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THE NEW CUP YACHT "RELIANCE."

At the close of the "America" cup races of 1901, when the results had proved that the two yachts had come so closely together that the result was largely a question of the accidents of seamanship and weather, it was acknowledged on all hands that their designers had apparently reached the limit of their skill with the type of yacht employed for these contests. Herreshoff, in spite of all the rich store of knowledge acquired in the construction of four previous cup defenders, had been unable in that year to produce a boat superior to his own "Columbia;" while Watson, in spite of the much-talked-of tank experiments, was unable to beat "Shamrock I." in her improved condition, by more than a very small margin. When the challenge for this year's series of contests was received and accepted, the necessity of building a new cup defender was apparent. The supposed superiority of "Constitution" to "Columbia" was at best very hypothetical, and based solely upon the presumably better handling that "Columbia" had received during the trial races. At the same time, in view of the fact that Fife, whose "Shamrock I.," after some readjustment of her sail plan, had proved to be practically equal under many conditions of sailing to "Shamrock II.," had been commissioned to build the new boat, and that in all probability he would succeed in turning out a craft that was faster than either of the two "Shamrocks," it was realized that to insure the retention of the cup a new defender should be built, and that the task of designing and constructing the craft should be given to Herreshoff. This much decided upon, there arose the important question as to what kind of yacht should be built—a question more easily asked than answered. Indeed, "Columbia" had proved such an extremely satisfactory boat, that when it came to the question of the design of "Constitution," Herreshoff made no further change in model than to increase the beam by one foot and enlarge the sail plan to match the greater power of hull thus secured. In construction "Constitution" had some advantages of lightness and strength due to the system of belt-and-longitudinal framing adopted; and it was a source of great surprise and general disappointment that with her greater power, greater sail spread, and general lowering of weights of hull, she did not show any decided superiority to the older boat. It looked as though Herreshoff had done what Watson had frankly declared that he had himself done, namely, exhausted his resources in the development of the conventional type of 90-foot racing yacht. There was no further gain to be looked for in the direction of reduction of weights, nor, judging from the results in "Constitution," was there any advantage in increase of power by increase of displacement and sail area—not, at least, if the same typical midship section was to be retained. If any radical departure was to be taken, experience in smaller classes of yachts had shown that it must be in the direction of the broad, shoal-bodied craft of the modified scow type, a type which had proved to be practically invincible in these classes.

Now, Herreshoff has never in his larger boats appeared desirous of going very far in this direction. At the same time, there is no denying the fact that the bold departure made by the young Boston designer, Crowninshield, when he produced the scow-fin 90-footer "Independence," while it did not achieve the object aimed at of producing the all-round fastest cup yacht of that year or any year, nevertheless served to give some most valuable data and proved to a demonstration that on certain points of sailing, a properly-designed 90-foot modified scow was faster than anything afloat. Although "Independence" showed all the faults of the scow type when going to windward, pounding heavily in a breeze and head sea, and spilling the wind out of her sails under the conditions of a sea and a light breeze after the manner of all beamy shallow craft, she had proved that on a broad reach she was the fastest 90-foot sloop ever constructed. On a certain memorable day off Newport, in a breeze of from 17 to 25 knots strength, although, as was to be expected, she was beaten by "Columbia" on the windward leg, she overhauled that boat (herself remarkable for her reaching qualities) at a pace which gave reason to believe that were "Independence" properly tuned up, she would, with all her faults to windward, have proved more than the master of "Columbia" or "Constitution" on a triangular course in a wind of any strength. Her performance in reaching made a profound impression upon the amateur element among those who are intimately connected with the defense of the cup; an impression so strong that when the cup yacht was ordered, it was made a *sine qua non* that she should embody some of the best features of the "Independence" type. And right here, it is but just to Mr. Crowninshield to acknowledge the most important contribution he has made to the defense of the "America" cup; for it was pretty safe to say that had "Independence" not been built, the defense of the cup this year would never have been intrusted to a vessel of the extreme type which is now being built at the Herreshoff yards.

