

"Time" May 26, 1941.

WAR IN THE LABORATORIES

In modern warfare, one hundred trained physicists may be more valuable than one million infantrymen.

With this judgment of Chicago's famed Physicist Arthur Holly Compton, U. S. scientists and military authorities agree. And this week not 100 but 1,500 U. S. physicists - one out of every four - are absorbed with problems of defense. Furthermore, Director Henry Askew Barton of the American Institute of Physics estimated that research recruits are being inducted at the rate of 100 a month. Steadily the state of physical research in the U. S. is approaching that in Great Britain. There, reported Harvard's President James Bryant Conant, "All research in physics, except on war problems, has ceased" (Time, May 12).

This sensational change in the direction of scientific research has been swift but almost unnoticed. For months, reporters, press agents and conventions have hailed each new can opener, each new technique of making plastics out of faded corsages as a major blow struck for U. S. defense. But on important research for directly military needs, the U. S. has been kept elaborately uninformed - especially on the doings of its major scientific defense agency: the National Defense Research Committee. Last week the Committee relented, released a few cautious details on what it was up to.

NEW WARS, NEW NEEDS. No such agency as NDRC existed in World War I. Military research was random and disorganized in the hands of Army and Navy technicians, of independent industrial laboratories. Bright ideas sometimes went begging. Giving advice when asked, was the National Academy of Sciences. Umbilical to the Academy was the National Research Council. The Academy and the Council are today still nourishing U. S. war measures with invaluable advice.

But the technological nature of warfare has grown until it is its dominant feature. NDRC was created last summer by executive order of President Roosevelt to "correlate and support scientific research on the mechanisms and devices of warfare, except those relating to problems of flight. ..." (These exceptions are the province of the National Advisory Committee for Aeronautics.)

NDRC has two unprecedented characteristics: 1) it is active and eagerly inquisitive, not just advisory; 2) its work is done by civilians, not by professional military technologists. Among the Committee's eight members, Major General Richard Curtis Moore and Rear Admiral Harold G. Bowen ("") coordinate its work with projects of Army and Navy Technicians. But the Committee is free to pluck suggestions from anywhere - from scientists, amateur tinkerers, soldiers in the ranks - and, if an idea looks good, instantly assign the best U. S. scientists to explore it. Unlike the Army and Navy specialists, who cannot stick their necks out, NDRC is willing, in the spirit of all academic and industrial science, to begin four experiments with cheerful confidence that three will be flops.

"All the revolutionary means of killing on a wholesale scale came from... technologists who were not professional soldiers," observes Waldemar Kaempffert, historian of U. S. invention. "Ericsson was not a naval officer but an engineer in private practice. Gatling was a physician and Maxim a Maine farmer. Haber was a cor-

poration chemist Bushnell, Bauer, Holland and Lake ... who brought the submarine to perfection, were all civilians. Lilienthal, an engineer, Langley, an astronomer, and the Wrights, two bicycle vendors and rapairmen... gave us the airplane."

NDRC has no laboratories. It simply asks industrial and academic scientists to drop their regular work, go to work on military devices. Each scientist has a contract with NDRC defining his project. But his salary and laboratory are contributed by his employer, a manufacturer or university. Extra assistants and equipment are furnished by NDRC, whose funds come from the President's private \$200,000,000 defense kitty.

WORK IN PROGRESS. Says NDRC's wiry, cheerful secretary, Dr. Irvin Stewart: "The NDRC is like Hollywood, where just ordinary things are colossal, and fine things are super-colossal. But with the NDRC, everything is secret except what is extra secret." The nature and significance of these secrets are suggested by one secret which leaked: the klystron. This is an instrument in which oscillating magnetic fields agitate streams of electrons until they can transmit power-packed, manageable radio waves far shorter than those now in common use. Such waves have unlimited revolutionary uses in television, telephone, aerial navigation. With them the wireless transmission of electric power has been accomplished. But soon after the klystron's invention by four Stanford physicists, its inventors and their devices disappeared into the dark depths of the Sperry Gyroscope plant in Brooklyn N.Y.

Says Dr. W. R. G. Baker of General Electric: "Transmitting intelligence... may represent but a small part of the total aid radio will render to the military services." Month ago General Electric announced that if had stopped all its normal research on commercial radio & television, frozen its models of receivers and tubes. G. E.'s great research staff, announced President Charles Edward Wilson, will henceforth devote itself to "vital defense production of an electronic nature for which a sudden need has arisen."

If World War II is as long and tough as NDRC Chairman Vannevar Bush expects it to be, the airplane may well have its striking power limited by electronic spotting and firing devices.

