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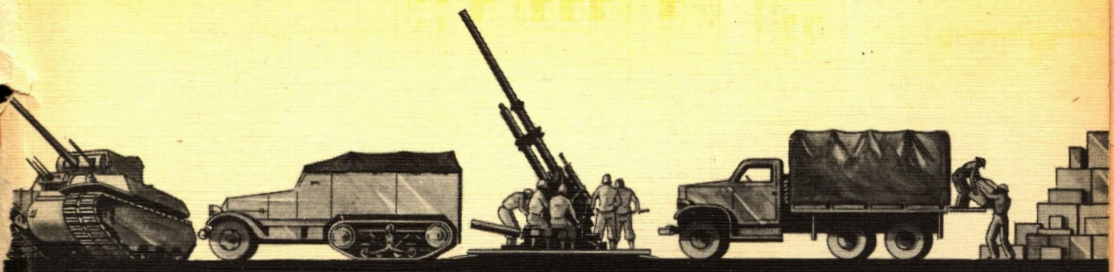

COMMAND AND GENERAL STAFF SCHOOL

FORT LEAVENWORTH, KANSAS

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A MONTHLY REVIEW OF MILITARY LITERATURE

Radio Relay, the War's Great Development in Signal Communications

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General Rumbough was Chief Signal Officer of the European Theater of Operations during World War II.—THE EDITOR.

ON the morning of D+2, 8 June 1944, First Army put its radio link station ashore on Omaha Beach and at 1314 it went into operation from the bluff above the Beach. The Headquarters in Normandy was thus in communication with a similar station on St. Catherines Hill, Isle of Wight, and through that station with the IX Tactical Air Force at Middle Wallop or the 21st Army Group, near Portsmouth, and through switchboards at these headquarters with the general wire system of the American and British armies in Southern England. This inaugurated the use of radio relay in United States operations in the European Theater.

Colonel Grant Williams, Signal Officer of the First Army, and Colonel E. Blair Garland, Signal Officer of the IX Tactical Air Force, were responsible for the success of radio relay. This was not ordinary, old familiar radio, with a single channel, an isolated circuit, separate from the general communication system. This new radio relay system was multi-channel; it had several speech circuits and several teletype circuits and it transmitted pictures and sketches. Perhaps the most striking feature was that it connected directly into the telephone and teletype switchboards at either end. These radio circuits thus became much more efficiently usable, being the approximate equivalent of wire circuits. Moreover, the equipment was more stable, more reliable and more easily kept in operation than we in the European Theater of Operations had dared hope. We had feared that operation would be "tricky" and that only long-trained "experts" could handle the equipment. This proved not to be the case.

This was new equipment; development had been rushed through the laboratories; the manufacturers were building the equipment under intense pressure from the Chief Signal Officer. Shipments were being made to us in the ETO as rapidly as the sets could be seized from the production lines. And this intense pressure to manufacture, to ship to the Theater and to issue to the troops continued to saturation. Tables of Allowances had not caught up with this equipment. At Theater Headquarters we kept informed of the relative needs of the several Army Groups, Armies, Air Forces, and forward sections of Communications Zone, and as new shipments were received we issued the equipment immediately in accordance with requirements. On VE-day there were sufficient sets issued in the ETO to provide 296 point-to-point installations or seventy-four 100-mile systems, each of these seventy-four systems comprising two terminal stations with spares. These quantities were actually in the hands of users on VE-day after certain small combat losses had been replaced.

Radio relay equipment is a revolutionary development in communications. Looking to the future of the Army, it seems certain that radio relay will have an important effect on the make-up of new tables of organization of communication units from the division all the way back through the Communications Zone. Its general features will be studied at the service schools because it will be a potent factor in the control of military operations. Every commander and every staff officer who is responsible for operations will want to know what service he may expect from radio relay; he will be interested in its mobility, its transport and its location in his road columns or landing craft and in how to direct its general employment. This brief article will be restricted to general features of the equipment; it will be non-technical.

