fell as if dead. With no premonition, about forty of them became almost instantly unconscious, and fell as they stood.

One of the men, only partially affected, made his way to the tunnel entrance and gave the alarm. A gravel train, with flat cars, happened to be standing there. It was run in to the place of the accident, and the bodies of the fallen men were dragged upon the cars and taken out to the fresh air. All were supposed to be dead, but, to the surprise of the rescuers, the recently dead men soon began to show signs of life, and in a short time all were themselves again, except one poor fellow, who died, and who, in his fall, sank into a pool of water, and probably was drowned.

One of the unconscious men was found hanging on a ladder, head downward, suspended by his feet.

THE NEW NAVY.

The recent expression of opinion, by naval authorities here and abroad, as to the needs of our navy and how far the types of the new ships are likely to meet them, furnishes us with important data. By far the major part of the testimony confirms the view frequently expressed in these columns that small, fleet-footed cruisers are more to be desired than ponderous, unwieldy fighting ships, and that torpedo boats are necessary to an effective defense. While it can scarcely be said that the new ships, as far as constructed, are altogether satisfactory, eminent authorities on both sides of the water seem to be agreed that we have made, at least, a good beginning; that, under the circumstances, it is not surprising that mistakes have been made or that errors, at first insignificant, should have multiplied as the work of construction progressed. It is only by such practical experience, they say, that anything like perfection can be attained in so difficult and undertaking as that of trying to combine the good qualities of various novel constructions.

In order to better understand the recent criticisms on what has already been accomplished by our naval constructors, and what they have proposed to themselves, it is necessary to have the list of new ships before us. Here it is:

	Displacement.	Guns. Breech loading Rifles.	Speed.	Condition.
Amphitrite	3,815	4 10-in.	12	Incomplete.
Monadnock	3,815	4 10-in.	12	Incomplete.
Terror	3,815	4 10-in.	12	Incomplete.
Miantonomoh	3,815	4 10-in.	12	Incomplete.
Puritan	6,000	4 10-in.	13	Incomplete.
Dolphin	1,500	1 6-in.	15	Complete.
Boston	3,000	2 7-in. 6 6-in.	14	Armament incomplete.
Atlanta	3,000	do.	14	do.
Chicago	4,500	4 8-in. 6 6-in. 2 5-in.	15	Incomplete.
Gunboat No. 1	1,700	6 6-in.	16	Not commenced
Gunboat No. 2	870	4 6-in.	12	Not commenced
Newark	4,000	12 6-in.	18	Not commenced
Charleston	3,730	2 10-in. 6 6-in.	18	Not commenced
Baltimore	4,400	4 8-in. 6 6-in.	19	Not commenced
Armored cruiser	6,000	4 10-in. 6 6-in.	16	Not designed.
Armored battle ship	6,000	2 12-in. 6 6-in.	16	Not designed.
Pneumatic dynamite gun ship	—	—	20	Not designed.
One first class torpedo boat	—	—	—	Not designed.

The Dolphin is a dispatch boat, not intended for fighting, nor fast enough to overhaul modern merchant steamers. The Atlanta has made 13 knots over the measured mile—a test always made under favorable circumstances—which places her, in point of speed, scarcely ahead of the ancient Iroquois, now 30 years old. Like the Boston, the Atlanta is a nondescript. Each has a battery consisting of two 7 inch and six 6 inch guns, and hence, with their limited speed, frail sides, and inability to carry heavy batteries, have neither the power to fight, the strength to stand assault, nor the ability to run away. Of the Chicago, which is larger than either the Atlanta or Boston, and has not yet been tried, Admiral Porter says: "She contains an absurd mass of machinery. The engines are of the type known as side levers—a cumbrous, friction-generating kind, unfit to put in the hold of a man-of-war. I take upon myself credit for having a change made in the valve arrangement which will better things somewhat. I succeeded in having the plans for poppet valves altered and slide valves substituted The clanking of the side levers will be like the noise of a chain gang. I know of a merchant steamer with a single screw, plying between New York and New Orleans, that has a side lever engine. She is under repairs more than the other ships of the line, although she is fast. For a man-of-war, the Chicago's engines are as bad as can be."

