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Racing for the "America's" Cup

When sport becomes a science

By Joseph Brinker



SIR THOMAS LIPTON has come to this country with one of the most remarkable and sensation-ally radical challengers that ever crossed the Atlantic. Yachting experts who have seen the hull of the *Shamrock IV* agree that she is perhaps the lightest and yet the most powerful British racing creation that has ever visited our shores.

The features of design that stand out conspicuously are the extremely long keel; the full form of the hull in the bow and stern sections; the bulge of the sides of the hull inward at the top or deck; and the unusually lofty sail rig. The hull is of the lightest composite construction, the planking being laid in three layers with the two inner layers placed diagonally. The outer layer of the planking runs longitudinally.

Because of the long keel, with the lead placed low, yachting experts predict that the best chance of success of the *Shamrock IV* lies in a strong offshore breeze. Then her great sail spread will drive her through the water at a high speed. In light breezes the chances of winning are not considered so good, because her large keel will present a big area of wetted surface, and the "skin" friction between it and the water will tend to decrease her speed.

Against the *Shamrock IV* either the *Resolute* or the

Vanitie will race. These yachts resemble each other to a far greater extent than either one resembles the *Shamrock IV*. Both of the American boats are approximately 75 feet on the water-line, the *Vanitie* being the

larger when measured by the extent of the part that overhangs the water-line dimensions. The *Vanitie* has the larger sail area, carrying 9,465 square feet of canvas, compared with 8,188 square feet of sail carried by the *Reso-*

lute, which is slightly narrower, but has a body that is more full beneath the water-line where the hull joins the vertical sides of the keel. All three of the contestants are provided with centerboards set in the bottom of the keels.

No matter which boat is selected to defend the Cup, she will compare in general design more closely to her foreign rival than did America's earliest cup contestant, the *America*. In the span of seventy-nine years from the *America* to the *Resolute* and the *Shamrock IV*, there has been a remarkable evolution in the design of the racing yacht.

The *America* was built to beat the sloop *Maria*, then the fastest pilot-boat in New York harbor. While she did not beat the *Maria*, she proved to be so fast for a schooner that the yachtsmen who had ordered the boat accepted her and made ready for the trip across the Atlantic. The route was to Havre. It was made in seventeen and one half days.

After watching the *America*, with her widest beam amidships and fine lines fore and aft, the British accepted the American type of clipper



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The racers coming head-on. From left to right are the *Resolute*, the *Vanitie*, and the *Defiance*. The *Vanitie* has a greater sail area than the *Resolute*

bow. But, because of the deep British waters, the hulls were deep and narrow. In America the conditions favored boats of greater beam and less draft because of the shallow waters. The British type is exemplified in the *Genesta* of 1885, as shown in one of the accompanying illustrations, and the American type in the *Mischief*, which was built in 1881.

Coming development was seen in the *Thistle*, the challenger for the Cup in 1887. She was wider in proportion to her depth than any previous contestant. Then came the *Valkyrie I* in 1893, with a fixed, finlike keel instead of a center-board, because a fixed keel can carry from sixty to ninety tons of lead. Finally the British type of narrow, deep hull gave way to the wide but shoal hull with a deep fin keel to carry lead ballast. The *Reliance*, an example of this type, with a water-line length of about 90 feet and an over-all length of 140 feet, carrying 16,000

square feet of sail—the largest ever carried by a Cup yacht—was perhaps the acme of the highly developed racing machine.

But the *Reliance* and the *Shamrock III* were rule-beating freaks, which, as soon as the Cup races were over, were broken up on the junk-pile because of their extreme design, their unseaworthiness, and the inability to get other boats to race against them in club regattas. Because these boats had developed into freaks, the racing rules were changed. The *Resolute*, the *Vanitie*, and the *Shamrock IV*, all with a water-line length of 75 feet instead of the 90 feet of the *Reliance* are far more wholesome boats, and will probably see many years of regatta racing before they are discarded.

The old racing rule put a tax on water-line length and sail area, but on nothing else. Provided the yacht did not exceed 90 feet in length on the load water-line, she could be as broad and deep, and as long over all, as desired. The boats built under the old rule drew too much water for cruisers sailing in the shallow American harbors. To save weight the hulls themselves were

made so shallow that there was insufficient headroom below the deck for comfortable accommodations. These reasons lie behind the fact that all of the racing machines of recent years were broken up for junk after the completion of the races.

