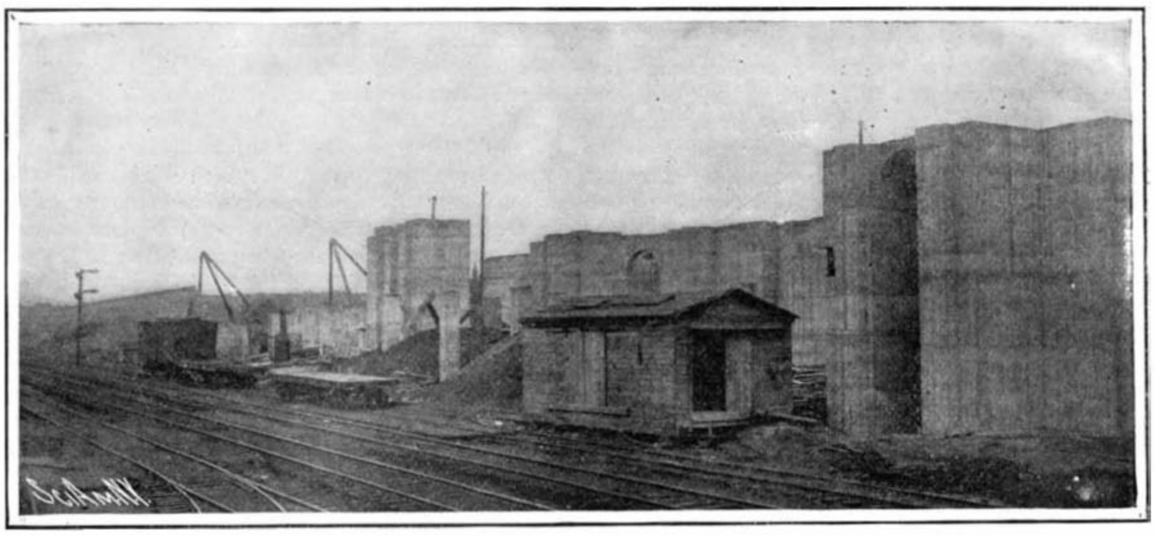
CONCRETE FOUNDATIONS OF THE NEW PASSENGER STATION, WASHINGTON, D. C.

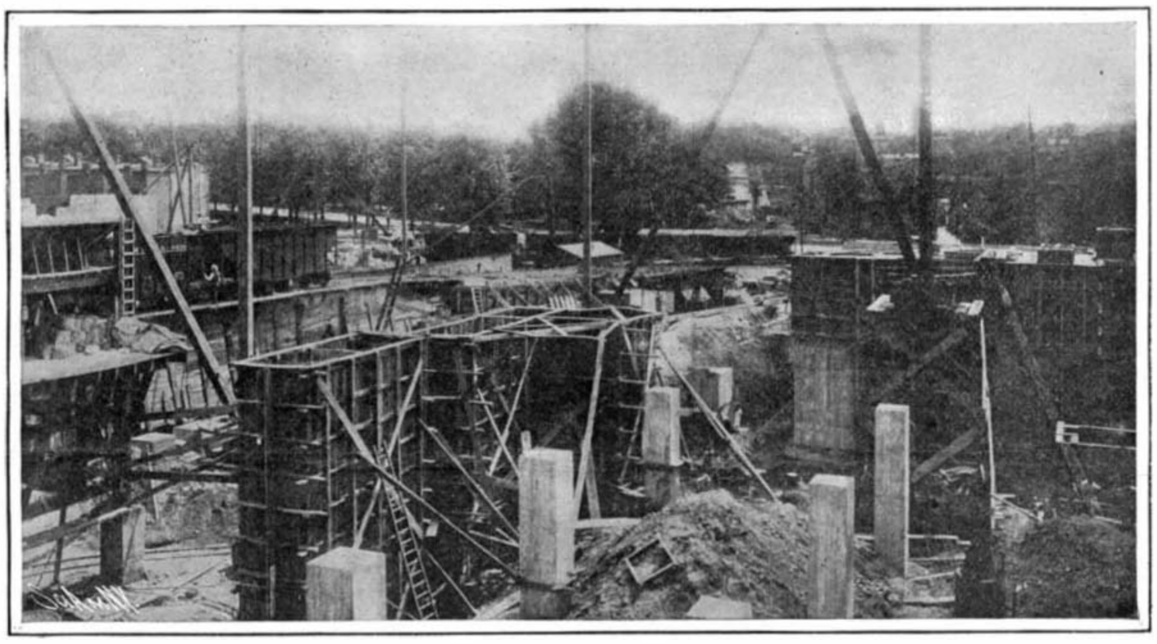
BY DAY ALLEN WILLEY.

