a spray of water falls by gravity from the top, while a finely divided spray of water is also injected into the bottom part of the tower by compressed air. Any impurities that may be impregnated in the gas are thus completely arrested. No solid material, such as is usually required in the scrubber, is employed, and this arrangement forms a conspicuous feature of the apparatus.

The facilities for drying the gas thoroughly and at the same time removing any traces of tar that may have escaped through the cooler constitute a prominent characteristic of the plant. It is absolutely essential for the most efficient operation of the engine that every trace of moisture should be removed from the gas, and this drying is effected by means of the centrifugal drier which is driven off the engine through a belt transmission as previously mentioned. This drier is made to run at a high velocity. A double-seated valve is fitted in the induction pipe near the engine for mixing the gas with air, the proper mixture being automatically regulated according to the speed of the engine. Should, however, a richer proportion of gas or air be desired, this can be regulated by hand. The hopper of the gas producer carries sufficient anthracite for a 10 hours' run at a speed varying from 10 to 12 miles per hour. The installation occupies but little space, the whole plant being contained in a floor area of 12 feet 6 inches by 9 feet 4 inches, while the maximum height is 6 feet 8 inches.

Unfortunately, owing to the short time which was available between the launching of this boat and the reliability trials in the Solent, it was impossible to make any preliminary runs for tuning-up purposes. The yacht was towed round from the Thames to the scene of the trials and entered at once in the contest. On the first day she proved highly successful, making a nonstop run for the whole 10 hours of the trial. During this time she covered the sheltered course six times and the open-sea course once—a total distance of about 80 miles—in 9 hours 12 minutes. This gives an average speed of 13.04 miles per hour which, considering all circumstances, was highly satisfactory. The boat, however, is capable of much higher speed, though it has not been constructed for fast running. During this 10 hours' run 467 pounds of anthracite was consumed, representing a cost of $1.08. The low cost of running a vessel with this type of fuel is thus conclusively demonstrated, since no other system can compare so favorably with it. On this basis it will be seen that a ton of coal would be sufficient for nearly two days' cruising at 13 miles an hour.

On the second day the vessel broke down, owing to the bearings of the water-circulating centrifugal pump seizing through a slipping belt. Still it was recognized that the vessel had justified the builders' anticipations and its future possibilities from a commercial point of view were realized. In recognition of the Thornycroft company's efforts to adapt the suction producer gas type of motor to marine purposes a special gold medal was awarded to them.

The trials proved that the gas engine in conjunction with a suction gas producer if properly designed is the most economical generator of power yet devised. The consumption of anthracite works out as low as 1 pound of fuel per brake-horse-power per hour. A compound condensing steam engine consumes from 1 1-3 to 3 pounds of fuel per brake-horse-power per hour according to size and type, while with the oil engine the consumption is approximately one pint of kerosene per brake-horse-power per hour. Anthracite costs only about $4.75 per ton, while on the other hand, kerosene costs about $30 for the same quantity. The respective cost of fuel per horse-power-hour for the three systems works out approximately as follows:

For the oil engine	1.47 cent
For the average steam engine	0.42 cent
For the producer gas plant	0.21 cent

—showing that the advantages in economy and relative efficiency are completely in favor of the suction producer gas engine. Messrs. Thornycroft & Co. have arranged to carry out a series of trials in the open sea upon the measured mile with the "Emil Capitaine" when she has been tuned up, and the experiments will be closely followed by all marine engineers both for commercial and naval purposes. Already the patents have been acquired for extending the system to large vessels by another prominent British shipbuilding firm, the Thornycroft company confining their efforts to its application to the smaller type of craft.

The use of superheated steam in locomotives does not entail the multitude of practical difficulties that so generally accompany any invention or improvement that is introduced to improve the economic results obtained from a locomotive, and indeed, it is probable that as experience with its application develops, some of the expenses that are incurred in the locomotive of to-day will be diminished rather than increased. There would only appear to be two possible sources of additional cost, the wear of valves and cylinders due to defective lubrication, and the cost of maintaining the superheater itself.