The new rule and the formula by which the rating of the yacht is determined includes the factors of sail

area, length, and displacement. The rating is determined by the formula:

$$\text{Rating} = 0.18 \frac{L \sqrt{\text{Sail Area}}}{\sqrt[3]{\text{Displacement}}}$$

Because the displacement factor is the denominator of the fraction, and because the larger the denominator the smaller becomes the final fraction or rating, it is seen that the new rule

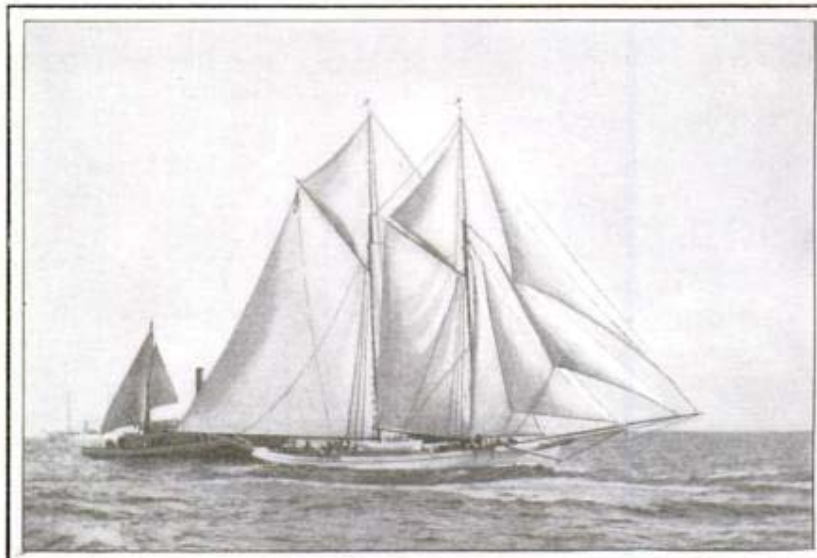
favors boats of larger displacement. Other things being equal, the boat with the larger displacement will have the smaller rating and will receive a larger time allowance.

The *Vanitie* departs less from the old rule than the *Resolute*. The *Resolute* has a fuller and deeper under-water body and is built more closely to the rule, as shown by her sharp ends, deep V sections, and large displacement. The *Shamrock IV* is a compromise between the extremes of the *Shamrock III* and the *Reliance*. The *Shamrock IV* is full ended, with a large sail area

and a deep keel having a large surface in contact with the water.

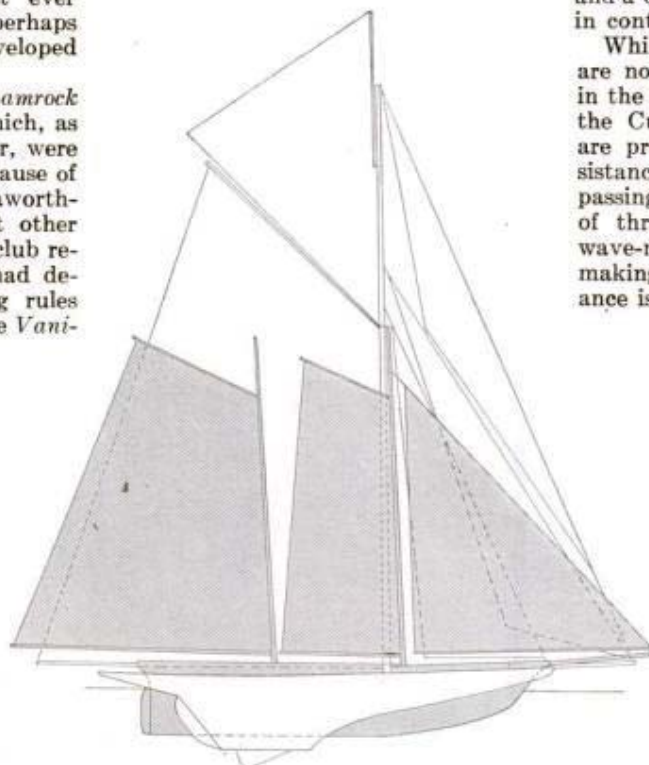
While the elements of yacht design are not expressed in so many words in the formula by which the rating of the Cup yachts is determined, they are present just the same. The resistance that a vessel encounters in passing through water is made up of three kinds—frictional resistance, wave-making resistance, and eddy-making resistance. Frictional resistance is that due to the friction of the

water on the under-water surface of the vessel. It depends upon the area of the surface and the nature and shape of the surface. This resistance is known as skin friction, and forms a large part of the total resistance at low speeds. It is, of course, decreased by cutting down the area of the hull in contact with the water. This area is commonly called the "wetted surface." The speed of the boat depends upon the ratio of the sail area to the wetted surface. Without unduly reducing the area of wetted surface, it is the task of the yacht designer properly to proportion the ratio of the sail area to the wetted surface. Because the