The Union passenger station under construction at Washington is notable for the reasor that it is not only one of the most elaborate ever designed, but by reason of the interesting features of construction which it involves. The site chosen for the depot and approaches—at the intersection of Massachusetts and Delaware Avenues—was 22 feet above tidewater, but the main floor of the station is at an elevation of 58 feet, the surface of the basement being 42 feet. To construct the roadbed for the terminal tracks and grade the area surrounding the depot, a large amount of excavation and filling was required, approximating 3,000,000 cubic yards. The contracts for grading the northern approach to the station alone represent 2,600,000 cubic yards of earthwork, in addition to 100,000 yards of masonry; while to bring the site of the station and its surroundings to the required level, no less than 1,000,000 cubic yards of material were needed, the average height of the filling being 20 feet above the ordinary surface. Most of the excavation was performed with steam shovels, each removing 1,000 cubic yards daily.



Detail of Outer Wall Support, Showing Massiveness of Concrete Work.

Because of its architecture and dimensions, the edifice, which is included in the group proposed to be erected to conform to the plan of L'Enfant for improving the city, will be one of the most picturesque and imposing structures of any kind in the United States. Consequently, a brief description may not be out of place in this article. Facing the dome of the Capitol, it will be approached by a grand plaza 1,000 feet in length and 500 feet in width, terraced and ornamented with balustrades and fountains. From the plaza nine thoroughfares will radiate to the east south, west, and northwest. The main building will be 620 feet long and from 65 to 120 feet in height. It is being built of white granite. The three entrance arches will each be 50 feet in height and 30 feet in width, and far exceed in scale their Roman prototypes. These central doorways will lead into a vaulted open-air vestibule, and thence into the main waiting room. At the end pavilions will be located two forty-foot arch carriage entrances, the last one leading to a suite of apartments for the President of the United States and his guests, and the one at the west end will lead to a general carriage porch near the ticket and baggage lobby. The central vestibule and the end pavilions are connected by an open-air portico, and constitute a continuous covered porch along the front of the entire building.

