solve partial equations, such as $x^5 + bx^4 - dx - f = 0$. It is, therefore, a machine for extracting any root of a number, for that requires only the solution of the binomial equation $x^n - f = 0$. If, for example, the weight, "a," is set at +1 and the weight, "f," at −17, the machine will balance only at 1·76, the fifth root of 17, for the equation solved is then $x^5 - 17 = 0$, or $x = \sqrt[5]{17}$

To detail an example, suppose the equation

$$2x^5 + x^4 - 11x^3 + 7x^2 - 13x + 6 = 0$$

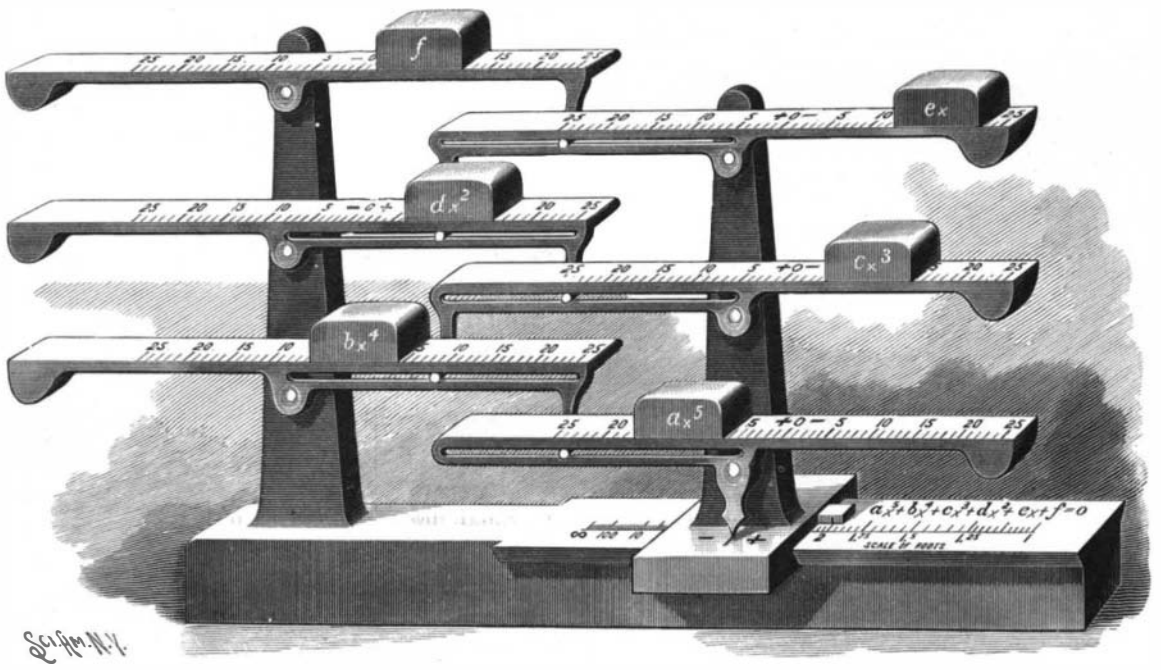
is to be solved.

The weight, "a," is set to +2, and the others to +1, −11, +7, −13, and +6, respectively, and the post moved to a position at which the beams will balance. It can be made to balance only at 2, showing that +2 is the only positive real root between unity and infinity. Now shift the weights, b, d, and f, each to the same setting on the other end of its beam, and again move the post over the scale of roots. It will find a balance only at 3, showing that −3 is the only negative root between unity and infinity. But there are five roots of the equation and there may be more between the unit points. Transforming the equation so as to add 2 to each of its roots, any root between +1 and −1 will be moved up to some point between 1 and 3, and the equation will be $2x^5 - 19x^4 + 61x^3 - 63x^2 - 45x + 100 = 0$. Setting this equation upon the machine and moving the post only from 1 to 3, we find that it balances only at 2½, showing that $+\frac{1}{2} = 2\frac{1}{2} - 2$ is the only real root besides 2 and −3. As there are five roots in all, there must be two imaginary roots, but the machine will not assist in finding them, for the reason that an imaginary root is an algebraic fiction and not a mechanical quantity.