The first winner of the cup, the *America*. Though a swift schooner in her day, the boat does not compare in speed with the modern racing yacht

built with a full hull and extremely long keel. The *Resolute* and the *Vanitie* could sail around her in circles, because of their modern construction



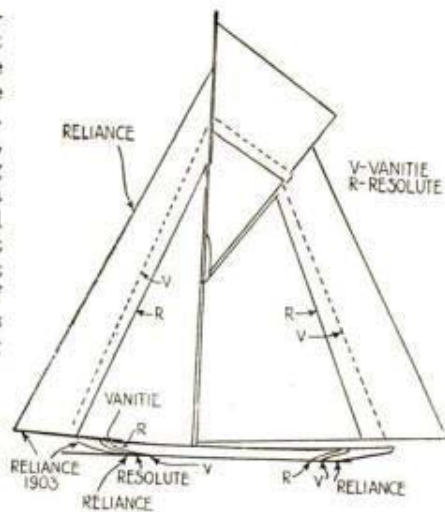
Compare the *America*, which won the race in 1851, with the *Resolute*. While the *America* was about 13 feet longer than the *Resolute* on the water-line, she was less in length over all, on account of the extent of that

part of her construction that "overhangs" the water-line measurement. The *America* is indicated by the darkened portion, to show the difference in the shape of the hull and the relative sail area

skin friction is the most important resistance to the progress of the yacht through the water, that vessel with the larger ratio of sail area to wetted surface will be faster, other things being equal.

In designing the *Shamrock IV*, Nicholson gave her an extremely long keel. This greatly increased the area of the wetted surface, but also enabled him to spread the lead in the keel out longitudinally instead of building it up vertically. Hence the center of gravity of the lead lies lower, and this in turn means greater sail-carrying capacity for the same weight. Because of this low-placed lead and great sail area, which increases her speed in strong breezes, yachtsmen contend that the *Shamrock IV* will have her best chances of winning in strong winds.

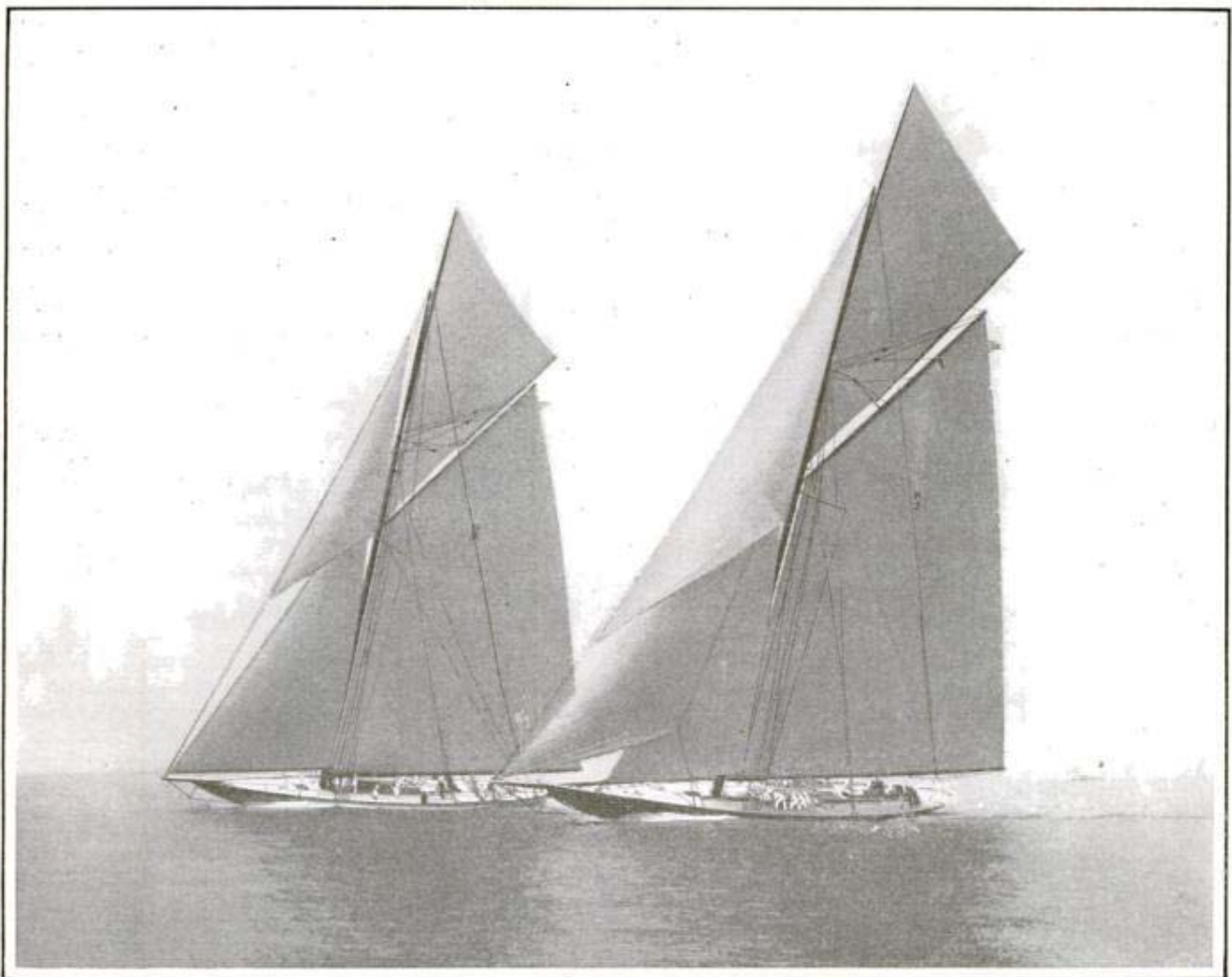
At lower speeds in light airs, where the wetted surface and its skin friction are the most important considerations, the Lipton yacht will be at a great disadvantage compared with either the *Resolute* or the *Vanitie*, which have a much smaller area of wetted surface. The bottom length of the keel of the *Resolute* is only about half



