needed for defending our troops if the enemy had used botulinus organisms in germ warfare against us.

Steps toward developing this defensive toxoid are reported by Dr. Carl Lamanna, Lt. (j.g.) Olive E. McElroy and Ensign Henning W. Eklund. (*Science,* May 17).

Pure white needle-shaped crystals of what is probably the most poisonous known substance per unit of weight were obtained by this group of scientists striving to build our defense against possible germ warfare, or "B.W." (biological warfare) as the scientists term it.

On the basis of the amount the scientists found would kill a mouse, Dr. Lamanna estimated that the killing dose for a 165-pound man would be roughly 0.15 gamma. A gamma is a millionth of a gram and it takes almost 30 grams to make one ounce. The material has about the density of water, but the killing dose would not approach in size even a single drop of water and is too small to be seen by the unaided eye.

This very deadly material is a protein chemical and is believed the pure toxin which causes a severe botulinus food poisoning. To obtain it, the scientists developed a complicated, eight-step method of separation, purification and crystallization.

Science News Letter, May 25, 1946

ELECTRONICS

Peacetime Sofar

Will save lives of civilians ditched or wrecked on across-the-ocean trips by locating exactly the position of the plane or life raft.

➤ THE WAR-DEVELOPED SOFAR system of determining the exact location of a ditched plane or life raft in the open sea will soon play an important part in saving civilians ditched or wrecked on across-the-ocean trips. How the system works was explained by three scientists largely responsible for its development. Stations to cover the California-Hawaii air route will be installed this year.

These scientists are Commodore J. B. Dow and Lt. Comdr. Walter Sands of the Bureau of Ships, U. S. Navy, and Dr. Maurice Ewing of Columbia University, who during the war was director of research in physics for the Woods Hole Oceanographic Institution, Massachusetts. All three were guests of Watson Davis, director of Science Service, on Adventures in Science, heard over the network of the Columbia Broadcasting System.

The SOFAR system, explained Commodore Dow, will make it possible to locate exactly the position of a ditched plane or life raft in the open sea by having three or more shore stations listen with hydrophones for the explosion of a light-weight underwater bomb dropped by the castaways.

In case of a crash, the plane will release one of these bombs either before it ditches, or afterward, and the bomb will sink to a required depth where it is exploded by pressure, Lt. Comdr. Sands added. Each of the shore stations will detect the incoming signal, both over loudspeakers and visually on recorder tape.

The recorder tape will also have second intervals marked on it so that each station will determine the exact time the explosion sound arrived. Each station will then radio the information to a central point at which, by reference to special charts and tables, it will be able to determine the location of the explosion to within a few miles even under the worst conditions. Help to the survivors will then be dispatched.

Dr. Ewing explained how the sound waves travel thousands of miles under water. While engaged in prewar studies and trial tests of the passage of sound under water, he discovered that sound could be heard for horizontal distances of thousands of miles if wasteful reflections could be eliminated, and if sensitive amplifiers and detectors were used to aid the ear.

"Oceanographers had already determined the speed of sound at various depths in the ocean, and found a minimum velocity at a certain depth, with higher velocities above and below," he stated. "The ray paths followed by sound in water are refracted toward regions of lower velocity. Thus, if a small bomb is fired at depth of minimum velocity, a considerable portion of sound from it will be refracted up and down, crossing and recrossing this depth and never encountering surface or bottom."

The underwater sound channel used in SOFAR is over 3,000 feet below the surface. In this channel sound waves take 20 minutes to travel 1,000 nautical miles, equal to about 1,130 land miles. The sounds are picked up by hydrophones lowered into the channel. In tests, a listening station in the Bahamas was able to pick up sound signals from bombs dropped 3,100 miles away. No other natural or man-made sound had ever been heard more than a fraction of this distance, one of the scientists stated.

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