SCIENTIFIC AMERICAN SUPPLEMENT No. 650

Scientific American Supplement, Vol. XXV., No. 650.
Scientific American, established 1845.

NEW YORK, JUNE 16, 1888.

Scientific American Supplement, $5 a year.
Scientific American and Supplement, $7 a year.

THE NEW PORT OF HAVRE.

THE Bellot basin, which bears the number 9 in the series of docks of Havre, is constructed upon made land to the south of Tancarville Canal. We borrow a description of it from an article recently published by Government Engineer H. Desprez.

The basin is bounded on the south side by a masonry dike 3,280 feet in length and a stockade 1,790 feet in extent. Its total length, including that of the entrance lock, is 3,762 feet. It is divided into two floating docks, called the east and west, which are of unequal length, but of a uniform width of 720 feet. The area of the dock is 253,460 square yards.

The entrance lock, the axis of which is in the prolongation of that of the Transatlantic lock, is 98 feet in width. It is provided with ebb gates that permit of isolating the Bellot from the Eure dock. The leaves of this gate, which are of rolled iron, are 54 feet in width and 36 in height. The system of construction adopted includes vertical posts that support the external edge and that rest upon two horizontal cross pieces placed, one of them, at the upper part, and the other at the lower part of the leaf. This latter comprises a series of air and water chambers below and water chambers above. The respective volumes of the leaves permit of reducing the weight of each upon its hinges from 155 to 25 tons.

The sluiceway between the two docks is 98 feet in width. Two revolving bridges, of a single span, and having two wagon roads, cross the entrance lock and the central sluice. The extent of the wharf walls is 8,708 feet, of which 7 806 are utilizable for navigation. The platforms are 270 feet in width at the north and 375 at the south, including the space reserved for the service roads and railways. Their total area exceeds two million square feet.

A water inlet closed by two metallic gates each weighing 11,100 pounds is formed in the southern wharf, in order to fill the dock at rising tide and diminish the currents between the jetties and in the locks.

The dike in the offing is prolonged toward the east by the stockade of which we have spoken, and which is to allow of the construction, behind the dock, of a vast platform of an area of over a million square feet, to serve as a location for a large maritime station connected with the tracks of the Railway of the West.

Great difficulties have been encountered in the construction of the Bellot basin in consequence of its execution on a shore exposed to violent tempests. The work has been done partly by means of pumping performed behind an insubmergible boat, and partly by compressed air. Among the first of the structures figures the dike in the offing, which is founded upon beton that was run into an excavation made on the shore of the mouth of the Eure to a depth of five feet beneath the level of the earth, the excavation being kept dry by pumping at every rise of the tide. How difficult this work was will be appreciated when it is known that after various fruitless tentatives to effect the pumping by means of centrifugal pumps established upon the neighboring platform, it became necessary to put the machines on the shore at every low tide, and then hoist them up and put them under shelter on the platform during flood tide, thus reducing the time of effective work to two hours per tide.

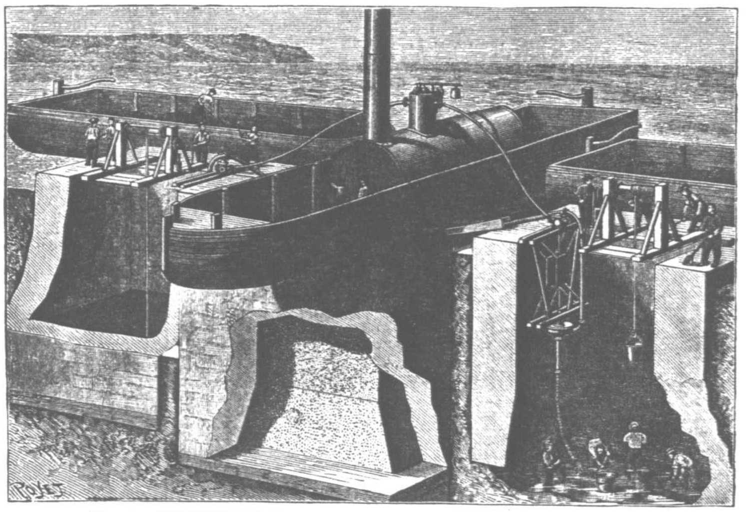

FIG. 1.—SINKING BLOCKS OF BETON IN THE PORT OF HAVRE.