A comparison of the rig and sail plan of the *Resolute* and the *Vanitie*, with that of the *Reliance*, which defeated the *Shamrock III* in 1903. The *Reliance* was 90 feet long on the waterline and 140 feet overall. The waterline length of both the *Resolute* and the *Vanitie* is 75 feet. The *Reliance* carried 16,000 square feet of canvas. The *Resolute* carries 8,188 square feet of sail, the *Vanitie*, 9,465 square feet

that of the *Shamrock IV*. Although changes may be made in the rig of the *Shamrock IV* before she crosses the starting line on July 15, she may carry approximately 10,000 square feet of sail area as compared with the 8,188 square feet of the *Resolute*. If these ratios hold true, the *Shamrock IV* will probably have to give the *Resolute* three or four minutes of time allowance. This is an important factor, for on at least one occasion the American defender of the Cup beat the British challenger on time allowance. That was the race between *Columbia* and *Shamrock II* on October 4, 1901, when the *Shamrock II* actually beat the *Columbia* by two seconds on elapsed time, but lost the race by forty-one seconds because she had to give the *Columbia* a time allowance of forty-three seconds.

Some idea of the tremendous sail spread of the *Resolute* may be gained from the fact that if her sails were made from ordinary bed-sheets, fifty-four inches wide by eighty-one inches long, it would require 270 of these sheets, sewed end on end, to give the equivalent sail area.



The *Resolute* at the left and the *Vanitie*, at the right, cutting gracefully through the water. The "lines" of the sails are calculated to lie perfectly straight in the wind in the speed of the race

Famous Contestants for the "America's" Cup

The America

The most notable peculiarities of the *America* were in the sharpness of her bow and in the shape of her hull on the sides which rose from the keel in straight lines, each pair forming a sharp V. She was only 94 feet over all; 88 feet on the water-line; 22 feet beam, and had 11½ feet maximum draft

The Mischief

The *Mischief* was an iron sloop, much smaller than the *America*; she had a draft of only 5 feet, but a deep center-board. She had a beam of 20 feet, with a length on the water-line of 61 feet. The *Mischief* defeated the Canadian challenger, *Atalanta*, in two out of the three races sailed

The British Cutter Genesta

The British cutter *Genesta* was built along entirely new lines. In light winds she was an easy mark for the *Puritan*, the American defender, but in a heavy blow showed such seaworthy qualities that her last race with the *Puritan* was considered one of the best Cup races of any sailed up to 1885

