D. B. Phillips, surgeon of the vessel: "The prow not being well put on was twisted off and lost in our first encounter with the 'Cumberland.' . . . I am also satisfied had not our prow been lost we should have sunk the 'Monitor,' when we rammed her on March 9, 1862."

Lieut. John T. Wood, of the "Merrimac": "The prow was of cast iron projecting four feet, and badly secured, as events proved. . . . The ram was left in the side of the 'Cumberland.'"

Midshipman H. B. Littlepage, of the vessel: "The only damage sustained by her worth mentioning was by ramming the 'Monitor' with her wooden stem, her cast-iron prow having been wrenched off the day before in the 'Cumberland.' She was then thoroughly overhauled and equipped for fighting an ironclad. A prow of steel and wrought iron was put on."

H. Ashton Ramsay, acting chief engineer of the vessel, to the writer: "At the time this vessel rammed the 'Cumberland' in Hampton Roads in March, 1862, the ram consisted of cast iron, the casting weighing about a ton, which was built into the wooden prow of the vessel. It was triangular in shape, about six inches wide at the extreme end, and extending back about three or four feet, embracing the wooden stem, to which it was secured by bolts passing through the flared sides of the casting. This ram, and the method of securing it, proved very temporary, as it was broken off at the time of the collision with the 'Cumberland.' Later, after the fight with the 'Monitor,' a much more effectual prow was forged of wrought iron, and extended well back into the vessel some six or eight feet, to which it was thoroughly bolted; but there was never an opportunity to use the new ram. . . . Some of the reports concerning the engagements of the 'Merrimac' with the 'Cumberland' and 'Monitor' mention that the ship was leaking badly after her encounter with the 'Monitor' on account of the cast-iron prow before described having been broken off, but as a matter of fact no considerable amount of water came into the vessel. There were water-tight collision bulkheads both in the forward and after ends of the vessel, and so little water came in that it was only necessary to use one of the bilge pumps, and this working slowly."

Several of these papers were written for the Southern Historical Society of Richmond, Va.

The best description of the origin and dimensions of the original prow or beak of the "Merrimac" is given by J. W. H. Porter, a son of J. W. Porter, who was the naval constructor of the Confederate States navy, to the writer: "I have in my possession, left by my father, the original plans of the 'Merrimac' which were approved by Secretary Mallory. Mr. Porter did not contemplate that she would be used as a ram, as the timbers in the old ship had not been arranged for that purpose; but a few days before (?) she made her fight Capt. Buchanan told him he would like to use her for that purpose, consequently Mr. Porter had an iron beak cast in the navy yard, as a sort of entering wedge, and bolted it on her stem. It was rude and hastily gotten up, as everything was being rushed to get the ship out before McClellan advanced from Yorktown. It was not on her original plan, but Mr. Porter subsequently added a rough sketch of it in lead pencil. It was something like the drawing I inclose. It projected two feet in front of the stem, was about 12 or 15 inches deep on the face, and weighed about 1,500 pounds. The 'Cumberland' was struck a glancing blow, and the impact broke the beak in two at the stem. The bolts held. The second beak was similar, but was more carefully made. It was somewhat shorter, projected about 15 inches, and ran back about 13 feet. It was made of steel and wrought iron, and the bow timbers were strengthened. . . . I saw the beak on the 'Merrimac' a number of times, and the description I gave you of it as to size, weight, and shape was taken from Mr. Porter's notes made at the time. Commenting on the subject a short time afterward, he wrote: 'As far as the ram is concerned, it was an idea of my own entirely. Very little was known about them at the time, and for the want of something better to make one out of we made it of cast iron. But scarcely anyone thought it would ever be used. It was fitted to the bow and stem head and bolted strongly to both, but having struck the 'Cumberland' a glancing blow it was broken off. When she was docked after her fight, I put on a better ram of wrought iron and steel, extending back on her bows about 14 feet, which could not be knocked off.'"

