viva the pressure of elastic-fluid from the initial pressure down to approximately atmospheric pressure, and to transform it into mechanical power, and the other part is adapted to convert into *vis viva* the pressure of the elastic fluid from atmospheric pressure down to the pressure of a vacuum-exhaust, and to transform the same into mechanical power.

The Massachusetts electric companies are to install Curtis turbines and generators built by the General Electric Company in units of 500 kilowatts and 2,000 kilowatts with a total output of more than 30,000 horse power in their new power stations. The 3,000 horse power Curtis vertical turbines to be installed operate at a speed of 750 revolutions per minute, the steam pressure at the nozzle being 175 pounds per square inch. The alternators mounted upon the top of the steam turbines and directly connected generate a three-phase current of a frequency of 25 cycles and a pressure of 13,000 volts. The 1,000 horse power turbines operate at a speed of 1,800 revolutions per minute and have a total height of about 12½ feet, including the generator, while the diameter at the base is 7 2-3 feet. The alternators driven by the Curtis turbines at the Newport Station are three-phase machines and generate a current of 2,500 volts pressure, the capacity being 500 kilowatts. The diagram on the preceding page shows the general outline and small floor space occupied by the vertical turbines and alternators. The total height from the bottom of the foundation is about 18 feet, the foundation being 5½ feet high and 11 feet in diameter at the base. It is of brick construction and 9 feet in diameter at the top while it rests upon a cement bed 1½ feet thick. The Newport Station is designed to have four steam turbo-alternators of 1,000 horse power each, which will be supplied with steam from Aultman & Taylor water-tube boilers. The steam enters the top of the turbines and exhausts from the bottom through a pipe 1 foot in diameter. The plant will be utilized as an electric railway power house as well as for supplying current for lighting.

The large 2,000 kilowatt General Electric turbo-alternators weigh about 95 tons each and have a total height of nearly 20 feet, the diameter at the base being 12 feet. These machines, generating a three-phase alternating current of high potential, are capable of taking care of an overload double their normal output for a short time, and the turning moment is far superior to that of the ordinary slow-speed fly-wheel engine generator. These machines are to be installed at power stations owned by the Massachusetts Electric Companies at Danvers, Mass., Quincy Point, and Fall River, each having a capacity of about 10,000 horse power. The current will be utilized for operating several hundred miles of electric railway on the Boston and Northern and Old Colony Divisions, now taken care of by a score of small power stations.

The saving of space in a large power station using the vertical type of steam turbo-alternators will without doubt be even greater than when the long horizontal turbo-alternators are employed. A comparison of the space required by a 100,000 horse power plant using the General Electric turbines and the immense vertical and horizontal compound and triple expansion slow-speed engines and revolving field alternators of large diameter, will go a great way toward the adoption of these new high-speed units. This is especially true in power stations where the cost of land is very high, and the other savings of the steam turbine, such as oil, labor, and repairs, should make the brilliant future of this new and yet old prime mover a fact. From all accounts the efficiency is also equal to or greater than the best reciprocating engine, especially when the highest superheated steam is used.

The Parsons steam turbine is being developed and introduced in America by the Westinghouse Electric and Manufacturing Company, and in England by the British Westinghouse Company as well as by C. A. Parsons & Co., while in Switzerland it is being manufactured by Brown, Boveri & Co., of Baden (Aargau).

In America a number of 300-kilowatt steam turbines have been in successful operation for some time in the power plant of the Westinghouse Air Brake Company. These machines operate at a speed of 3,600 revolutions per minute, and are directly connected to bipolar alternators, having a frequency of 60 cycles per second. Among the many other installations of the Westinghouse-Parsons steam turbo-alternators may be mentioned those at the power plant of the Hartford Electric Light Company. These consist of 2,500 horse power Parsons turbines directly connected to Westinghouse 1,500-kilowatt 60-cycle 2-phase alternators. These are six-pole machines supplying a current of 2,400 volts, and operating at a speed of 1,200 revolutions per minute. The weight of the revolving part is 14 tons, while the total weight of the unit is 90 tons, and its length nearly 34 feet.

