RADIO

"Loran" Guides Pilots

Vast network using radio, not radar, covers over three-tenths of earth's surface. Locates pilot of plane or ship within a mile or two regardless of weather.

By WATSON DAVIS

See Front Cover

➤ SHIPS and planes plying the international air and sea lanes can locate their positions accurately to within a few thousand feet by means of the "loran" navigation system developed and constructed by joint effort of scientists of the Radiation Laboratory of the Office of Scientific Research and Development, U. S. Navy's Hydrographic Office, Coast Guard, and the United States Army Air Forces.

One of the most tightly held secrets of the war, loran consists of a vast network of radio stations which in effect spread into space an electric stop watch accurate to a millionth of a second. By means of a little box, which aboard airplanes weighs only 35 pounds and should cost about $500 in peacetime production, dancing green lines on a cathode ray tube read by the navigator allow him to place the location of his craft with as great accuracy as is provided by celestial navigation based on shooting the stars or the sun with a sextant.

First put into actual operation late in 1942, loran was one of the secret weapons in fighting German submarines in the Atlantic. Later, as the war was carried to other parts of the globe, loran went to the fighting fronts in the air and on the sea with its radio impulses extending over enemy-held territory in order that bombers and ships alike might navigate safely. Now 70 loran stations spray their signals over three-tenths of the earth's surface. A total of 90,000 loran receiving boxes were ordered for war use on ships and aircraft.

The loran network is an excellent example of successful international cooperation during the war, which, American authorities are confident, can be continued in the peace years if the present stations can be kept in operation and various nations will cooperate in providing new service in the areas which they control. To date the American, British and Canadian governments are operating stations and using the signals for navigation. To operate a station costs approximately $100,000 a year and about $8,000,000 a year would be the world cost of providing this essential and superior navigation aid.

Loran is not radar, but it does use radio. By comparing two radio signals from stations separated by about 400 miles, a navigator can locate exactly the position of the craft on the sea or in the air. Simple charts or tables are used.

The determination of position is based upon very accurate measurement of the difference in the time of arrival of signals from two radio stations operating on a frequency just above the broadcast band. The part of the radio spectrum used is that formerly used by amateurs. Signals of the two transmitting stations are precisely synchronized.

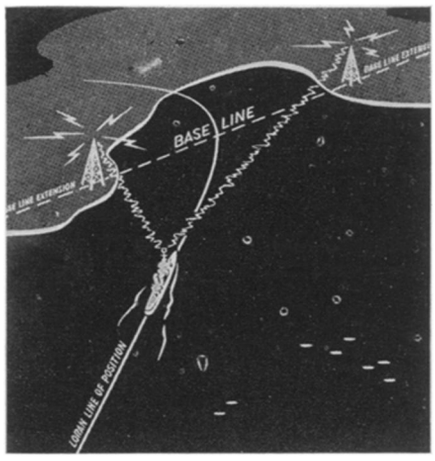
Great Accuracy

The loran receiver determines with great accuracy the difference in the time at which the two signals from the loran transmitting stations are received. Curves are printed on a navigation chart showing the loran lines of position for various time differences. These sweep around the transmitting station's location in the form of hyperbolas. Since the areas of frequent travel by ships and planes are blanketed by the loran signals from several transmitters, the navigator can determine three or four or more such lines of position. Where these lines cross gives the point known as a "fix" which represents on the navigating chart just where the craft is located.

Loran gets its name from the fact that it is a long range aid to navigation (*lo* from long, *r* from range, *a* from aid, and *n* from navigation).

In the daytime loran can be relied upon for 700 miles from the transmitting station, while at night, thanks to the reflection of the signals in the 160-meter band by the ionosphere, reliable determinations of position can be made at twice the maximum daytime range of the transmitters.

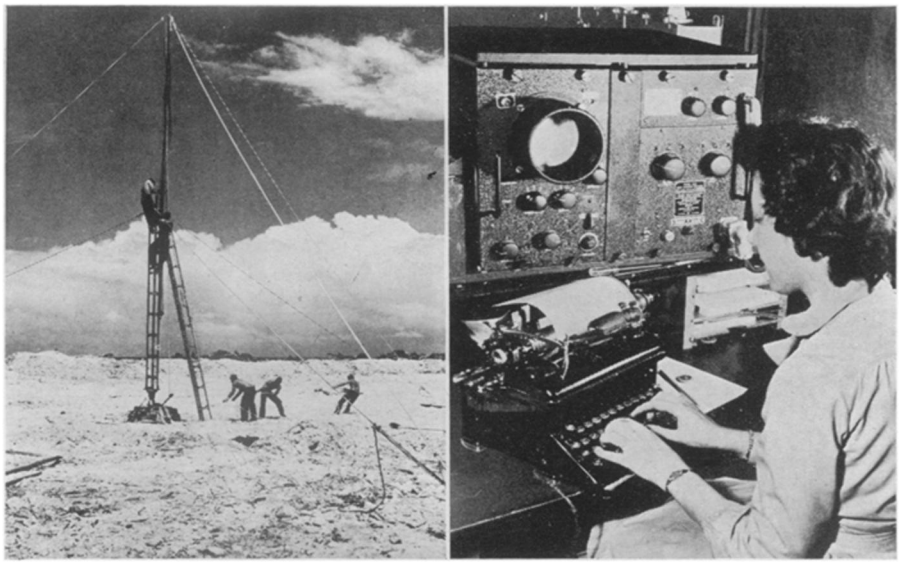
In the fight against submarine warfare, loran was used extensively to enable a ship and an airplane to meet each other. Often in those dark days of the war ships sailed for three and four days, often across the entire Atlantic, relying solely on loran and conventional dead reckoning, because the stars and the sun could not be "shot" in the conventional navigation manner during bad weather. Loran proved much more accurate and safer to use than the ordinary methods of dead reckoning.



