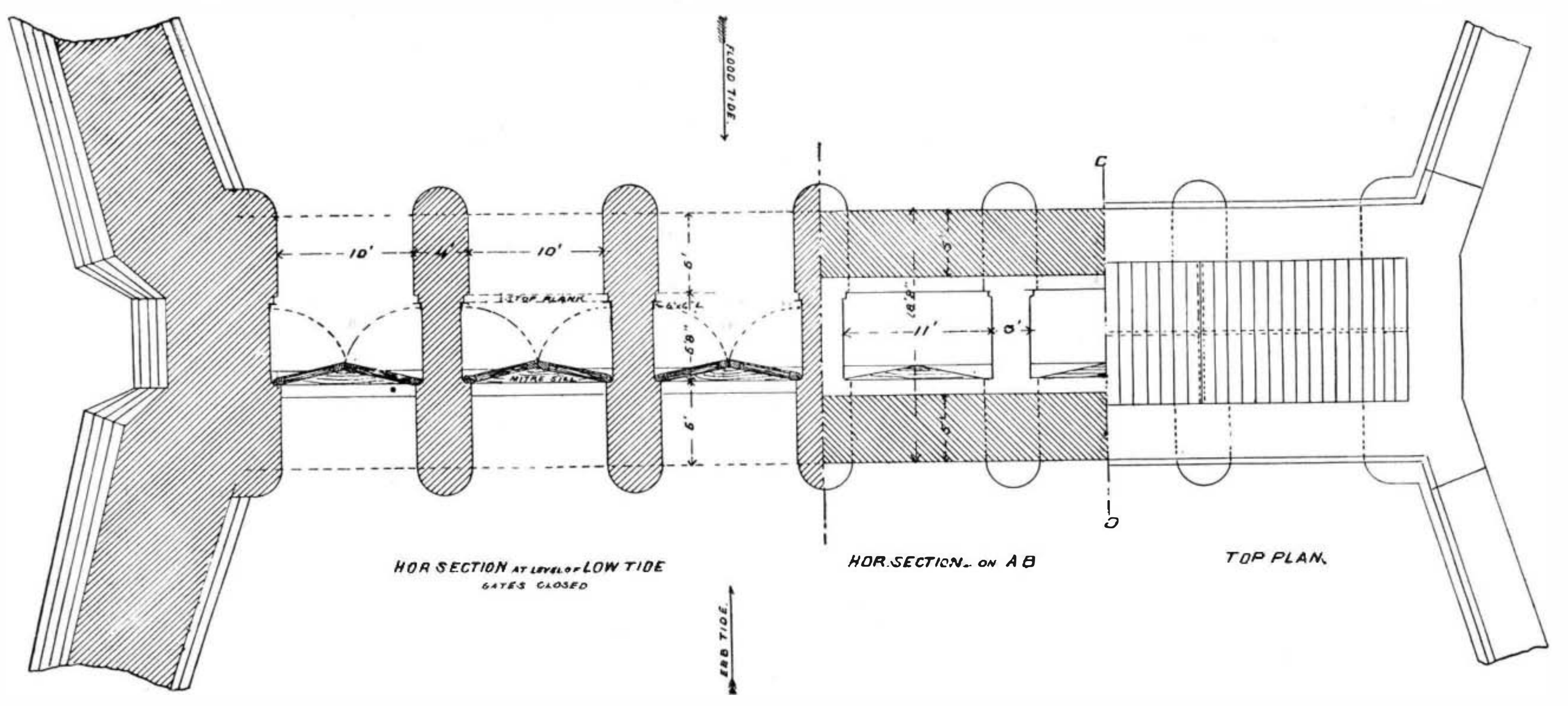
Another method was introduced at a later stage of the work, and consisted in dredging the material into scows and conveying it to a pump operated on the pulsometer principle. This pump was located near the margin of the flats, and set in a hole in the bed of the river. The dredged material was dumped into this hole, from which it was sucked up by the pump and forced into a chute which carried it out to the place of deposit. The mode of operating the pump was to fill a large cylindrical tank with steam, the pressure from which drove out any material in the tank, and raised it to the top of the chute into which it discharged. By means of a shower bath the steam was then condensed, which closed a valve in the discharge pipe and opened one in the suction. The latter being buried in the dredgings which were deposited over the end of it, and a vacuum being produced by the condensation of the steam in the tank, an inrush of mud or mud and water took place, soon filling the tank. It was then forced out as before. This method of dredging necessitated the construction of long chutes, and as the material had to run down by gravity, the end into which the pump discharged had to be high.

