"One of the most important factors both in defense and in offensive action is protection against injury and disease. Not only are effective medical and surgical measures valuable in relieving suffering and in enabling the wounded to return to duty in a minimum length of time, but every hour that we allow illness to steal from our laborers is a proportional loss in vital materials. Although considerable progress has recently been made in medicine, additional research, especially in the new techniques of chemotherapy, will probably play an important role both in the war itself and in the post-war reconstruction." — From the essay of Marina Prajmovsky.

GENERAL SCIENCE

Scientists Fight the War, Says Westinghouse Head

By A. W. ROBERTSON

Chairman of the Board, Westinghouse Electric and Manufacturing Company

Excerpts from address made at the First Annual Science Talent Search Dinner.

WE THINK of war as being fought with tanks, bombers, aircraft and battleships. But in another sense it is being fought in the scientific laboratories of the country.

Scientists are more interested in war than most citizens. Science thrives best in a peaceful society of free men. Our brothers and fathers are fighting this war to preserve scientific activities as well as to save our lives, our property and honor.

America is about the last country in which a meeting of young science students could be held; either fear or governmental orders would prevent such meetings elsewhere.

In a sense, this war is fought by scientists. Men of science invented and perfected every weapon of both aggressor and defender. It is developing into a war of the scientific specialist—the odds favor the side with the best scientists. It might be thought that science debased itself by thus becoming the handmaid of war. But the fact is, we either win the war or scientific activities will suffer a major eclipse.

Science News Letter, July 25, 1942

MILITARY SCIENCE

Radio Detectors, New Engines, Product of Navy's Research

Director of Naval Research Laboratory Tells Search Dinner of Achievements of Science in Fighting War

By Rear Admiral H. G. Bowen

Director, U. S. Naval Research Laboratory.

Address at the First Annual Science Talent Search Dinner

AT THE time of the last war the research laboratories which existed in this country were relatively few and small. The Navy Department was assisted by the Naval Consulting Board of which Thomas A. Edison was the Chairman. This Board mainly handled inventions, and its report is a very interesting document to read today because it reveals very clearly the confused state of mind in regard to research, engineering developments, engineering testing, and inventions. I am sorry to say that there has not been too much improvement since that time in the proper understanding of the concept embodied in these operations.

One of the most important results of the Naval Consulting Board in which the then Secretary of the Navy, the Honorable Josephus Daniels, concurred heartily, was its decision to establish a Naval Research Laboratory. The Laboratory was not established until 1921 due to the unwillingness to start another activity which could not possibly contribute to the war then in progress. A wise remark of the Naval Consulting Board was, "One of the great virtues of the Naval Research Laboratory is that there would be developed during peacetime a corps of technically trained men who would be familiar with Naval affairs and the present state of development of the arts used in warfare whenever war occurred. They would be able immediately to direct their attention and that of civilian assistants to the operation of war devices. Its technical personnel would be the nucleus for mobilization of scientists for war."

We thus see that in the period under discussion the various phases which must be undertaken before a new product can be launched were not clearly understood, that there was relatively little research going on in this country, and that research did not play a large part in the war of 1917-18 as far as the United States was concerned. The research situation in Germany at this time was completely different. The Allies were very much impressed by the progress of organized research in Germany, and two of the Allies at least, the United States and Great Britain, subsequently profited by the German demonstration of the importance of research.

Research from 1918 to 1941

The development of commercial research in the United States and Great Britain naturally followed different lines due to certain intrinsic differences which exist in the two countries. In this country we have a tremendous domestic consumption which not only warrants but supports mass production. One of the many by-products of mass production is the commercial research laboratory. The rise of the great commercial laboratories since the last war has been truly phenomenal and they have played a tremendous influence in the scientific, the commercial, and the economic field. The commercial research laboratory probably represents the first time in the history of civilization that any art has been self-supporting. The great progress in the United States in engineering has been due to its commercial research laboratories. The commercial research laboratories and industry together have been responsible for placing more men at work than any other influence or agent except the National Government.

Great Britain with a much smaller population and therefore a much smaller domestic market has never approximated the United States in the full utilization of mass production. Research there has been more often associated with manufacturers associations and Government-aided activities.

During the same period, on July 2, 1923, the Naval Research Laboratory was formally opened. In the words of Congress: "for laboratory (*Turn to page 60*)

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and research work on the subject of gun erosion, torpedo motive power, the gyroscope, submarine guns, protection against submarine, torpedo and mine attack, improvement in submarine attachments, improvement and development in submarine engines, storage batteries and propulsion, airplanes and aircraft, improvement in radio installations and such other necessary work for the benefit of the Government service, including the construction, equipment and operation of a laboratory [and] the employment of scientific civilian assistants as may become necessary." Although some of the above-enumerated functions are now prosecuted in specialized laboratories under the cognizance of various Naval bureaus, much purely scientific work is done at the Naval Research Laboratory.