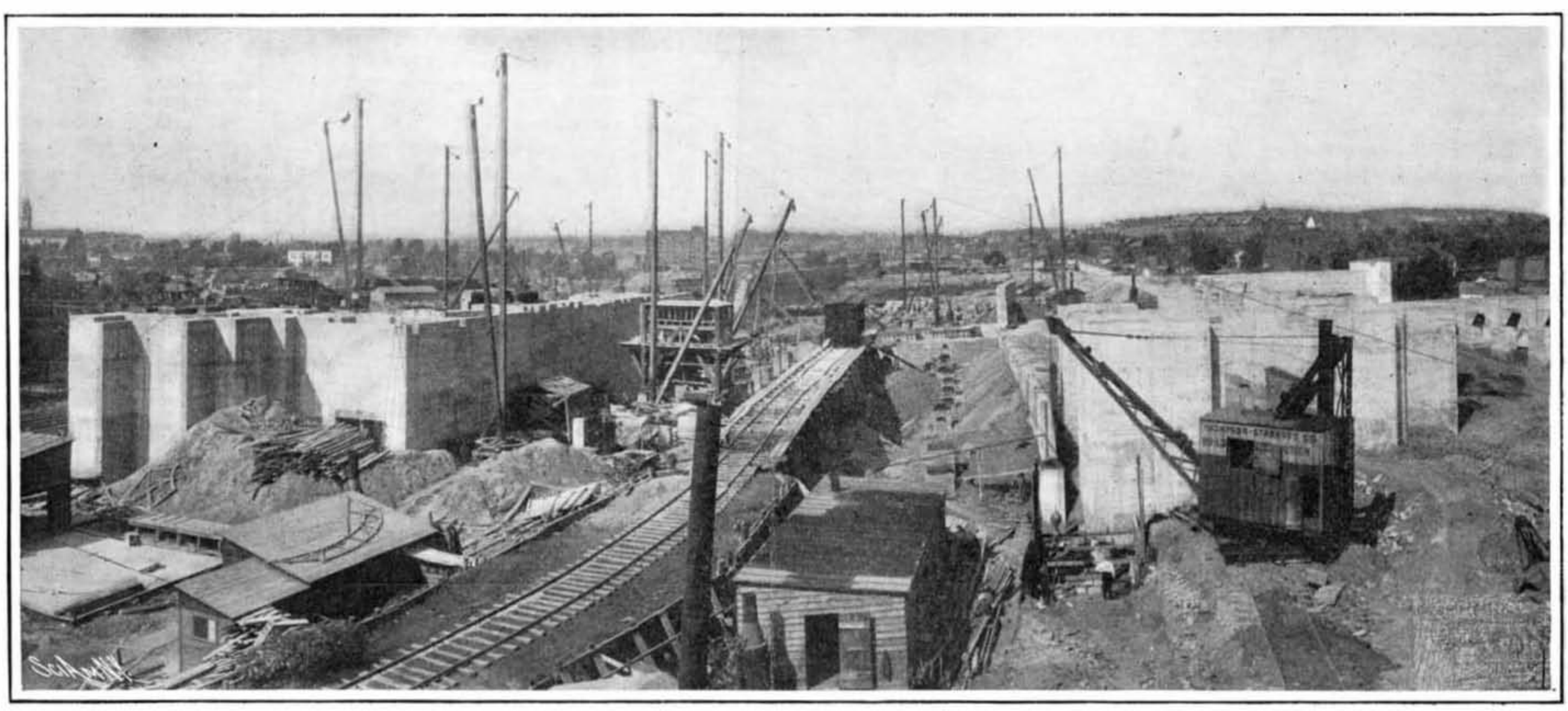


Molds for Interior Columns.

The general waiting room will be 220 feet long by 130 feet wide, and covered by a Roman barrel-vault 90 feet high, that will be decorated with sunken coffers or panels after the manner of the Baths of Diocletian. Natural light will be supplied by a great semicircular window at each end, 75 feet in diameter, and by five semicircular windows 30 feet in diameter, on each side. At the east end of this hall will be grouped the dining room, lunch room, and women's waiting room. At the west end, and on opposite sides of a lobby 50 feet wide, are located the ticket offices and baggage checking room, with the smoking room and package room adjacent. Telephone and telegraph booths will be provided in the general waiting room. The baggage room will be located in the basement, and reached from the west side of the station. To avoid conflict between passengers and baggage on the train platforms, certain platforms will be set aside exclusively for use in handling baggage. The size of the passenger concourse, or lobby, will far exceed anything ever built for a similar purpose. It will be 760 feet long and 130 feet wide, and will be covered by an arched ceiling in a single span, decorated with panels, and part of which will transmit the light.

The building is supported entirely on a base of concrete, and the work of this character is probably the most elaborate which has yet been attempted in America, for no less than 50,000 cubic yards have been required. The columns of the steel framework rest upon columns of concrete, capped with iron, the size varying according to the requirements; while some are only 2½ feet square, others are no less than 6 feet square. The height of the retaining walls and pillars was partly governed by the formation upon which they rest, it being necessary in many instances to make a considerable excavation, in order to obtain a suitable base. To sustain the outside walls, the material was molded into massive piers, both solid and in the form of arches. Some of these masses were no less than 30 feet in length and 20 feet in thickness.

Despite the dimensions of the work and the large amount of material required for the base retaining walls and other supports, a remarkably short time has been required to complete the substructure, and the average number of men that has been employed in handling and mixing the concrete, filling the molds, making and removing the molds, has not been over 150. The material for the station was mixed almost entirely by a gravity process, the idea of Mr. Harlow Lewis, superintendent of construction for the contractors for the foundations and exterior. At a convenient point a trestle was erected, on which the carloads of crushed stone and sand were pushed, being emptied into bins built be-



Panoramic View, Showing Thickness of Concrete Piers for Outer Walls.