The problem, then, before the Bristol designer was to produce a yacht with all the best features of the scow type, such as great sailing length when heeled, and large sail-carrying power, with as few as possible of the scow's drawbacks, such as the flat floor forward and the hard shoulders which helped so greatly to the undoing of "Independence" in a troubled sea. And this Herreshoff has achieved, if we may judge from the model of "Reliance," although with what measure of success will never be known until the boat commences to toy on some calm day with the left-over disturbance of a yesterday's blow. The new boat has more beam and considerably less dead rise than "Constitution," a harder bilge and longer ends, particularly in the forward overhang. Her extreme beam is 25 feet 8 inches; her draft, 18 feet 9 inches; and her length over all, 140 feet. In her midship section she shows exactly 2 feet less dead rise than "Constitution," and while her hull is not so shallow as that of "Independence," it is still sufficiently shallow to allow the ends to be carried out to give practically the same length on deck as the Crowninshield boat. While she will thus secure something of the same long, flat floor, she differs from "Independence" in the fact that the fullness of her bilges, as shown in the midship section, is not carried out into the forward overhang, as was done in the Boston boat, the sections from the water-line at the stem to the bow being something of a compromise between the almost semi-circular sections at the water-line of "Shamrock II." and the decided V-sections of "Columbia" and "Constitution." While there is some loss of power in this modification, there will be a decided gain in easiness in a seaway, especially when the seas are short; and while the new boat will pound somewhat heavily under these conditions, she is not likely to take the bit in her teeth, as did "Independence," and run wild under a freshening breeze or in sudden puffs. Although the draft is less than that of "Constitution," the keel is longer and the bulb is drawn out to finer lines. The mast relatively to the load-water line is stepped in the same position as in "Constitution," and with her 100 tons of lead in the keel, her harder bilges, greater beam, and greater length of water-line when heeled, she will naturally possess larger sail-carrying power; she will spread in the neighborhood of 15,000 square feet of canvas.

It is a curious fact that, broadly speaking, the English designers are working on opposite lines from those outlined above. The new Fife boat, as compared with the two "Shamrocks," will have a deeper body, considerably more dead rise, greater fullness in the garboards, and somewhat less overall length, the model thus reverting somewhat to the type of "Valkyrie II." and "Britannia." Hence, for the second time in the history of these cup races, the American and British designers have crossed each other, our boat running to great beam, shoalness of body, and large wetted surface and the English craft tending to greater fullness of body, large displacement, and a small wetted surface. Should both boats come up to the designers' expectations and prove to be a success, the outcome of the races will depend, more than it has for several years past, upon the conditions of wind and weather. In light breezes and troubled water the advantage should lie with "Shamrock III." Also when "split open," that is running dead before the wind, with spinnaker set, the larger displacement and finer-lined Fife boat, with her smaller wetted surface, should prove to be the faster both in light winds and strong. On the other hand, on a triangular course, where there is much reaching to be done, especially under the conditions of a strong breeze and a smooth sea, "Shamrock III." should be hopelessly beaten, while in a rough sea and strong wind, and under any conditions where reefing becomes necessary, the advantage, except in reaching, should lie with the Fife boat. Seeing, however, that moderate winds and fairly smooth seas prevail during August, it would look as though the extreme boat which Herreshoff is building should prove to be the winner.

