

in position in this tube, four others will be carried. The boat is provided with a hull of sufficient strength to permit the submarine to descend to a depth of 100 feet, and the water tanks are of small dimensions, so that the size of the moving masses of water is considerably reduced, while at the same time there is every facility for filling and discharging them to readjust the balance necessary for stability when the vessel is diving or returning to the surface. The boat is fitted with four rudders, two of which are for steering on the surface, and the other two to be employed for diving. The official trial is to consist of a surface run of 10 knots, which is to be covered within the hour, while the submerged run will be 2 knots, to be accomplished at an hourly speed of 7 knots. When the runs have been undertaken a surface torpedo will be discharged at a target 150 feet in length by 16 feet deep, the upper edge of the target being awash and placed at right angles to the course of the submarine. While the boat is undertaking her submerged trials she will not rise to the surface on more than three occasions from the time of starting until the firing of the torpedo, the duration of each appearance not to exceed one minute.

#### BELLEVILLE VERSUS CYLINDRICAL BOILERS.

PRESIDENT OF BRITISH ADMIRALTY COMMITTEE'S REPORT.

Vice-Admiral Compton-Domville, the president of the committee appointed by the English Admiralty to investigate the efficiency and reliability of the Belleville boilers in comparison with the cylindrical boilers, has issued his report concerning the trial run that was undertaken from Portsmouth to Gibraltar and back by the two sister ships "Hyacinth" and "Minerva" at full speed. The former vessel is fitted with the Belleville boilers, while those of the latter are of the Scotch cylindrical type.

Representatives of the boiler committee embarked on board these two vessels at Devonport on July 6 last. Both vessels started from that port for Gibraltar at 3 o'clock in the afternoon of the same day and commenced working up to 7,000 horse power. It was intended that the ships should maintain 7,000 horse power till all the coal, except the 82 tons in the reserve bunkers, was exhausted. Three-quarters of an hour from the start the revolutions of the "Hyacinth" were 152 per minute and the horse power 6,994, and her trial started from this time. The "Minerva's" trial commenced a quarter of an hour later. The latter vessel soon showed that she was the faster ship, and steadily drew away from the "Hyacinth." By midnight on the 7th she was about four and a half miles ahead.

It had been arranged that the water in the reserve tanks of both ships should be used as the only make-up feed-water until it was reduced to 20 tons, in order that the amount of make-up feed used per day might be accurately determined. When the reserve had been reduced to 20 tons, this water was to be kept intact in the tanks ready for use in case of emergency, and all make-up required was to be obtained from the evaporators. Special reserve tanks had been fitted on the "Hyacinth" to hold about 100 tons; this, added to the original tank stowage, gave a total reserve tank stowage of about 140 tons. The total reserve tank stowage on the "Minerva" was about 170 tons.

When the amount was reduced to 35 tons on the "Hyacinth," the staff engineer asked to be allowed to start the evaporators, on account of the difficulty of getting the water out of the tanks by the special pump fitted for these trials. Two Weir's evaporators working with exhaust steam were started for the purpose.

At 1:15 A. M. on July 11, the staff engineer of the "Hyacinth" reported the engines would have to be eased on account of the large loss of water, and the trial was abandoned from 1 A. M. All the evaporators were working at this time, and in addition to the water from the reserve tanks, 25 tons of drinking water had been used for boiler make-up. The "Hyacinth" steamed into Gibraltar at slow speed, arriving there on the 11th, in the evening.

The "Minerva" continued steaming at 7,000 horse power till 11 P. M. on the 12th, at which time there were still 39 tons of coal in the bunkers, not including the reserve, and 20 tons of water remained in the reserve tanks.

The average horse power of the "Hyacinth" was 7,047 for 103¾ hours, with a coal consumption of 1.97 pounds, and the distance run was about 1,810 miles at an average speed of 17.6 knots. The "Minerva's" horse power was 7,007 for 147 hours, with a coal consumption of 2.06 pounds, and the distance run was about 2,640 miles at an average speed of 17.96 knots.

On the night of the 10th flaming occurred at the after funnel of the "Hyacinth," but no such flaming occurred on the "Minerva." When the boilers of the latter vessel were examined upon arrival at Gibraltar the openings in the Admiralty ferrules were seriously choked, the sizes of the openings in some cases being reduced to about one-third of the original.