Among the important plants in England in which Parsons steam turbines have been in successful operation for some time, should be mentioned the four 75-kilowatt units in the original Fourth Banks Station, each of which operates a 2,000-volt single-phase alternator, having a frequency of 80 cycles per second. The satisfactory operation of these sets resulted in the installation of a number of other turbo-generators in this plant having a total capacity of 3,000 kilowatts. These machines were of various sizes up to 500 kilowatts each, the dynamos being of both direct and alternating current types. In the new Close works of the Newcastle and District Electric Lighting Company, several turbo-dynamos, having a capacity of 1,000 kilowatts each, have been installed, while provision is made for increasing the capacity to 12,000 kilowatts. These 1,000-kilowatt Parsons turbines operate at a speed of 1,800 revolutions per minute, and are directly connected to two continuous-current generators supplying direct current at 500 volts pressure.

The sizes of the steam turbine unit have been rapidly increasing, and many are now being constructed both in this country and in Europe for an output of 5,000 kilowatts each. The British Westinghouse Electric Manufacturing Company are now building and installing a number of these large units, driving three-phase alternators, which supply current at 10,000 volts pressure. These machines will be utilized in the electric generating station of the Metropolitan Railway of London, the current being transmitted to various sub-stations, and there changed by rotary converters to a continuous current for use on the railway motors.

The Brown-Boveri-Parsons steam turbines and dynamos have been quite largely installed in Europe and range in size from 100 kilowatts to 2,000 kilowatts. One of the smaller units consists of a 100-kilowatt continuous-current dynamo directly connected to a Parsons turbine operating at a speed of 3,500 revolutions per minute. The generator supplies a direct current of 220 volts and is very similar to ordinary direct-current machines, except that a small number of poles are employed, and the diameter of the machine is small, while the armature is much longer than with ordinary direct-current types. It has been found difficult to construct a machine which will not spark at variable loads, on account of the small number of poles and high speed required. The Swiss engineers, however, have overcome this difficulty by employing a compensating winding which counteracts the magnetic field produced by the armature winding.

In a comparison of a 400 horse power steam turbine and a compound steam engine of about the same output, it was found that the steam consumption per kilowatt hour was 10.5, with an output of 400 brake horse power for the steam turbine, while the steam consumption per kilowatt hour was 12.25 kilogrammes with the steam engine, the output being 420 brake horse power. The steam engine operated at a speed of 150 revolutions, and had an efficiency of 86 per cent, the output in kilowatts being 284, while with the steam turbine at full load, the output was 270 horse power. The curves and data of this test also show that the steam turbine when operating at half load, or 200 horse power, had a steam consumption of 11.4 kilogrammes per kilowatt hour, while the compound steam engine, with an output of 211 brake horse power, had a steam consumption of 13.3 kilogrammes per kilowatt hour. In a similar test, comparing a 600 horse power compound steam engine with a steam turbine of the same capacity, operating an alternator of 400 kilowatts capacity and 2,000 volts, it was found that the steam engine had a steam consumption of 13.4 kilogrammes per kilowatt hour, the output being 670 horse power and the speed 125 revolutions per minute. The steam turbine operating at a speed of 3,000 revolutions per minute, with a pressure of 7.5 atmospheres, had a steam consumption of 10.5 kilogrammes per kilowatt hour, the output being 600 horse power. The steam consumption of the compound engine at half load, or 305 horse power, was found to be 16.2 kilogrammes per kilowatt hour, while the steam turbine had a steam consumption of 12.8 kilogrammes per kilowatt hour, the load being 300 horse power. The curves of the comparison of steam consumption of the turbine alternator and generator driven by reciprocating engines show that the steam consumption at practically all loads was greatly in favor of the steam turbine, while the actual steam consumption for the steam turbine was in nearly every case lower than that guaranteed by the Swiss engineers.

The amount of oil used in lubricating a steam turbine is very much less than that needed for ordinary steam engines, as the bearings are practically the only portion of the outfit which require lubrication. The actual cost of the oil for even the largest units is guaranteed to be so small by the best makers of steam turbines, as compared with the oil required for the high power steam engines, as to be hardly worth mentioning.

The governor on the Parsons steam turbine, as constructed by the Swiss engineers, is very close in its regulation. The effect of the Parsons governor is to change the duration of the periodic puffs of steam. According to the tests of a 400-kilowatt turbine alternator, it was found that the sudden dropping from three-quarter load to no load caused a variation of but about 2½ per cent in the speed. The variation in voltage when this alternator was supplying about 200 kilowatts and suddenly was operated at no load was only about 80 volts in 2,000, the speed being increased only about 30 revolutions, with a normal speed of 3,000 revolutions per minute.