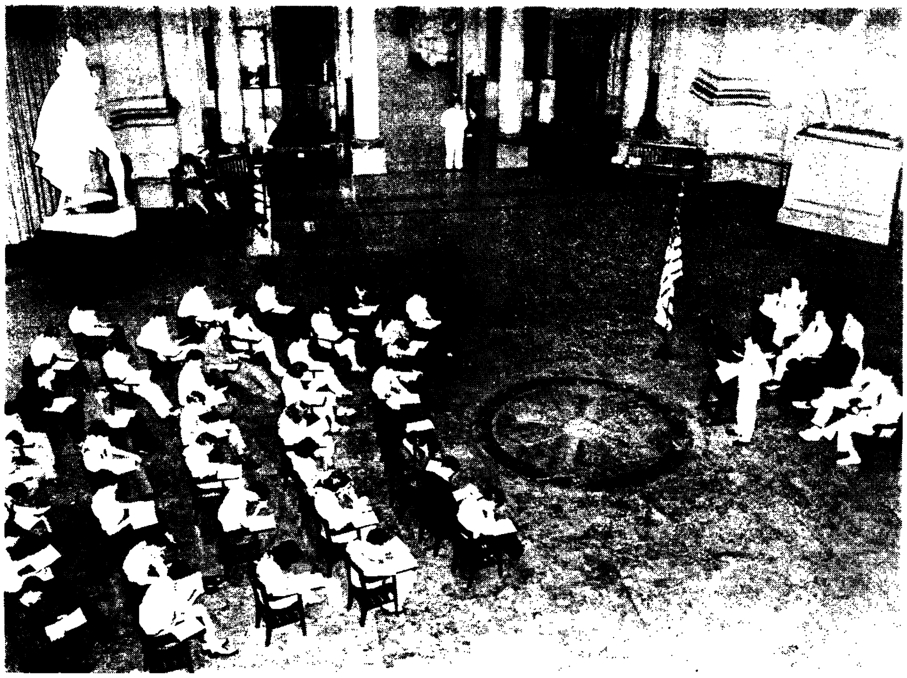
Prior to this time, research in the Navy, principally restricted to radio development, was performed at the Bureau of Standards under a group financed by the Navy Department, and at various other laboratories under the cognizance of the Navy Department.

During all this period from 1918 to 1941, the Navy maintained and still maintains the closest contacts with the commercial research laboratories. The fact that the Navy found itself technologically in such splendid condition at the outbreak of war in 1941 reflects great credit on industry, on the commercial research laboratories, and those of the Navy who were so eager to embody in Naval warfare the best products of industry and the products of industry's best brains.

High Pressure and High Temperature Steam

This short title covers a large and widespread development with an interesting historical background. Prior to 1933 the design of the machinery for Naval vessels was pretty much in the hands of the so-called ship and engine builders with licenses from Parsons Ltd.

You will remember that when James Watt put a condenser on the steam engine, steam engines were quite universally used for pumping mines. It was Watt's invention or development which sent the steam engine to sea and from the time of Fulton on for a great many years the scientific development in steam engineering was to be found on Naval or commercial vessels. In other words, marine engineering led the steam engineering field.



FINAL EXAMINATION

The forty winners assembled in the inspiring surroundings of the rotunda of the National Museum to take their final written examination. Here they are hard at work.

With the invention of the Parsons and the Curtis turbines, and with the beginning under Thomas A. Edison of the great central power plants for generating light and power, the situation gradually changed until the central power plant design dominated the field of steam engineering. Thus, it became apparent to those of us who were in charge of engineering design for the Navy that in our time at least, and perhaps for a long time to come, marine engineering must derive its inspiration from the central power plant. Central power plant performance was much more efficient than Naval steam plants and to effect improvements, pressures and temperature were raised to 600 pounds and 850° F.

This was one of the wisest decisions ever made because the large American turbine manufacturers with their competent research and test facilities behind them were in a position to afford splendid support to the Navy in its effort to bring its engineering more in line with the phenomenal work which had been done in the central power plants of the United States in raising pressures and temperatures due to utilizing the great progress which had been made in metallurgy in this country.

This decision naturally encountered much opposition from those who could not realize that we had passed a big turn in the road; that intense specialization was the order of the day; that we must greatly increase the fuel efficiency of our ships, which of course, adds greatly to the cruising radius. With high pressure high temperature came high-speed turbines with much fewer blades, double-reduction gears, much improved feed-water systems, with the corresponding reduction in the oxygen content of feed water, super-heat control boilers, and many other engineering details too numerous to mention on this occasion.

