The doom of the centerboard was further sounded by the visit subsequently paid by "Vigilant" to Great Britain when she lost eleven out of eighteen races to the "Britannia," a sister cutter to "Valkyrie."

The third phase of yacht construction may be said to date from the construction of the American yacht "Defender" in 1895. Just as the "Genesta"-"Puritan" year saw the introduction of more thoroughly scientific methods of design, so does the "Valkyrie III."-"Defender" series witness the full recognition of the fact that scientific construction is only less important than scientific design. Of course, it would be manifestly unfair, both to the British designers and to Herreshoff himself, to infer that no attention had been paid previously to what might be called the engineering features of the problem, for "Genesta" in 1885 was of composite construction, with wood planking on steel frames, and "Galatea" in 1886 was built entirely of steel, at a time when we were still clinging to cumbersome wooden frames in "Puritan" and "Mayflower"; moreover, Herreshoff had already introduced, in 1893, the use of bronze in the underbody of "Vigilant." But it was in "Defender" that the engineer and metal worker were first given a free hand, while hollow steel spars first made their appearance on both challenger and defender. It is probable that "Defender" was, and will always remain, the lightest yacht for her size ever constructed; she has also the unenviable distinction of being the only boat built either for challenge or defense that was useless as soon as her racing days were over—for, contrary to popular belief, the three 'Shamrocks" and their competitors are as sound to-day as when they were launched. "Valkyrie III." was of composite construction; but in her we see the last of the wood-sheathed cutters.

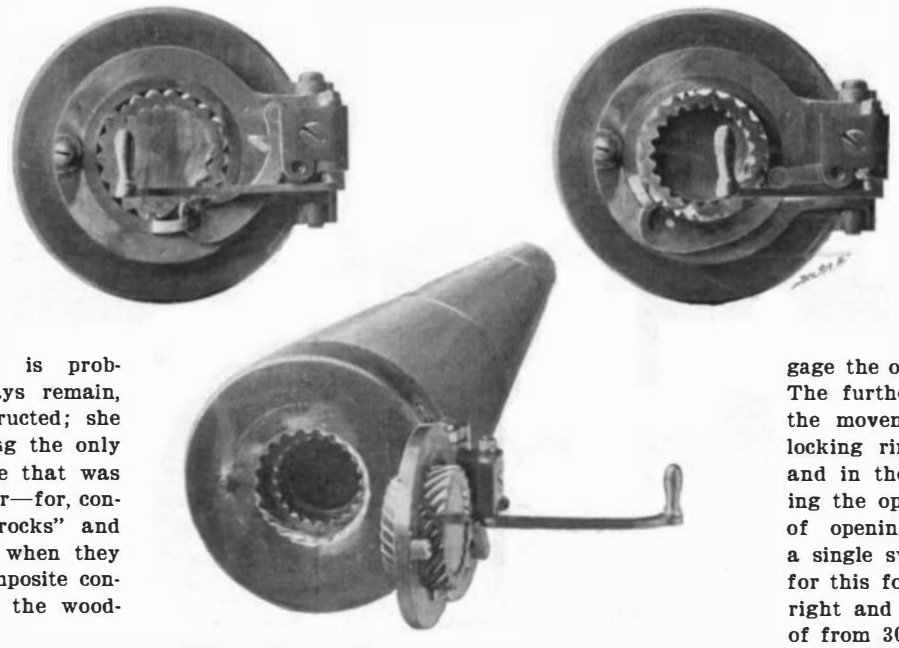
With the advent of Sir Thomas Lipton to the great international contest, there was assured for the challenging yachts the necessary capital to meet the enormously-increased cost of construction due to the use of expensive alloys and high-grade steel; and although in this respect it has been one man's purse against a syndicate, no stint has been put upon either the designer or the builder. The first "Shamrock" was a bronze boat with aluminium topsides and deck, and in "Columbia" she met a boat with bronze underbody, steel topsides and wooden deck. The second "Shamrock" was plated with bronze from keel to rail; but in "Shamrock III." we see a return to steel plating for the hull, the necessary smoothness of surface being secured by the use of a special enamel paint, each coat of which is carefully rubbed down before the next is applied. The result is a remarkably smooth surface which it is claimed is not surpassed by the polished bronze. "Reliance" is built on the belt-frame and longitudinal system which Herreshoff introduced in "Constitution." It is possibly a trifle lighter than the customary bulb angle method of framing; but it posseses the drawback that the wide frame-spacing renders it difficult to build the boat with perfectly fair lines, the plating having a tendency to straighten out between frames, rendering the longitudinal lines a series of chords instead of true continuous curves. In this last period of cup designing there has been a wonderful development in the sizes and power of the boats, until the climax has been reached in "Reliance." As compared with "Defender," the beam has gone up from 23¼ feet to 27 feet, and the over-all length from 126 to 145 feet, while the sail spread of 12,640 feet on "Defender," thought to be prodigious in 1895, would be insignificant against the towering fabric on "Reliance," with its total area of 16,199 square feet.