LAUNCH OF THE "RELIANCE."

Contemporaneously with the publication of our special Yachting and Automobile number, the new cup defender "Reliance" was having her first taste of salt water, and the new challenger "Shamrock III." was engaged in one of her most successful trials against "Shamrock I." In the issue referred to, we so fully described the design and construction of "Reliance," that it is not necessary to do much more now than point out how completely the photographs of the boat which we herewith publish agree with that account of the yacht.

The events of the yachting seasons of 1901 and 1902, and the performance of certain very successful racing craft in those two years, notably the cup yacht "Independence," and the sister boats "Neola" and "Weetamoe," which more than saved their time on the Herreshoff 70-footers last year, rendered it pretty certain in the judgment of the yachting "sharps" that, when the folding doors of the Herreshoff building shed were opened, there would pass out through them a vessel of very extreme type. Consequently the exaggerated proportions of the forward and after overhangs of the new boat, as shown in our illustrations, caused no surprise, even though they are the work of such cautious and conservative builders as the Bristol firm.

In view of the rather demonstrative merriment which greeted the appearance of "Independence," with her hard turned bilges, her blunt forward and after waterline, and her huge overhangs, each some 25 feet in length, it must have been something of a shock to the critics to witness, sliding down the ways on which the wholesome models of "Columbia" and "Constitution" made their first bow to the public, a boat which so far out-Heroded Herod, that her overhangs divide up nearly 60 feet of the overall length of the yacht between them.

At the same time it must be admitted that, with all her exaggerated proportions, the boat bears a strong family likeness to the modern Herreshoff boats; and there is no denying that in drawing out her lines to such extreme length, Herreshoff has produced an extremely handsome craft. As we explained in our previous issue, the hard turn of the midship sections at the bilges is softened out gradually as the forward and after ends of the waterline are reached, with the result that the overhangs themselves are very symmetrical and show a sweetness of modeling which goes far to redeem their disproportionate length. The deckline does not flow toward the bow and stern with so flat a curve as has been customary in earlier Herreshoff boats, with the result that when the yacht is heeled, she will take a very long bearing, and there will be no hard spot or shoulder to pile up the water when the vessel is driven at high speed—as happened in the case of "Shamrock II.," and even more noticeably in "Independence." The great beam of "Reliance," and the fact that her waterline is full, proves that her wetted surface will be very large; and while the small deadrise and long flat floor will give her great initial stability, they will render it somewhat difficult to get her to heel to her sailing lines in light winds. These characteristics combined will render her relatively less speedy in light weather, particularly if there is a troubled cross sea running. But with every added pound in the pressure of the wind, and every added angle of heel, the boat, to our thinking, will show great increase in speed, and even in spite of the excellent work which is being done by "Shamrock III.," on the other side, she should prove to be the fastest 90-footer afloat.

One of the most striking features in the boat is the long drawn-out bow which projects nearly thirty feet beyond the waterline. Only a small proportion of it can be utilized for gaining sailing length; for "Independence" at thirty degrees heel only added five feet of length forward, and she was even flatter than "Reliance." Driving into a head sea, she will take the seas a little earlier but not so much earlier as to compensate, one would think, for the carrying of so much added bow weight at a height of eight or nine feet above the water. Many yachtsmen will wonder why the bow was not made shorter relatively to the stern; for in a low, long stern such as that of "Reliance," every foot of length can be utilized. "Reliance," however, is regarded even by her designer as something of an experiment, and only the actual test in a jump of a sea off Newport or Sandy Hook can determine the value of such an extreme bow.

When the new craft was fairly afloat, it looked as though she might sit a little low in the water when her spars, sails, anchor, crew, etc., which will weigh about 19¼ tons, were put aboard; and although her full waterlines give her great buoyancy, it is not probable that much, if anything, can be gained by a shortened waterline when she comes to be measured.

Unquestionably the new cup defender is the most interesting 90-foot racing yacht that Herreshoff has built. She is certain to be fast, and under certain conditions extremely fast. Judged on her lines, power, and huge sail plan, she should beat "Shamrock III.;" but the latter boat, up to the hour of her disaster, was certainly doing wonderful work against "Shamrock I.," herself a greatly improved boat.

Where the Mississippi Floods Originate.