ACCURATE—"Loran" enables navigators to place their locations with as great accuracy as is provided by celestial navigation based on shooting the stars or the sun with a sextant. This diagram shows how the impulses go out to ships and planes.

Successful use of airplanes in the foggy Aleutians was due very largely to the installation of loran systems in that area. Loran network and navigation not only kept many transports and cargo planes flying safely but guided bombers and other fighting craft over the Hump in China. As the push was made at extraordinary speed across the Pacific toward Japan, installations of loran stations kept up with the advance. The B-29s that bombed Japan, including the areas of the atomic bombs, were guided on their missions by loran. Altogether about $100,000,000 was spent on loran equipment and installations, but most of this expenditure can be considered an investment for use in building up a world navigation system for sea and air. The cost of research proved to be relatively small, only about 1% of the total.

Only the most severe electrical storms which create a large amount of static will



"LORAN" IN ACTION—On the right is the Loran receiver indicator in use at a monitor station. On the left, a vertical radiator is being erected.

make loran unusable, and accurate positions can be determined even under conditions when other radio signals cannot be deciphered.

The development of loran began in 1940, and it was in an advanced experimental state at the time of Pearl Harbor. The first navigational network was put in operation on Oct. 1, 1942. By the end of 1942, 40 vessels of the Atlantic fleet were fitted with receivers. When the Coast Guard, acting for the Navy, took over the operation of ground transmitting stations in June, 1943, the system was well on its way towards world wide use. In 1943 the Army began installing airborne receivers on bombers.

The British pioneered in developing a pulsed hyperbolic navigation system which they call "Gee" and this method was used in navigating the relatively shorter flights of the RAF over Europe. The inventor of the British system is R. J. Dippy, a small, quiet, former school teacher who worked at the British Telecommunication Research Establishment where major work was also done on radar. Mr. Dippy spent six months collaborating with the American scientists who were developing loran. Loran as developed through American efforts with British cooperation has been put to use not only by our fighting forces, but also the Canadian Navy, the British Navy, and the RAF. Plans are under way whereby loran stations established in other countries, such as Australia, will be taken over and operated by those countries. Canada is already operating stations in Canada.

Principal research and development work on loran was done at the OSRD's Radiation Laboratory of Massachusetts Institute of Technology where Melville Eastham of the General Radio Company of Cambridge, Mass., Dr. J. C. Street of Harvard, J. A. Pierce of Harvard, Dr. J. A. Stratton of M. I. T., and D. G. Fink of Electronics magazine were the principal persons involved. Charts and tables used in loran navigation were produced by the U. S. Navy's Hydrographic Office with Lt. Comdr. F. G. Watson, USNR, formerly at the Radiation Laboratory and earlier on the staff of the Harvard College Observatory, in charge of this work. The U. S. Coast Guard assigned to Capt. L. M. Harding the principal responsibility for supervising the installation of loran transmitting facilities; while the application of loran to air warfare was the work of Maj. Gen. H. H. McClelland and Maj. J. M. Hertzberg. Comdr. Arthur F. Van Dyck, USNR, formerly with RCA, supervised for the Navy the planning of the world-wide network of loran.

The U. S. Coast Guard in conferences to be held shortly is urging the application of loran to merchant marine use as well as for overseas air transport. Along with radar, loran promises to be one of the most important applications of electronics to safety on the sea and in the air. Not only does it provide continuous safe navigation, but permits greater payloads through lower fuel reserve by aircraft.

To give adequate coverage over the travelled areas of the sea and the air a world-wide network of some 150 loran stations would be needed and the maintenance of these is estimated to cost about $20,000,000 a year. Each loran station would cost about $100,000 to construct and about the same amount to operate for a year. Authorities point out that if in addition to fuel savings, safety is increased, resulting in saving of life and property, by the operation of this world system each year, such an annual expenditure would be worthwhile.

Science News Letter, November 3, 1945

SCIENCE NEWS LETTER

Vol. 48 NOVEMBER 3, 1945 *No. 18*

The weekly Summary of Current Science, published every Saturday by SCIENCE SERVICE, Inc., 1719 N St. N. W., Washington 6, D. C. NOrth 2255. Edited by WATSON DAVIS.

Subscriptions—$5.00 a year; two years, $8.00; 15 cents a copy. Back numbers more than six months old, if still available, 25 cents. Monthly Overseas Edition: By first class mail to members of the U. S. Armed forces, $1.25 a year. To others outside continental U. S. and Canada by first class mail where letter postage is 3 cents, $1.25; where letter postage is 5 cents $1.50; by airmail, $1.00 plus 12 times the half-ounce airmail rates from U. S. to destination.

Entered as second class matter at the post office at Washington, D. C., under the Act of March 3, 1879. Established in mimeographed form March 18, 1922. Title registered as trademark, U. S. and Canadian Patent Offices. Indexed in Readers' Guide to Periodical Literature, Abridged Guide, and the Engineering Index.

The New York Museum of Science and Industry has elected SCIENCE NEWS LETTER as its official publication to be received by its members.

Member Audit Bureau of Circulation. Advertising Representatives: Howland and Howland, Inc., 393 7th Ave., N.Y.C., PEnnsylvania 6-5566 and 360 N. Michigan Ave., Chicago, STAte 4439.