The delicacy and accuracy of the machine is greater as the root is smaller; therefore, if a very large root be roughly determined, the equation can be transformed so as to reduce its size and enable it to be measured with greater precision.

There is no limit to the possible refinements in the way of agate bearings, micrometers, etc., but they are expensive and are not needed. A machine of very ordinary construction will determine a root to hundredths if it is near unity, and any root can be set in that position by an easy transformation of the equation. Even a wooden model will get the roots ready for extension by Horner's method.

If only two adjacent beams are weighted, the machine will perform ordinary multiplication and division of numbers, for the equation $ax - b = 0$ will give $ax = b$ and also $x = b \div a$, but the range in this case is too small for ordinary purposes.



GRANT'S EQUATION MACHINE.

THE Bréant prize of the Paris Academy of Sciences for 1897 is to be awarded for the discovery of a remedy which will cure attacks of Asiatic cholera in the great majority of cases. The prize is of the value of 100,000 francs. The memoirs must be sent to the Academy before June 1 next.

TORPEDO BOAT NUMBER 6, FOR THE UNITED STATES NAVY.

We give an illustration of the fastest vessel of any kind ever built in America, torpedo boat No. 6, which on its trial trip maintained an average speed of 28·74 knots per hour for a distance of 60 miles. This is equal to 33·1 statute miles per hour, a speed which not a great many years ago would have been equal to the average all day speed of our passenger trains.

The course was 12 miles long and it was covered in five successive runs. On the first run she crossed the line carrying a steam pressure at the engines of close upon 220 lb. to the square inch, and her engines were running at the high speed of 405 revolutions per minute. There were two excellent features that were immediately apparent to those on board, the first being the absence of any banking up of a heavy bow wave (the commotion which our readers will notice in the cut being merely the surface foam); the second good feature was the absence of that extreme vibration which is usually felt in a torpedo boat when she is pushed to her full speed. The quiet way in which she cuts through the water will be an invaluable feature during a night attack. It will increase the chances of stealing up to the enemy unobserved, and the silence and smoothness with which her engines run at high speed will also be greatly in her favor. It was remarked by the officials on board that the vibration was not sufficient to interfere with writing legibly in any part of the vessel. Any one who has been aboard one of the 30 knot torpedo boat destroyers on a trial trip will appreciate what this statement means. It is well known that torpedo boat service is about the most trying that exists in any navy, and much of its discomfort arises from the perpetual jarring to which the crew are exposed. The vibration is due to the fact that such enormous horse power is crowded into a little vessel of extremely light construction.