Those who look upon the great yellow river that flows past the city of New Orleans, never realize what a vast flood of water and what an enormous assemblage of forces are concentrated in its movement. The area drained by this river and its tributaries equals one-third of the territory of the United States. This area may be divided into the following drainage basins, with their respective areas:

	Sq. miles.
The Missouri River	518,000
The upper Mississippi	169,000
The Ohio River	214,000
The Arkansas and White	189,000
The St. Francis River	10,500
The Red River	97,000
The Yazoo River	13,850
The small tributaries	28,688

This immense area covers some twenty-eight States of the Union, extending from the 35th to the 50th parallel of latitude, and from the 79th to the 114th meridian of longitude. Although the greatest tributaries come in from the West, draining as they do the wide regions extending to the Rocky Mountains, fortunately for the people along this mighty river the rainfall over that region is small; otherwise the Mississippi Valley would be wholly untenable. If the Missouri, which is 3,000 miles long, carried as much water in proportion as does the Ohio, which has a length of only 1,200 miles, the main river would be five times as great as it is.

The Ohio is the chief factor in producing a flood, but alone its waters are comparatively harmless when they get into the main river. When they are supplemented by freshets out of the Arkansas and the Red, however, they become dangerous. The upper Mississippi is only to be feared when its frozen waters break into a thaw earlier than usual. The Missouri waters seldom come before June.

The Current Supplement.

The current SUPPLEMENT, No. 1425, opens with an archæological article on the construction of the Roman camp at Lambessa. The article is well illustrated by two handsome photographs. "New Stereopticon Apparatus" is the title of a description of new projecting devices used in France. M. A. Dastre tells much that is instructive of salt and its physiological uses. The rug industry of the Caucasus and of the Transcaspian countries is described in a picturesque account. By far the most important electrical article in the issue is that by Emile Guarini on the "Development of the Marconi System of Wireless Telegraphy," which article is to be continued through three numbers of the SUPPLEMENT. Each installation will be fully illustrated with diagrams and photographs. Don Maguire presents a vivid picture of the terrors of Death Valley. Alcohol figures prominently these days as a fuel. For that reason two articles, one on the use of alcohol as a fuel and illuminant, the other on the results of tests of alcohol motors in Germany, should not be without interest. A new process for making briquettes is described. M. A. Verneuil's paper on the artificial production of rubies by fusion is published.

Excavation of Prehistoric Bones.

Prof. Warren Morehead, of Phillips Academy, Andover, Mass., has discovered on a farm east of Hopkinsville, Ky., what is presumably the burying ground of a prehistoric people. Ten skeletons in a fair state of preservation were exhumed. The bones are probably those of an extinct race of mound builders. The skeletons were discovered in receptacles built of flat stones. Stone utensils were also found.

A Scottish power scheme of great interest is that which has been recently approved by the British Parliament, and which will soon be under way. It is proposed to generate electricity in the vicinity of the coal mines, and to transmit it to the city of Glasgow and industrial establishments along the Clyde in the neighborhood of that city. Three generating plants will be established, located at Yoker, Motherwell, and Crookston, and the ultimate capacity of this trio will be 25,000 horse power. The two first mentioned will be built at once, but the initial installation will be only about half of the total contemplated.

The Maryland School for the Blind has issued the first general dictionary ever published for the use of the blind. The work comprises 18 volumes, and contains definitions of 40,000 words.

Correspondence.

Bird Catching by a Snake.

To the Editor of the SCIENTIFIC AMERICAN:

Allow me to add a chapter to your late article on snakes. Some thirty years ago a Shoshone Indian told me that a rattlesnake used the rattles on his tail to catch birds. In less than two hours I saw an illustration of it. The snake hides himself in the tall grass and imitates the buzzing of a bee. The insectivorous birds, such as the phœbe and kingbird, are attracted by the sound, and become an easy prey for his snakeship. I have seen rattlesnakes concealed in the dense foliage of trees twenty feet from the ground practising the same deception on the birds and getting the bird every time. G. A. FITCH.

Reading, Cal., March 22, 1903.

Clouds of Pollen Dust in the South.

To the Editor of the SCIENTIFIC AMERICAN:

In your issue of this date reference is made to a shower of volcanic dust that fell in the city of Athens, Ga., March 17.

Similar showers fell in this district. It is a common occurrence in all the great pine belts when their pollen is blown about in clouds. I send you samples of this dust as it falls from the flowers, and evidence of its deposit on leaves that floated in ditches.

Closer investigation might identify the Georgia shower as the result of a similar cause.

Biloxi, Miss., April 4, 1903. JAMES BRODIE.