CONSTRUCTION.—The belt-and-longitudinal framing that Herreshoff used in "Constitution" proved to be so successful, that it has been adopted practically without any change in the new boat. This system was elaborately described and illustrated in the SCIENTIFIC AMERICAN of May 11, 1901, and the reader is referred to that article for the details of construction. Broadly speaking, the framing of "Reliance" consists of nickel-steel belt frames of deep section, which are spaced 6 feet 8 inches apart, the frames occurring at every fourth station of the eighty-four stations which make up the full overall length of the yacht. These frames extend entirely around the interior of the yacht, and embody the floor plates, frames, and deck beams in one. They are deepest where they form the floor plates, and they become shallower as they run up through the bilges to the deck beams. The hull plating, which is of Tobin bronze and nickel-steel, is laid on in seven strakes with flush joints; the first six strakes are of bronze and the seventh or sheer strake is of nickel-steel. In addition to the belt-framing there is a series of longitudinal frames consisting of alternating T-irons and bulb angles. The T-irons are laid along the seams to which they are riveted, while the bulb angles extend longitudinally midway between the seams, and serve to give additional stiffness to the plating and to reinforce the longitudinal strength of the boat. To prevent the buckling of the belt-frames, a series of plate-steel knees are worked in between the frames and the T-irons, the knees being placed on opposite sides of the belt-frames, that is, one series of knees being on the left side of the frame on one T-iron, and on the right side of the frame on the next T-iron. In a vessel of the great deck area of "Reliance," especial attention must be paid to the question of lateral stiffness; and this is provided by a system of diagonal strapping consisting of 5-16 nickel steel straps, covering the whole area of the deck. These straps are securely riveted to each other where they intersect, and at the partners where the mast passes through the deck there is worked in a diamond-shaped plate of steel ⅜ of an inch thick and measuring 4 feet on the side, which is riveted to the strapping and serves to hold the heavy collars which form the mast partners. Over the strapping thus formed is laid a continuous deck of aluminium plating. The mast-step will be of the same general construction as that of "Constitution." It is formed by deepening the keelson to a depth of 4½ feet, by adding an additional belt-frame and by considerably deepening the foot-plate portion of these frames in the wake of the mast. At the partners there will be two heavy collars, one above and one below the steel deck plate, the upper one being formed of a 6 x 6 inch angle iron, 1 inch in thickness, and the lower of a 6 x 12 inch angle iron also 1 inch in thickness. The 6-inch flanges of these collars will be riveted to the steel deck plate by rivets which pass entirely through from collar to collar. Four heavy, vertical ties also extend from the deck to the top of the mast step where they take hold of the collar which forms the actual footing for the mast. The construction at the mast is also greatly stiffened by a pair of heavy struts of box section, which extend from the mast pardners to the bilges. It will be noticed that the construction is in general very similar to that of "Constitution," whose hull was so stiff that when the vessel was close-hauled it was impossible to tell by the bulkhead doors upon which tack the yacht was sailing.

THE NEW MEASUREMENT RULE OF THE NEW YORK YACHT CLUB.

There has been a growing dissatisfaction of late years among yachtsmen with the type of boat which has been developed under the rules of measurement that govern yacht racing. Not only has the construction of yachts been pushed to such an extreme of lightness that broken spars and leaking hulls are becoming increasingly common, but the form of the yachts themselves has gone to such extreme proportions that the racing machine of to-day is not only costly to build, troublesome to handle and subject to rapid deterioration, but its construction and model combine to render it about the very worst kind of seagoing craft that could be designed. As a cruiser it is pre-eminently uncomfortable and unsafe. The question of developing a rule of measurement under which it would be possible to produce a yacht that would be both speedy and comfortable, one which, when its racing days were over, would have before it a long term of usefulness as a cruiser, has been agitated both by British and American designers, and they have been in practical agreement that something should be done to produce a more wholesome type. This conviction took form in the appointment in 1902 by the New York Yacht Club of a Committee on Measurement, whose first step was to send a letter to the leading yacht designers of the world, asking whether they did not consider that it was desirable to formulate a new system of measurement, which would "produce a wholesome type of boat," and asking whether these designers did not consider it possible to "formulate a system of measurement which might be adopted as an international standard." The letter requested that suggestions should be sent in as to what system of measurement should be adopted. The replies received were unanimous in agreeing that it

was practicable to formulate the desired rule, and that displacement or its equivalent should be incorporated as a factor in the rule of measurement adopted. As a result of the discussion thus opened up, it developed that there was a practical agreement on the three elements of length, sail area, and displacement as those which should enter into the question of measurement, and the rule as finally adopted by the Club is as follows:

$$\text{Rating measurement} = \frac{L \times \sqrt{S.A.}}{5\sqrt[3]{D}}$$ or the length multiplied by the square root of the sail area, and divided by five times the cube root of the displacement.