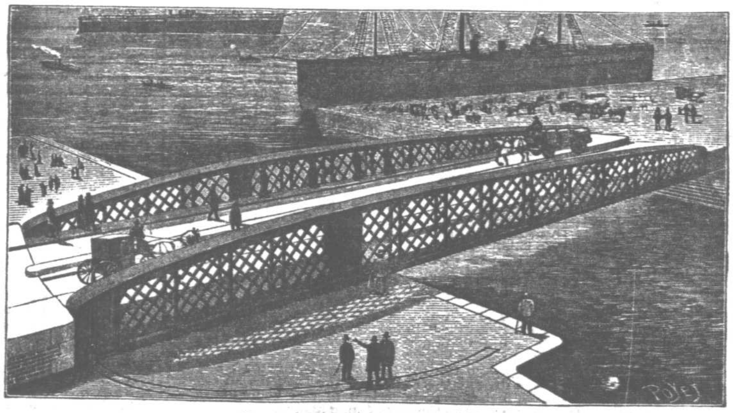

FIG. 2.—REVOLVING BRIDGE.

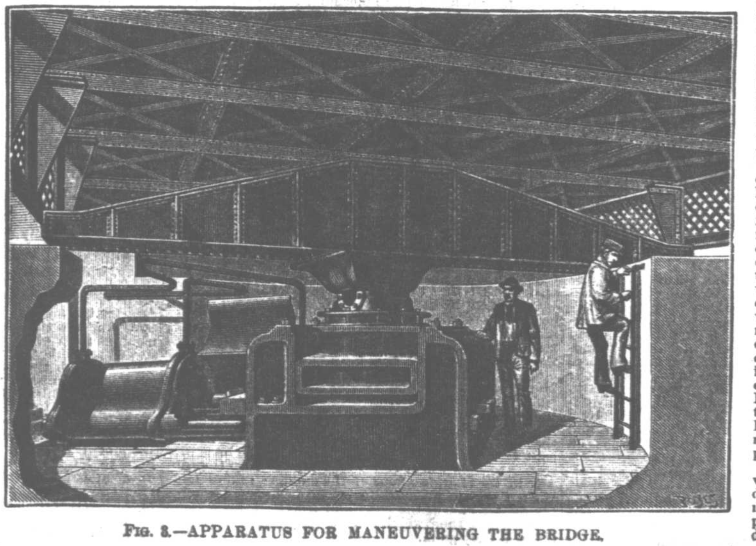

FIG. 3.—APPARATUS FOR MANEUVERING THE BRIDGE.

Another operation no less delicate was the sinking of the foundation blocks of the wharves of the western floating dock. The blocks used for the substructure of the wharf walls were 33 feet in length by 22 feet in width, and had a central aperture to allow of the removal of the excavated material, and thus determine the sinking of the blocks themselves. The masonry for each of them, 14 feet in height, was laid upon a simple platform of planks placed upon the shore. After allowing thirty days for setting, the earth was excavated in the interior so as to sink the block into the ground for its entire height. Then the masonry was laid to a further height of 10½ feet, and after another rest of twenty days, the sinking was resumed and completed. The central aperture was then filled in with beton.

The sinking of the blocks necessitated pumping, which was performed at first by Letestu pumps worked by hand; but, for the second period of sinking, it became necessary to have recourse to a special installation that permitted of moving the pump and its motor, in order to follow the progress of the work. To this effect there were used small centrifugal pumps with vertical axis driven by three-cylinder Brotherhood engines. The pump and motor were established upon a wooden framework in the interior of the well, and remained in the latter permanently during the entire operation. A barge moored between two of the blocks, and carrying a boiler, furnished steam to two engines (Fig. 1). With this method of working, great rapidity was attained in pumping out each block. The excavated material was drawn up in buckets to the top of the block, put into a lighter, and carried to the earth heap.

