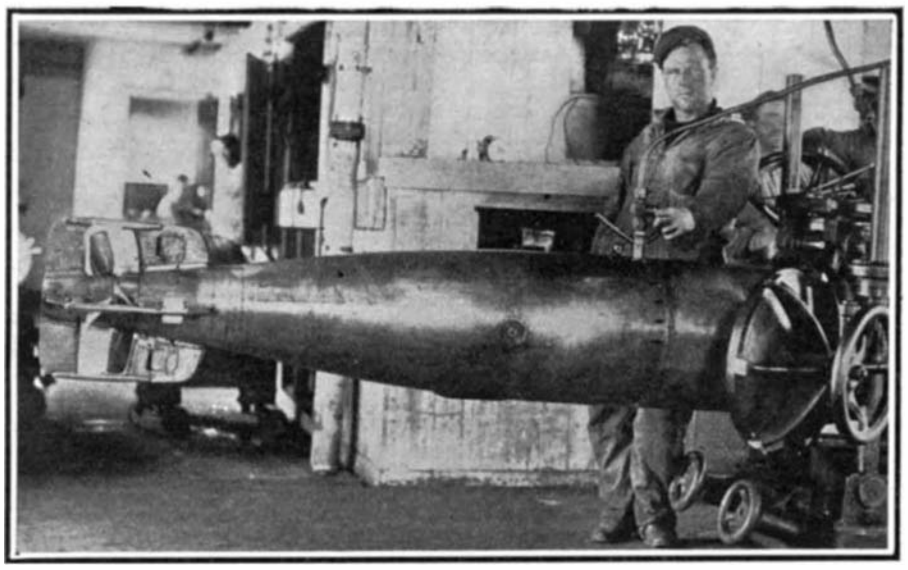
THE NEW TURBINE TORPEDO OF THE UNITED STATES NAVY.

It is always difficult to ascertain just what other navies are doing in torpedo work, because special secrecy is maintained with regard to what is still considered to be one of the deadliest forms of naval warfare; but the new turbine torpedo, known as the Bliss-Leavitt model, which has recently been adopted by the United States government, furnishes the American navy with what is probably the speediest and most effective weapon of the torpedo type in existence.

The readers of the SCIENTIFIC AMERICAN have been made familiar with the Whitehead torpedo of the standard type. The new weapon conforms, in its external appearance and in the leading features of its internal subdivision and method of control, to the Whitehead, but in size, power, speed, range, and accuracy it far surpasses it. The Whitehead of the standard type as used in the United States navy has a speed of 28 knots and a range of about 1,200 yards, and about 22 knots at 2,000 yards. The new torpedo has a range, guaranteed by contract, of 3,500 yards, and its speed is 28 knots at this range and 36 knots at 1,200 yards range. The United States government has been so well satisfied with the new weapon that contracts, amounting to several millions of dollars, have been awarded for the construction of this type of torpedo, which, from this time on, will be the only type used in the navy. Two sizes are being made: one, 18 inches in diameter, which can be fired from the existing 18-inch tubes on our battleships and torpedo boats; and the other, a much larger and more powerful torpedo, 21 inches in diameter. The 18-inch torpedo of the new type has an effective range of 2,000 yards and a speed of 33 knots, and 100 of this type have been contracted for, while of the larger 21-inch, 300 are called for by the contract. Thirty of the 18-inch and two of the 21-inch have been delivered at the torpedo station at Newport, where officers and men are instructed in torpedo work under probable war conditions.