The filling of the flats converted the old Washington Channel into an arm of the river, closed at the upper end, into which some sewage would necessarily go. To purify this, a tidal reservoir of about 110 acres was constructed just above Long Bridge, from which about 250,000,000 gallons of water would be discharged daily into the head of the Washington Channel. The water is taken into the reservoir from the Virginia Channel on the flood tide and discharged into the Washington Channel on the ebb. To control this operation it was necessary to construct, near Long Bridge, the reservoir outlet, which is provided with gates that work automatically, closing on the flood and opening on the ebb tide. A set of inlet gates, to work on the same principle, may also be needed.

The reservoir outlet is a masonry structure, consisting of a breast wall perforated by six arched openings, with two wing walls on the upstream and two on the downstream side. Each opening is 10 feet wide and 13 feet to the crown of the arch, the bottom being 6 feet below mean low tide. The discharge area is therefore 360 square feet at low tide and 540 square feet at ordinary high tide. The gates, when closed, rest against miters at the bottom and top, and when open set back into a recess in the side walls. They are built of wood, and pivoted at the heel, so as to make the friction the least possible. No mechanism is needed to start the gates closing from their positions in the recess of the masonry; the action of the water does this automatically as soon as the tide begins to run up stream.

Considerable difficulty was experienced in securing a foundation for this structure. The bed of the river here consists of very soft mud to a depth of fifty to sixty feet, then layers of sand of varying thickness are encountered, with layers of mud between. At a depth of seventy-two to seventy-five feet a compact layer of gravel is found. As any unequal settlement would disarrange the gates, it was deemed necessary to drive piles to the latter depth. These were capped by two sets of grillage timbers, and the spaces between them, and for two feet below the heads of the piles, were filled in with concrete.

The total amount of material thus far dredged and deposited on the flats is in round numbers about 8,642,000 cubic yards. The price paid for dredging, exclusive of embankments, has varied from 12·37 cents to 21·2 cents per cubic yard, but besides the dredging there has been a large amount of stone used as a footing for



RESERVOIR OUTLET—HORIZONTAL SECTION.

the embankments, and foundations for protectir walls. The total cost of the entire work thus far, cluding everything, has been $1,624,798. The value of the land reclaimed, in its present condition, is estimated at not less than about $3,000,000, so that viewed as a commercial enterprise, it has been a profitable undertaking for the government.

One of the views shows the condition of the flats at low tide, as given by a photograph taken from the top of the unfinished Washington monument in October, 1883, when the monument had reached a height of 384 feet. Another view represents the improvement as it appears to-day, and was taken from the top of the present Washington monument. The diagram, drawn to a scale, gives the relative size and positions of different parts of the work, all of which has been done under the direction of Col. Peter C. Hains, U. S. A., in charge of various public works in the immediate vicinity of Washington, and to whom we are indebted for the details given.

From the Capitol to the Virginia Channel is now one large park, marred only by the unsightly tracks of the Baltimore and Potomac Railroad. Embraced in this area are the Botanical Gardens, Medical Museum, Smithsonian, Agricultural Department, Bureau of Engraving and Printing, and the Washington monument. This park is a favorite drive for the thousands of visitors to the capital, and the grounds of the White House border it on the northwest.

Something Queer in the Numbers.

