MILITARY SCIENCE

Speeding Torpedo Production

Navy's Torpedo Factory at Alexandria, Va., Open Again for Business After Seventeen-Year Shutdown

By DR. FRANK THONE

See Front Cover

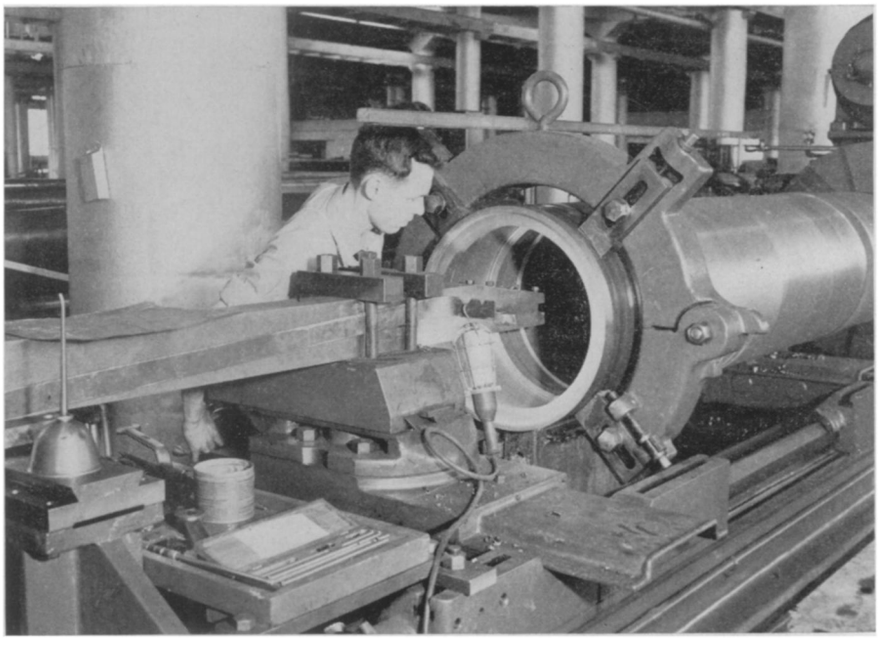
BUILDING a bigger navy means a lot more than simply riveting the ships together, putting sailors on them, and sending them to sea. A modern warship, whether light destroyer or ponderous battleship, is a mechanism of manifold intricacy, requiring munitions and supplies in a bewilderingly long list and mountainous in quantity to keep it functioning at full service efficiency.

So it comes to pass that while headlines hail the laying of keels of the world's biggest battleships for the U. S. Navy, and the launching of new destroyers and submarines in whole batches, there is a tremendous speeding up in these little noticed but vitally necessary services of supply behind the fleet.

Among other things, the Navy's capacity for manufacturing torpedoes is quietly being doubled. The Torpedo Station at Alexandria, Va., across the broad Potomac from Washington, has been opened after a 17-year shutdown. It is being re-equipped with the newest, most modern machinery and re-staffed with a force of skilled machinists and trained technicians. There are about 300 of them on the civilian payroll now, and when the station settles down to its full production stride their number will rise to some 750. Its capacity will become as great as that of the long-established torpedo station at Newport, R. I.

Why should the Navy need so many torpedoes? In normal times it doesn't. But the times are emphatically not normal. War roars to the east, mutters threateningly far to the west. We are building new ships for our protection in any possible emergency, re-commissioning over-age destroyers that have been laid up during the truce between the first and second World Wars.

Of surface torpedo craft, built and building, our Navy has well over 250. These destroyers carry from 8 to 12 torpedo tubes apiece. Of submarines, built and building, we have more than 100, each carrying from 4 to 6 tubes. Add to these the tubes carried by some of our cruisers and a few of our older battleships, and you have something between 2,500 and 3,000 tubes to be provided for —not counting torpedoes needed for those formidable new engines of war, the torpedo-carrying planes. Recall also that in addition to the torpedo it holds ready to discharge, every tube and every plane must have several others in the racks for immediate reloading, besides a stock in reserve at the fleet base. No wonder, then, that in the present state of world emergency the U. S. Navy has need for enough torpedoes to keep both its production plants steadily at work.



AT WORK ON AN AIR FLASK

Heaviest single part in a torpedo is the air flask, thick-walled to carry the charge of compressed air which serves instead of steam to drive the propelling turbines. These air flasks have to be finished smoothly, inside and out.

Efficient Machine Shop

Because a torpedo is a highly complicated set of mechanisms, its production calls for the most skilled, accurate and carefully planned kind of machine-shop work. That, in fact, is what the torpedo station at Alexandria really is: a huge, superbly organized machine shop. Its official designation is exactly and frankly that: it is known as Shop 70 of the U. S. Naval Gun Factory, and it is administered as a part of the Gun Factory whose main plant is across the river in Washington.