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neath the trestle. The bins were within reach of a derrick placed on the platform of the mixer. When a batch of concrete was to be made, hand-cars containing buckets were run under the proper bins, and loaded by gravity with the requisite quantity of stone and sand. The buckets were then transferred to the mixing platform by means of the derrick, where the cement was added. The mixer was composed of three hoppers, each having a movable gate or trap in the bottom. In the first or top hopper the sand and stone were combined with the cement, and allowed to fall by gravity into the second hopper, where water was added, then into the third directly beneath it, where the process of composition was completed. From this the material fell into ladles mounted on cars, whence it was hauled by animal power to the vicinity of the mold. Here the loaded ladle was lifted by a derrick, its contents transferred to the mold, then replaced on the car to be again filled at the mixer. The derricks of the ordinary boom type, operated by steam hoisting engines, were set at convenient points on the station site. The tramways used were composed of rails weighing but 15 pounds to a section. Consequently, they could be quickly and easily laid by a half dozen men as fast as needed for moving the material.

At the beginning of the work, iron rods were used in connection with the concrete to give it more strength and tenacity, but wire was finally substituted for reinforcing the material. The sizes set into the material ranged from ¼ to 7/16 of an inch in thickness, depending upon the nature of the work. In setting the wires in the molds, they were placed at an average distance of three inches apart, the outer sections being laid at right angles to each other. As the photographs show, the molds for the walls as well as the interior columns and piers were constructed of wooden framework in the usual manner. Where possible this was built in sections, so that when the concrete had solidified, the false work could be pulled off by means of a derrick, saving the time and expense of knocking it apart. One reason for the rapidity with which the foundations have been built, is the short time required for the concrete to solidify. In the spring and summer months it would set in a maximum period of 36 hours from the time material was poured into the molds in a semi-liquid state. The time in winter is somewhat longer, depending of course upon the temperature.

THE MODERN HIGH-SPEED LOCOMOTIVE.

The great increase that has taken place of late years in the size, weight, and power of fast passenger locomotives, is to be ascribed mainly to two causes. First, the increased weight of the trains, and second, the demand on the behalf of the public for faster trains. Of these two causes, the former has been the most active in influencing the design of the locomotive; for while there has been a decided increase in the speed of express trains, there has been a relatively greater increase in their weight, some of the trains being of a weight which, a few years ago, would have been considered prohibitive.

Contemporaneously with the increase in weight and power of express locomotives, there has taken place a decided change in type. Not many years ago the term "American locomotive," as applied to those that hauled passenger trains, was universally understood to mean an eight-wheel engine with a forward truck, four coupled wheels, and the cylinder driving the leading axle. The call for greater power and a larger boiler then led to the introduction of a third pair of driving wheels, giving us the six-coupled express engine which, for a while, held undisputed possession of the field for heavy fast passenger trains. This, in turn, was succeeded by the celebrated Atlantic type, a ten-wheeled engine with a forward truck, four coupled driving wheels, and a pair of trailing wheels beneath the firebox, the cylinder being connected to the rear driving wheels—a type that is in such wide use to-day that it may be considered the typical American locomotive of the opening years of the twentieth century. It has proved in every respect a most successful type, and some of the heaviest, fastest, and most famous trains in America are hauled exclusively by Atlantic engines. The credit for the introduction of this type belongs largely to the Baldwin Company, and the first engines turned out by them sprang into immediate favor and prominence by the great work they accomplished in hauling the fast summer expresses between Philadelphia and Atlantic City.

The remarkable photograph shown on the front page of this issue represents the most powerful express engine of this type in existence. It was built for the Chicago & Alton Railway, for hauling their fast passenger trains between Chicago and St. Louis during the World's Fair. It is one of several that were ordered, and it formed part of the exhibit of the builders in the Transportation Building at St. Louis. Perhaps the best known of the large Atlantic engines are those which were built by the American Locomotive Company for handling the fast passenger traffic on the New York Central Railroad, and the great power of this Chicago & Alton engine can be understood by comparing its cylinder dimensions with those of the New York Central engine, which are 21½ inches in diameter by 26 inches stroke. The Chicago engine has cylinders of 22 inches diameter and 28 inches stroke, and as the steam pressure, heating surface, and diameter of driving wheel are the same, the engine is, of course, more powerful than the New York Central engines, the tractive force or drawbar pull being 28,798 pounds. The weight on the drivers is 145,000 pounds, the weight of the engine in working order is 221,300 pounds, and the weight of the tender 166,000 pounds. The barrel of the boiler is 70 inches in diameter, and it contains 276 tubes, 2¼ inches in diameter and 20 feet long, whose aggregate heating surface is 3,234 square feet. The firebox contains 202 square feet of heating surface, giving a total heating surface of 3,436 square feet. The driving wheels are 80 inches in diameter.