The Scotch Cutter Thistle

The Scotch cutter *Thistle* marked a new departure in British challengers. She was 108 feet over all; 86 feet on the water-line; 20 feet beam and 13¾ feet draft. Her underwater hull near the bow was well cut away and she carried 55 tons of lead on her keel. Inside she carried ten tons of lead

The Valkyrie

The *Valkyrie I* was the prototype of the present day racing yacht with long overhangs at the bow and stern. She was the biggest of the challenging sloops up to 1893 and was 126 feet over all, 85 feet on the water-line, and she had a draft of 16½ feet. She carried 10,042 square feet of sail

The Vigilant

The *Vigilant* which defeated the *Valkyrie I* in two races in 1893, was deeper and wider than any cup defender built up to that time. She was designed and built by Nat Herreshoff. Her sail area was 11,272 square feet

The Columbia

The *Columbia*, which defeated Sir Thomas Lipton's *Shamrock I* in 1899, was the most pronounced skimming-dish type of hull up to that year. The hull proper with a beam of just 24 feet had a depth of only 7 or 8 feet

The Vanitie

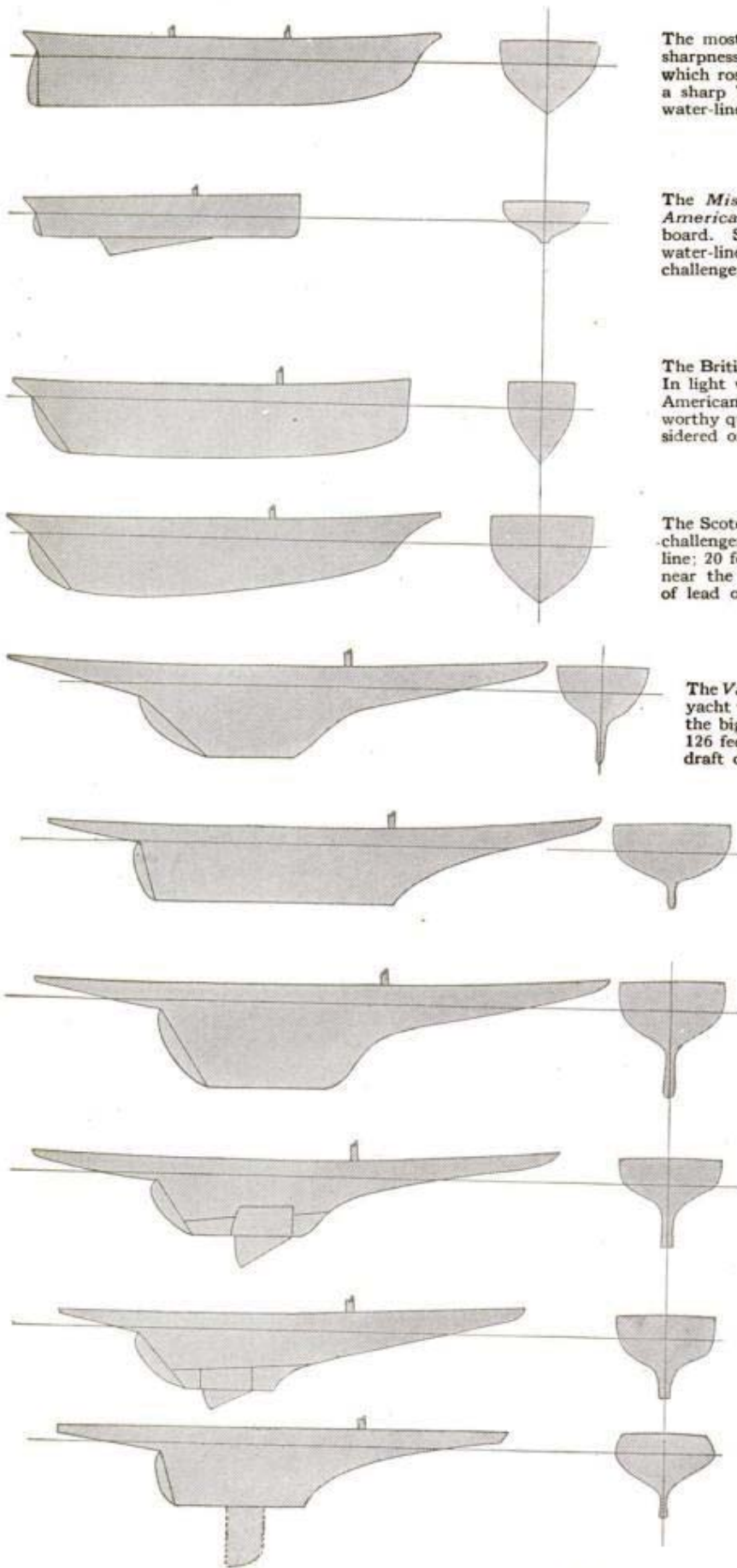
One of the contestants for the honor of defending the *America's* cup this year, the *Vanitie*, has 65 tons of lead in her keel and draws 13¾ feet of water exclusive of a small centerboard. She is 119 feet in length over all, but only 75 feet on the load water-line