It is but fair to say here that it is not the contractor, as the public is inclined to believe, who is responsible for this kind of work. He only carries out the design placed in his hands. It is the Bureau of Steam Engineering, quoting again from the Admiral of the Navy: "An ax to grind here, a pet hobby there, a patent arrangement yonder, and there you have it. I would not allow the Bureau of Steam Engineering to touch a plan or alter an engine provided by a contractor. It is the incompetency of the designers of the engines, to call it no worse, that leads to such direful results as we have seen."

The Admiral and other authorities who have recently spoken upon the subject believe that private firms should be called upon to design the engines. In other words, they should be expected to furnish engines which would give a certain speed. The rest is easy. If the required speed is not obtained, the ship is not accepted. But when the engines are designed by the department, and the contractor expected to get speed out of them, disaster usually follows. All seem agreed that, to be efficient, a fleet should be composed of three classes: First, commerce destroyers—fleet-footed unarmored vessels, carrying two or three heavy guns; second, armored fighting ships; third, torpedo boats. As to how many of each are required, or the proportion of one class to the other, opinions differ; the majority, however, believing our requirements would be best served by torpedo boats and light-footed, unarmored cruisers. The National Line's steamer America is thought to be a good type of what these cruisers ought to be. She is much broader than the Oregon type, and can steam 17 knots an hour, not only on the measured mile, but continuously through the day's work. The English cruiser Inconstant, also of 17 knots speed, is an admirable specimen of this class, but is thought to be altogether too large and, consequently, too costly for our needs. What would our 13 and 14 knot unarmored ships do in the presence of an Inconstant, which could always choose her target and the most favorable firing point, and get away when the odds were against her? The general opinion of the two 4,000 ton unarmored ships is that they are too large, or, rather, needlessly large.

John Herreshoff, the ship builder of Bristol, Rhode Island, is perhaps as good an authority on speed as there is to be found. He designed and built the Stiletto, undoubtedly the simplest steam yacht afloat. He pins his faith on swift-moving torpedo boats as a main reliance. He says that torpedo boats built on the same lines as the Stiletto, but of steel, instead of wood, and of 150 feet length, could be made to steam a speed of 30 miles an hour. The Stiletto has made 27.

That the swift-moving torpedo boat is likely to take a very important part in the future naval war there can be little doubt. Even the French Admiral Aube and Sir Spencer Robinson, Sir Edward Reed, George Mackron, of the Thames Ship Building Company, Mr. Watts, the constructor at Elswick, and ex-Chief Constructor Warren, of the Chatham Royal Navy Yard, were all spoken to recently on this subject, and either expressed confidence in the efficiency of torpedo boat attack or, if not affirming the proposition, were unwilling to deny its truth.

In view of this, it seems strange that the naval board should have contented itself to advise the construction of "one first-class torpedo boat."

THE DYNAMO COLOSSUS AT WORK.

BY WM. H. HALE, PH.D.

An account of the newly invented process of smelting by the Cowles system of electric furnace was given in the SCIENTIFIC AMERICAN of May 22, 1886 (p. 328). The dynamo Colossus, the most powerful ever constructed, was illustrated and described in the SCIENTIFIC AMERICAN of August 28 last.

On the 16th of September, I had the good fortune to pay a visit to Lockport, N. Y., just in time to find the dynamo engaged in smelting its first run of metal, which was an alloy of aluminum and copper.

Although the process of electric smelting is capable of reducing the most refractory ores, and securing many costly metals, such as potassium, sodium, magnesium, and the like, besides metalloids, boron, silicon, etc., yet the company now aim especially to secure aluminum in large quantities, because of the many valuable properties of that metal and its alloys, and the almost infinite variety of uses and inexhaustibility of demand for them at the reduced price which this process renders possible.

Both the Cowles brothers, Eugene H. and Alfred H., the joint inventors of the electric furnace, were present—the latter having only the day before returned from Europe, where he had been exhibiting specimens of product as previously obtained by smaller dynamos at Cleveland, having secured, among other fruits of his trip, an order from Whitehead, manufacturer of torpedo boats, for 6,000 pounds of the 10 per cent aluminum and copper alloy. No other visitor was present. The big dynamo was running at 380 horse power, though capable of 500 horse power when required. It was making 420 revolutions per minute, and, as the electricity was drawn off, it scintillated in a brilliant and continuous fusillade of sparks varying in color from white to emerald green, and occasionally flashing out in a burst of unusual splendor, yet perfectly controlled and free from danger to the spectators.