Radio Relay Competes with Wire

Most of the radio relay equipment in the

European Theater was used forward of Army Group Headquarters. Here it competed with field wire, with spiral-four cable, with rehabilitation of French, Belgian, and German open wire and cable and with Signal Corps construction of open wire and cable. All these types were used and each had special advantages in special situations. For long-term use, newly constructed standard type open wire or cable circuits were best in quality and reliability, but they were most expensive in time, in troops and in transportation. Such construction could not keep up with the rapid sweep across France from Normandy to the Siegfried Line.

Rehabilitation of French open wire and cable was indicated whenever a tactical axis followed an existing circuit route. However, destruction had been severe. Our own air bombing had destroyed enemy air fields, railroad yards, bridges and other military objectives and, with them, all the communication lines in the vicinity. In their retreat, the Germans had effected widespread demolition, including repeater stations and any bridge and bridge-supported cables which had not already been destroyed by our air bombardment. In addition, there was much battle damage to wire lines and cables. As a result, considerable time and effort was required to restore existing lines and cables to operation, and in many cases destruction was so complete that forward units could not rehabilitate lines in time to meet their requirements. It remained for Communication Zone troops and French telephone men to place these lines and cables in service to serve as the backbone of the rear area communication system to control supply, administration, and evacuation.

Field wire could be laid rapidly; it was used in enormous quantities, over 900,000 miles being consumed in the ETO during the eleven months of operations, 105,000 miles of it during the last month prior to VE-day. However, field wire was suitable for distances only up to about twenty miles. Spiral-four cable was the closest competitor of radio relay. It could be laid rapidly in the manner of field wire, placed on the ground, tied to trees, draped on top of hedges. But, eve though tough and heavy, it was not proo against black-out traffic, road repair opera tions, construction projects, tanks moving o the road, and other hazards of congeste areas. This field wire type of constructio was permissible for short distances whe circuits had to be produced quickly, but fo longer leads it was subject to too many in terruptions and required excessive numbers o maintenance men. For long circuits involving repeater stations, spiral-four was placed overhead and tied up carefully, usually being suspended from messenger wire.

It was the general case, rather than the exception, that long circuits were required or desired faster than any type of wire circuits could possibly be installed. The big advantages of radio were that it could be put into operation quickly and it needed few maintenance men. Radio relay retained these advantages and had the additional ones that a single installation furnished several telephone and several teletype circuits and that each of these circuits became a part of the general communication system and was readily connectible with any telephone or any teletype machine in the system. The virtues of radio relay were striking and of vital importance. The equipment was in tremendous demand by the Signal Officers of all Army Groups, Armies, Air Forces and forward sections of the Communication Zone. Demands were so urgent that the Theater Signal Officer found it desirable personally to receive requests for it and to direct issues of new equipment as it was received.

What the Equipment is Like

Radio relay differs from the usual field radio equipment in several important respects. One is that it remains in operation continuously. Its circuits are out of service for only a few minutes each day while the circuits are being realigned and the equipment maintained. This period is generally designated as a precisely fixed time shortly before dawn or at some other time when the circuits are expected to be in least demand. Care is taken to have spare transmitter, re-

ceiver, gas engine generator, extra tubes and other parts at each station and to have a radio repairman and a power equipment maintenance man on each shift. The sets are used in rotation and as soon as a switch is made, the attendants check the equipment which has been removed from service and prepare it for operation in its next turn or for immediate use if trouble should develop in a component which is currently in service. Anyone who has been responsible for the operation of small stationary gas engine driven power plants would probably guess that this was the most difficult part of the equipment to keep in operation; this guess would be correct. Eternal vigilance was necessary on the part of the gas engine maintenance man and high standards of maintenance and good supervision were required of the officer in charge of the system. When stations were dependent on their own small power plants, as was usually the case with relay stations, since they were generally located on isolated hill or mountain tops, and as was often the case with terminal stations, the officer in charge generally had a specified schedule to shift from one generator to another at each station. A procedure used in the ETO was to make the shift every three hours, changing over instantly and simultaneously on a signal transmitted over circuit number one, the engineering circuit, all stations having been alerted a few minutes before the schedule time and all switching immediately on the signal. At each new location, the station crew explored the possibility of taking the station's power from any nearby Diesel, large gas engine driven generator or other source of electric power in order to save wear on the station's own small, light-weight equipment. No claim is made that radio relay operated perfectly in the ETO. However, by reasonable standard, it was "reliable." Its performance greatly exceeded our expectations.