Now the development of the racing yacht under the old rule, in which the length of the waterline was added to the square root of the sail area, and the result divided by 2, had led to the production of an extremely undesirable type of boat, it having been found that the very fastest type of craft built under this rule was an unballasted scow—a broad, shallow, box-like structure with its under-body slightly curved longitudinally, so that when measured it would float on an extremely short water line, and when heeled to a breeze would lengthen out to something like double that waterline, using the windward portion of the hull with the crew crowded on the windward rail as ballast to enable the craft to carry its abnormally large sail spread. The most outrageous instance of this development is an extraordinary freak known as "Outlook," which was built for the defense of the Quincy cup. This craft, which is called a 21-footer, is 52 feet 7 inches in length on deck, 16 feet in extreme beam, has a draft of hull of only 8 inches, and yet has a sail spread of 1,800 square feet. This boat (*sic*) proves what may be done under a faulty rule, that is a rule that is not sufficiently comprehensive, when a clever designer sets out to build the most extreme boat possible under that rule by breaking the spirit without breaking the letter of it.

Broadly speaking, the adoption of a rule which took cognizance merely of length and sail area, was based upon sound scientific principles; for length is the chief determining factor of the resistance of the vessel, and sail area of her power. Other things being equal, the longer vessel will be faster than the shorter one, and the vessel with the larger sail area will have the greater driving power. Building under this rule it was soon found that of two vessels of equal waterline length, the beamy boat of shoal draft with a hull of small displacement was faster under the average weather conditions than a boat with moderate beam, greater draft, and larger displacement. Moreover, if a shallow hull was adopted, it became possible to carry out the overhangs of the boat to an excessive length, and by maintaining the hard turn of the bilges in the sections as they ran out into the overhangs, it became possible to greatly lengthen the waterline as the vessel heeled down to a breeze. Consequently a 21-footer, like the "Outlook" mentioned above, became, to all intents and purposes, when she was heeled, a 40-footer, the great stability due to her extreme beam and lengthened waterline enabling her to carry the rig that would ordinarily appear on a 40-foot yacht.

Although the New York Yacht Club rule is not likely to be applied to any boats under 30 feet in length on the waterline, we have chosen for comparison the two 21-footers, shown in the accompanying diagram, for the reason that the full data regarding these boats was accessible. The "Arbeeka" is a 21-foot knockabout, designed in 1898 by Mr. Crowninshield, at a time when the craze for extreme proportions and the tendency to run to the freak type had not made itself felt in what was known as the knockabout class. She is a moderate boat, with easy sailing lines, a good-sized displacement, and a snug sail plan. The other 21-footer, "Don," built in 1901, shows the rapid development toward the extreme type which had taken place in the brief period of three years. She was designed by Mr. Mower, and in the season's racing she had a brilliant career, proving to be practically invincible and winning by very large margins. It will be seen at once that though she is nominally a 21-footer and to that extent in the same class as "Arbeeka," she is actually a very much larger and more powerful craft. When she is heeled to a breeze her sailing waterline is from 28 to 30 feet in length, and with her 600 pounds of live ballast in the shape of the crew strewn along the weather rail, she is well able to carry her 811 square feet of sail even in a pretty fresh breeze. The abnormal sailing length is due to the great length and fullness of the ends. We have traced the designs of the two boats, one over the other, so as to show graphically how the New York Yacht Club's rule of measurement, if it were applied to them both, would give to the more wholesome type of boat a handicap so liberal that the faster boat could never cut it down.