[Our correspondent is undoubtedly correct in his theory. Letters have been received from correspondents in other parts of the South confirming his statement. The dust on the leaves sent by our correspondent closely resembled finely powdered sulphur.—ED.]

Manganese on Manhattan Island.

To the Editor of the SCIENTIFIC AMERICAN:

In the spring of 1901, while noticing some geological conditions on Washington Heights in Manhattan Borough, I found on 146th Street, between Broadway and Amsterdam Avenue, some sharp points of schist, so black as to be noticed even from a distance. At first sight I thought they were smoked by bonfires, but after special attention I found them too many in number and varieties and in impossible locations for such an explanation. On closer examination they were found to be thin weathered incrustations of schist, varying from yellowish-brown to jet black, and they were found not only in that neighborhood, but almost all over the Heights at certain points on fresh-cut surfaces well exposed to the sun.

About two months before this, I had already found at 161st Street and Broadway, a bluish-black mineral which seemed to be psilomelane or wad by the outward look, and had kept specimens in my collection. Thought about this mineral and the black incrustations of the schist suggested to me that I test them chemically by a few drops of hydrochloric acid and potassium iodide and starch test paper. The test proved the mineral and specimens from the black incrustations to be wad or black oxide of manganese. This was a sufficient hint to suggest the existence of silicate of manganese in the schist, which being decomposed must be found deposited as wad somewhere on the island or in the harbor. I followed that, too, and at many fresh cuts found the schist plainly showing the rhodonite ($MnSiO_3$) or tephroite ($MnSiO_4$) while their decomposition could be noticed at different points, according to the length of the time of their exposure, in different shades of bluish-gray or red to brown and black. According to my very limited observation, there are two traces of decomposition of the oxide on the Heights, one at a crevice of the schist between 161st and 162d Streets, on the east side of Broadway, whence a specimen can be seen at the Museum of New York University, and the other in a glacial sandy deposition at 158th Street and Broadway, about six feet below the surface. The main deposition must be sought for elsewhere. It may be under some glacial debris on the island or in the harbor.

Manganese oxide being one of the most valuable minerals of the day, it is well worth the special attention of the city surveyors to locate the main deposition if possible. M. A. YESHILIAN.

New York City.

A Scheme for Pumping Water 380 Miles in Australia.

To the Editor of the SCIENTIFIC AMERICAN:

On Monday, January 19, there was opened at Kalgurli, West Australia, what is claimed to be the longest and biggest pumping scheme in the world. The plant, which is now in full working order, will pump 5,000,000 gallons of water daily, 387 miles, from the Helena reservoir near the sea, to the big terminal reservoir at Bulla Bulling in the heart of the gold fields. To do this there are over 380 miles of 2½-foot pipes, with twenty pumping stations along the route, at which sixty-five big pumping engines are in use.

The work has been made necessary by the great scarcity of water on the famous Kalgurli and Coolgardie gold fields. This district, which is over 400 miles inland, and which embraces such big mines as the "Great Boulder," "Ivanhoe," "Lake View Consols," and "Association"—whose output of gold is measured, not by ounces, but by tons—has a very scanty rainfall, no rivers, and no fresh water lakes. Even the water in the wells is almost always salt or brackish and unfit for general purposes. The residents, therefore, have had only two methods by which to supply their wants —dams to catch the surface water, and condensing plants by which the salt and brackish water was purified. The first of these was unreliable and the second expensive.

In 1895 the then Premier of the State, Sir John Forrest, during a trip, made in very hot weather, to the gold fields, saw plainly that, with the growth of the district, a good and reliable water supply was an absolute necessity. Out of this trip came the present scheme. The great difficulty was the fact that the nearest permanent water was 350 miles away, and that no supply by gravitation was possible owing to the high level of the gold fields. After much surveying and exploratory work a pumping scheme was decided on, and in 1898 tenders were accepted for the work. It speaks well for all concerned that only seven years have elapsed between the conception and completion of the work.

The cost of the scheme will total about £2,850,000, and of course the work of pumping will form a big annual charge. Some 64,000 pipes were used in the work, all being made by Messrs. Mephan Fergusson's (Melbourne) patent locking-bar process, which was illustrated and explained in the SCIENTIFIC AMERICAN some time ago. The manufacture of these pipes used up 9,000 tons of steel plates, and 4,000 tons of Trinidad asphaltum were used for coating them. The pipes are laid in shallow trenches, and owing to the great heat in the summer, trouble was caused at times by leakage, through expansion.