Another difference from usual field radio equipment is that radio relay is duplex in operation; that is, the transmitting and receiving circuits are both in operation continuously; both are "on" simultaneously. With the usual field radio it is impossible for the listener to break in on the talker because the latter's receiving circuit is "out" while his transmitting circuit is "on" and he could not hear an attempted interruption. Since both the receiving and transmitting circuits of radio relay are in operation continuously, the listener can break in at any time. This makes the conversation natural and more efficient of circuit time; it is like talking over a wire telephone circuit and, in fact, the users would not know whether they are talking by radio or by wire except that the switchboard operator cautions when the connection is made, "You are using a radio circuit; you are cautioned not to divulge secret or confidential information." Some Signal Officers believe such a caution redundant since it is also forbidden to discuss secret or confidential matters in the clear over wire circuits. This duplex operation necessitates the use of two frequencies between each two stations in the chain, one to carry the conversation one way and the other the other way. A hundred-mile set-up using three relay stations and two terminal stations has four station-to-station links, and since the frequencies must not be duplicated within this range, such a chain of stations uses four times two, or eight different frequencies. This is expensive of frequencies, of course, but there are 300 frequency settings available within the thirty million cycle band of the equipment, which covers from 70 to 100 million cycles. The equipment is frequency modulated and thereby is less subject to interference than if amplitude modulated.

Another important difference between radio relay and usual field radio is that the latter is single channel whereas radio relay can be, and almost always is, used in conjunction with telephone and telegraph carrier equipment to produce several channels of each. The field telephone carrier produces four telephone channels and telegraph carrier can be superimposed on one or more of these telephone channels to produce four teletype channels for each telephone channel so used. The possible combinations are: four telephone and no teletype; three telephone

and four teletype; two telephone and eight teletype; one telephone and twelve teletype or no telephone and sixteen teletype. The combination which usually best fits the need is three telephone and four teletype.

A fundamental disadvantage of radio is that it is subject to interception. The radio relay equipment used in the ETO had this disadvantage, but to a less degree than the usual type of radio. Radio relay employs such very high frequencies that reception is restricted almost to line of sight; moreover, its di-pole antenna is beamed on the distant station with which it works and the angle of dispersion is relatively narrow. Hence, in order to listen in on a transmission over one of these circuits, an enemy would have had to be either very near the station or else be almost in line with the two stations and up on an elevation. We monitored various of our radio relay circuits from time to time and found considerable information being transmitted which was dangerous and which would have been more dangerous if our armies had been in static position. It was verified when higher German headquarters and installations were captured and through investigations after VE-day, that the Germans did have the ample and efficient radio and signal intelligence organizations which we had expected them to have. However, these services operated under the serious disadvantage of being forced frequently to withdraw their stations to the rear under the pressure of our advance. This handicap applied particularly to elements which would have had to be located close up to the front in order to intercept our short-range transmissions such as radio relay. It would be impossible to make an authoritative statement that the Germans had never intercepted important radio relay traffic but it is believed that they did not. At any rate, nothing occurred during the operations to indicate that they had made use of any intercepted American radio relay message. It was fortunate for us that radio relay was needed urgently only during rapidly moving phases of operations and that when, from time to time, our advance was temporarily checked, time became available to install spiral-four cable or open wire or to rehabilitate existing wire or cable circuits and thus to be able to relegate radio relay to stand-by or emergency use. However, and in spite of our good fortune in being able to use radio relay rather freely in the European campaigns, it should never be forgotten that speech in the clear is dangerous over any kind of circuit and particularly over radio circuits, and that even though radio relay is less insecure than normal field radio, it must be used with caution. Our written message traffic was well protected by our cryptographic systems but we did not have available voice secrecy equipment for application to radio relay circuits.