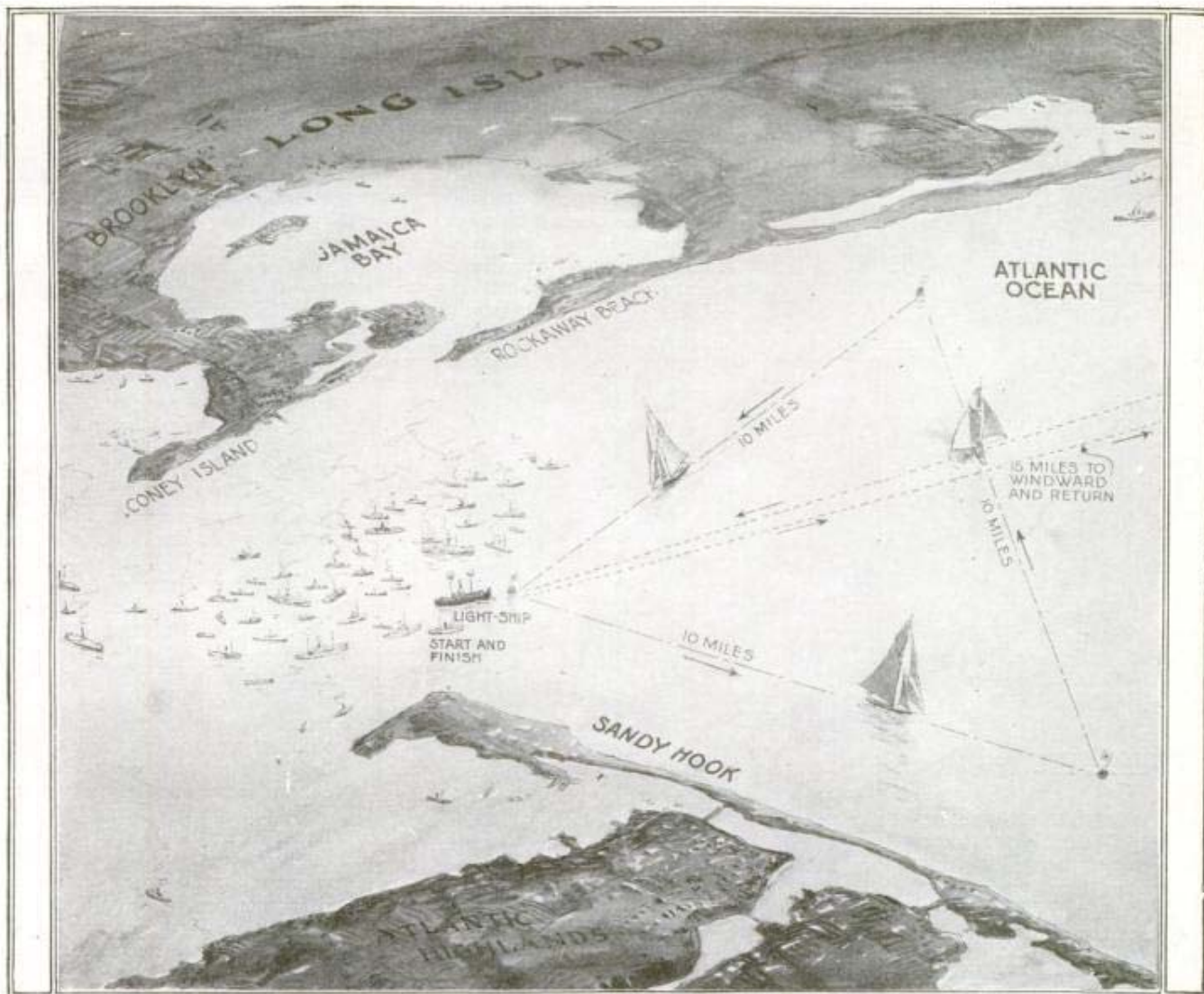
The Resolute

The *Resolute*, the second candidate for the defense of the Cup this year, is similar to the *Vanitie* in design except that she has fuller underwater body lines and shorter overhangs