The dynamo is driven by water power. The waterways were constructed by Holley, and are replete with ingenious appliances for utilizing all the power there is, and for keeping the water at a uniform level. The water wheels used are double turbine with horizontal shaft, each turbine being eight feet in diameter. The dynamos—for there is also a smaller one—occupy a room by themselves intermediate between the turbine wheel room and the furnace room.

Passing to the furnace room, we see where the energy of the dynamo is being expended. The furnaces are built larger for the Colossus than those used with smaller dynamos, and are charged with 60 pounds granulated copper, 60 pounds corundum, and 30 pounds coarse charcoal, besides the pulverized lime-coated charcoal used as packing. This mixture contains over 32 pounds of aluminum or about 54 per cent of the corundum. Into the furnace thus charged pours the current from the Colossus, fusing the almost infusible corundum like wax, causing its molecular structure to be broken up into its elements, and raising the temperature of the entire mass to a very high heat. Vent holes are left in the covering of the furnace, through which escape the liberated gases and some of the volatilized aluminum, the whole glowing with a bright flame which sometimes darts up to the height of many feet. The amperemeter on the wall shows with what force the current is flowing, and the attendant must watch it closely to keep it at the desired gauge. A force of 2,000 to 2,400 amperes is generally preferred. As the index approaches the higher limit, the carbon electrodes are from time to time drawn asunder, till at last they stand wide apart, and the current flows freely through the entire furnace. The process of reduction takes about two hours.

Returning to the dynamo room, we find at the end of the run that the bearings of Colossus are not raised to the temperature of blood heat; and it proves to be the case that it may be run continuously without becoming overheated, thus demonstrating the excellence of its construction under the personal supervision of Mr. Brush. The bane of dynamos is overheating.

What do we find in the furnace at the end of the reduction? The products of the electrical furnace have furnished the theme for several papers already before scientific societies, and will supply a probably fruitful field of research for time to come. Since the first run of the dynamo, I have on several other occasions visted the works and seen the charges withdrawn from the furnace. The product appears in the form of a fused mass of metal embedded in the surrounding carbon. Most of this mass is an alloy of copper and aluminum, varying much in the proportion of the two. Mostly it exceeds the 10 per cent of aluminum which gives the alloy of maximum strength, and is a brittle white metal, which is again fused with the addition of more copper to such an alloy as may be required.

But the furnace gives many other products. Sometimes there are found small fused rubies and sapphires. The sub-oxide of aluminum—never found in nature, and never before known to exist or to be capable of formation—is always present in larger or smaller quantities. I have also seen specimens of beautiful, white, fibrous alumina. With other charges, sub-oxides of silicon and titanium are found—very curious products indeed. The intense heat even partially fuses the carbon, and the electrodes are converted into graphite.

The rush of visitors has been so great that the company have been compelled to restrict facilities for admission latterly.

Important economical as well as scientific results have been already attained by the dynamo. The price of aluminum alloys has been reduced to a scale adopted by reckoning the value of the contained aluminum at $2.50 a pound, previous sales of that metal having been at the rate of 75 cents an ounce.

The 10 per cent alloy is said to be the strongest metal known, though alloys of a less per cent have great utility, being tougher, but not so strong. Krupp cannon require a tensile strength of 70,000 pounds per square inch of wrought steel, the labor on which raises its cost to 75 cents or a dollar a pound. Some specimens of the alloys made by the Colossus, which are simply cast, not wrought, have recently shown the phenomenal strength of 131,000 pounds per square inch.

Since writing the above, I notice the statistics of production of different metals in the United States for 1885, as given in the SCIENTIFIC AMERICAN for Nov. 6, 1886. In that table the whole amount of aluminum produced during the year is stated as 3,400 oz., aluminum being then regarded as a precious metal.

The capacity of the Colossus will enable it to reduce a larger amount than this, in the alloy with copper, within the period of twenty-four hours.

Alloy of Aluminum and Tin.

A useful alloy of aluminum and tin has been obtained by M. Bourbouze, by melting together 100 parts of the former metal with 10 parts of the latter. This alloy is whiter than aluminum, and has a density of 2·85, a little greater than that of the pure metal, so that it is not too heavy to replace aluminum in instruments requiring great lightness of their parts. It is less affected by reagents, etc., than is aluminum, and also is more easily worked. Another of its merits is that it can be soldered as easily as brass without any special preparation.