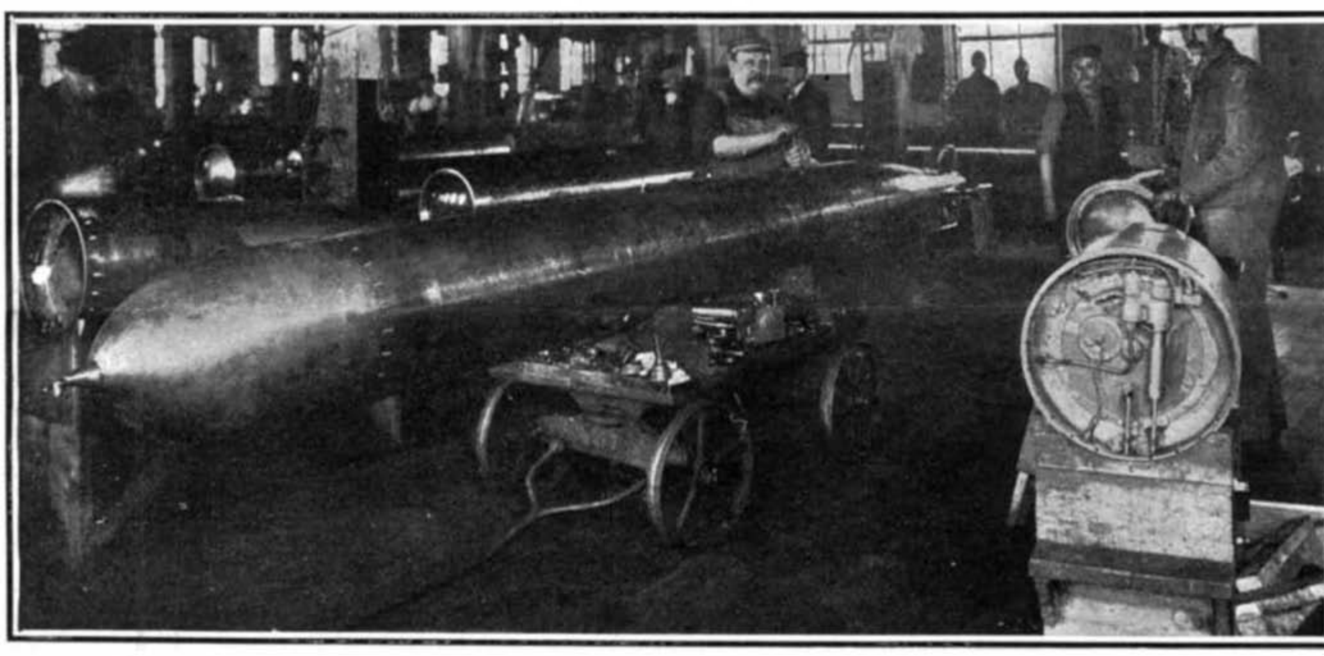
By the courtesy of the Bliss Company our representative was recently given an opportunity to study the construction of the new torpedo in the special department of the works set apart for torpedo work. The new 21-inch type consists essentially of three sections. First, the head containing the explosive: then the central flask in which the compressed air for driving the torpedo is stored; and last, the after body, which contains the turbine for operating the propellers, the immersion chamber for regulating the depth of the torpedo beneath the surface of the water, and the gyroscope gear by which the torpedo is automatically steered and maintained on its proper line of flight.

The head is a beautiful specimen of hammered sheet-metal work. It is formed in two halves, divided longitudinally, the edges of the joints being made with a square, saw-tooth form and brazed together. The war head, which, as distinguished from the practice head, is used only in actual hostilities, is loaded with 132 pounds of gun-cotton, containing 25 per cent of moisture. The gun-cotton is packed in disks through the center of which is a hole that contains a cartridge primer of dry gun-cotton for detonating the charge. The small propeller carried at the extreme point of the torpedo is for preventing premature explosion, which it does by locking the firing pin. When the torpedo enters the water, the revolution of the propellers releases a sleeve, which uncovers the firing pin, putting it in position to strike the detonating primer the instant that the torpedo finds its mark. The central body, or shell of the torpedo, occupies a little more than one-half the total length. It is made of a special forged steel of an elastic limit of at least 90,000 pounds. The rough forging is over 1¼ inch in thickness, and it is bored and turned down in the lathe to a finished thickness of 7-16 of an inch.



Note the two 4-bladed propellers; the two vertical steering rudders; and the horizontal submergence rudders.

The Tail of the Torpedo.



The small propeller at the head by revolving releases the firing pin as soon as torpedo enters the water. To the right is seen the principal valve group.

A Completed 21-Inch Bliss-Leavitt Torpedo.

