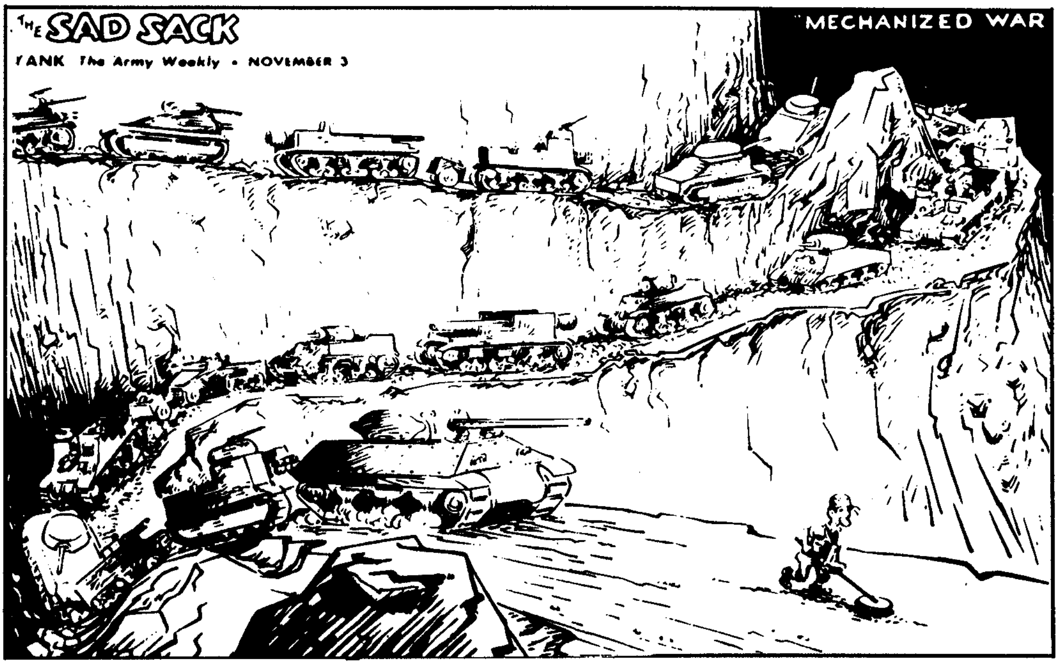
The Portable SCR-625 Mine Detector

by Frank N. Schubert

In February 1942, less than three months after the United States entered World War II, the Army completed a long development process and stood ready to begin production of a small but important piece of equipment, the SCR-625 mine detector. The Army had known that it needed a detector long before the United States became involved in the war. Early interest dated back to studies of the effectiveness of various artificial obstacles in 1937 and 1938. In those years, engineer troops had run tests comparing land mines, antitank ditches, wooden piling, wire rolls, and road craters. The experiments had shown that all of the obstacles would be effective if properly placed and led to further research at the Engineer School.

These assessments were carried out for the Engineer Board, a small organization housed in a World War I barracks at Fort Belvoir, Virginia. The seven-member board, managed on a daily basis during the prewar years by its executive officer, Captain James M. Young, was the research



and development arm of the Corps of Engineers. Despite the large mission, which involved considering and evaluating possible changes in engineer equipment, the board was a low-budget operation. In 1939, it had only 40 civilian employees to go with its handful of officers and a budget of $100,000. The small size of the enterprise allowed for little specialization. Captain Young himself, while seeing to the daily operation of the board, worked on projects involving bridging, construction machinery, and demolitions. The board was a field agency of the Office of the Chief of Engineers and reported to the chief through the Military Division of his headquarters.

While still operating in this framework of very meager support, the board reached its basic prewar conclusions about the utility of mines. These conclusions held that antitank mines alone could be singularly effective obstacles, with other types of obstacles augmenting them as needed. With or without supporting systems, the mines were devastating as well as easily transported, emplaced, and hidden.

The emphasis on the value of mines as obstacles led eventually to investigations of possible ways to either destroy or remove them. Technical responsibilities for mines rested with the Chief of Ordnance, but the mission of detection belonged to the Corps of Engineers. So, in April 1940, the Office of the Chief of Engineers ordered the Engineer Board to study detection and neutralization. The project got under way in earnest in the fall of 1940.

All of the mines that were known to exist in 1940 were encased in metal. This characteristic simplified development of a mechanism to signal the presence of these hidden underground explosives. On 3 September 1940, the engineers asked for help in developing a metallic mine detector from the recently organized National Defense Research Committee. The specifications required that the instrument be able to detect a steel plate 1/8-inch thick and 10 inches square that was buried as deep as 18 inches below the surface. At the same time the detector had to be able to discriminate between mines and small bits of metal, such as the nails in an operator's shoes.