In the new rule the length is no longer measured on the middle vertical plane of the vessel, but on a vertical longitudinal plane taken at one-quarter of the greatest beam at the load waterline, and it is obtained by measuring the length in this plane at the waterline and on deck, adding these together, and dividing by 2, which gives the mean length on the quarter breadth. By looking at the plan of the two yachts, it will be seen how greatly the full waterlines of "Don" and her long overhangs contribute to her high rating of 35, while the sharper waterlines and moderate overhangs of "Arbeeka" assist to reduce her rating to less than 20.

It should be explained that the rule states that in case the width of the stern on deck exceeds one-half the greatest beam at the load waterline, the measurement for the length on deck shall be taken to a point aft of the stern where the continuance of the fair line of the top edge of the plank-sheer would intersect the quarter-beam line. This tends to keep down the broad overhanging sterns that are so much in vogue, and causes "Don" to add several feet more to her deck length. Not only is the extreme boat penalized for length, but also for sail area and displacement. Of sail area it is not necessary to say anything here; but regarding displacement it may be mentioned that it is in this respect that the extreme craft is subjected to one of her heaviest penalties. A shoal, broad boat is of relatively light displacement compared with a boat of deeper body, and since the deep-bodied and large-displacement craft is a better sea boat, has better accommodations, and gives greater comfort generally, displacement has been brought into the rule by making it a divisor of the results obtained in measurement of the length and sail area. In the case of such a yacht as "Don" the penalty is simply enormous and quite prohibitive—her measurement working out as 35 against 19.6 for "Arbeeka," with the result that she would have to allow "Arbeeka" about 2¾ minutes per mile—something which even such a flier as "Don" could not do with any possible chance of winning.

The new rule, as we have said, will probably not be applied to boats under 30 feet in length, and in the case of the larger yachts of extreme form, the penalties, though very heavy, will not work out at such an absolutely prohibitive figure as shown above. The weak point in the rule, if it has one, is the very large displacement divisor, and we think it will probably be found, after one or two seasons' racing, that it will be advisable to take say three times the cube root of the displacement, instead of five times, as the divisor.

It is interesting to note the effect which the new rule will have on existing yachts: Thus "Columbia," whose rating under the old rule was 102, under the new rule becomes 131. The 70-footers "Mineola" and class, which are more extreme in model than "Columbia," have increased in measurement from 76.34 to 90. The most interesting comparison is that between last year's extreme racing yacht, "Neola," which measures 51 feet on the waterline, and the Fife boat "Isolde," which measures 59.7 feet on the waterline. The "Neola" is the most extreme, and for her size the fastest, large cutter that has been built to date. The "Isolde" is a large-displacement, deep-bodied, easy-lined craft of moderate sail plan, and is practically the type which the New York Yacht Club rule is expected to produce. The 51-foot "Neola," whose rating measurement is 60 under the old New York Yacht Club rule, measures 73 feet under the new rule; whereas the 60-foot "Isolde," which measured 60.5 feet under the old rule, measures practically the same, or 61 feet under the new rule. Or in other words, the 51-foot yacht under the new rule has a measurement 12 points higher than that of the 60-footer. It will thus be seen that the new rule, even in the larger classes, bears very heavily upon the extreme craft that have been turned out during the past two or three years.

For the sake of comparison, we have shown the allowance which "Don" would have to give "Arbeeka" under the Larchmont-Hyslop rule, which is used by the Larchmont and Seawanhaka clubs, and under what is known as the modified Larchmont rule, which has been adopted by the Long Island Sound Yacht Racing Association. Under the Larchmont rule, measurement is made of the waterline length; the sail area; the breadth taken at the greatest breadth and at an eighth of the distance from the forward and after points of waterline measurement; the depth; and the midship section—the difference between the two rules being that in the Larchmont rule 3 1-3 of the midship section is taken, and in the modified Larchmont rule 3.85 of the midship section. Both rules are favored by those designers who have done most of the work in the development of racing craft in the smaller classes, and they claim that the modified Larchmont rule would promote a type of vessel that conforms more closely to the typical American model than would the New York Yacht Club rule, which, because of the big displacement factor, will tend to produce a big-bodied vessel with moderate overhangs, and excessive displacement, conforming more to the typical British cutter.