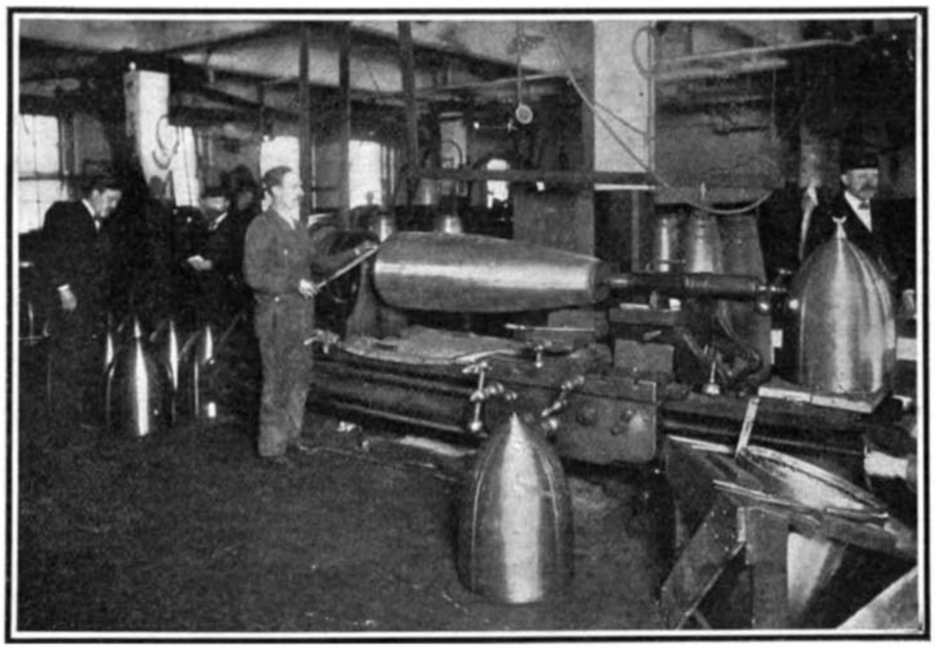
The "flask," as the central portion, or air chamber, is called, is to the turbine engine of the torpedo what the boiler is to the reciprocating engine of a steamship. It is charged at an initial pressure of 2,225 pounds to the square inch.

The after portion of the torpedo, or the tail, contains in its forward end the wonderful little torpedo engine which drives the propeller. It is of the Curtis compound type, and consists of a central row of fixed blades and two wheels, one 11⅛ inches and the other nearly 12 inches in diameter. There are two propellers, adapted to run in opposite directions, one being fixed upon the central shaft, and the other upon an enveloping outer shaft. The turbine runs at a speed of about 10,000 revolutions per minute, which is reduced by suitable gears to a speed of 900 revolutions for the propellers. At this speed the turbine developed about 160 horse-power, the corresponding speed being 40 knots an hour, although the contract speed required by the government is only 36 knots.

Immediately astern of the compartment containing the turbine is the wonderfully ingenious and delicate apparatus for maintaining the proper depth of immersion and for steering. The regulation of the depth is effected by means of a vertical diaphragm, on one side of which is the water, which is allowed to enter by holes provided in the shell for that purpose, and on the other side a series of coiled springs, the water pressing against the diaphragm on one side, and the springs pressing the diaphragm in the opposite direction on the other side. The springs are adjusted so that their pressure shall exactly equal the pressure of the water at the given depth at which the torpedo is to travel. If the torpedo descends below that depth, the water pressure, overcoming the spring pressure, pushes the diaphragm inwardly. If the torpedo is above the desired depth, the springs overcome the water pressure, and push the diaphragm outwardly. The center of the diaphragm is attached to certain levers and rods, which pass through the tail of the torpedo and act on a pair of horizontal rudders, throwing them up or down, according as the diaphragm is pressed inward or outward, and thus correcting the deviation of the torpedo from the horizontal plane at which it is designed to travel.

Astern of the immersion chamber is located the steering gear. This is a modification of the principle employed in the Obry gear, and depends upon the well-known tendency of a gyroscope to maintain itself in its original plane of rotation. The Obry gear was given its high velocity by means of a coiled spring which was released at the moment of firing. In the Bliss-Leavitt torpedo the spring is dispensed with, and a small reaction turbine is used in its place. This consists of a disk with a series of discharge orifices arranged tangentially to the circumference, which are fed with compressed air. The air rushing from the orifices reacts on the disk, and turns it exactly in the same way as did the pipes on Hero's original turbine of two thousand years ago. If the torpedo tends to deflect to the right or to the left, this little gyroscope turbine maintains its original position, and its angular motion with regard to the torpedo (or to speak more accurately, the angular motion of the torpedo about the gyroscope) serves to actuate a very ingenious mechanism, which turns the vertical rudders to the right or left, and corrects the deviation. The turbo-gyroscope is driven at a speed of 18,000 revolutions per minute.