Flameproof Cable

The development of flameproof cable is typical of the procedure which has happened literally thousands of times where the Navy Department goes to a group of manufacturers and asks them to create something which not only does not exist but is way beyond anything required in commerce and industry.

Multi-Engine Submarines

One of the great accomplishments of this period was the multi-engine Diesel electric drive for submarines. It has enabled us to build submarines vastly superior in performance and reliability to anything which had been produced before. It was developed by the manufacturers of the country and the Navy Department working in conjunction. One of its amazing by-products was the application of these engines to the locomotive, an application which, if my information from the newspapers is correct, has resulted in Diesel electric locomotives constituting half of the locomotives being built in this country at the present time.

Pancake Engine

Recent press releases from the Navy Department announced the arrival of the General Motors Diesel engine for sub-chasers, etc., described as "the lightest ocean-duty Diesel engine in the world" and the "best engine any sub-chaser ever had."

There is a very interesting story behind this announcement.

In July 1937, I went with Commander Leggett to Detroit to inspect the pencil drawings of a new lightweight Diesel engine designed by C. F. Kettering at the General Motors Laboratories. Pencil drawings, that's all—no model—nothing else. Now at that time, there was no interest in this country in patrol boats, sub-chasers and any of those small craft, because the present war was too far away to permit any visualization of the future by most people—in or out of the Navy.

Well, the design looked good and in spite of lack of support, I decided to proceed with the development of this engine and to get myself into the position where I could put this engine on the shelf, ready for an emergency not as yet foreseen by others.

As a result of this meeting in Detroit in early July, I put $250,000 of the Government's money into the development of this engine which at that time existed only on paper, no model having been built. I was positive that Boss Kettering's dream was worth $250,000.

Now, here we have a good example of the field of the commercial research laboratory in the preparation of the Navy for a future war. The building of a radically new engine, revolutionary in space requirements and in weight per horsepower, was initiated before there was any demand for it and while some skeptics were saying it would never be of any use to anyone.

Well, this unwanted baby, conceived in 1937, arrived in 1942 to help us solve a submarine menace never dreamed of in 1937. But the engineers in 1937 were confident that this engine was destined to great future usefulness.

Radio Detection

Another great piece of research work, started years ago, was in radio detection. The details of this can not be told here at this time.

All work on this subject done anywhere stems from the original work of Dr. A. Hoyt Taylor. All the fundamental work done in this country must be credited to Dr. Taylor, Mr. L. C. Young, Mr. R. M. Page and other brilliant associates, all members of the Naval Research Laboratory. This Republic can never repay these geniuses for their outstanding contribution to the National Defense. Through their efforts and the efforts of other equally able men, the contributions of the Naval Research Laboratory in chemistry and underwater sound, to mention only a few subjects, together with radio detection, have repaid the Government all costs of the Laboratory to date and would finance future expenses for an almost indefinite period.

Current Research Situation

I have given you several examples to show how long it takes for the products of research to become of general use.

All the developments in connection with the modern machinery of our Naval vessels were worked out by 1939, a long time before the public ever thought we would get into this war, before the present stupendous appropriations became available, and while we were still building a one-ocean Navy.

The ground work for radio detection was well prepared, well before the outbreak of war; the fact that we are making such rapid progress in developing it to its logical conclusion, the fact that we are building so many Naval vessels so rapidly, the fact that we have pancake engines in production today is due largely to research work done long before Pearl Harbor.

The public should know that the Army and Navy have not been asleep in regard to the prospects of research during the period between the two World Wars. It is indeed fortunate that Congress foresaw the necessity for organized study of Naval problems, and that they established the Naval Research Laboratory. This Laboratory is indeed a reservoir for the accumulated scientific and technical experience of the Naval scientist so coordinated with Naval practice that the experience may be immediately applied to new and changing situations. During the past two years it has in fact been an important and experienced nucleus for the indoctrination of new investigators with the fundamental requirements of Naval research and has also provided a pool of information on the scientific aspects of many specialized Naval problems.

Of course, in time of peace there naturally is not expended the tremendous energy on any subject that is expended in time of war. Men are not available, money is not available, in like amounts, and sales resistance to new ideas is unbelievably high. It is one hundred times as hard to put over a new idea in times of peace as it is in times of war.

But the time to lay the groundwork and to standardize engines and equipment is before the time for large production arises.

The Naval Research Laboratory is required to fill a large field in research, development, and consultation in connection with production, installation and operation. We can't research a product into being, turn it over to a production activity, and then wash our hands of it. As much as we would like to, we can not devote our time exclusively to research.