Mr. John W. Kirk, the white-haired veteran who was with Morse when the first working telegraph line was stretched, and who stood beside the great inventor when the first message was transmitted from Annapolis Junction to Washington, has made, during his life, a great many interesting calculations in numbers. The two most remarkable numbers in the world are 3 and 7.

"The numeral 7," says Mr. Kirk, "the Arabians got from India, and all following have taken it from the Arabians. It is conspicuous in Biblical lore, being mentioned over 300 times in the Scriptures, either alone or compounded with other words. It seems a favorite numeral with the divine mind, outside as well as inside the Bible, as nature demonstrates in many ways, and all the other numbers bow to it. There is also another divine favorite, the number 3—the Trinity. This is brought out by a combination of figures that is somewhat remarkable. It is the six figures 142,857.

"Multiply this by 2, the answer is 285,714.

"Multiply this by 3, the answer is 428,571.

"Multiply this by 4, the answer is 571,428.

"Multiply this by 5, the answer is 714,285.

"Multiply this by 6, the answer is 857,142.

"Each answer contains the same figures as the original sum and no others, and that three of the figures of the sum remain together in each answer, thus showing that figures preserve the Trinity.

"Thus 285 appears in the first and second numbers, 571 in the second and third, 428 in the third and fourth, and 142 in the fourth and fifth.

"It is also interesting to note that, taking out of any two of these sums the group of three common to both, the other three, read in the usual order from left to right, will also be in the same order in both sums.

"Take the first and second sums, for example. The group 285 is common to both. Having read 285 out of the second sum, read right along and bring in the first figure of the thousands last. It will read 714. All the others will read in the same way.

"Again, note that the two groups of three in the first sum are the same as the two groups of threes in the fourth, reversed in order, and that the same thing is true of the second and third. The last multiplication has its groups of threes the same as those of the original number, reversed again.

"Examine these results again, and you will see that in these calculations all the numerals have appeared save the 9. Now multiply the original sum by the mighty 7—the divine favorite of the Bible and of creation—and behold the answer! The last of the numerals, and that one only in groups of three—again the Trinity!

$$\begin{array}{r} 142,857 \\ 7 \\ \hline 999,999 \end{array}$$

"No other combination of numbers will produce the same results. Does not this show the imperial multipotent numeral 7 and its divinity?"—*N. Y. Sun.*

A DOUBLY tin-lined and hermetically sealed box containing rubber coats has been in the Atlantic Bonded Warehouse, San Francisco, Cal., for some time. Recently it was found to be quite hot, and day after day the heat became more intense until it was decided to investigate. Finally a permit was got from the collector to open the box. It was taken from the building and opened with an ax. As soon as the fresh air struck the contents, flames leaped into the air for several feet and a cloud of smoke escaped. The rubber goods were mackintoshes containing some compound which caused spontaneous combustion.

Correspondence.

Concerning Steam Vessels.

To the Editor of the Scientific American:

A few weeks past I saw in your paper of the 18th of April, in our Howrah Institute, that you had made inquiries into the reason why your American cruisers fell short of keeping up the speed which they made on the four hours' trial. There can only be one answer; That the boiler power was not in the vessel. The engines can be made all sizes, but the boiler power must not be a sham, or failure is the result.

In the same paper you state a vessel is being constructed of the cruiser class, 7,400 tons displacement, and to have three screws, and the speed for four hours to be 22 knots and the indicated horse power 23,000. For a vessel of this displacement to steam 23 knots the engines would require to indicate 26,000 horse power, and the vessel would require to be of the following dimensions: Length, 450 ft.; breadth, 56 ft.; depth of hold, 36 ft.; mean draught, 22 ft. 6 in.; coefficient of fineness block, 0·45; midship section, 0·7854; angle of entrance, 10°.