Of course, the most interesting feature in the building of the new torpedoes is the construction of the wonderfully efficient little turbine engine that drives them. The Bliss Company has designed a very effective



A finished warhead is shown on the bed of the lathe. It carries 132 pounds of gun-cotton.

Tail of Torpedo in the Lathe. Finishing the Joint.

THE NEW TURBINE TORPEDO OF THE UNITED STATES NAVY.

SCIENTIFIC AMERICAN

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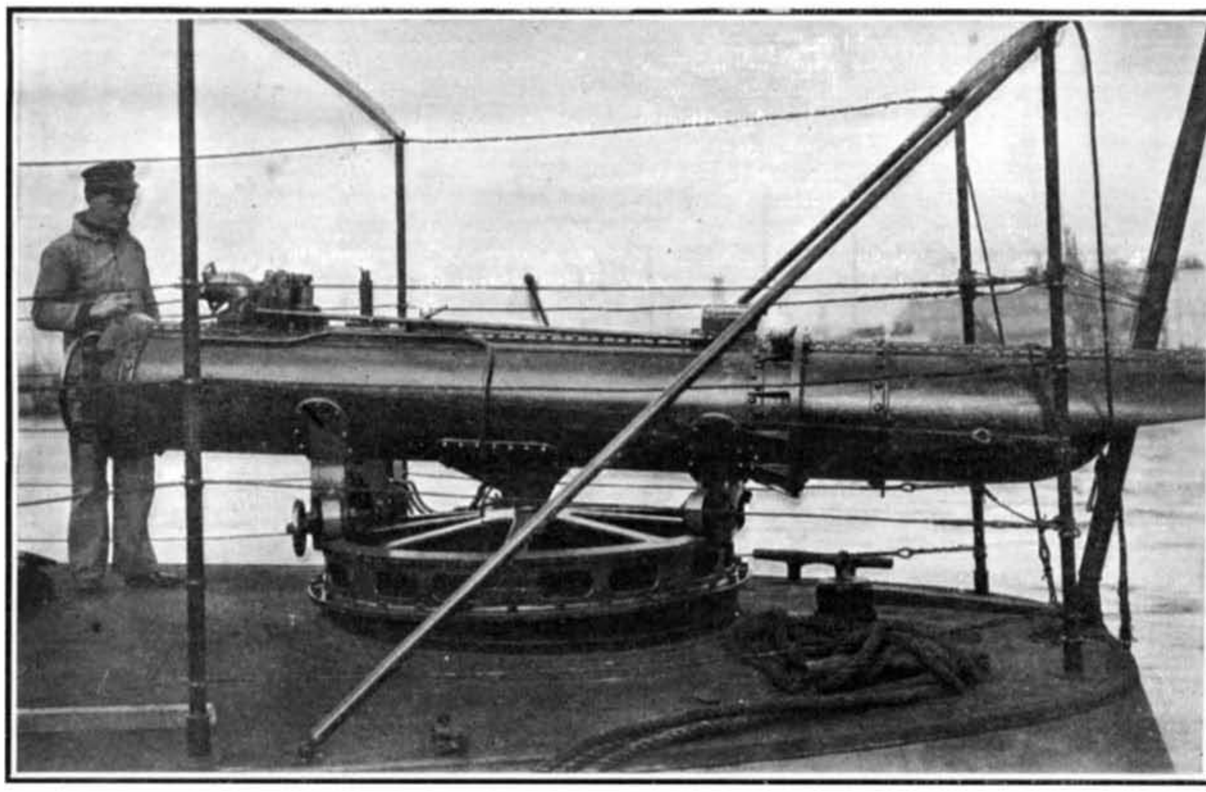
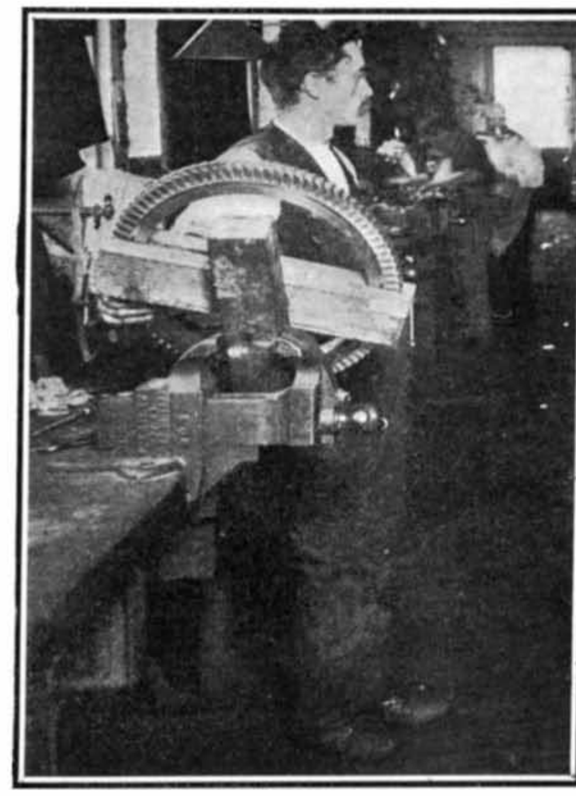
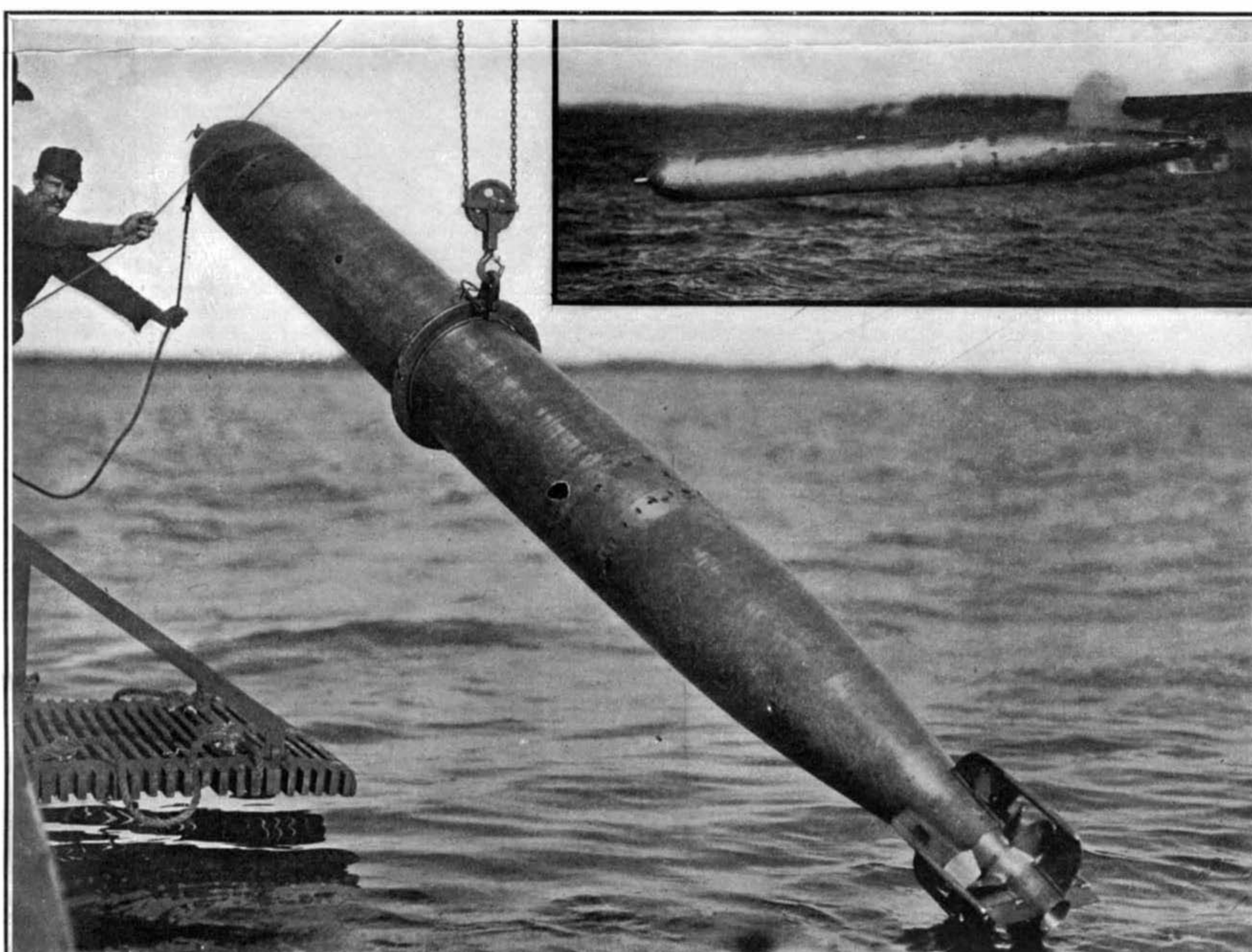