The engine shown on our front page was engaged in hauling, during last summer, what are known on the Chicago & Alton road as trains No. 2 and No. 11. Train No. 2, running from St. Louis to Chicago, consisted of eight cars which, with baggage and passengers, weighed 475 tons. Five stops were made, the average duration of stops being four minutes, and the average speed of the train was 40 miles an hour including these stops. The weight of train No. 11, running from Chicago to St. Louis, varied from day to day, but frequently no less than fifteen cars were coupled on behind the big engine, in which case the weight of the train, passengers, and baggage exceeded 800 tons. This train was scheduled to make the same speed, and it had to do this in spite of four stops, the average duration of which was 4½ minutes.

When we read of 80-inch driving wheels, 22-inch cylinders, and 70-inch boilers, the average reader receives no adequate impression of the resulting size of the locomotive. In the present case, the photographer selected a point of view that gives one a most impressive sense of the huge bulk and impressive dignity of this splendid engine.

THE GREAT 3,000-MILE YACHT RACE.

The hearts of the deep-sea yachtsmen must have been gladdened on the afternoon of May 16, when they saw that noble fleet of nigh upon a dozen ocean-going yachts sweep over the starting line at the historic Sandy Hook lightship. Of late years, with every recurring international race, we have been accustomed to hear many an expression of regret that the influence of the America Cup contests on yacht design and construction should have resulted in the development of a yacht that was a racing machine pure and simple, costly to build, costly to operate, and practically worthless when the three brief races for the cup had been sailed. There is a large body of yachtsmen, including most of the older men and not a few of the younger and most progressive, that has been endeavoring to control the development of the mere racing machine, and bring back the design and construction of yachts to more reasonable models and more wholesome and less costly materials. There are two effective ways in which this may be accomplished. One is by framing rules of measurement which will give a yacht of wholesome model such a decided advantage in time allowance over yachts of the "freak" type that the motive for building these extreme "measurement cheaters," as they are called, will disappear, and yacht building will be brought back to normal conditions. Another sure way to eliminate the flimsy and freakish yacht is to encourage deep-sea or ocean racing; for it is a fact that the very extremes of form and dimensions which render a yacht fast in the more or less sheltered waters on which the majority of yachting courses are laid, produce a yacht that is entirely unsuited for the severe conditions that may be met on outside courses. Proof of this was shown during the last America cup races, when the "Shamrock" and "Reliance" were afraid to venture outside Sandy Hook one morning in weather that would have delighted the heart of a yachting skipper in the days of the good old ocean schooners "Henrietta," "Fleetwing," and "Dauntless."

The great ocean race which is now under way across the Atlantic will do much to assist in producing racing yachts of a stancher and more seaworthy type, and we may look for a revival of interest in the genuine ocean-going cruiser. This, in its turn, will improve the type of racing yacht that follows the regattas of the summer season; for owners will naturally wish to have a boat that is capable of winning cups, whether the race be over a triangular course of thirty miles off Sandy Hook or a race for the Kaiser's cup for 3,000 miles across the broad Atlantic Ocean.

As to which yacht is likely to win this race, it is altogether idle to speculate. For the past few weeks, and at the present writing, prognostications as to the outcome have been and are very plentiful. The absolute uncertainty as to the winner undoubtedly lends to ocean yacht racing much of the charm that attaches to it. There are so many variable conditions affecting the result. In the first place, there is the wide variety among the yachts themselves; for they range in size from the little 86½-foot schooner "Fleur-de-Lys" up to the great, full-rigged ship "Valhalla," which measures 240 feet on the waterline. They vary in age from Lord Brassey's world-renowned yacht "Sunbeam," now thirty-four years old, to the up-to-date fore-and-aft schooner "Atlantic," built as late as the year 1903. They vary in construction also from the heavy scantling of the "Valhalla," the "Apache," and the "Sunbeam" to the light construction of the out-and-out racing craft, as represented by the German fore-and-aft schooner "Hamburg" and the even more lightly constructed racing yawl "Ailsa." Some of the craft are sailing vessels pure and simple, such as "Fleur-de-Lys," "Thistle," "Ailsa," "Hildegarde," "Endymion," and "Hamburg." Others, such as "Sunbeam," "Valhalla," "Apache," "Utowana," and "Atlantic," are auxiliaries; that is to say, they carry engines and boilers of sufficient power to drive them at a speed of from 8 to 10 knots under steam alone. The auxiliaries, which have unshipped their propellers, are handicapped as compared with the other yachts by the fact that they must carry from 30 to 70 tons of dead weight in the way of engines, boilers, condensers, shafting, etc., which is not as favorably placed for stability as the same amount of weight when carried in the form of lead in the keels of such vessels as "Hamburg" and "Ailsa."