As we go to press, only one meeting of "Reliance" and "Shamrock" has taken place. The wind, light at the start, died away at times to a calm. Although the race was called off, "Reliance" showed indications of being the better drifter. As long as the wind held true, there was but little appreciable difference between the boats, although "Reliance" gave indications that in a true breeze she could draw out to weather of the English yacht. The conditions were those in which "Shamrock" has done her best work, and if she cannot drop "Reliance" in a light breeze and rolling sea, she is not likely to do so in stronger breezes.

The largest complete mounted mammal in existence can be seen in the American Museum of Natural History. The specimen is the clumsy little skeleton of the pantolambda, whose age is placed, with doubtful accuracy, at three million years. The fossil was found in New Mexico and presents an impressive example of the possibilities of evolution.

IMPROVED BREECH MECHANISM FOR HEAVY GUNS.

The vast improvement that has been made of late years in the rapidity of fire and general handiness of heavy guns is due largely to the great amount of attention which has been given to the breech mechanism. So important an element is this in the construction and manipulation of heavy ordnance, that it has had more to do with decreasing the weight and increasing the rapidity of fire than perhaps any other single feature. If we except the guns made at the Krupp works, the breech mechanism of all modern ordnance is of the threaded type, that is to say, after the charge has been introduced, the breech block or breech plug depends for its ability to resist the rearward force of the explosion of the powder upon the total strength of the threads by which the block is screwed home to its position in the breech box. As usually constructed, equi-distant parallel channels are cut through the threads both of the block and the box, so that the breech block can be thrust right home into position and locked by giving a third or quarter turn to the block as the case may be. This cutting away of so large a portion of the thread, thereby reducing the shearing section, necessitates an increase in the length of the block and, therefore, an increase in the length of the gun at the point where it carries its greatest diameter. To provide a breech block of less depth, but presenting an equal section of thread, thereby saving in the length and weight of the gun, has been the constant aim of gun-makers for several years past, and in the accompanying illustrations is shown one of the latest and most ingenious attempts to solve this problem. In the new breech mechanism, which was designed by John B. Moore, of Washington, D. C., the breech box is stepped so as to present two different diameters, and the outer or larger section is threaded with a left-hand thread, and the inner or smaller section adjoining the powder chamber is threaded with a right-hand thread, the threads in both cases being uninterrupted. The breech block, which has a diameter corresponding to that of the interior section of the breech box, is cut with a left and right-hand thread, corresponding to that of the breech box, the length and pitch of the threads corresponding to those of the two sections of the breech box, although the diameter of the breech block is the same throughout and matches that of the inner section of the breech box. Over the outer left-hand-threaded portion of the block is carried an annular locking ring which is cut both on its interior and exterior surface with a left-hand thread. This locking ring is threaded on over the outer part of the breech block, and it is itself carried by a swinging carrier, which is hinged in the customary way to the right-hand edge of the base of the gun. The carrier for this breech block is swung into an open or closed position by means of a handle lever, and by the co-operation of a pair of bevel pinions suitable motion is transmitted, during the swinging of the handle lever, to a rocker which is pivotally connected with the operation ring in such a manner that this operating ring is moved in one direction or the other according to the opening or shutting swing of the handle lever.