Torpedo in Tube Ready for Launching.



One of the Turbine Wheels.



Torpedo in Mid-Air, as It Leaves the Launching Tube.

Hoisting a 21-Inch Torpedo Aboard After a Trial Run.

NEW 21-INCH TORPEDO FOR THE UNITED STATES NAVY. SPEED, 36 KNOTS AT 1,200 YARDS RANGE.—[See page 7.]

machine for cutting the buckets of the turbine wheels. The whole wheel is made out of a single disk of steel, the buckets being integral with the wheel. The machine for cutting the buckets resembles a double-spindle lathe. The work is held in a horizontal position on the tail stock, and two cutters alternately advance toward the rim of the wheel, make a cut of the desired curvature and recede, leaving the wheel free to revolve sufficiently to bring the next bucket into position for another cut. One cutter operates on one wall of the bucket, and the other on the opposite wall. The result is a wheel of perfect form, carrying a highly finished surface. It should be mentioned here that the remarkably high efficiency in speed and range of the new torpedo is due to the use of a superheating process applied to the compressed air. This consists of a flame which is automatically ignited, the instant the torpedo is launched from the tube, and which burns during the entire run. The compressed-air flask contains a burner or pot, the flame of which is fed automatically with alcohol. The flow is so regulated that an even and steady temperature is maintained in the air flask.

During the past few months, the company has been carrying out a series of very exhaustive tests on board the proving steamer "Sarah Thorpe," which is anchored in the secluded waters of Noyak Bay, near Sag Harbor, Long Island. Here each torpedo is tested and brought up to the required standard of efficiency in speed and range before being turned over to the torpedo station at Newport. The Navy Department assigned a lieutenant and several gunners to witness and record the run of each torpedo. The target is a submerged net, 100 feet in length, which is located 1,200 yards from the point of fire. The torpedo breaks through the meshes, and after each shot the net is hauled up, and the exact striking point is located by the tear in the net. The maximum deviation in the range allowed is 15 feet to the right and left of the bull's eye, and 30 inches above and below at five feet of depth. Each torpedo must come within these measurements in three out of five trial runs, in order to be accepted. The average speed of the run is 36 knots, and the time run is about 60¾ seconds for 1,200 yards. The cost of the 18-inch torpedo is about $5,000, and the 21-inch torpedo costs proportionately more.

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The Current Supplement.

Jacques Boyer opens the current SUPPLEMENT, No. 1566, with an interesting article on the truffle industry in France. Excellent illustrations accompany his text. The manufacture of rosin oils is thoroughly discussed by E. Rabaté. Sepia watertone papers, simple to work and cheap, can easily be made by the amateur photographer, if he follows the method outlined in the current SUPPLEMENT. Notwithstanding the fact that much of the music produced by chimes is rendered with discords, a peal of bells always finds ready listeners. The late George M. Hopkins describes in a painstaking article how an electric chime may be made by any one at a comparatively small expense. Major Ronald Ross, to whom we owe the discovery that mosquitoes are purveyors of malaria, has computed the number of mosquitoes which infest a given area. The method which he pursues is very carefully set forth. Curves in pattern work is the subject of an article which must be of interest to the foundryman. In a very brief and yet comprehensive article Mr. E. F. Chandler tells how to construct an electro-thermostat. The telemobiloscope is the invention of a German scientist. Its purpose is to discover the nearness of one vessel to another at sea during foggy weather, in order to avoid collisions. The invention is described and illustrated.