Boilers twenty-two in number; diameter, 13 ft. × 18 ft.; four furnaces to each (double-ended boilers), having combustion chambers 4 ft. × 4 ft. common to both furnaces. Boilers to work under forced draught. Tubes 7 ft. long by 3½ in. diameter. Total heating surface, one boiler, 3,500 sq. ft. Furnaces 3 ft. 6 in. diameter by 7 ft. long. Total grate surface, one boiler, 84 sq. ft. Total steam space in one boiler, 600 cu. ft. Working pressure, 180 lb.

Engines—three sets of triple expansion; sizes according to the number of revolutions to get up the indicated horse power, say for engine having 5 ft. stroke and to indicate 8,500 at 100 revolutions.

						Inches.	
100 rev. per minute,	working	pressure 180 lb.,		cylinders	40	60	100
120 "	"	"	"	"	36	56	95
130 "	"	"	"	"	35	55	92
140 "	"	"	"	"	34	53	88
150 "	"	"	"	"	34	50	86
160 "	"	"	"	"	33	48	83

Each set of these engines will indicate 8,500 H. P. on a consumption of 1·5 lb. of coal. Calculations made from a 110 in. cylinder, cutting off steam at $\frac{1}{20}$ of stroke. Revolutions 130, working pressure 180 lb. steam.

Consumption of coal per H. P., 1·5 lb. per hour.

Diameter of screw shaft, 22 inches.

Diameter of propeller 16 ft., pitch 20 ft., for 160 revolutions.

Diameter of propeller 18 ft., pitch 28 ft., for 100 revolutions.

Angle of blade at tip 26°, at boss 4 ft. 6 in. diameter, angle 63° for propeller 18 ft. diameter, pitch 28, wing engines. Propeller for center engine 20 ft. diameter, pitch 30 ft., angle at tip 25° 30', 5 ft. boss, angle at 62°.

The first set of cylinders, viz., 40 in., 60 in., 100 in., with propeller 18 ft. diameter, 28 ft. pitch, 100 revolutions, should be fitted in the wings of vessel; and engines having cylinders 45 in., 70 in., 106 in., with 6 ft. stroke, 100 revolutions, propeller 20 ft., pitch 30 ft., angle at tip 25° 30', diameter of shaft 24 in., should be fitted to center of vessel.

The cost of a vessel of this class in England would, if built by Laird Brothers, Birkenhead, be about $2,750,000.

W. WOODS, *Engineer Apprentice*,
Ahmuty & Co., Howrah Foundry, Calcutta.

Calcutta, August, 1891.

Underground Wires in China.

"A superstitious reverence for the dead accomplished years ago in China something that regard for the comfort and safety of the living, even when aided by judicial mandates and radical municipal methods, has been only partially able to accomplish in this country," said a telegraph lineman who was in the employ of the company that established the first telegraph line in China.

"The telegraph wires are placed underground there, and if the company had not so disposed of them there would have been no telegraph lines in China to this day. Dead ancestors are held in peculiar reverence in that curious country, and the casting of a shadow upon the grave of an ancestor is looked upon by the Chinese as an insult not to be borne, and it is always resented with impetuous rage. Now there are no cemeteries or general burying grounds in China, but every family's ancestors, particularly in the rural districts, are buried on the family premises. Consequently, every yard or garden is a receptacle of ancestral remains, and as China is thickly populated, the revered bones of the dead and gone Mongolian progenitors may be found resting beneath every few rods of earth. When the telegraph company went to work to put up the poles on which to hang its wires, the workmen were embarrassed every little while by wrathful Chinamen, who would rush angrily upon certain poles and chop them to the ground, and warn the workmen with much furious chatter that they would put them up again at their peril. The cause of this interference was unknown to the workmen, who were at last forced to discontinue the work, and explanation was demanded by the authorities. Then it was learned that the poles that were cut down had cast a shadow some time during the day on the graves of revered ancestors of Chinamen, and the insult could be wiped out in no other way but by summarily removing the poles. It was found that this superstition was too sacred a one among the Chinese to be overcome by persuasion or bribery, and at last the telegraph company, as a matter of economy and self-protection, laid their wires beneath the surface, where they have been ever since."