A GOVERNMENT-BUILT BATTLESHIP.

It takes but a glance at the handsome engraving that forms the front page of this issue to be convinced that the policy of the government in placing the order for the construction of the battleship "Connecticut" at the government yard was a far-sighted act that has been abundantly justified by the results. When we bear in mind that the keel of this, the largest battleship afloat, was laid in March, 1903, and that she will be ready for her official trials during the spring of next year, we can see that in the construction of this ship, the Navy Department has buried once and forever the old popular fiction that the construction of warships in a government yard is necessarily slow and expensive, and the work indifferently done. For the origin of this popular impression, we have to go back some twenty years or more to the date of the building of the two second-class battleships "Maine" and "Texas," both of which took a long time to build and cost an unconscionable sum of money. The cause was to be found in the fact that at that time the government yards were largely dominated by political influence. "Pull" was rampant, and the hands of the naval constructors were tied, or if not tied, were at least greatly hindered by the fact that incompetent and lazy employes who believed that political influence would prevent their discharge, were to be found in every yard and in every department at these yards.

The breaking up of the political system was due mainly to efforts of the naval constructor at the Norfolk yard, who subsequently, on coming to New York, became an ardent advocate of the construction of some of the new warships at the more important government yards. He argued that the yards having been rid of political interference and brought up to a high state of efficiency, ships could be built with greater expedition, with equal thoroughness, and for but very little greater cost than they were at private shipyards. Furthermore, it was urged that by having a government ship always on hand at the more important yards, it would be possible to maintain a large and efficient staff of workmen constantly in government employ, instead of being under the disastrous necessity of discharging a large proportion of the force when the annual repair work on the ships in commission was completed.

Congress very wisely determined to give the matter a trial, and of the two sister battleships authorized in the same year, one was given to a private yard, and the other to the Brooklyn navy yard, New York.

The results thus far achieved have more than fulfilled expectations. The "Connecticut" has not only been built faster, and considerably faster, than any previous battleships constructed for our navy, but she is to-day slightly ahead of the sister ship at the Newport News yard, and this in spite of the fact that great enthusiasm prevails at the southern yard, and there is an unspoken understanding among the workmen to push the boat along and have her completed ahead of the government-built ship. In the report of August 1 of this year, the "Connecticut" was 0.83 per cent ahead of the "Louisiana." During the month she was advanced 2.48 per cent toward completion, so that on September 1, 86.15 per cent of the work was done. The indications are now that she will be ready for her preliminary trials in the spring of next year, and ready for her final sea trial two or three months later.

Perhaps the most valuable result of the successful construction of the "Connecticut" is the stimulating effect which it has had on government work in the private shipyards. At the time that the building of the "Connecticut" was commenced, the five battleships of the "Georgia" class were making very slow progress, indeed. The act of Congress authorizing these five ships was passed on March 3, 1899. Three years later, on July 1, 1902, was passed the act authorizing the building of the "Louisiana" and "Connecticut." On August 1 of the present year, the "Nebraska," one of the ships authorized in 1899, was only 77 per cent completed, the "Georgia" 85 per cent, and the "New Jersey" 87 per cent; while the "Connecticut" and the "Louisiana," in spite of the three years' handicap, were respectively 83.67 and 82.81 per cent advanced toward completion. The stimulating effect of the "Connecticut" upon the construction of other ships is shown in the case of the three battleships "Vermont," "Kansas," and "Minnesota," practically sister ships of the "Connecticut," which were authorized in March, 1903, and are already respectively 57.1, 57.8, and 69.9 per cent completed.

The argument in favor of government-built ships, based upon the fact that there is not sufficient repair work in the yards at all times to keep a large force constantly employed, does not have the force that it did six or eight years ago, when our navy was considerably smaller. At the present time there are few months of the year when the navy yards, and particularly the larger ones like that of New York, are not well supplied with ships that are undergoing refitting and repair. No doubt ultimately we shall reach a point where repair work alone will keep our present navy yards thoroughly busy all the time. But until that point is reached, we think it would be advisable, in view of the good results obtained in the "Connecticut" experiment, to have at least one warship upon the stocks at all times at our principal navy yards.