There were 87 blocks sunk by this process, representing 1,575,000 cubic feet, at the rate of 106 days per block, inclusive of stoppages to let the cement set. The work was regular, and the blocks were kept in a satisfactory position.

While the dike was in process of construction, the Bellot basin walls and the western wall of the western floating dock were undertaken by means of pumping in an excavation made in the center of the platform adjacent to the Eure dock. The earthwork of the western floating dock and a portion of the walls were executed in dryness after a portion of the dike had been finished and a dam separating the two floating docks had been constructed. The wing walls of the Bellot dock, and the demolition of the wharf wall of the Eure dock, were executed by means of a caisson and compressed air.

The bridges, gates, sluice valves, and capstans of the docks and drains are all maneuvered by hydraulic power. We shall give some details in regard to the spestrain. Lime in excess is also to be deprecated, for it necessitates the purging of the cement, as it is termed—that is, the cement is spread out on floors so as to admit of the hydration of the lime; in some of the works where the cement is produced from limestone, it is usual to keep it for two months, turning it from time to time, thus entailing considerable expense.

Makers of cement have suffered severe losses through their lack of knowledge in not being able to ascertain the quality or estimate the component parts of the cement-producing mixture. Some of the large works now employ chemists, and so carry on the business in a scientific manner.

It will be seen from what has been stated that it is essential in the production of cement to have a carbonate of lime in as fine a state of division as possible, either in the form of ground limestone or chalk.

Carbonate of lime, as a by-product, has been produced by alkali manufacture for the past thirty years, and in a state that will compare favorably with the finest ground limestone, or even chalk. This substance, commonly known as lime mud, has always been a source of trouble to the manufacturer. To use it as a substitute for limestone in the black ash mixing retards the process very considerably, owing to the amount of water the mud contains, the best appliances in the shape of filter beds and pumps failing to reduce moisture to much less than 30 per cent.

Some manufacturers have sent the lime mud away as refuse at a considerable expense, while others run it into the river.

When alkali was of far greater value than it is at the present day, there was not the same necessity to study economy so strictly; now we find what have been hitherto waste products have been utilized with considerable advantage. In the case of lime mud, having experimented with it (some two years ago) with a view to manufacturing Portland cement, I came to the conclusion that, by proper manipulation, and by washing the mud as free from alkali as possible, and eliminating the sulphur compounds, the alkali manufacturer had in his hands a substance as valuable for cement making as chalk, with the advantage over the latter substance of being free from flints, and in a state ready for mixing with the least possible trouble.

In the first instance I made a cement from the lime mud without the latter being purified, and found it produced a cement of a very uncertain nature; when made into briquettes and placed in water, they frequently crumbled away, or if they held together at all, a very slight strain caused them to break. The cement had also an unpleasant slippery feel with it when taken from the water; it also evolved sulphureted hydrogen when treated with an acid.

I expected that the sulphur compounds would have been decomposed by coming in contact with the CO_2 evolved in the decomposition of the $CaCO_3$ during the process of making the clinker in the kilns, but in every instance I found sulphides present. Knowing that it was most important that Portland cement should be free from sulphides, I endeavored to eliminate them from the lime mud. I found by passing CO_2 through a mixture of lime mud and water, a chalk was produced that quite answered my expectations; the CO_2 can be obtained from the kiln during the decomposition of the slurry(a technical term for the mixture of clay and chalk). It has also suggested itself to me that the CO_2 from the above process could be used in Chance's process for the recovery of sulphur from alkali waste, instead of burning limestone especially for that purpose, or the new process of Simpson and Parnell for the same purpose, now being worked by the Lancashire Sulphur and Alkali Co. at their works, Widnes.