On account of long contact with industry and the Navy, our scientists are accustomed to build models that, first, are reasonably susceptible to production, and second, are practical to use aboard ship. That means, of course, that the Naval Research Laboratory model doesn't have to be entirely rebuilt by the manufacturer or contractor in order to so reduce its weight or its volume that it can be used aboard ship, or in order to make it susceptible to modern shop methods of production. The Naval Research Laboratory not only furnishes consulting advice to the contractors in the case of its models, but for practically all models produced elsewhere.

After production, installation difficulties arise in the case of radically new and complicated installations. In this case we not only furnish consultation and do installation work, but also train installation engineers. We have had to educate and train operators and maintenance engineers. We assist in the formulation of new tactics which may have to be developed to meet realistic changes required to best embody new equipment in operation. These scientists fly in planes, cruise in surface ships, and dive in submarines.

The Naval Research Laboratory in its work has always enjoyed support from the Congress. The Naval Appropriations Committee of the House under the able chairmanship of the Honorable James G. Scrugham, has enthusiastically supported the Laboratory and supplemented its hearings by frequent and detailed inspections of the problems under way. This encouragement has been invaluable.

The work of the Army and Navy in research and inventions has lately been supplemented by the efforts of the National Defense Research Committee and the National Inventors Council. The work of the National Defense Research Committee has been widely commented on in the magazines and press and there is no necessity for further reference to it here.

The National Inventors Council handles inventions for the Army and Navy, doing in this respect for both services what the Edison (Consulting) Board did for the Navy in the last war. Its work is also well known.

The Navy has been alive to all new ideas down through the years. Of course, if one could be definitely sure that a certain thing would happen in the future, that would permit different dispositions. No nation has ever been completely prepared for war—not even Germany, and wars are fought with what you've got, not something you wished you had.

Pancake engines, extraordinarily economical machinery, radio detectors, etc. are not pulled out of a hat. It takes a lot of work and a lot of time, and if you aren't well along with them when war breaks out—why, they don't fight in the current war.

You can be assured that this country is today by far better off technologically than it has ever been in any other war.

Science News Letter, July 25, 1942

New Machines And Gadgets

Novel Things for Wartime Living

Transportation of glassware and other fragile objects can be made safe by an ingenious new wrapping material. It is made by cutting a system of slits in stiff wrapping paper and then stretching it out into an open network. This causes the paper between slits to stand on edge, and is exactly the process by which expanded metal lath for plastering is made. One advantage over old newspapers is that the objects can be seen through the open network without unwrapping.

Blackout buttons, small nickel-sized disks of methyl methacrylate resin of high reflecting power, have a multitude of uses during blackouts. They reflect the dimmest light, showing up as though illuminated from behind. They can be worn on a belt or used to make directional signs or to indicate danger spots such as stairs, elevator shafts and the like. Each disk has a hole in the center so that it can be nailed, screwed or wired in place. Six hundred of them weight only a pound.

Dry electrically conductive paper has been invented for the purpose of telegraphically transmitting facsimiles. This was previously done with wet paper. The new paper is prepared by dipping it in an electrolyte such as ammonium nitrate dissolved in one of the higher alcohols. The paper is then dried and subjected to heat and pressure. The solvent and the electrolyte melt and form a solid solution within the paper, which is then conductive even when dry.

To reduce spoilage of war machine parts by moisture, an electronic "weatherman" has been developed which keeps continuous watch over the furnace gases used to heat-harden tough steel airplane, tank and gun parts, and detects as little as four-thousandths of one per cent water vapor in the gases. The new recorder is said to be more accurate than the long tests previously made by a skilled technician. Anyone can use it who can read a meter.

Wooden pipe replaces steel culvert. It is made of prefabricated pieces of short lengths of wood, sizes that ordinarily would be discarded. They are light, easily transported, and require no special skill to put together. Used in army camps and cantonments, the wooden pipe is expected to last the life of these projects. For permanent drainage, the usual corrugated steel pipe can be simply threaded through the wooden culvert after the war.

If you want more information on the new things described here, send a three-cent stamp to SCIENCE NEWS LETTER, *1719 N St., N. W., Washington, D. C., and ask for Gadget Bulletin 114.*

Science News Letter, July 25, 1942

Bossy herself may soon supply the lining for *milk cans*—a U. S. Department of Agriculture chemist has invented a lacquer made largely from lactic acid, an ingredient of milk.

Fiber from a common *mallow* species that grows wild in the West Indies, Central and South America, is being substituted in large quantities for East Indian jute in making bags and cord.