Luridest field of NDRC work is atomic power - smashing of atoms to release the locked-up voltages which hold them together. This longtime Sunday-supplement fantasy was consummated on a minute scale in 1939 by the breakdown of a uranium isotope (Time, Feb. 6, 1939). U. S. and German physicists alike are now seeking means of isolating this isotope from uranium ores in useful quantities. NDRC's Bush expects nothing to come of this work, but there is a slight chance - and that chance has such terrifying industrial and military implications that no nation can risk neglect of the problem. "I hope they never succeed in tapping atomic power," says Bush. "It will be a hell of a thing for civilization".

CALCULATOR. Vannevar Bush is a small, eloquent Yankee engineer with an insatiable curiosity and a strong streak of humanitarian idealism. His restless interests range from flute playing and turkey raising to astronomical calculations. A chronic tinkerer, his biggest invention so far is a calculating machine which in a half-hour solves differential equations of several variables (common in naval gunnery and electrical engineering) which otherwise require a fortnight with a slide rule.

Onetime vice president of M. I. T., Van Bush is now president of Carnegie Institution of Washington, world's biggest scientific empire under one management

2) chairman of NDRC; 3) chairman of the National Advisory Committee for Aeronautics. At no time in history has one man held the reins of so much scientific research.

Dr. Bush can direct these vast enterprises only through his talent for delegating authority. He knows every good scientist in the U. S. picks the right man for the right job, trusts him to do it well. His calculating-machine mind moves with genial briskness among intricate, tangential committees and problems. Bush's big think right now is NDRC, yet he can walk through the wind tunnels and shops of NACA's great Langley Field (Va.) laboratories, recognize instantly work begun since his last visit, sometimes make offhand suggestions that save weeks of research effort.

"INTO THE NIGHT". What will be the effects of this focusing of scientific research on military problems? Charles Franklin Kettering, general manager of General Motors Research Division, believes that the prosperity of the 1920s largely resulted from industry's gradual absorption of scientific advances made during World War I. In a recent issue of the American Journal of Sociology, Waldemar Kaempffert developed the thesis that, since the invention of gunpowder, war has been the chief inspirer of science. Even the homely sewing machine, he claims, was invented in 1829 by Thimmonier to make uniforms for the mass armies of Napoleon.

Yet Vannevar Bush believes that the war research under his direction, however vital to the safety of the U. S., represents at the same time not a gain but a long run waste of scientific effort. When World War II is over, of course, out of locked laboratories will come the klystron - and other discoveries - whose civil uses will provide an immense stimulus to industry. But great industrial research laboratories like General Electric's have long encouraged their best scientists to follow pure or "impractical" research, knowing from experience that it leads to the most practical, commercial ends. That is the kind of research that is suffering now.

Worse still, perhaps, is the breakdown of science as an international cooperative effort. Reviewing the work of the Rockefeller Foundation during 1940, its president, Raymond Blaine Fosdick, saw science sinking dismally "into the night". Wrote he:

"The free flow of ideas across boundary lines between laboratories and universities has dried up.... The condition of university life and standards on the Continent is now little short of appalling.... Even when fundamental research is being continued, publication has largely been abandoned or postponed....

"When the German Minister of Justice tells the Association of University Professors that the old ideal of objectivity was nonsense and that today the German professor must ask himself one question: "does my scientific work serve the welfare of National Socialism?" he is voicing a doctrine which if broadly applied spells the end of Western scientific thought."

Perfect teamwork now prevails between U. S. and British scientists working on military devices. Harvard's Conant, a chemist by trade and a member of NDRC, recently spent a month in Britain sharing his secrets, filling his head with new ones. Britain's scientific ambassador to the U. S. is Charles Galton Darwin, grandson of the great evolutionist and head of Britain's National Physical Laboratory.

SCIENCE DEFENDS ITSELF. Like the New York Daily News's Cartoonist Clarence Daniel Batchelor, thoughtful folk often brood on science's responsibility for the ruin and slaughter of technological warfare. Blame cannot be fixed. As Physicist Robert Andrews Millikan has pointed out, "Explosives and fertilizers are basically the same". Like Tartaglia, who founded the science of ballistics in the 16th Century,

scientists in Britain and the U. S. may sometime feel their work on instruments of death to be "a thing blameworthy, shameful and barbarous, worthy of severe punishment before God and man." But Tartaglia consoled himself with the thought that his work helped overpower the terrible, infidel Turks. In Britain and the U. S. scientists are fighting with science in the belief that they are defending science itself.