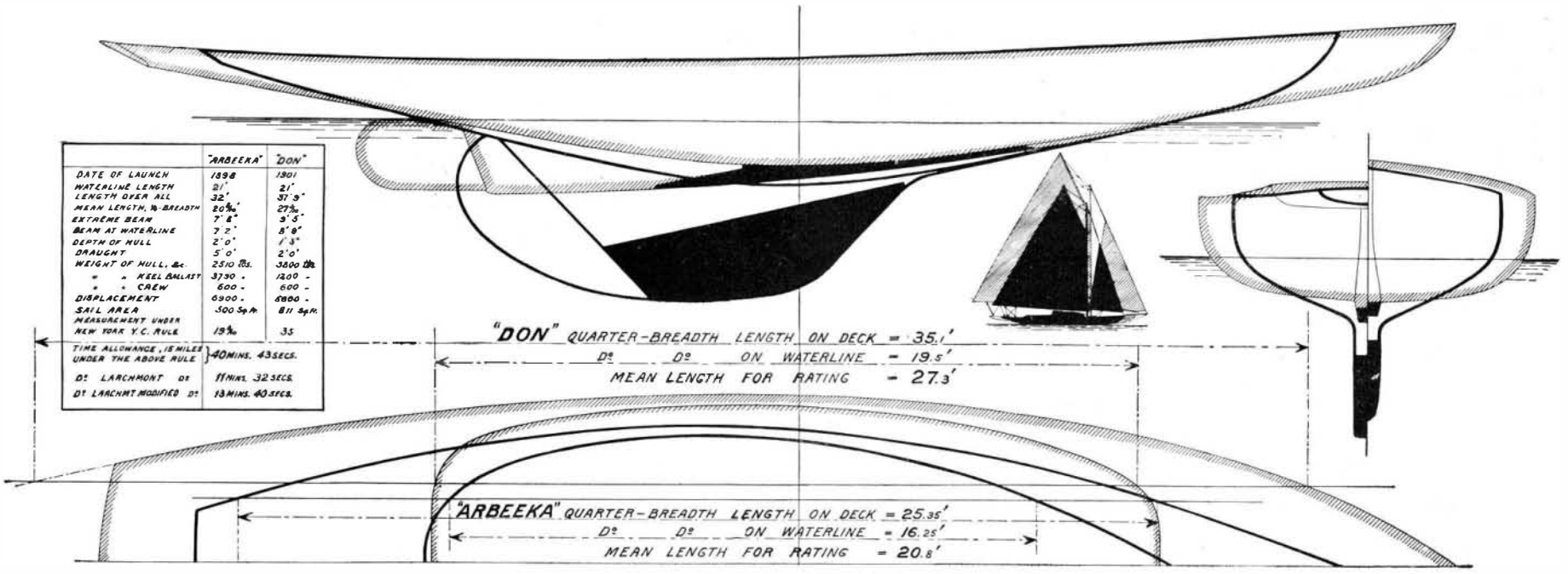

DIAGRAM SHOWING THE EXTENT TO WHICH THE N. Y. Y. C. NEW RULE OF MEASUREMENT TAXES THE EXAGGERATED PROPORTIONS OF A MODERN SCOW-TYPE RACING CRAFT.

THE HOME OF THE NEW YORK YACHT CLUB.

The famous yacht club, of whose beautiful home on 44th Street, in this city, we present a series of photographs, is perhaps best known both here and abroad because of the remarkable series of contests, extending over a period of more than half a century, which have been carried on under its auspices for the possession of the "America" Cup—undoubtedly the most famous yachting trophy in the history of sport upon the sea.

Among the names that call for prominent mention in any reminiscences of the New York Yacht Club, none is more widely known than that of Commodore John C. Stevens, for it is