Speed and Economy

The characteristics of radio relay which made it outstanding in fast-moving operations were its speed of installation and its economy of personnel and transportation. In World War I the speed of attack was that which infantry could make through organized defenses. Each mile was won at the cost of terrific losses and the attack thus became weaker and weaker until it was halted through sheer exhaustion. Even the most carefully prepared and prodigally supported "drive" with selected units in the assault and backed up by reserves massed in rear, lost its punch within three or four days. Five, six, a dozen miles was termed victory.

But World War II moved swifter and farther. The basic pace was that of mechanical vehicles and the speed with which the armored spearhead could be supported. Immediate support was by infantry in trucks and by air bombing and strafing. This immediate support was followed by infantry on foot, mopping up and cleaning out pockets of resistance but with other elements moving forward in route column. Further support was given by the advance of weapons of all types, by supplies moving up by road and railroad and with more urgent shipments by air. Close air support was essential and this meant that damaged enemy air fields had to be repaired and new ones constructed close

behind the forward elements. Evacuation of wounded had to be taken care of daily, hourly. Once the enemy defensive line had been breached in Normandy, the attack moved so swiftly as to prevent the defeated troops reorganizing a defense in Western France, and for 400 miles the attack pushed with incredible speed against an enemy who was being by-passed, confused, routed in detail and blasted from the sky.

None of these things could have been done without direction and coordination, and when one thinks of direction and coordination he is thinking of signal communications. Effective communication was the key to the success of our operations, and during the vital periods when those operations were moving fast, radio relay was the key to effective communications in the forward areas. Radio relay could be installed quickly, it could be moved swiftly to meet a changing situation, it carried great volumes of traffic and it made minimum demand on road space, on personnel and on our hard-pressed supply system.

The great advantages of radio relay over wire circuits which could carry equivalent traffic is shown best by figures. Material for a 100-mile wire line with four wires weighs ninety-four ship tons, whereas radio relay for that distance weighs only twenty-five ship tons. The construction of such a wire line would take four battalions, or 1,820 men ten days, while forty-four men can install the equivalent radio relay and put it into operation in two days or less. Moreover, after the wire line has been constructed every foot of it is vulnerable to bombing, sabotage, demolition, accidents from vehicles; even buried cables were cut by bulldozers, graders, etc.; whereas a radio relay system is subject to trouble at only the two terminal stations and the two or three relay stations, and there are always alert men at each of these points to prevent or to correct immediately any interruption.

The equipment is adaptable for installation in trucks or trailers or in the Hut HO-17 (modified for increased headroom), this hut being designed to fit in the 2½-ton, 6x6 truck body and to be readily removable (by crane) for placement on the ground at the site selected. At Bristol, England, in April 1944, the First Army installed the pilot model of its radio terminal equipment in a one-ton trailer in less than two working days. Additional installations were made rapidly and were completed in time for the Normandy invasion. The carrier terminal equipment was installed in a 2½-ton, 6x6 cargo truck and this truck towed the radio trailer. Thus the entire equipment for the terminal for three telephone and four teletype circuits and the operating personnel was placed on the road as a single truck and trailer unit. Complete equipment for a relay station was installed in a 1½-ton, 6x6 truck. Many different variations of these installations were made in the ETO, and almost invariably each crew which made an installation felt that it had the perfect solution, that it had the neatest and most efficient setup in the Theater.

When used at and forward of Army Headquarters, stations are apt to move frequently and it is a great advantage to have the equipment installed in a vehicle, but for rear area stations it is generally more convenient and certainly more economical of transportation to set up in a building or tent and thus to release the transporting vehicles for other duty. When this is done, of course, there must be longer notice of an impending move and high priority must be given for the necessary vehicles to carry the equipment and personnel to the new site.

Figure 1 shows a terminal station in a tent. Outside the tent there are two antennas, one for receiving and one for transmitting, and at least two gas engine generators, one in operation and one or more in stand-by position. Figure 2 shows a relay station installed in a half-ton weapons carrier. A generator is shown outside and, beyond it, the mast of one of the four antennas; one of these is for receiving and one for transmitting up the line, and one of each for down the line. Figure 3 is a pictorial view of a system with two terminal and three relay stations.