Correspondence.

The Lunar Rainbow.

To the Editor of the SCIENTIFIC AMERICAN:

I read with interest the different discussions concerning the lunar rainbow in some recent issues of your paper, and would say that, in some respects, I quite agree with your correspondent, Mr. Harry Clifford Doane. Although the occurrence of the so-called lunar rainbow may be comparatively rare, I, too, think that the phenomenon is not generally known because of lack of observation. Before coming to this country I often had occasion to witness lunar rainbows, and I think I can give some explanation as to their origin.

The city of Luxembourg (Grand-Duchy of Luxembourg) is situated at an altitude of over three hundred meters above the sea level and a peculiarity of the air of this city is, that during the greater part of the winter, the atmosphere seems to contain an exceptional amount of humidity. Now, I can recall that I saw lunar rainbows quite often during the winter in that city, and always under the same circumstances. I never saw a bow unless the moon was full or very near its fullness. The air was always hazy and misty and very humid. I never saw the phenomenon before 11 P. M. or after 1 A. M. The moon was then always very high. As far as I could see, the diameter of the bow which surrounded the moon sometimes was five and sometimes ten times that of the moon. I always could plainly distinguish the spectrum colors, but never saw them as brilliant or perfect as those of the solar rainbow; probably the mist is a little too dense. Also the color band of the bow seemed to measure only half that of the solar rainbow. This is doubtless due to the great distance of lunar bows from the earth.

My own theory as to the formation of the lunar bows is as follows:

The moon rays, upon entering our atmosphere, will be refracted to a certain degree, and after traveling further touch the dense layer of the humid air. As very humid air is nothing else but rain in a very minute form, the moon rays will be refracted in the millions of small water drops and will form a bow similar to the solar rainbow, which we know takes place under quite analogous circumstances.

I do not think that lunar bows can be formed in an absolutely dry atmosphere. HUCK GERNSBACK.

New York, August 29, 1905.

The Largest Dam in the World.

To the Editor of the SCIENTIFIC AMERICAN:

In the very interesting article that appears in your issue of July 1, on the subject of the Wachusett reservoir, it is claimed that this is "by far the largest fresh-water reservoir in the world."

This statement is evidently made under the misapprehension that the largest reservoirs in India are those shown in the list (on page 11) in the article in question. Those lakes there mentioned are merely those in the Bombay Presidency, and do not include the largest in India.

In the native state of Udaipur in Rajputana, some 30 miles south of the city of Udaipur, is the great Jaisamand, the Dhebar lake. The dam of this lake was built some 200 years ago by the Maharana Jai Singh to rival the beautiful and extensive lake built by his predecessor at Rajnagar, 60 miles further north.

This lake covers an area which, according to careful planimeter measurements from the 1-inch-to-the-mile topographical maps, is 25 square miles. The old and now out-of-date Imperial Gazette I see, however, speaks of it as 21 square miles, so I will take this figure.

The depth of water at the dam is 90 feet. The average depth of the water is not known, but assuming that it bears somewhat the same ratio to the height of the dam as the lakes given in your list do, the average depth would be roughly 35 feet—a not improbable figure.

Taking this average depth and 21 square miles of area, this lake would have a volume of 2.43 times as much as the Wachusett reservoir, and holds therefore $2.43 \times 63 = 153$ billion of gallons.

This lake is a remarkable one in many ways, but is unfortunately in a very inaccessible part of the country and is therefore not very well known.

The dam is only about 1,000 feet long and is of the style favored by those old chiefs of Rajputana. It consists of two massive and ornamental masonry walls some 500 feet apart with the space between filled in with earth and ornamented with gardens.

The overflow is not provided for in the dam at all, but some five miles off at the end of a spur in the range of hills, and consists merely of a light cut.

I send you this information, as it may be of interest to your readers. G. E. LILLIE,

Divisional Consulting Engineer for Railways.

Government of Bombay, Public Works Department, August 4, 1905.