At the supply head, Helena, a splendid reservoir has been formed in a valley, with a huge weir, by which the water is banked back some eight miles. This reservoir impounds 4,600,000,000 gallons, and will be fully equal to all demands for very many years. At each of the pumping stations, reservoirs with a holding capacity of 1,000,000 gallons each have been built, while at Bulla Bulling the main terminal reservoir will hold 12,000,000 gallons. The chief distributing reservoir, at Kalgurli, which is the most important gold fields center, holds 2,000,000 gallons. The towns of Boulder, four miles from Kalgurli, and Coolgardie, a few miles further south, are the other leading centers within the immediate supply area.

Owing to the heavy cost of pumping, the charges are heavy. Interest, sinking fund, maintenance and working expenses will total nearly £300,000 per annum, reckoning on a supply of 2,500,000 gallons daily. To meet this the average charge for water will be six shillings and sixpence per 1,000 gallons. This looks heavy, and would be considered oppressive under ordinary circumstances. But the conditions on the gold fields are far from ordinary, and even with this charge some of the mines calculate that they will save three or four shillings per ton in dealing with their stone. If the maximum supply—5,000,000 gallons daily—be needed, the charge could be reduced to about four shillings per 1,000 gallons. It is believed that, owing to the high price of food, it will even be profitable to use the water for irrigation purposes on a fair area of land. Altogether the scheme is a great one, carried through in the face of much opposition and criticism, and there is a general hope that it will mark the beginning of a new era on the gold fields.

FRANK S. SMITH.

Noorat, Terang, Victoria, Australia.

Test of the Lebaudy Airship.

Dispatches received from Europe state that the Lebaudy airship made two ascents on the morning of April 13. On its first trip the airship covered 19 kilometers, and attained an altitude of 200 meters. On the second trip, made a half hour later, 300 meters altitude was attained, and good progress made against a strong northeast wind. A description of the airship has been published in these columns.

Flooding a Burning Mine With Sea Water.

Sea water is now used to extinguish the burning colliery of the Dominion Coal Company, Nova Scotia. Through a sluice cut from a dam on the shore of the ocean, sea water is pouring in at the rate of some three and a half million gallons an hour. The pit is flooded up to the seventh level, but four more must be reached before the fire can be extinguished. In other words, 450,000,000 gallons of water will be needed, and six days' time required.

