

to be built of steel. She was about 5 feet longer on the water-line than "Puritan," and carried a much larger sail plan, the boom being 84 feet as against 76½ feet of "Puritan," and the hoist to the topmast sheave being 111 feet as against 104 feet in the earlier boat. "Volunteer" also was a perfectly sound and wholesome vessel. Although her rig was a large one, she was well able to carry it; and like her predecessor she was changed after the cup races to a schooner, and is to-day in service as a successful cruiser. After a lapse of six years the New York Yacht Club was called upon once more to defend the cup, and on this occasion they went to Herreshoff, from whom they obtained two yachts, one of which, the "Colonia," was a keel boat, drawing 14 feet of water, built of steel, and carrying about 11,000 square feet of sail. She was a failure, for the reason that, like the "Navaho," another Herreshoff 90-footer of the same year, she was a poor boat on the wind.

The other yacht built for cup defense by Herreshoff was the "Vigilant," and in her we see the engineer attacking the problem of yacht design from his own particular point of view. Tobin bronze is used for the plating, hollow spars are experimented with, high-grade steel wire rope, blocks and other gear of extreme lightness, make their appearance in the spar and sail plans. As a consequence, although the "Vigilant" was only a few inches longer on the water-line than the "Volunteer," she carried over 2,000 square feet more sail. The boom was lengthened out to nigh upon 100 feet, while the hoist went up to 132 feet; and the sail spread to 11,312 square feet. "Vigilant" was to be the last of the centerboard yachts; for although she beat "Valkyrie II." in the series of races, she was beaten badly to windward by that boat in a stiff breeze; and subsequently, during a season in English waters, was beaten eleven times out of eighteen by the deep-keel cutter "Britannia," a sister boat to "Valkyrie II." That season's experience sealed the fate of the centerboard, and when the next challenge came, the Herreshoffs, intrusted with the contract of building a yacht to beat her, turned out to meet her the deep-keel cutter-sloop "Defender." "Vigilant" was the last of the cup defenders that was good for anything but cup defense. She has been changed into a yawl, and has proved to be an excellent cruiser under her reduced rig. In "Defender" we see the engineer still at work, reducing scantling and lightening up on construction even to the smallest detail. "Defender" was built of manganese bronze in the underbody, and aluminium in the topsides and framing. She carried a hollow steel mast, boom, and gaff. As a consequence, although she was a smaller boat than "Vigilant," having some 3 feet less beam, so great was the lightening of her weights, and the increase in stability due to lower ballast, that she carried over 1,000 feet more sail than the larger yacht, spreading 12,640 square feet. The main boom reached far over the taffrail, being 106 feet in length over all. The hoist was 7½ feet greater, and the forward measurement from mast to end of bowsprit had increased to over 73 feet.

THE DEVELOPMENT OF THE 90-FOOT RACING YACHT.

	Waterline Length.		Base of Fore Triangle.	Hoist from Boom to Topmast Sheave.		Boom.	Gaff.	Spinnaker Boom.	Total Sail Area.
	ft.	in.		ft.	in.				
Puritan.....	81	11½	63	0	104	0	76	6	7,370
Mayflower.....	85	7	67	0	111	0	80	0	8,324
Volunteer.....	85	10	67	0	111	0	84	0	9,107
Vigilant.....	84	2	69	0	123	0	98	0	11,312
Defender.....	88	5½	73	3	129	5	105	0	12,640
Columbia.....	89	7½	73	3	138	5	107	0	13,211
Constitution.....	89	9	78	0	142	0	110	0	14,400
Reliance.....	90	0	84	0	155	0	115	0	16,247

When the "Defender" commenced her trials, it began to be evident that in the development of the 90-foot racing yacht the limit, not merely of convenience, but of actual safety, had been passed. The draft of 19 feet was in itself prohibitive of the use of the boat as a cruiser, since it shut her out from many of the harbors and desirable anchorages, while the experience of the boat in fresh to moderate breezes was marked by breakdowns which, on one occasion, came very near to being disastrous. In some races, when the wind breezed up, rivets were sheared off, and the climax came when in a bit of a squall the pull of the weather shrouds was so great that the mast came very near punching a hole for itself through the bottom of the boat. Herreshoff evidently had overlooked the fact that, in cutting into the keel until its forward edge was aft of the mast-step, he had left nothing but the light floor-plates and the frail plating to take the enormous downward thrust of the mast. Emergency repairs were at once made by carrying a pair of ½-inch by 8-inch steel straps from the foot of the mast up to a junction with the chain-plates at the deck. Trouble was also experienced in keeping the bowsprit from coming inboard; several of the frames of the boat broke at the turn of the garboards; and from first to last the extreme lightness of the craft was a source of unceasing anxiety to her owners.

Four years later the Bristol yard turned out "Columbia," a yacht that embodied some of those features of hull and sail plan which experience in the smaller classes had shown to be conducive to high speed. She had a foot more depth, or 20 feet; her overhangs, forward and aft, were carried out until on a water-line length of 89 feet 7½ inches she had an overall length of about 50 per cent more, or 132 feet. Although a 90-footer when at anchor, she was a 115-footer when heeled to her sailing lines, the great increase in the overhangs being due to the effort to build the biggest possible boat on the arbitrary so-called 90-foot length. The enlargement of the sail plan was chiefly in the direction of greater hoist, the distance from main boom to topmast sheave being 138½ feet. The disastrous experience with "Defender" showed the absolute necessity of using more reliable materials in the hull, which was constructed of Tobin bronze plating on steel frames. The hull structure proved satisfactory, but the lightening up of the spars and standing rigging had been carried too far, as shown by the fact that in her trial races she carried away her mast.