The boilers and engines on both vessels worked well on the way out, with the exception of the breaking of the eccentric-strap bolt of the starboard intermediate engine of the "Minerva," which delayed her for about two hours. A number of leaks developed in the "Hyacinth's" boilers, which became worse when the vessel was eased up when entering a fog, on which occasion the steam pressure became sufficiently high to lift the safety valves. The loss of water was at first attributed to leaky feed-suction pipes, but during the stay at Gibraltar these pipes, the feed, and the hot well tanks, and the boilers and boiler blow-outs, were water-pressure tested, and no leaks, beyond those already known to exist in the boilers, were discovered. The leaky joints were remade by the ship's staff while at Gibraltar, and on the 16th the ship was taken out for a run at about 7,000 horse power, to test the amount of feed-water being lost. This was found to be at the rate of 55 tons a day, according to the record of the six hours' run. The boilers of both ships were thoroughly cleaned out at Gibraltar, so that the race home might be determined under the most advantageous conditions.

Both ships lay at anchor—the "Hyacinth" with two boilers alight for auxiliary purposes, and the "Minerva" with one alight. The homeward run was commenced at 4:27, by a previously unknown signal, on the 20th. Directly the signal was given the fires were lighted in the boilers not at work and the ships were headed for Portsmouth. Both ships started punctually at 4:30—three minutes after the signal. The "Hyacinth's" engines were worked slowly in accordance with orders from the deck, steam being supplied by the two boilers which were alight. At 4:52 the after group of boilers was connected up; at 5:05 the forward group; and at 5:09 the middle group were connected up, the steam pressure being 22 pounds. At 5:20—less than one hour from weighing anchor—the "Hyacinth" was proceeding at 150 revolutions per minute, the horse power being nearly 7,000.

When the "Minerva" set sail the boilers were also worked slowly. The second boiler was connected up at 4:55; the third at 5:02; the fourth at 5:07; the fifth and sixth at 5:10; seventh at 5:12; the eighth at 5:15. The engines were working up to full power at 5:16, but had to be eased several times during the next three hours, owing to the eccentric straps warming up.

At 5:15 on the 18th the "Hyacinth" was about six miles ahead of the "Minerva." Both ships, however, ran into a fog, and the "Minerva" caught up to the "Hyacinth," and at 9:30 A. M., on emerging from the fog, the "Minerva" was still ahead. Both ships then worked up to the maximum, but throughout the day the "Minerva" gained one-third of a knot per hour on the "Hyacinth." At 7 P. M. another fog was encountered, and the ships went slow through the night, keeping close to each other.

At 9 A. M. on the 19th they were again level, but during the day the "Minerva" again gradually drew ahead, traveling a quarter of a knot per hour faster. At 7 P. M. the "Hyacinth" again eased, owing to a fog, and went slow till 5 A. M., the "Minerva" being out of sight ahead. The "Hyacinth" then steamed at over 9,000 horse power till 6:10 on the 20th, when the fires of 10 boilers were drawn on account of a burst steam tube. At 9:50 P. M. the trial finished, the ship then being off St. Catherine's, and she arrived at Spithead at 11:30 P. M. The "Minerva" had anchored at Spithead 1 h. 45 m. previously. The coal consumed in the "Hyacinth" on the way home was 550 tons; on the "Minerva" it was 451 tons. The "Hyacinth" used her evaporators all the way; the "Minerva" utilized hers but very little.

The maximum power developed by the "Minerva" was 8,700 horse power, while that developed on the "Hyacinth" was nearly 10,000 for at least two hours, during which time the "Hyacinth" did not perceptibly gain upon the "Minerva." The "Hyacinth's" average power while running clear of fog was about 9,400 horse power, and the "Minerva's" about 8,400 horse power. From the results of the outward run it appears that the radius of action of each of these vessels at 7,000 horse power, as far as the coal is concerned, should roughly be: "Hyacinth," 2,930 miles; "Minerva," 3,000 miles. No difficulty was experienced in either ship during any part of either the outward or homeward runs to maintain a sufficient supply of coal to the fires.