The cut of this long ram is submitted with the firm belief that it is a true sketch of that instrument of naval warfare that was made for the "Patrick Henry" or "Jamestown." Mr. E. R. Archer, the present engineer of the Tredegar Iron Works, of Richmond, Va., who furnished this sketch, was assistant engineer of these works during the first years of the civil war, and says regarding this ram: "A ram was cast about the dimensions of the sketch I sent you. . . . It has been a long time since I saw the ram cast at these works." There is no doubt this ram was cast for the "Patrick Henry" or "Jamestown," as these vessels had receding stems, high freeboard, and long bow-

sprits, and it required a long ram where it was to be fitted two or more feet under water on such a vessel, to make it effective in offensive operations."

It will not be far from the truth to say that the engagement of the "Manassas" and "Richmond" was the cause of the adoption of the beak on the "Merrimac" and other later vessels of the Confederate States navy, and not until then was that fixture considered in the plans of any of their armored vessels.

The ram that was fitted to the Confederate ironclad "Arkansas," that was under construction at the same time as the "Merrimac," was of a peculiar form. It was made of cast iron, for in the early part of the civil strife the Confederacy were without the necessary tools to work heavy wrought iron. It was formed in the shape of a V to fit the bow of the vessel, and as fitted in place was about ten feet high and the sides four feet long and three inches thick, and fastened to the vessel by screw bolts. There was on the front of this casting an iron beak or projection about six or seven feet from the top, that was six feet long, ten inches thick at inboard end, and four inches at extremity. There was a similar ram prepared for use on the "Tennessee," a mate of the "Arkansas," but never put in place, as the vessel was burned while on the stocks, just prior to the naval battle before Memphis, Tenn.

There were no other Confederate naval vessels fitted with these long iron beaks, for they gained experience from the loss of the one on the "Merrimac." Their vessels constructed later had a short and stout wooden ram built out from the stem of the vessel as a part of the structure, from the waterline to three feet below the surface of the water, and this was covered with the armor plating. This type of ram was on the "Albemarle" and the "Atlanta."

There was another ironclad of the type of the "Arkansas," but smaller, named "Albemarle," that demonstrated the usefulness of the ram in offensive operations when she sank the U. S. S. "Southfield" by ramming, when off the mouth of the Roanoke River, N. C., on April 19, 1864. This was the vessel that was a few months later destroyed by Lieut. W. B. Cushing, U. S. Navy, with a torpedo.

In taking account of these three fatal ramming occasions during the civil war, it is found that the U. S. S. "Richmond" was rammed during the night while the vessel was lying at anchor; the "Merrimac" rammed the U. S. sloop of war "Cumberland" while lying at anchor in Hampton Roads; and the "Albemarle" rammed the U. S. S. "Southfield" while both vessels were moving through the water toward one another in nearly opposite directions. The "Manassas" could not have been moving very rapidly when striking the "Richmond," or the damage would have been more extensive. It is no surprise that the "Merrimac" crashed through the side of the "Cumberland," which was anchored; and with the "Albemarle" and the "Southfield" approaching from opposite directions, the light-built converted ferryboat must give way under the crushing impact.

The first contract made for a vessel by the Union Secretary of the Navy, having a ram bow, was for the ironclad frigate "New Ironsides" on October 15, 1861. This ram was covered with the extension of the armor plating, and was 4½ feet deep, 9 inches thick, and projected 6 feet from the stem proper. The iron-hull turret gunboat "Keokuk," having a ram bow, was under construction before the "Monitor"-Virginia contest in Hampton Roads took place.

The first few years of the war there was a great difference of opinion regarding the best application of the ram to a seagoing vessel. Many considered that a vessel that was well strengthened in the bow, and the stem built to stand a crushing blow, was as well suited for ramming as another vessel having a bow built for the purpose and with a stem having a convex front and plated with heavy iron.

There were a few of the double-ender type of side-wheel naval vessels built in 1862 having a false metal stem or ram. The "Sassacus" was one of the number, and the only one of the type that had an opportunity to do any ramming during an engagement in the civil war. This was during the naval battle in Albemarle Sound with the Confederate ironclad "Albemarle" on May 5, 1864. The "Sassacus" was shod with a bronze beak weighing fully three tons, well secured to prow and keel, and this was twisted and almost torn away in the collision," is in the report of an officer of the vessel of the engagement. There were twenty-seven of these wooden-hull vessels built for the Union Navy Department in 1862-3. The Bureau of Construction and Repair advises the writer that "no description of said ram other than appears on the plan of the 'Tacony,' a sister ship of the 'Sassacus,' can be found. A tracing has been taken from this plan showing the bow of the 'Tacony' with the ram attachment in place." There were a few others, in all probability, of this same type of vessel, with a similar ram attachment. They were the only wooden-hull naval vessels of the United States navy, not ironclad, that had a ram.