Two years later, to meet "Shamrock II.," Herreshoff brought out the "Constitution," which differed in form from "Columbia" merely by an increase of one foot in the beam. The sail plan was greater than that of "Columbia" by about 1,200 square feet. The hoist had now increased to 142 feet, the boom to 110 feet, and the base of the forward triangle to 78 feet. "Constitution's" appearance is comparable only to that of "Defender" in the constant succession of breakdowns that have occurred; but with this distinction, however, that whereas "Defender's" trouble was in the hull, "Constitution's" has been up aloft. At different times she has carried away her mainmast, her topmast, and her gaff. Of the hull, however, it must be admitted that the system of belt-and-longitudinal framing adopted by Herreshoff has been eminently successful. Although it is probable that no large amount of weight is saved over the old system of framing, it is certain that weight for weight it is considerably stronger. "Constitution" proved so much of a disappointment, that it was realized this year that to defend the cup successfully some radical departure must be taken, and Herreshoff struck out most boldly in the direction of the "scow" type, which had proved so fast in the smaller classes of yachts. On a water-line of 90 feet, the new boat has a beam of over 26 feet, a draft of 20 feet, and an overall length of close upon 150 feet. Although she is a 90-footer at anchor, she is fully a 120-footer when heeled to a breeze; and to this fact is to be ascribed the astonishing sail-carrying power which she has shown, the area under the New York Yacht Club measurement being 16,247 square feet; and if changes are made, they will be rather in the direction of an increase than a reduction of sail plan. The growth of sail power in the last fifteen years may be summed up in the statement that on an increased water-line length of only 10 feet the "Reliance" of 1903 spreads over twice as much sail as did "Puritan" in 1885. In her we see unquestionably the highest possible development under the existing rule, and although the boat is an overgrown monstrosity as a sailing craft, she is certainly a great tribute to her builder, both as a naval architect and as a wonderfully resourceful and ingenious mechanic. She is the biggest, lightest constructed, most powerful, and probably the fastest yacht of her water-line length that ever was or ever will be constructed; and she possesses that dual quality, never before found in one and the same yacht, of being relatively just as fast in light as she is in strong winds.

The Current Supplement.

The current SUPPLEMENT, No. 1438, has for its front page article a very good description of the new Corinthian canal, which promises to be of much commercial importance to Greece. Admirable illustrations give one a good idea of the engineering difficulties which must have been encountered during the course of construction. Dr. Fleming's fourth paper on Hertzian wave telegraphy is presented. Prof. Wattiez gives a résumé of our present knowledge of radium. The Paris correspondent of the SCIENTIFIC AMERICAN presents the last installment of his series on some details of the Paris-Madrid automobile race. In the present installment, the Passy-Thellier and Clement voitures are described. The Antarctic experiences of the "Discovery" are given. The Atomic Theory and the Development of Modern Chemistry is the subject of an article which is of timely interest, since this is the centenary of John Dalton's famous discovery. Of archaeological interest are articles bearing the titles "Discovery of a Roman Palace at Carthage" and "Investigations at Assos." Randolph I. Geare gives a most interesting account of bronze casting in Egypt, Europe, and Japan.

It has been announced that Dr. Charles Wardell Stiles, the well-known zoologist who has been associated with the Marine Hospital Service for several years, has discovered a parasite which is a natural enemy of the mosquito.

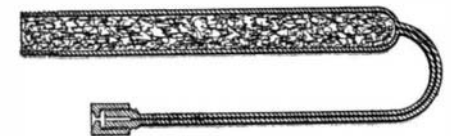


LAMP FOR BURNING VAPORIZED GASOLINE.

A patent was recently granted to Mr. E. P. Brown, of Cottonwood Falls, Kan., covering a lamp burning a mixture of air and vaporized gasoline, the oil being vaporized by the heat of the lamp itself. We illustrate herewith one form of this lamp, though obviously the same invention could be applied to many different constructions. The oil is stored in a tank of neat design, placed near the ceiling. Leading down from this is a feeder tube which terminates in a valve just above the top of the lamp chimney. From this point the vaporizer projects at right angles over the chimney and doubles on itself, ending in a nipple at the mouth of the mixing tube. The mixing tube is bent around the lamp and opens into the burner at the bottom. The novel feature of the lamp is the peculiar form of vaporizer, which consists of two sections, as shown in our detail view. One of these sections, which has a circular cross section, contains wire gauze packing, this serving to break up or atomize the oil. The oil then passes into the flattened section, and here it is vaporized by the heat of the lamp or in starting by the heat of the lighted lamp. It is obvious that owing to its shape this flattened section affords an excellent heating surface on which the oil can be quickly and thoroughly vaporized. The vapor thus generated passes out of the vaporizer into the mixing tube, sucking in with it a quantity of air which thoroughly mixes with the vapor



IMPROVED GASOLINE VAPOR LAMP.



THE VAPORIZER SHOWN IN SECTION.

while passing on to the burner where the mixture is burned. The lamp can be started with a single match and requires no alcohol torch. We are informed that these burners have been in use for over a year and have proven singularly free from clogging.

SNOW GUARD FOR LUMBERMEN'S OVERSHOES.

A recent invention which should prove of particular value to lumbermen and others who are obliged to travel through deep snow and slush, provides a foot covering which prevents the intrusion of snow, keeping the feet dry and comfortable. The improvement relates particularly to the boots of felt and the heavy rubber overshoes which are ordinarily worn by lumbermen. It is found that if the vents in the rubber overshoes are closed completely for the exclusion of snow and slush, the ankle joints are so bound that free action of the feet is impeded, and if the shoe vents are not fully closed, so as to incase the ankles, the intrusion of snow and the like will soon wet the feet of the wearer, much to his discomfort. Furthermore, as more or less friction between the heel portions of the



SNOW GUARD FOR LUMBERMEN'S SHOES.