I will now give you a brief description of my process for the manufacture of cement from lime mud. It is very similar to the method adopted in ordinary cement works, with the exception that the chalk or lime mud requires purification before being calcined. Either before or during the process of mixing the lime mud and clay (say the latter), I take the lime mud direct from the filters, after being washed as free from alkali as possible, and mix with a good unctuous clay in such proportions that will produce a cement corresponding to analysis already mentioned. It is highly important that every attention be paid to procuring a reliable clay of regular quality, for upon this depends the success of the operation; an upland clay, containing as it generally does a considerable amount of sand, will not produce nearly so good a cement as that made from river mud, which is an alluvial deposit and free from the impurities contained in the upland clay.

After the lime mud and clay have been thoroughly mixed with a sufficient quantity of water to reduce it to a consistency that will admit of its flowing easily, I run it on to a drying bed to a depth of from a foot to fifteen inches (the drying bed consists of a series of flues covered with tiles at the end next to the fire and iron plates at the cool end, so as to utilize the heat as much as possible). Heat is generated in ordinary fireplaces and passes through the series of flues to the chimney; the drying operation occupies about four days. The heat causes the mixture to crack, and generally forms pieces of a convenient size for handling.

By using a kiln that was patented some years ago, the drying on the beds mentioned is obviated, and a great saving effected both in fuel and labor. The kiln is so constructed that the heat generated during the calcining process dries the slurry, and is at the same time convenient to the kiln for charging.

(Here shown.) Samples of slurry made with upland clay and river mud, the former is ordinary brick clay. The mud can be procured from the Mersey on the Cheshire side, extending from Bromborough to Rock Ferry; it is also found near Hale Head, on the Lancashire side of the river.

The slurry, as you now see, is a mechanical mixture of lime mud and clay; cement is supposed to be a silicate of alumina and calcium, but as yet we have no decided authority upon the matter. To effect the decomposition of the mixture it is placed in kilns, with alternate layers of coke, until the kilns are filled. The kilns now being used by the Widnes Alkali Co. at their Seacombe works are the ordinary dome kilns, and will contain when filled 30 tons slurry, and will produce about 20 tons of clinker. A very high temperature is attained during the process of decomposition, which occupies on an average about three days. The eyes or openings in the kiln, which have been loosely built up with bricks and plastered, are now opened, and the clinker allowed to cool. One or two bars are then removed from the bottom of the kiln, and the clinker with a very little assistance is discharged on to the floor, to be loaded into barrows and conveyed to the crusher. Any pieces that have not been decomposed are put aside to go into the next kiln.

It is an easy matter to judge what quality of cement the clinker will produce, by its appearance as it leaves the kiln.

A clinker produced from a slurry containing an excessive quantity of clay, upon coming into contact with the atmosphere, will gradually disintegrate, forming a fine powder or dust utterly valueless.

A clinker containing lime in excess is of very dark color and very difficult to grind; the resulting cement has a rough, gritty feeling, and must be allowed to remain in the house until the uncombined lime has become hydrated. Good clinker possesses a bronze-greenish appearance.

The crusher mentioned is an ordinary Blake's crusher; the clinker when passed through it is broken to one inch size and deposited into a recess, from which it is elevated to a large hopper placed over two pairs of stones. It is gradually passed through the latter, to be again elevated and deposited into a chute containing a worm that conducts the ground cement to a screen varying in fineness from 2,500 to 3,600 holes to the inch. Particles that have not been ground sufficiently to pass through the screen are, by a suitable appliance, caused to pass through a small pair of stones situated near the screen, where it is rendered sufficiently fine to pass into the store.

Cement made from lime mud, which, as you are aware, is a carbonate of lime in a most finely divided state, is equal in every point to that manufactured from any other source; it is capable of standing a high tensile strain, as will be seen from the following results obtained by an old firm of cement makers in this neighborhood, who adopted my process over six months ago.

Briquettes (similar to these) stood the following tensile strains:

Two briquettes, after being made seven days, six of which they were immersed in water, showed—

No. 1	1053 lb.	:		
" 2	1210 "	:	7 days on the 2¼ in.	
	1326 "		14 "	
	1475 "		39 "	
	1612 "		61 "	Not broken.