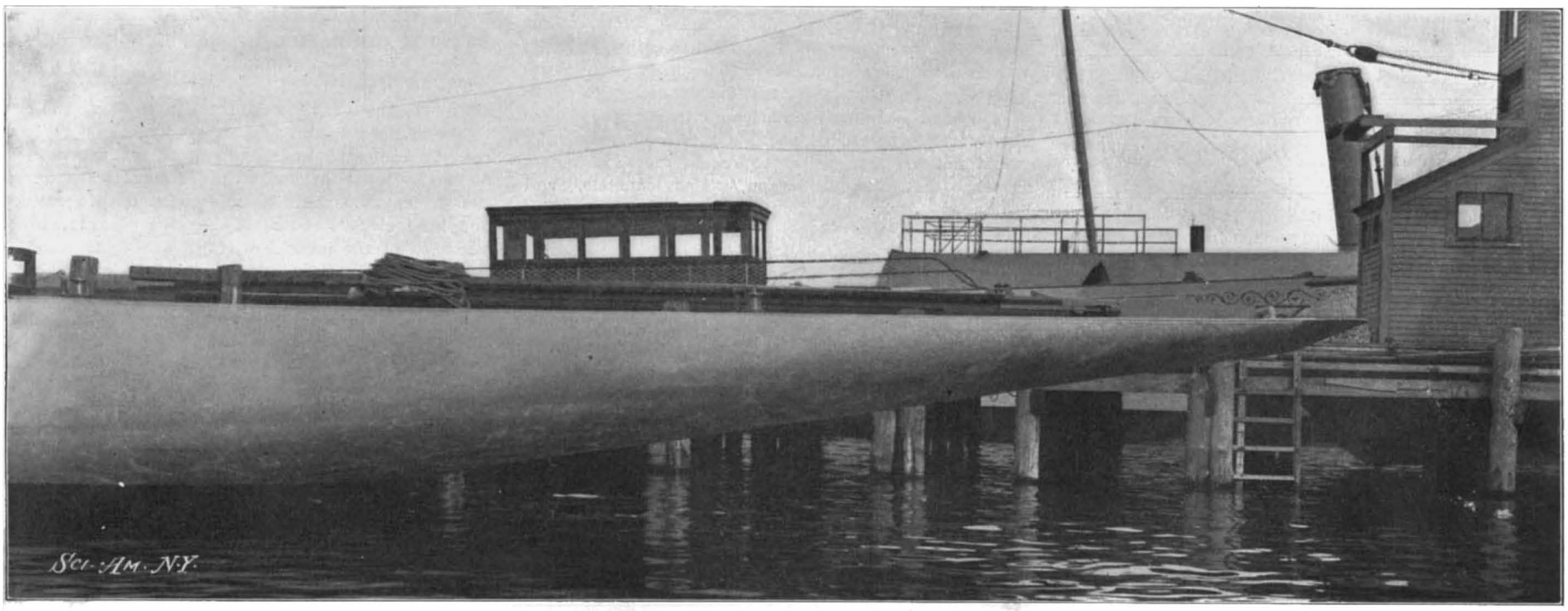
SCIENTIFIC AMERICAN

[Entered at the Post Office of New York, N. Y., as Second Class Matter. Copyright, 1903, by Munn & Co.]

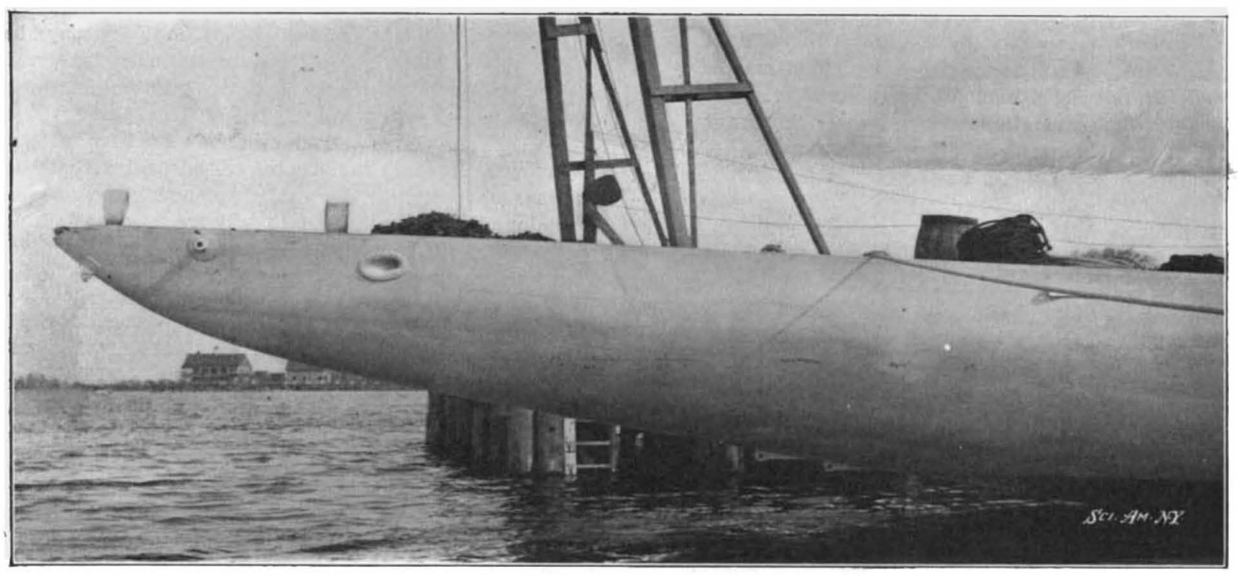
Vol. LXXXVIII.—No. 17.
ESTABLISHED 1845.

NEW YORK, APRIL 25, 1903.