The greatest element of uncertainty is, of course, the weather, and this for the reason that each yacht, or rather each type of yacht, has its own best weather conditions for speed, and a wind that favors one may be disadvantageous for another. It is probable that the yachts will become considerably scattered. Some will take the more northerly and shorter course, disregarding the warnings of the government to the effect that a large amount of ice will be encountered on this course. They will judge that it is better to accept the interruptions, change of course, etc., that will be necessitated in sailing through an ice field, where the ice is closely strewn, and get through the difficult and dangerous belt as quickly as possible; while others again, among whom is Lord Brassey, who will navigate his own ship, will prefer to take a more southerly course, where there will be no fear of being hindered by having to dodge ice floes and bergs. Those who take the northerly course, and have the good luck to avoid collision and escape delay in passing through the ice, will reap a great advantage in being able to sail a course laid on or approximately on a great circle, and, therefore, considerably shorter than a course laid more to the southward. It is this wide scattering of the yachts that brings in one of the greatest elements of uncertainty; for not only will the distance of the course vary, but the weather conditions also may be widely different. Thus a vessel may be so favored with wind and weather to her liking that she may show up at the Lizard ahead of faster competitors, which sailing under their own most favorable conditions could have easily outdistanced her.

Each skipper, of course, is praying that he may have the particular winds and weather that suit his craft. The big "Valhalla" would like nothing better than to have from half to three-quarters of a gale of wind three points aft of the beam for the whole distance; for under these conditions she could reel off 15 knots with ease. The Earl of Crawford informed the writer that on one occasion he sailed the "Valhalla" from Cape St. Vincent to Gibraltar, a distance of 190 knots, at an average speed of 16.8 knots an hour, the maximum possible tide with or against the yacht being 5-10 of a knot an hour. Under such conditions she could drop the fleet easily. But the probability of a continuous wind of, say, 40 to 45 miles an hour for the course is very remote. With head winds she would be easily left by the fore-and-aft-rigged vessels. Lord Brassey informs us that he has logged 300 miles a day in the "Sunbeam." The fore-and-aft schooners like "Thistle," "Hildegarde," "Endymion," "Hamburg," and

THE INTERNATIONAL OCEAN RACE FOR THE KAISER'S CUP.

Yacht.	Rig.	Where built.	Yacht Club.	Length in feet.	Beam in feet.	Draft in feet.	Owner.
Sunbeam.	Auxiliary Schooner.	England.	Royal Yacht Squadron.	154.7	27.6	13.9	Lord Brassey.
Ailsa.	Yawl.	England.	New York Yacht Club.	89.0	25.5	16.6	Henry S. Redmond.
Thistle.	Schooner.	America.	Atlantic Yacht Club.	110.0	27.8	14.0	Robert E. Tod.
Fleur-de-Lys.	Schooner.	America.	New York Yacht Club.	86.5	21.9	13.0	Lewis A. Stimson.
Valhalla.	Auxiliary Ship.	England.	Royal Yacht Squadron.	240.0	37.2	20.0	Earl of Crawford.
Apache.	Auxiliary Bark.	England.	New York Yacht Club.	178.0	28.0	16.6	Edmund Randolph.
Utowana.	Auxiliary Schooner.	America.	New York Yacht Club.	155.0	27.8	14.6	Allison V. Armour.
Atlantic.	Auxiliary Schooner.	America.	New York Yacht Club.	135.0	29.0	16.5	Wilson Marshall.
Hildegarde.	Schooner.	America.	New York Yacht Club.	103.4	26.0	16.9	Edward R. Coleman.
Endymion.	Auxiliary Schooner.	America.	New York Yacht Club.	101.0	24.4	14.0	George Lauder.
Hamburg.	Schooner.	England.	Kaiserlicher Yacht Club.	116.0	23.9	15.0	German Syndicate.