These tests, made by independent cement makers, are satisfactory evidence of its quality. As regards the sp. gr., it is equal to standard requirements, a bushel weighing 118 lb.

This sample of concrete was made by mixing six parts of limestone to one of cement; it was sawn through, to show adhesive power of the cement, some few weeks ago.

The Widnes Alkali Co., limited, have been manufacturing about fifty tons of cement, weekly, since the beginning of the present year(and to obtain that quantity they mix about seventy tons lime mud with twenty tons clay). This has been readily sold to local users, the Manchester Ship Canal, and for export.

After carefully going into the prices of material, etc., I find the cement can be produced at a much less cost than ordinary Portland cement; of course this is obvious, as it is made from what has hitherto been a waste product, having as well the advantage of cheap fuel.

A COTTON CENTENARY.

IN 1790 the first successful crop of sea island cotton was raised at Hilton Head, South Carolina. It is now proposed to make the one hundredth anniversary of that event the occasion for the celebration of the centenary of American cotton. As South Carolina was the State in which the above mentioned crop was raised, and as Charleston was the port from which the first cargo of American cotton was shipped, there is a reasonable appropriateness in the selection of the city of Charleston as the place in which the celebration has been held.

Probably very few persons who have not considered the matter attentively realize what cotton has done, and what has been done for cotton, within the century just expiring. The cotton fiber has been known and used for the manufacture of cloth so far back in the ages that the memory of man runneth not to the contrary. It has been spun and woven in India for centuries, and cotton cloth from India has drifted in small quantities to different parts of the world for other centuries. But the cotton fiber did not assume a place of real importance with relation to human existence, and cotton cloth did not even begin to come into general use, until American cotton appeared in the field of industry. Indeed, we may go further than this, and confidently assert that the manufacture of textile fabrics for export upon a large scale from one country to another dates from the introduction of the American fiber to the market; so that it is literally true that the vast textile industry of modern times had its origin in the cotton plant grown and developed upon the soil of our own country. What a mighty revolution in industry has this fiber wrought! When we observe the results it has produced, we may well agree that the centenary of American cotton deserves to be celebrated with honor.

We now export every year three or four times as much raw cotton as the entire world produced when the industry was begun here, and we reserve for home manufacture a larger quantity than was consumed by all other nations until late in the present century. The product of the world in 1791 was estimated at 490,000,000 of pounds, of which the United States produced 2,000,000 pounds. In 1821 the product of the world was 630,000,000 pounds, of which the United States produced 180,000,000 pounds, an increase of 178,000,000, or 38,000,000 pounds more than the increase of the crop of all countries. From 1821 to 1824 the American development was so rapid that in the latter year the crop of the United States was reported to be 460,000,000 pounds, or nearly as much as the product of the world in 1791. Meanwhile, however, the crop of some other countries had materially increased, the total yield being estimated in 1831 at 820,000,000 pounds, and in 1834 at 900,000,000 pounds. It may therefore be asserted that this country now produces six times as much cotton as the rest of the world produced one century ago, while we annually retain for our home manufacture as much cotton as was made up by all nations fifty years ago.

We should like to place especial emphasis upon the fact that while 1890 will be the centenary of the first crop of sea island cotton, it will be the centenary also of the imposition of the first protective duty upon American cotton. In the years preceding 1790, Americans began to perceive that their cotton culture was an industry of importance and promise. This induced them to lay a duty of three cents a pound upon cotton in the tariff act of August 10, 1790. That this protective duty had a great effect in stimulating the cultivation of cotton in our Southern States cannot be questioned, and no doubt we owe to the wisdom of our fathers, in thus fostering the industry, very much of the magnificent supremacy now held by the American staple. It will be not a little odd, and certainly not at all creditable, if we shall be forced to enter upon the centennial year of this important event with the American cotton manufacturing industry prostrated by reversal of the very policy of protection which enabled American cotton growing to begin its career of splendid prosperity.