Shop 70 occupies a tract of 2.34 acres on the Alexandria waterfront, down among the warehouses and boat docks. Although its two buildings are large they are not conspicuous. They are not visible from Alexandria's main street, and you can reach the plant only by driving over the rough-pavemented, truck-frequented water-front street, criss-crossed with railroad tracks.

Shop 70, like the rest of the Navy Yard established in Washington, is very distinctly not in the tourist attraction class. Visitors are definitely not wanted, unless they have legitimate business there. Once you are properly identified, however, and your mission established as lawful and justified, you are treated with the utmost courtesy.

When I called at the plant (by previous appointment) I was met at the door by a Marine sentry, who ushered me up two flights of stairs to the office of the Officer-in-Charge, Comdr. R. W. Hayler, U.S.N. Busy though he was, Commander

Hayler dropped his work, called in Mr. J. L. Luber, his shop master, and the two men accompanied me on a complete tour of the plant, patiently answering all questions, showing staff photographer Fremont Davis where he could get the best camera shots, and not dismissing us until we had seen everything we had come to see. It was an experience that would probably be completely impossible in any other country in the world.

Nearest the commandant's office is the drafting room—for like any other modern mechanism, a torpedo is paper before it becomes steel. Here, under a flood of light from high windows, worked a couple of score draftsmen and designers, for further improvements toward a still more highly polished perfection are always being sought.

Then out into the shops. On this upper floor are produced the smaller, lighter parts with which the interior of a torpedo is packed. Row upon row of machines, small and medium lathes, drill presses, screw cutters, milling machines, each turning out piece after piece of steel, brass, light alloy, every piece a twin of its fellow to the thousandth of a hair's breadth.

Every machine has its individual electric motor drive; there isn't a line shaft or a foot of belting in the whole big plant. This helps to make it a very quiet shop, also a very well lighted one. There is no clangor, no sense of rush. Noise is wasted energy, as smoke is wasted fuel; energy is not wasted in Shop 70.

Still Installing Machines

New machines are still being installed. At one spot, a crew of Negro concrete workers were smoothing off the base for the installation of another lathe, while alongside them a machinist was watching the tool on his machine as it smoothly cut a thin curling ribbon off the surface of a short brass tube. Beyond were spaces where yet more machines will be placed.

Then downstairs to the ground floor, where the heavier lathes are installed, that turn out the three big pieces—cylindrical middle, tapering stern and rounded nose—that make up the outer shell of the torpedo. These are really big machines, almost as big as the great gun lathes in the gun factory proper, on the other side of the river.

They need to be, of course, for a modern torpedo is a pretty big affair, with a diameter of 21 inches and a length of more than 20 feet. These huge lathes true off the outside surfaces of the shell forgings, reach inside and thin them down to the requisite lightness.

Thus far, no finished torpedoes have been turned out by Shop 70. They are simply building up stocks of parts in the bins and racks, so that when the assembly line is started it may be kept well fed and running smoothly.

During its earlier operation, in immediate post-war days, the Torpedo Station was principally an assembly plant. Finished parts were procured elsewhere and put together here. The present plan, however, calls for complete self-containment. With the exception of a few simple, standardized stock parts, like rivets and screws, every piece of the complex mechanism that is a torpedo will be manufactured on the spot, even the gyroscope steering device and the delicately balanced depth adjuster.

Load Explosives Elsewhere

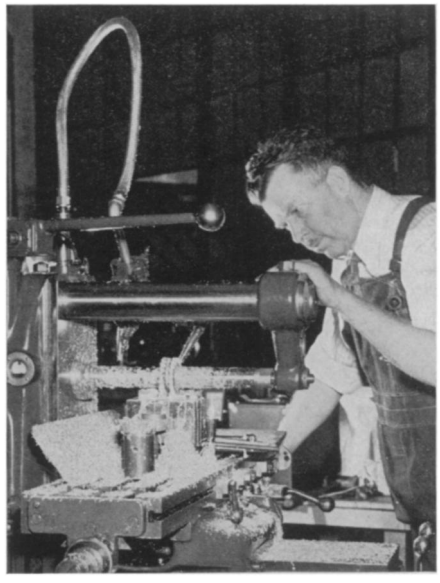
The loading of the high-explosive war heads will, of course be attended to elsewhere. The neighborhood is a bit too crowded to permit the handling of TNT in quarter-ton batches. With this exception, torpedoes will leave Shop 70 as finished products.

When a torpedo is finished at the Alexandria plant, it is wheeled out of the back door onto a wharf on the river. Here it is taken aboard a Navy service boat and carried downstream to the proving range at Piney Point, on the wide water about 90 miles down the Potomac.

Here it is taken in hand by a picked crew of the Navy's best torpedomen and put through its paces. Fired from a tube mounted on a testing barge, it makes run after run under close observation, until the officers in charge are satisfied that it has the accuracy in both direction and depth that will insure proper performance if it is ever launched in actual combat. Then it is permitted to join the Fleet.