Forests.

"Did it ever occur to you to consider what an enormously valuable inheritance man has received in the 'forests primeval'? said Professor Fernow, of the Department of Agriculture, in conversation with a Washington *Star* writer. "Of all the natural resources received by nature for our benefit, they are the most directly useful. In the woods we find ready at hand and obtainable for mere harvesting materials applicable to all the needs and means to satisfy every immediate want.

"Probably you will be surprised when I tell you that the annual increase of the forests by natural growth, representing the interest which we are at liberty to draw without impairing the principal, exceeds in the United States alone ten times the value of the gold and silver output of this country, and is worth more than three times the product of all our mineral and coal mines put together. If to the value of our total mining product be added the value of all the stone quarries and petroleum resources, and this sum be increased by the estimated value of all the steamboats, sailing vessels, and canal boats plying in American waters, it will still be less than the value of the annual forest product of the nation by a sum sufficient to purchase at cost of construction all the canals, buy at par all stocks of the telegraph companies, pay their bonded debts, and equip all the telephone lines. The annual product of the woods is worth three times as much as the wheat crop. It exceeds the gross income of all the railway and transportation companies, and it would more than wipe out the entire public debt.

"More than 300,000 people are occupied to-day in the direct manufacture of forest and sawmill products alone. Were I to attempt an enumeration of the uses to which the product of the woods is put, it would be necessary for me to mention all the phases and employments of human life. Railways annually consume 500,000,000 feet of timber. The same material builds the houses and yields for two-thirds of the population the fuel necessary to warm their dwellings with and to prepare their food. Upon charcoal the iron industry largely depends. Not only in its natural form does the substance serve our needs, but our ingenuity has devised methods for transforming it into all sorts of useful things. Paper is made from it, and even silk, while it has become possible to prepare from brushwood a feed for cattle as nutritious as hay. By distillation are derived from it alcohol and acetic acid, while the barks yield indispensable tanning material, resin and tar for pitching vessels, turpentine, sassafras, oil, and cork.

"The decayed vegetation of forests has furnished to the fields their present fertility, upon which man depends for food. In the tree growth of virgin woods and in the floor of rotted foliage beneath are stored the accumulations of centuries. Nature does not care whether this growth is useful to the human race or not. It is left for us to encourage the growth of such trees as we find valuable, to the exclusion of others. Thus an economical use is made of the resources at hand and a new conception of the forest arises. The forest primeval becomes 'woodlands, while the new 'forest' includes only cultivated woods.

"If left without interference by man, Nature would keep the entire earth covered with forests, save only a few localities. The treelessness of the great central plains of the United States has been accounted for by the deficiency of rainfall, and the belief is generally held that by reason of this lack of moisture trees can never grow there. Nevertheless the conclusion does not of necessity follow. There is excellent cause for believing that these prairies were not always treeless, and that their nakedness might once more be covered by the adoption of proper means to that end. The barrenness occasioned by prairie fires and herds of tramping buffalo may yet be made fruitful. You must remember that the entire earth is a potential forest. Wherever there is sufficient depth of any kind of soil for the roots, if it is not too frigid a climate and man does not interfere, arborescent growth will ultimately prevail on account of its perennial character and its power to shade out lower vegetation. In such localities as the interiors of large continents forest planting must progress by gradual advances from the borders of the unproductive territory. Once let woods be spread over the now arid plains of the West and there would be rain in plenty there. But success in this matter can only be achieved through co-operation systematically and methodically carried out, commanding knowledge, means, and power such as a government, whether of the nation or of States, can alone control."