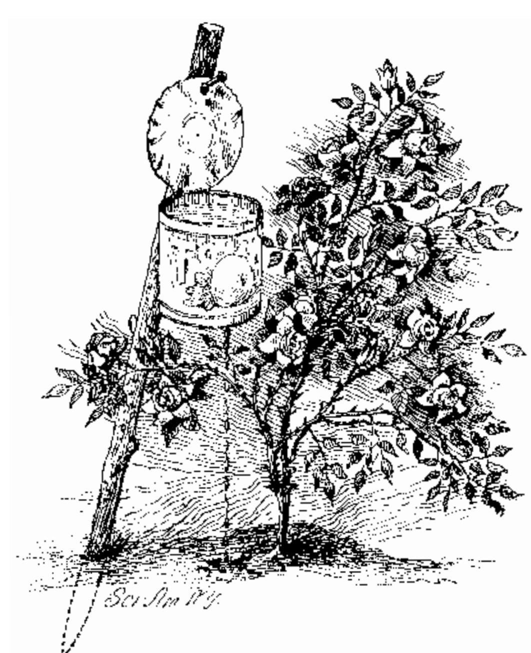
The Poisons of an Egg.

M. Gustave Loisel, in a paper recently read before the Academie des Sciences, describes some experiments he has been making in regard to the toxicity of certain glands of different animals, vertebrate and invertebrate, and also finds the same result in the case of eggs. He uses in this case eggs from the duck, chicken, and turtle. As to the toxicity of the duck's egg, he makes the following experiments: First, relating to the venous injection of yolks of the eggs which are emulsioned in distilled water. By injecting this emulsion into the veins of rabbits, he finds that seven adult animals are killed by 8 cubic centimeters of the yolk on an average. The animals die in a variable time, from some minutes to two hours, showing at first a contraction of all the members, followed by paralysis. Second, the injections were made with extract from 21 yolks of eggs dried and reduced to powder, extracting with salt water. Using 10 grammes of this powder, treated to 100 cubic centimeters of salt water (1 per cent) then filtered, the solution caused the death of three rabbits when injected into the veins in the proportion of 80 cubic centimeters per kilogramme weight of the animal. Chickens' eggs have about the same effect, but in a somewhat less degree, while turtles' eggs (from the Mauritanian tortoise) have a greater effect, especially for the mature ovules taken directly from the ovaries. Not only does the yolk cause the rabbits to succumb with convulsions and tetanic contractions, but the albumen forming the white of the turtle's egg has an equally powerful effect. Sub-cutaneous injections have the same action. In the case of the yolk, a series of check experiments was made, using an emulsion of oil and salt water, but this had no effect upon the rabbits.

AUTOMATIC WATERING POT.

Our article, with its illustrations, concerning an automatic apparatus for watering plants, recalled to Mr. M. M. Moore, a subscriber, a device which he used upon the suggestion of a "forty-niner."

A few years ago Mr. Moore lived upon a small ranch,



AN AUTOMATIC WATERING POT.

where the only water supply was a small well. In order to have a few plants and flowers, he gathered a number of tin cans—tomato, corn, etc.—cut out the top so that it held by an inch or so, bent it back, so that it could be nailed to a stick, punched a very small hole in the bottom, through which he drew three or four inches of cotton cloth or string, drove the stick near the plant he wished to water, so that the can was eight or ten inches above the ground, filled the can with water, and then drop by drop the water fell upon the ground near the plant all day, sometimes all day and night. The ground soon became saturated, the plant throve, and the quart of water did as much good as an all-day rain.

The accompanying sketch will give an idea of the device.

A New Ozone Apparatus.