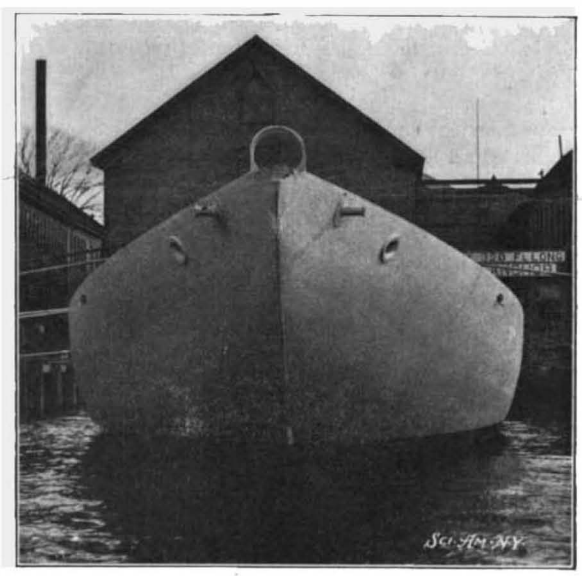
[8 CENTS A COPY.
$3.00 A YEAR]



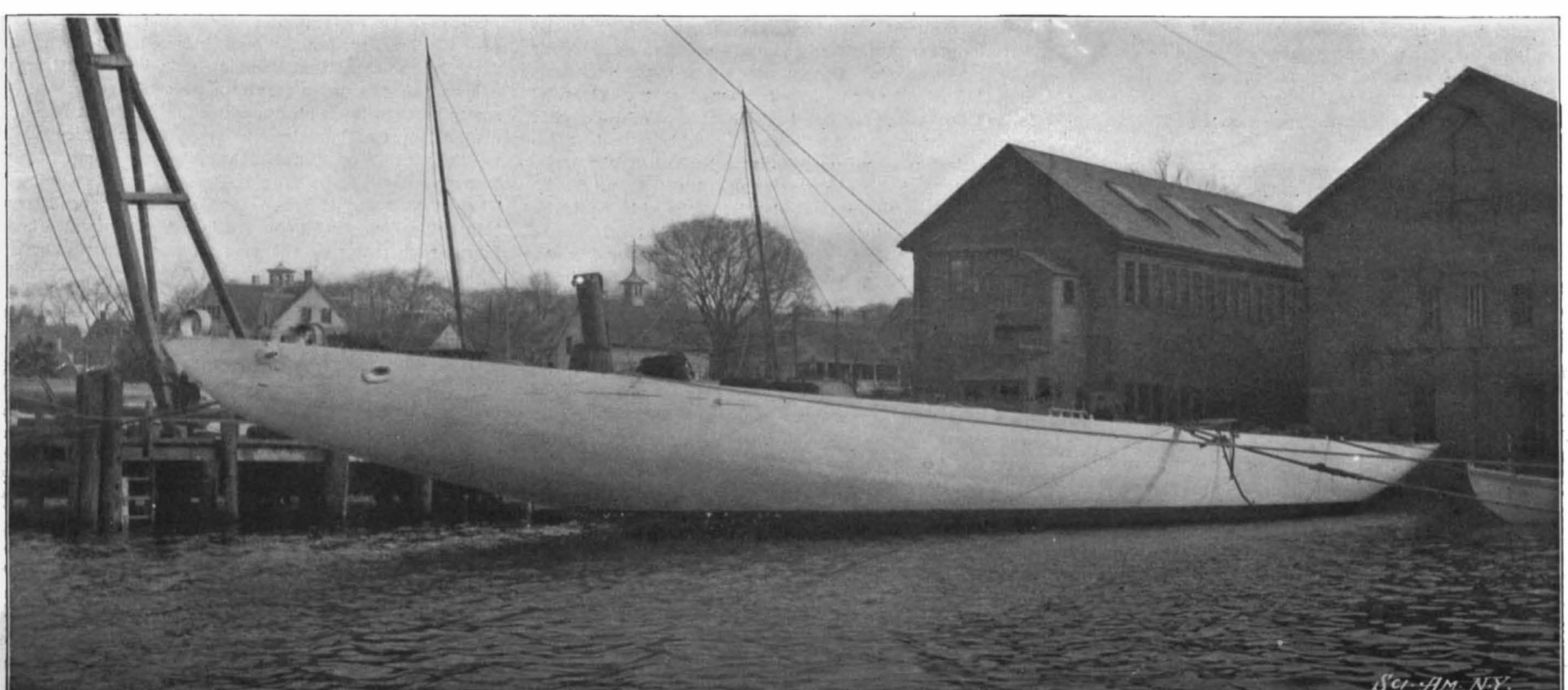
View Showing the Great Length of the Stern of "Reliance."



Broadside View of the Long Overhanging Bow.



Bow View from Dead Ahead.



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Ready for Her Spars.

THE NEW CUP-DEFENDER "RELIANCE."—[See page 314.]