In this connection it is worth noting that such cotton manufacturers as we had in 1790 were opposed to the imposition of the three cent. duty, upon the theory, made very familiar of late, that their industry could not thrive without free raw materials. They believed that the United States could not produce enough cotton, or cotton of sufficiently good quality, for their purposes, and that they could not compete with India or with England unless they could get Indian or African cotton. It is well to recall such forebodings at this time, when multitudes of Americans are talking about our domestic wool clip in just such a fashion as some Americans a hundred years ago talked about our cotton crop. In the case of cotton, the ultimate result was that we obtained from our own fields all the cotton we required for our domestic uses, and enough to supply all the world besides. And we venture the assertion that persistence in the policy of protecting American wool growers will very soon place us in a somewhat similar position with respect to wool. We shall never, probably, supply the world with wool as we supply it with cotton; but beyond a doubt we may grow all the wool we want for ourselves and have a large surplus for export.

Of course the invention of Whitney's gin gave to American cotton its largest impulse; but then, it must be remembered that Whitney's invention came because the cotton was there, requiring such mechanical aid; and the protection duty produced the cotton and created the demand for the inventor's skill. And this may lead us to show how large a part mechanical invention has played in enlarging the supply of cotton for human necessities. It was the possession of Whitney's gin that helped the United States, with dear labor, to push far ahead of India, with cheap labor, as a producer of raw cotton. It was estimated in 1826 that, if no machinery for making cotton fabrics other than was available in 1790 had then been in existence, about fifty million people would have been required to do what was done in 1826. It is now calculated that the cotton fabrics made at the present time, if made with the appliances available one hundred years ago, would require the labor of three hundred million persons. And the industry makes forward strides every year, so that in a short time its product may be expected to represent what would, without machinery, be the labor of the entire population of the globe. It is noteworthy, also, that increased production has never overtaken the capacity of mankind to consume, and we are confident it never will; but that every improvement, by cheapening the supply while enlarging it, will permit the wider use of the material.—*Textile Record.*

COMPOSITE PORTRAITURE.*

IN the composites I have thus far made, I have merely attended to keeping the vertical distance between the eyes and the parting of the lips at exactly the same length in all cases, and to making the best fit of the remainder that each case severally admitted. It strikes me now that it would be well worth while to vary the whole procedure by attempting to approximate to a mean result, and in the following way. First, find by measuring the portraits about to be combined the proportion that the distance between the pupils bears *on the average of all of them* to the vertical distance between the pupils of the eyes and the parting of the lips; then optically transform every component portrait into that same average proportion. Secondly, straighten every face that is asymmetrical in the way above described, into a symmetrical one. Lastly, make the composite from the transformed portraits.

I suspect that a pinhole camera would be found perfectly suitable for effecting these transformations, if the component portraits were not too small. A portrait of sufficient size could, by a single operation, be reduced by its means to any desired scale, both in breadth and in width, independently of each other, namely, by the ingenious device I saw lately in your columns, but cannot specify where, of replacing the pinhole by a vertical slit in one movable diaphragm and a horizontal slit in another. The asymmetry could at the same time be remedied by so inclining the portrait to the optical axis of the camera as to foreshorten the side that was too long. Foreshortening is accompanied by no blur of image in a pinhole camera.

The sliding adjustments of the camera would have to be graduated, and each portrait measured carefully by laying a glass scale upon it, and using a low power lens. After this had been done, a table calculated once for all for the camera would tell at what graduations of distance and of inclination the portrait should be set, in order to obtain the desired result.

"The transformations I propose are small in amount. They are always made, and we unconsciously witness them, whenever the person at whom we are looking holds his face a little inclined from a full face view. But, small as they are, I think they are worth making. I have not now got my photographic things in working order, and am busied in other ways, so I speak for the most part theoretically; but not wholly so, as I have made some optical experiments which corroborate, so far as they go, the feasibility and advantage of what has just been said.—*Photo. News.*

* A communication from Francis Galton.