The ozone apparatus for medical use which are employed at present do not always work perfectly, as they are more or less influenced by the state of the weather, and besides, the ozone which is produced is often mixed with combinations of gases, nitrogen, ammonia, also phosphorus or metallic oxides, which result from the contact of the ozone and the metallic poles when a too dense charge is produced. To overcome these difficulties, M. Breydel, a Belgian scientist, brings out a new process in which the electric discharge is obtained between plates of large surface which have a special insulating coating. In this way he prevents the spark discharges and the volatilization of the metal at the electrodes. He finds that when above 20 degrees C. the ozone tends to be transformed to oxygen, and thus the amount of ozone depends upon the temperature and also the degrees of the ozonized gas. For this reason he uses poles which are placed in a medium having a somewhat low temperature. The air is well dried before going into the apparatus. A funnel-shaped opening allows of making inhalations, placing the face some eight inches off, or a narrow opening can be used, for local treatment. The ozone can also be passed through liquids, where needed. The new apparatus gives a much larger quantity of ozone than can be obtained by other forms, and it has a great advantage in not being influenced by the weather.

Engineering Notes.

Shipping circles in Great Britain are closely interested in a new experiment in ship construction that is being carried out in a shipbuilding yard on the northeast coast by the inventors of the turret ship, which is now such a popular type of freight vessel. This boat is being constructed without beams and is practically an application of the cantilever principle to shipbuilding. Instead of the beams crossing over the hold, stout stanchions are raised nearly flush with the sides of the vessel and, when these have been brought to a certain height, equally strong diagonal joists are raised from them to the upper decks, thus forming a bracket or cantilever at each side. The stanchions and joists closely follow the lines of a turret ship and thus take up little room. The advantages of this design are that the vessel has a lighter draft in proportion to dead weight, while at the same time it gives greater freedom for shipping long and bulky goods.

Propeller design with the turbine is more difficult than with the reciprocating engine, because the conditions are entirely different from those which have hitherto obtained, and there is so little experience with propellers running at speeds of over 1,000 revolutions a minute in the case of small ships, or at 500 to 750 in the case of large ones. The Cunarders' propellers, it is understood, are to be limited to 180 revolutions per minute. For it must be remarked that in spite of the fact that we now have very clear and logical rules for the design of propellers under existing circumstances logically worked out, nevertheless these rules and formulæ came after the experience rather than before. This matter, however, can undoubtedly be cared for, and when more experience has been gained the design of propellers will be as easy for existing conditions.

Of the various materials used for lagging, magnesia may be considered one of the best and most practicable for use in connection with locomotive service. This composition is of a strict neutrality, and composed of inert mineral matter that will exert no chemical action, corrosive or otherwise, upon any metallic surface with which it may be brought in contact. It will remain unaltered under all conditions of heat and moisture which confront the coverings of locomotive boilers. It has qualities of lightness, firmness, structural strength and porosity, the latter quality especially, upon which depends largely the efficiency as a non-heat-conductor; and this quality being most pronounced in magnesia, it affords the greatest resistance to the transmission of heat. It can also be molded into sectional blocks of any form and size desired for ready application and removal.

As a superintendent of motive power a generation ago, a good mechanic sufficed. He was an old locomotive runner, or a shop foreman promoted, and he was usually called "master mechanic." It was but a short and comparatively easy step from the locomotive, or the shop, to the position of head of the department. In the present day of record-making, of heavy locomotives, large-capacity cars, strenuous operation, large shops and intricate labor problems, such a step is now a hopelessly long one. The sort of man who successfully directed the department twenty-five years ago would find his ability overtaxed to properly manage a single busy roundhouse to-day. A different kind of ability is now required to direct the mechanical department of a single progressive road, and as great roads combine into systems still another new kind of a man will be needed. He must soon be ready, for his work is even now waiting. Is this appreciated? Are the men being prepared?

An interesting new machine has been installed at the yards of the well-known British shipbuilding firm of Messrs. Beardmore & Co., Ltd., for bending ship beams. The general practice of rounding deck beams is by means of powerful hydraulic pressure applied section by section to the member for which the camber is required. With this new appliance, however, the beams are bent and completed with the greatest rapidity notwithstanding their dimensions or caliber. The machine consists essentially of rollers which are set vertically and can be made to suit any degree of camber or curvature. These rollers operate upon the steel beam just as it arrives from the steel-works. It passes quickly through the machine, and is then ready for working into the hull of the ship for which it is intended, the beam being quite completed when it leaves the bender. Any type of beam can be handled, from the heaviest to the lightest, and angle or T-shape, with equal facility. The apparatus is being utilized for cambering the T-beams, 12 inches deep, required for the British battleship "Agamemnon" now in course of construction by this firm.