The National Defense Research Committee, established in June 1940 by order of the Council of National Defense, was the brainchild of Dr. Vannevar Bush. It coordinated and supported scientific research on military equipment. The committee supplemented the experimental and research efforts of the War and Navy Departments, including the Corps of Engineers, and also undertook its own projects. It had no laboratories of its own and assigned projects to existing government laboratories, the National Academy of Science in conjunction with the National Research Council, academic institutions with research facilities, and industrial research laboratories. The National Defense Research Committee's successor, the Office of Scientific Research and Development, established by an executive order in June 1941, served as a center for the mobilization of scientific personnel and resources for defense purposes. Most of the research done under its auspices came at the request of the Army or Navy.

For most of 1941, the Engineer Board and the National Defense Research Committee sponsored parallel investigations. Captain George A. Rote of the Corps of Engineers supervised the research for the board. Essentially his project, numbered SF 316 by the board, looked for a device similar to the commercial treasure-hunting detectors then on the market, with the additional possibility of mounting it on the front of armored vehicles to warn them to stop before hitting a mine.

Rote purchased examples of the seven most promising commercial detectors. All of these worked on the basis of radio frequencies. Two transmitters emitted radio beams that canceled each other out except when a metal object got in the way. A receiver detected the changing sound. One product in particular interested Rote. It worked on an audio frequency, with the increased volume of the 1,000-cycle note in the resonator showing the presence of metal. He found this model, manufactured by Hedden Metal Locators, Inc., of Miami, Florida, especially appealing because it was light and had about the degree of sensitivity needed. By the summer of 1941, Rote chose the Hedden model as the basis for further development.

Meanwhile, the National Defense Research Committee contracted with the Hazeltine Service Corporation of New York for the purchase of its detector. The Hazeltine model, which was delivered to Fort Belvoir on 1 August, was heavier and bulkier than the Hedden detector, but Hedden lacked the facilities to make refinements in the instrument for military use. Hazeltine, on the other hand, was well equipped to modify the Hedden-type detector and was awarded the production contract for the SCR-625, which was dubbed "the Hedden-Engineer Board-Hazeltine mine detector" by the authors of the official Army history, *The Corps of Engineers: Troops and Equipment.*

The most prominent feature of the instrument that emerged from this collaboration was the 6-foot exploring rod which the operator held. At the end of the rod was a pie-

An instructor in the Engineer Mine School demonstrates a mine detector to soldiers of the 81st Engineer Combat Battalion, Honsfeld, Belgium, March 1945.

shaped search coil mounted under a wooden disk that was 18 inches in diameter. Strapped to the operator's side in a canvas haversack were the dry-cell batteries that induced a magnetic field around the search plate and amplifier. The resonator was attached to the operator's shoulder. A set of earphones completed the instrument. The entire detector set weighed 7.5 pounds and produced a low hum in the operator's earphones. The SCR-625 discerned metallic mines 6 to 12 inches below the surface, rather than the desired 18 inches, but was acceptable because few mines were ever buried more than 12 inches below ground. It had two serious shortcomings: it was not waterproof and it was quite fragile.

By February 1942, just weeks after American entry in the war, the engineers were in position to standardize this set. The timing was fortunate. That summer, operations of the British Eighth Army in North Africa, in the campaign that ultimately drove the Germans from the Egyptian border across Libya and toward Tunisia, provided the first operational test for the SCR–625. The detector was standardized and put into production by the Army's Services of Supply in September 1942 and was available for the American units that landed in Morocco in November.

Overall, the new detector performed well and became one of the most popular pieces of Army equipment in North Africa. Mines played important parts in the highly mobile campaigns along the coastal plain and adjacent desert as each side sought to channel or impede the movements of the other. Engineer units in North Africa spent as much as half of their time laying mines or lifting and clearing them. Often engineer troops had to probe for them slowly and tediously and at great personal risk with bayonets. The detectors proved safer and more reliable than the bayonets and even surpassed "scorpions"—flailing chains attached to drums that were pushed by tanks and detonated mines that they contacted. Moreover, the supply system worked well enough that detectors generally were sufficiently plentiful for use in clearing long stretches of road, bivouac areas, and airfield sites. They, along with bayonets and a keen and wary gaze, represented the engineer's primary tools for removing mines in North Africa.

Ralph Ingersoll, a journalist and editor who accompanied engineer troops of the 1st Infantry Division in Tunisia, watched many times as soldiers clearing a road walked forward and swung their detectors—sometimes known as outdoor carpet sweepers—slowly from side to side, as if "sweeping with a broom held at arm's length." The detector swept a band 3 to 4 feet wide. In the presence of metal buried less than 12 inches below the surface, the hum produced by the magnetic field increased in pitch. With the search plate directly over a mine, the sound became so high and strong that it was almost a shriek. The deflection of the needle on the meter in the control box at the operator's side also showed the presence of the mine.

When the operator detected a mine, he did not stop to disarm it. He pointed it out to another man following him, who marked the spot. Others came behind them, cautiously unearthed the device, and deactivated it. In his book, *The Battle is the Pay-off*, Ingersoll called the method "simple and foolproof," and boasted that the 1st Engineer Combat Battalion, "which has probably removed more enemy mines than any other single engineer battalion at the front, has not had a single casualty in the process."