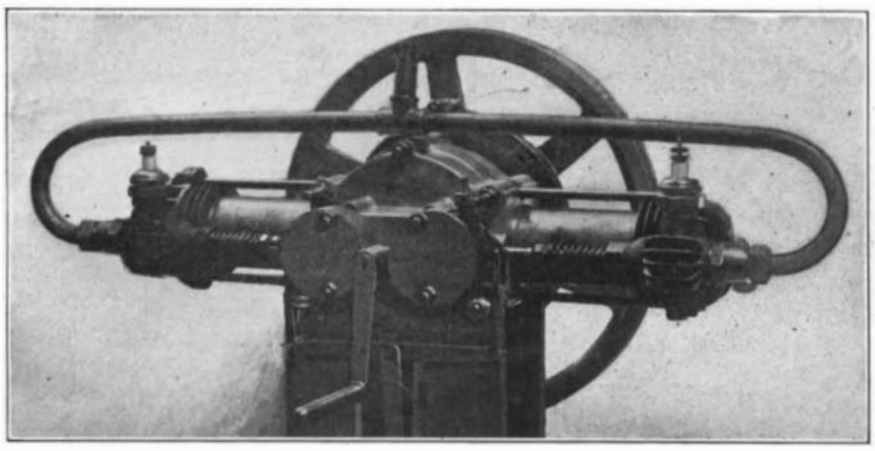
IMPROVED BREECH MECHANISM SHOWN IN THE LOCKED, UNLOCKED, AND FULLY OPEN POSITIONS.

Our three engravings show the breech first, in an entirely closed and locked position; secondly, with the breech block unscrewed, but still in position against the breech of the gun; and thirdly, with the breech block swung wide, clear of the gun, ready for the insertion of the charge. Let us suppose now that the charge has been inserted and it is desired to close the breach. By pulling the handle lever round to a quarter turn the block will be brought up with the ends of its threads in position against the ends of the threads of the breech box, ready for screwing home to position. The further movement of the handle lever toward the gun then operates to turn the breech block into the threaded portion of the gun breech. This is accomplished by turning the locking ring on the threads of the breech block, when the threads of the block will engage the outer ends of the threads of the gun breech. The further movement of the handle lever reverses the movement of the operating ring and turns the locking ring in on the threads of the breech block and in the threads of the gun breech, thus completing the operation of closing. Each of the operations of opening and closing is thus accomplished by a single swing of the lever. The advantages claimed for this form of construction are that by using these right and left-hand multiple threads there is a gain of from 30 to 50 per cent of strength over any block of the same weight and general dimensions that is at present in use. The considerable shortening-up of the breech of the gun, due to the shortness of the breech block, not only greatly lightens the weapon, but it allows for more advantageous disposition of loading and hoisting machines, particularly in large gun mounts. There is a further advantage in the fact that by dividing the strain occasioned by firing the gun equally between a right and a left-hand thread, there is obtained the advantage of equilibrium of forces; the operating mechanism is relieved of strain or shock, and there is no tendency, as in a block carrying the ordinary type of thread, for the block to unscrew itself. Another advantage is that when the swinging carrier strikes the gun, the momentum of the breech block causes it to enter its threads in the block for a considerable distance, thereby rendering a rebound of the carrier before the block enters impossible, and because of the great pitch of the threads the momentum of the block is almost sufficient to screw it home to its closed position.

LIGHT MOTOR FOR A ST. LOUIS CONTEST AIRSHIP.

The coming race of airships at the St. Louis Fair is doing a great deal to interest inventors in the problems of aerial navigation, and as a result we may expect to find substantial advances made in this most fascinating effort of man to master the element which has so long baffled him.

One of the goals toward which all designers of airships are striving is the construction of a propelling motor which shall have a minimum weight per horse power. A prominent contestant in the St. Louis race has just succeeded in obtaining an exceedingly light gasoline motor for his airship. Our illustration shows the motor with the carbureter removed, mounted on the testing block. The motor was built by the Walters Power Company, of 62-66 Van Winkle Avenue, Jersey City, N. J. The contract stipulated that the motor alone should weigh not more than 26 pounds and should yield at least 2 horse power. The completed motor comes well within these requirements, having a weight of about 24¼ pounds and an efficiency of 2¼ horse power. Even with the addition of the carbureter, the weight is but 25½ pounds, and naturally the builders are much elated with their success. In the construction of the motor aluminium is, of course, used wherever possible, and the other parts are made as small and compact as practicable. The general design, however, closely follows standard lines. The motor is of the four-cycle type and the cylinders have a 2⅛-inch bore by a 2 7-16-inch stroke. One feature which is particularly noticeable is the absence of radiating ribs on the main body of the cylinders. Mr. Walters, who designed the motor, has found that the heat of the cylinders could be dissipated with suffi-



GASOLINE MOTOR WEIGHING 24¼ POUNDS, YIELDING 2¼ HORSE POWER.