Following the report of the president of the committee is one by Rear-Admiral W. H. Hay, Controller of the Navy, relating to the condition of the boilers after their unusual exertions. He draws the attention of the Admiralty to the following points in this trial:

(1) The very serious loss of water in the "Hyacinth," as pointed out by the president of the committee. This was due to leaky joints. A certain number were located at Gibraltar, and on examination at Portsmouth other leaks were discovered and reported.

(2) The state of the "Minerva's" tubes at the end

of each run. On arrival at Gibraltar the cup ferrules were discovered to be partially choked, due to bird-nesting, and the ship could not have gone any further at that power (7,000). As it was, she was using up to 1.7 inches of air pressure, instead of ½ inch, to maintain the necessary combustion for this power. On arrival at Portsmouth practically the same thing occurred.

(3) The "Hyacinth" developed an average of 1,000 more indicated horse power than the "Minerva" on the run home. This should have given the former a substantial increase in speed, whereas there was a slight decrease. This extra indicated horse power must have been absorbed either in the engines, or on the main shaft's bearings, or in the hull. It is possible that the shape of the hull may have had something to do in the matter, but former trials do not bear this out. For example, when the "Highflyer" (same class) was tried against the "Minerva" last year, the former maintained a higher power and speed, except at 10 knots, when she had to exert more indicated horse power to obtain the speed.

The Controller of the Navy, in his conclusion, significantly remarks that this last feature of the Belleville boilers requires investigation. Although these trials were not conducted under the most satisfactory conditions, yet they conclusively established the relative merits and disadvantages of the two types of boilers, and the cylindrical boiler appears to have issued from the ordeal with the greatest success. It has been proved to be far more economical, in every respect, than the water-tube boiler.

#### SCIENCE NOTES.

The contest for the Pollok Prize is now open, and it is to be hoped that this competition will result in the award of the prize to some American inventor.

An exhibition for accident, sanitary, and life-saving service is to be held at Frankfort October 5 to 21. It is to be exclusively scientific. Visits of workmen will be arranged, as the chief aim will be to benefit those engaged in industrial pursuits.

Consul Haynes, of Rouen, under date of August 26, 1901, says that the metric system is to-day compulsory in twenty countries, representing more than 300,000,000 inhabitants—Germany, Austria-Hungary, Belgium, Spain, France, Greece, Italy, Netherlands, Portugal, Roumania, Servia, Norway, Sweden, Switzerland, Argentine Republic, Brazil, Chile, Mexico, Peru, and Venezuela—and advises American exporters in dealing with any of these countries to adopt the system.

The Italian government has definitely decided to restore Leonardo da Vinci's "Last Supper." Ordinarily the restoration of a masterpiece of painting would be regarded as dangerous in the extreme, but in this instance the conditions are peculiar. The picture is in such a bad condition that it would be difficult to spoil it, and the work will be done in the most careful and scientific manner. A celebrated expert has been engaged to give his services, and the first work will be to destroy the micro-organisms which are eating up the paint. The wall will then be treated so that it will not be damp in the future, and then the work will be "restored" with the help of the old copies of the fresco and the engravings of it.

The dangers attending laymen who undertake to act as judge, jury, and advocate in legal matters are well shown in a recent trial for infringement in England. A party had invented a pneumatic hammer and established a business in it, when other parties also embarked in the manufacture, having patented the same device. These last were sued, when they set up a defense of prior publication before the first, or original, patent was issued. The judge required the alleged infringers to prove the prior publication—they having admitted the infringement. It then appeared that the ostensible prior publication was not a fact; there had been no publication whatever in the legal meaning of the word, but merely a conversation between two tradesmen as to the commercial value of the hammer. Upon such a slender base as this the defendants had gone to considerable outlay with the belief that their view of the situation was correct. In cases of this kind it is much better to take professional advice than to act upon intuitions or beliefs.

#### THE "FOOL KILLER" TAKING SOUNDINGS.

In our last issue we described Peter Nissen's "Fool Killer," which is intended to be used in taking soundings in the Niagara River, and, if possible, pass through the Whirlpool Rapids. Nissen began making soundings on September 21. He maneuvered the "Fool Killer" in a satisfactory manner, showing that it was a very staunch craft. The boat was run repeatedly into the spray so that it was hidden for several seconds. Then it would emerge, and under a full head of steam would toss among the waves with the water dashing over it and threatening to capsized it. He found the rocky bottom of the river very uneven, its depth varying from 15 to 100 feet.