The SCR–625 did indeed perform well in North Africa, but proved less reliable during the Italian campaign later in 1943. There were several reasons that such a useful piece of equipment so quickly became inadequate. First of all, the soil in Italy contained substantial amounts of iron ore, which the detector was unable to distinguish from metallic mines. In addition, the Germans responded to Allied success with the SCR–625 by lessening their dependence on metallic mines. Instead they used ever-increasing quantities of nonmetallic Schu antipersonnel mines, which were assembled in wooden boxes. The Germans had used these mines in North Africa, but in such small numbers that they were not a serious problem.

The defects that came to light in Italy underscored other shortcomings as well. Operators tired quickly because of the 7.5-pound weight of the instrument. Moreover, even though the SCR–625 was not used while under enemy small arms fire, soldiers still disliked having to stand upright while using it. Besides, the sets did break down, especially in the rain. So, while it may have been true, as the authors of *The Corps of Engineers: Troops and Equipment* claimed, that "the development of the portable mine detector was the outstanding contribution to the passage of artificial obstacles. . ." during the so-called defense period between the start of American preparation for war and the first movement of our troops overseas, the detector was far from perfect.

Once these defects became known, the Engineer Board team that worked under Rote, promoted by 1944 to major, went in several directions seeking improvements. The program of development changed constantly as the enemy introduced new mines that were lighter and used less metal. Rote worked on a vehicle-mounted detector and experimented with devices that would detect nonmetallic mines, both in combination with a metallic detector and alone. His team also wanted to develop a detector with a shortened arm, so soldiers would not be as exposed while using it.

The modification of the SCR-625 to make it lighter, more rugged, and more resistant to water did solve some of the problems. The coils were compressed lightly into grooves between light and strong balsa wood disks that protected the coils from damage and water. The balsa was also a relatively poor conductor of heat and reduced the susceptibility of the instrument to changes in temperature. Rubber rings, l/Z-inch wide, were added to support the coils, allowing them to resume normal positions after expansion.

A new model, known as the Short-Arm Detector Set, SCR-625 (H), was designed and authorized for procurement at the start of 1945. This modification retained the original

The Short-Arm Detector Set, SCR-625(H).

standard of performance but incorporated two significant changes. At 3.5 pounds, this model weighed less than half as much as the original. A soldier could use the new version while kneeling or prone. The short-arm detector was developed after tests of commercial equipment and improvements that took over one year. However, the project moved quickly once basic decisions were made about the basic approach to be taken. Four months of development and testing culminated in the issue of specifications by the end of October 1944 and the start of procurement in January. The new instrument, which was not introduced in time to be used in the European theater of operations, would have enabled a soldier to feel for trip wires with one hand while sweeping for mines with the other. Also, with a kit, it was convertible in the field to the original size for use in an upright position. Although Rote's team never developed a suitable detector for non-metallic mines before the end of the war, their ongoing research did bring the unit cost of the SCR-625 down from $820 to $491.

The engineer research program did not produce the perfect detector, but late in the war, during the battle for Europe, the SCR-625 still retained some usefulness for troops sweeping roads for metal antitank mines. Soldiers on the western front during the advance across France into Germany in 1944-45 did not encounter the same ore-rich soil that had caused problems in Italy, but many of the roads were littered

Soldiers of the 308th Engineer Combat Battalion minesweep a snowy road in Belgium, 6 January 1945 (left: Corporal Joseph Denucchi; right: Private First Class Dennis Lulowski).

with shrapnel, which caused the same problems as buried ore. The "manhole covers on a stick," as a New York Times reporter called them, picked up everything, while bayonets frequently prodded for mines that were just not there.

Still, the 105th Engineer Combat Battalion of the 30th Infantry Division relied extensively on the original instrument on the campaign across France and into Germany. One day of August 1944, a company of the battalion removed

122 Teller mines. However, the battalion journal reported the limitations of the detector. In October, Company B ran across three small minefields: "The fields contained Schu mines which cannot be detected by the mine detectors so it was necessary to probe the fields." It was back to dependence on keen eyesight and bayonets.

In Europe the SCR–625, even with its later modifications, never attained the level of success reached by the first model in North Africa. Overall, however, it never lost its utility; and the research effort that produced it showed itself to be responsive to the needs of engineers, capable of cooperation with industry, and productive.

Sources for Further Reading

For the best discussion of the SCR–625 in the context of overall development of engineer equipment, see Blanche D. Coll, Jean E. Keith, and Herbert H. Rosenthal, *United States Army in World War II. The Technical Services. The Corps of Engineers: Troops and Equipment* (Washington, DC: Office of the Chief of Military History, 1958).

Also useful is the report of the historical staff of the Engineer Board, "History of the Development of Electronic Equipment. I. Metallic-Mine Detectors," (Fort Belvoir, VA: The Engineer Board, 1946), on file in the research collections of the Office of History, Headquarters, U.S. Army Corps of Engineers.