SCIENTIFIC AMERICAN

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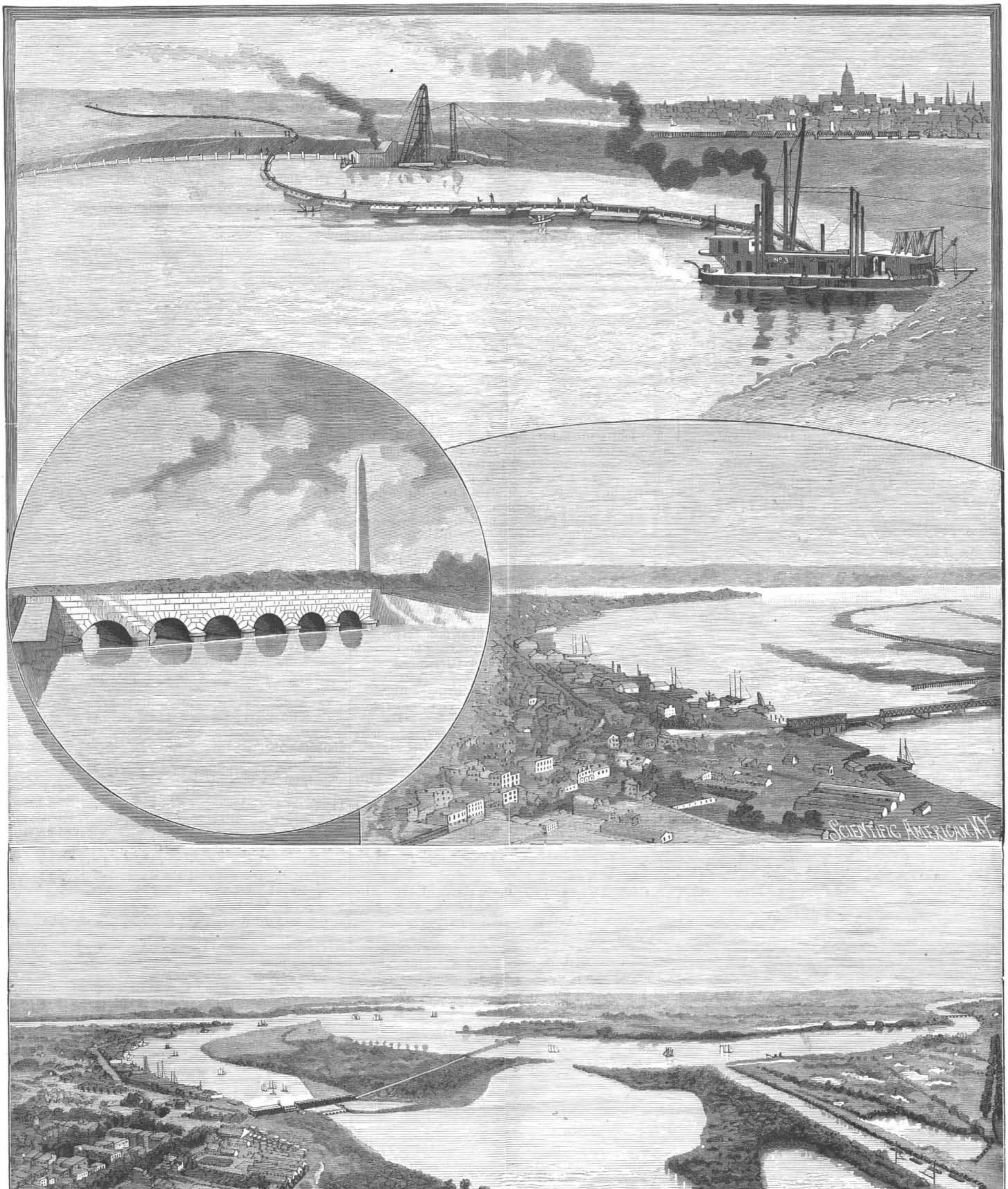

1. McNee dredge removing material to a distance. 2. Reservoir outlet. 3. General appearance of island before the work was commenced. 4. Bird's eye view from top of Washington monument, showing present appearance of island and other reclaimed lands.

IMPROVEMENT OF THE POTOMAC FLATS, WASHINGTON D. C.—[See page 180.]