During test runs, of course, the torpedo does not carry its high-explosive war head, but a dummy or practice head filled with water. At the end of the run, an automatic mechanism blows the water out, so that the torpedo floats to the surface where it can be picked up and carried back for another run. Under war conditions, the torpedo is adjusted to sink instead of float if it misses its target, thereby removing it as a menace to navigation and also preventing it from falling into the hands of the enemy.

Shop 70 began its career as a war baby. Its construction was authorized by President Wilson in August, 1918. Even



SKILL AND MODERN MACHINERY

Newest lathes, milling machines, drill presses, each with its individual electric motor drive, fill up one floor of the Navy's torpedo plant. Some of the most highly skilled metal workers in the country are employed there.

before the buildings were completed, in 1920, the shop force was at work producing parts, and the first complete torpedo was ready for testing in November, 1920.

After the Armistice there was of course less immediate need for torpedoes, and on June 15, 1923, the station was closed down. Shortly thereafter it was placed under its present jurisdiction as part of the Naval Gun Factory and latterly has been given the designation of Shop 70.

The torpedo, one of the most formidable of modern naval weapons and one of the most dreaded, has come a long way from its crude beginnings two-thirds of a century ago. It was first developed by Robert Whitehead, a Scottish engi-

IN THE STOCKROOM

Within a torpedo's fish-shaped shell is a bewildering assortment of small parts—some 1325 different shapes and sizes in all. Accumulating a sufficient number of these is the biggest part of the torpedo factory's work.

neer managing a factory at Fiume, then an Austrian naval base. He first applied the idea of making compressed air the propelling power, and his name still clings to the greatly improved and enlarged descendants of his brain-child.

Whitehead's first torpedo weighed 300 pounds, carried 18 pounds of dynamite, and reached a top speed of six miles an hour. Present-day torpedoes carry a 500-pound charge of TNT and develop speeds around 40 miles an hour, with an extreme range in excess of 8,000 yards.

There has been a steady increase in torpedo caliber. Early models, before the close of the nineteenth century, ranged around 14 inches in diameter. By World War days, 18-inch torpedoes were giving way to the 21-inch caliber now in general use in the world's principal navies. Until recently, the Germans held to a 19.7-inch caliber, but their newest torpedo craft have 21-inch tubes.

There is some hint of further increases. The French navy mounts a good many 21.7-inch tubes, and Britain's two big battleships, the Nelson and the Rodney, are listed as carrying two 24-inch tubes apiece. All other torpedoes used in the British navy, however, are 21-inch, like our own.

It will require very good and urgent reasons, however, for the U. S. Navy to abandon the 21-inch torpedo for another caliber. On the score of manufacture alone, it would mean a terriffic amount of trouble to change. There are about 1325 parts in a torpedo, and practically every one of them would have to be redesigned if a new caliber were adopted. It is better to stick to one good, efficient model as long as we can, the more so since we have such a heavy commitment in existing torpedo armament in that caliber.

A pronounced contrast to the uniform and standardized torpedo armament of the American navy is provided by the French. They have to provide torpedoes to fit tubes of the following calibers (in inches): 15.7, 18, 19.7, 21 and 21.7. Obviously, quantity production, on an assembly-line basis, must be seriously interfered with.

There has been a decided tendency, in the U. S. Navy, to abandon the mounting of torpedo tubes on battleships and cruisers. Our older capital ships and cruisers mount at least a few tubes, but not our later ones. Whether we shall continue thus to omit them from our larger vessels will probably depend, in part, on the lessons of the present war.

Torpedoes played a considerable role in the cruiser action off the mouth of the Plate river last December, even though no hits were scored, and all reports of the tangled fighting in the first days of Germany's invasion of Scandinavian countries indicate that torpedoes were freely used then. It may well be that the tubes will be given back to light cruisers, at least.

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MILITARY SCIENCE

Super-Tanks, if Used in U. S., Must Cross Railroad Bridges

SUPER-TANKS of 70 to 90 tons or more, such as have taken part in the fighting during the past several weeks, would probably have to cross railroad bridges if used in this country. Very few of our highway bridges could carry such heavy and concentrated loads, and even all but the most massively built railroad bridges might find them something of a problem.

A fully loaded modern freight car weighs about 74 tons—50 tons for the load and 24 tons for the car itself. That puts on railroad bridges a load of the same order of magnitude as a super-tank, although even at that the tank's considerably lesser length would concentrate the weight to a dangerously high point. Yet in spite of all difficulties, American railroad bridges, built for much heavier rolling stock than is used in Europe, would be most nearly able to bear super-tank loads.

Highway engineers figure 22 tons as the maximum permissible truck-length load for even the strongest of our ordinary highway bridges. Heaviest tanks now in use in the U. S. Army, 18 to 20