The Shamrock IV

In his fourth attempt to win the Cup, Sir Thomas Lipton has brought over in *Shamrock IV* one of the most remarkable challengers built. Her keel is extraordinarily long, measuring about 35 feet along the bottom



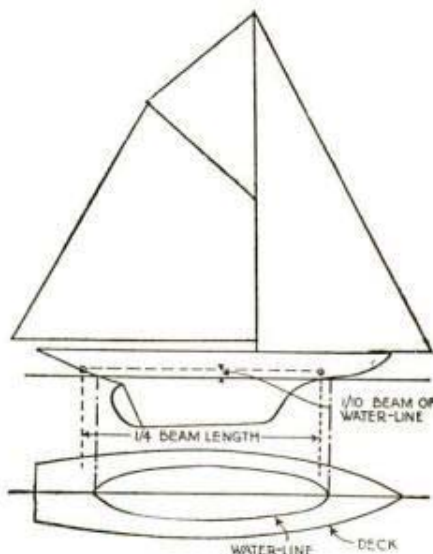


The race-course for the yachts off Sandy Hook. The first race for the *America's Cup* will be held on July 15. It will be a race fifteen miles to windward and return, as indicated by the dotted lines in the center of the triangle. Three out of five

racers must be won. The second and alternate races will follow the triangle, each side of which is ten miles long, making the total length thirty miles. These races will be sailed on Tuesdays, Thursdays, and Saturdays until the winner is decided

While the present racing rule gives a bigger rating the longer the water-line length and the larger the sail area, the length L in the formula is not the water-line length, nor does the rating increase in the direct ratio of the sail area. The sail area rating increases as the square root of the area, and it follows as a matter of course that four times the sail area would double the rating. The cube root of the displacement, being the denominator of the rating fraction, helps to give a smaller rating as the displacement increases, and this means greater seaworthiness of the boat. The length L in the formula is not the water-line length, but a corrected length

Sail area, displacement, and water-line length are considered in determining the rating of a racing yacht, with the time allowance that must be given a vessel of smaller rating. The water-line length is not measured on the load water-line, but is a corrected length



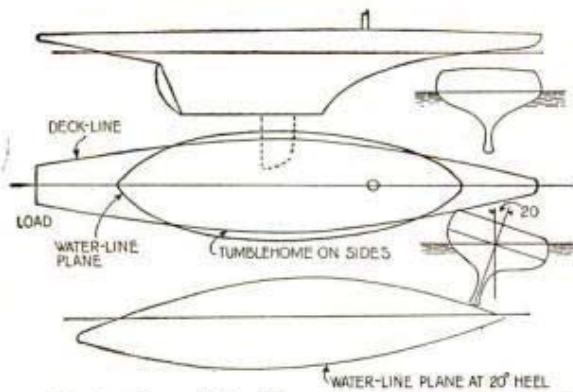
Sail area, displacement, and water-line length

which includes the load water-line length plus one-half the excess of the quarter-beam length over the percentage of the load water-line length given by the formula:

$$P = 100 - \sqrt{\text{load water-line length}}$$

The formula quarter-beam length is determined as shown in the accompanying sketch, and is employed to prevent beating the rule by freak designs in the bow and stern overhangs.

The rating, as determined by the above formula, gives the time allowance, which depends upon the assumption that a yacht of racing measurement R will sail a nautical mile in the number of seconds shown by the formula:



The drawings of the *Shamrock IV* show the tumblehome of sides of the hull in the center. The form of the hull at bow and stern is shown by the increase in area of the water-line plane when the *Shamrock IV* is heeled over to an angle of twenty degrees in the water

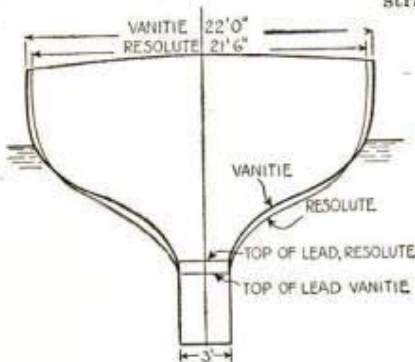
$$\frac{2160}{R} + 183.62$$

For a yacht of a different rating *r*, the allowance per mile between the two yachts will therefore be expressed by the formula:

$$\frac{2160}{r} - \frac{2160}{R}$$

in which *R* is the rating measurement of the larger yacht and *r* that of the smaller one. Tables have been worked out to give the time allowance in seconds for any given difference in rating.