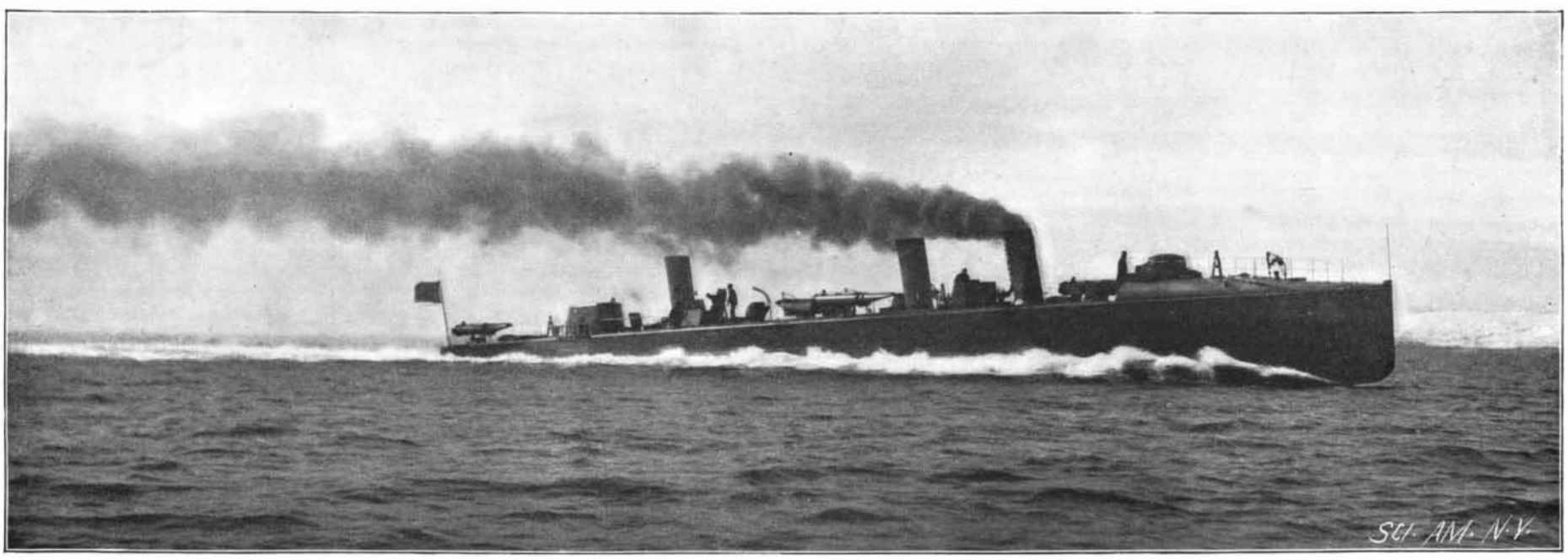
It is a difficult problem to place in a boat only 175 feet long and 17½ feet wide a set of 4,000 twin engines that shall drive the propellers at over 400 revolutions per minute, and do it without shaking the little craft from stem to stern. The lightness of the construction of No. 6 may be judged from the fact that there is not a plate in her hull that is more than a quarter of an inch thick.

The first heat of twelve knots was run off in 24 m. 52 s., at a speed of 28·97 knots. The second was made in 24 m. 57 s., corresponding to 28·85 knots. The third trial resulted in a speed of 28·78 knots, and the fourth showed a speed of 28·87 knots. The average for the 48 knots was, therefore, 28·87 knots. The last run had scarcely commenced when one of the blowers broke down, a mishap which caused a falling off of the steam pressure and brought down the speed to 28·23 knots, which was 0·73 knot above the contract requirement. The average speed of the whole 60 knots was 1¼ knots above the contract speed of 27½ knots.

The maneuvering powers of the new boat are excellent, the turns at the end of each run being made in a very small circle, and although the helm was "hard over" the amount of "heel" was insignificant.

She carries three torpedo launching carriages, one forward on the port side, one amidships on the starboard side, and a third at the stern on the center line. She is also armed with three 1 pounder rapid fire guns. The full complement of the little ship is four officers and twenty-four men.

The remarkable success of this little craft will give increasing interest to the trials of the three 30 knot boats which are now building for the navy, one on the Pacific coast and two on the Atlantic. If they show as great an advance on contract requirements as No. 6 has done, it is possible that the record for torpedo boat speed may remain for a few months on this side of the water, or until the new 32 knot destroyers for the English navy shall have had their trials.



TORPEDO BOAT No. 6, FOR THE UNITED STATES NAVY ON HER TRIAL TRIP.

Speed, 28·74 knots per hour. From an instantaneous photograph. Copyrighted, 1897, by F. H. Child.

The Origin of the Druggists' Show Bottles.

An interesting story is told by the Chicago Grocer in connection with the familiar red, yellow and green vases that brighten the windows of drug stores. The custom of placing them there originated with an apothecary who found himself one night minus the red light with which tradesmen of his class were accustomed to ornament their store fronts. To make up the deficiency he got a bottle of red liquid and placed a candle behind it. The effect pleased him so well that he decided to improve it by placing a second red light in the window, with the aid of another bottle of red mixture and an additional candle. This sign made such a brave showing that an envious rival cast about for means of improving on the sign. He hit upon the scheme of placing a bottle colored with yellow fluid beside the red one, and then surpassed his previous effort and carried all before him by placing a green bottle beside the yellow. The three made a sign that caught the town, and all the druggists quickly fell into line. The bottles were replaced with the handsome vases at present in use, and the druggist's sign was here to stay to brighten the dingy streets of town and village.