(To be continued.)

WHITE CEMENT.*

By A. G. LARSSON, C.E.

NUMEROUS experiments have been conducted, especially during the past three or four years, both on this continent and in Europe, in connection with the manufacture of white cement. The reason for this is that, in spite of the common Portland cement being an excellent building material for coarser work, such as foundations, sidewalks, etc., it is, on account of its dull gray color, of less avail for artistic work. The cementing material required for this purpose must be pure white and weatherproof, and need not have, as a rule, the strength of Portland cement. Plaster of Paris and magnesia cements have been used to some extent, but the former is not weatherproof, and the latter are not very reliable.

The coloring matter in Portland cement is oxide of iron, and sometimes oxide of manganese. To obtain a white color, the product should not have more than 0.80 per cent F_2O_3 . With this limitation there are some difficulties. It is not an easy matter to find suitable raw materials. Even if the limestone is easy to locate, the clay, which must be china clay, is scarce, and when found is likely to be rather expensive. Then, again, a mixture low in Fe_2O_3 requires very high heat, and is, therefore, hard to burn.

Some of the experimenters have tried to make white Portland cement, and others to make white Roman cement. Both have succeeded. There are now factories for white Portland cement in the United States and Germany. The following analysis is of a sample from Stettin, Germany:

SiO ₂	19.82 per cent
Al ₂ O ₃	11.49 per cent
Fe ₂ O ₃	0.67 per cent
CaO	61.60 per cent
MgO	0.72 per cent
SO ₃	1.99 per cent

The cement was sound, but was ground rather coarse. Mr. Julius Gresley, president of the Liesberg cement mill, Switzerland, has analyzed the best French Roman cements, and from these analyses he figures the following standard formula for his cement:

$$x [2 (CaO, MgO), SiO_2] + y [2CaO, Al_2O_3] + z [CaO, SO_3]$$

The CaO, SO_3 is not necessary, but seems to make the mixture burn easier. This cement comes on the market under the name of "Marbrit."

The following analysis shows the proportions of this product:

Moisture	3.75 per cent
SiO ₂	17.66 per cent
Al ₂ O ₃	16.52 per cent
Fe ₂ O ₃	0.74 per cent
CaO	54.69 per cent
MgO	0.53 per cent
SO ₃	6.11 per cent

Specific gravity = 2.815.

The cement is sound, and ground fine, but is quick setting. Any kind of work will be hardened enough to release from its mold in two hours, or even sooner.

This cement possesses an advantage over the white Portland cement in that when it is strong enough for the purpose required it is easier to burn and cheaper to manufacture.

Dr. Delaire, a French physician, has just completed an interesting work by restoring a part of a face which was blown away by the bursting of a shotgun. The man had his chin, the lower part of his jaw, a portion of his tongue, and the whole of his upper jaw and nose blown away. The restoration, which is considered a marvel of mechanical as well as surgical ingenuity, has been exhibited before the Academy. From ten or fifteen feet distance the mechanical face appears quite natural, and the man is able to masticate his food and speak with comparative ease. Every day he takes off his artificial face and washes it with soap and water. The face consists of four parts. The first is a silver groove, into which some of the lower teeth are fixed. This is attached to a dental apparatus of tin, into which are fixed the remaining teeth. The second piece consists of a dental apparatus in vulcanite and gold for the upper row of nine teeth. This is fitted to two small protuberances, which fit into the nasal cavities. This also fills up the right sinus, which was smashed in. At the back is a piece of gold mechanism with hooks, used to fasten on the face piece. The third piece of the mechanical face consists of the chin and lower lip. This is of India rubber, painted to resemble nature. Over the chin a false beard is fixed. At the back are a couple of small bolts, which pass through holes in the teeth and fix the lip to the artificial lower jaw. The fourth and last piece of the apparatus consists of the upper lip and nose, also in India rubber, and painted, to which is attached a false mustache. At the back are two small clasps to which the upper dental piece and jaw are fixed.

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