In these days of airplanes, motor-boats, and swift automobiles, the racing of yachts seems a tame sort of sport. But the modern yacht race is indeed the keenest of sports. To those who like the touch of the salt air, and who delight in the sight of a trim sailing-craft leaning in the wind, the race for the Cup has lost none of its former charm.



The chart shows the narrower width of the *Resolute* compared with the *Vanitie*, and the fullness of lines of the *Resolute* under water. The lead keel is higher than that of the *Vanitie*. The keel of each boat is three feet wide at the base

What more could be desired, on the day when the race begins, than a "spanking" breeze, a sun-glistening sea with waves of just the right size to add spirit to the scene? If the present race is like its predecessors, a procession of tugs, launches, motor-boats, excursion steamers, and all manner of craft will pass through the Narrows to take the throng of yachting enthusiasts

reserve. It may be that no one will know, for a while, who the winner may be. If one boat skims the line a fraction of a minute before the other, this does not mean that it has actually won the race. When the rules of the "game" are applied and the proper "weights" allowed, the judges will announce the winner. Not until then will the curiosity of the crowd be satisfied.

But cheering will not be hindered on account of that. It is often well for those on each side to enjoy the pleasures of success, and then to suffer the pangs of disappointment; for then everyone is given a chance to prove himself a good sport. But the man who laughs last is the one who wins the bet, and he will have to await the decision of the judges who have considered every factor and applied the mathematics of the rules.

Further zest is added to this year's races because they mark the thirteenth attempt to lift the cup, twelve made by British challengers and one by the Canadians. If Sir Thomas believes 13 is his lucky number, who can say but that when the mist lifts off the Sandy Hook course some fine morning in July, the cup will be on its way back to England? It has remained continuously in this country for 69 years or since that memorable day in 1851 when the fleet *America* out-sailed the fastest that Britain could produce.

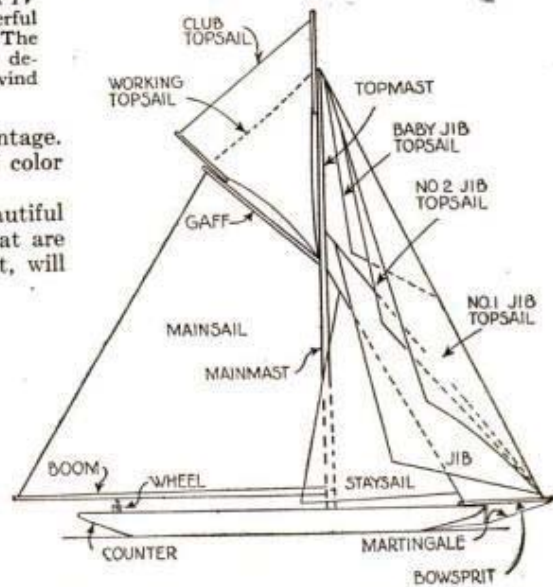


Experts agree that the *Shamrock IV* is the lightest and most powerful British racing boat ever built. The chances of winning the race will depend upon a strong offshore wind

and "good sports" out to a point of vantage. It will be a gala occasion, a scene of color and life.

In the staked-off course the beautiful yachts, their sails presenting lines that are straight and beautiful in the sunlight, will be seen. Tilted in the wind, cutting through the green water, glistening where the waves have split around their bows, the yachts will speed from buoy to buoy. Thousands of eyes will be focused upon them through glasses from deck and shore, wherever a glimpse of the course can be obtained.

Whether the *Resolute*, the *Vanitie*, or the *Shamrock IV* will be first to reach the final stake, this yacht race perhaps more than others will arouse international interest in yachting. But the rules of the race will make the crowd hold its decision in



A diagram of the sails of a racing yacht. The shape of these sheets of canvas are cleverly designed to respond to the wind and air resistance. It is the manipulation of the sails combined, with their area, that speeds the craft through the water. The mainsail of the *Vanitie* weighs about one ton and the top of the mainmast towers more than one hundred feet in the air. The amount of canvas carried is almost twice that carried by the *America*