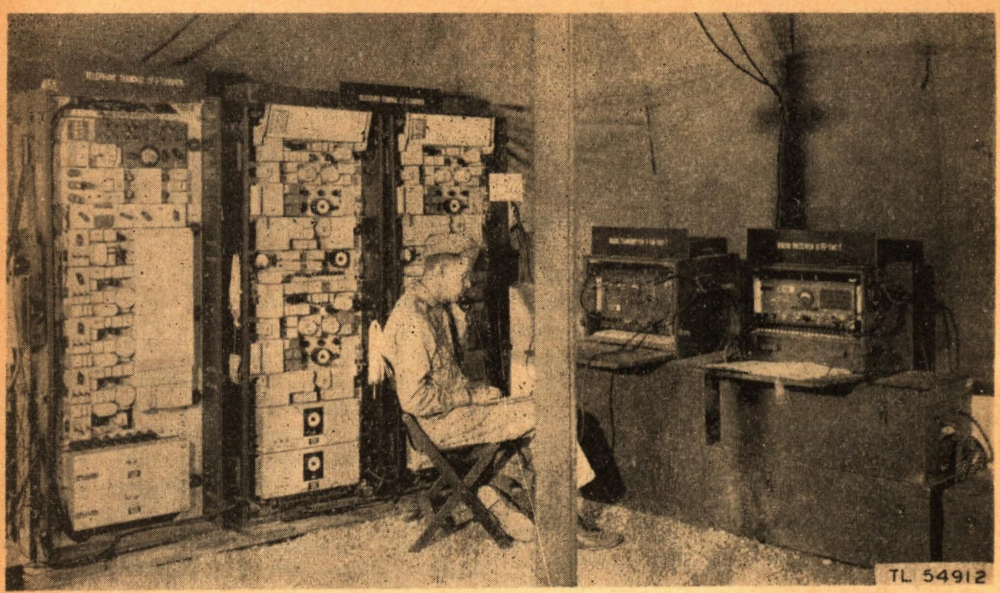

Figure 1.—Radio relay terminal station in tent. Left to right are CF1 telephone terminal carrier, two CF2 teletype carriers, radio transmitter and radio receiver.

Radio Relay in Operations

Specific examples of the use of radio relay show its value. Radio relay made its reputation from the start, in North Africa, in Sicily and in the first campaigns in Italy, even though this early equipment provided only a single duplex channel of teletype. The first long circuit was from Allied Force Headquarters at Algiers to Hill 609 in Tunisia and thence to mobile stations at Bizerta and Sidi-Bou-Said (near Tunis). The total length was 379 miles using four relay stations. The longest span was 120 miles between the relay station on Tourka at 4,900 feet elevation and the relay station on Djebel Ouasch at 4,200 feet elevation. This circuit carried the bulk of operational and administrational traffic for the II Corps, the load reaching a maximum of 16,000 words per day, 12,000 with Algiers and 4,000 between the forward terminals. Due to the rapid movement of II Corps Headquarters and the great distances covered it was impracticable for wire circuit construction to keep up with the advance. Hence these radio relay circuits were vital to the operations.

From the opening of the Sicilian Campaign on 7 July 1943 until 9 August 1943 a duplex radio teletype circuit was operated between Sidi-Bou-Said and Malta with relay stations on Cape Bon and Pantelleria, a total distance of 243 miles, all over water. The longest span was that between Pantelleria and Malta, 148 miles. The station on Pantelleria was at an elevation of 500 feet and that on Malta 800 feet; application of the formula for line of sight gives seventy-two miles as the limiting distance but communications were good in spite of this doubling of the theoretical limit.

Radio relay was the main reliance between Anzio and Headquarters Fifth Army at Presenzano and this installation illustrates flexibility in the routing of radio relay. There is a high range of mountains on the direct route; these were in the hands of the enemy and therefore unavailable for radio relay sites. The solution was to place the relay station back near Naples, far in rear of both

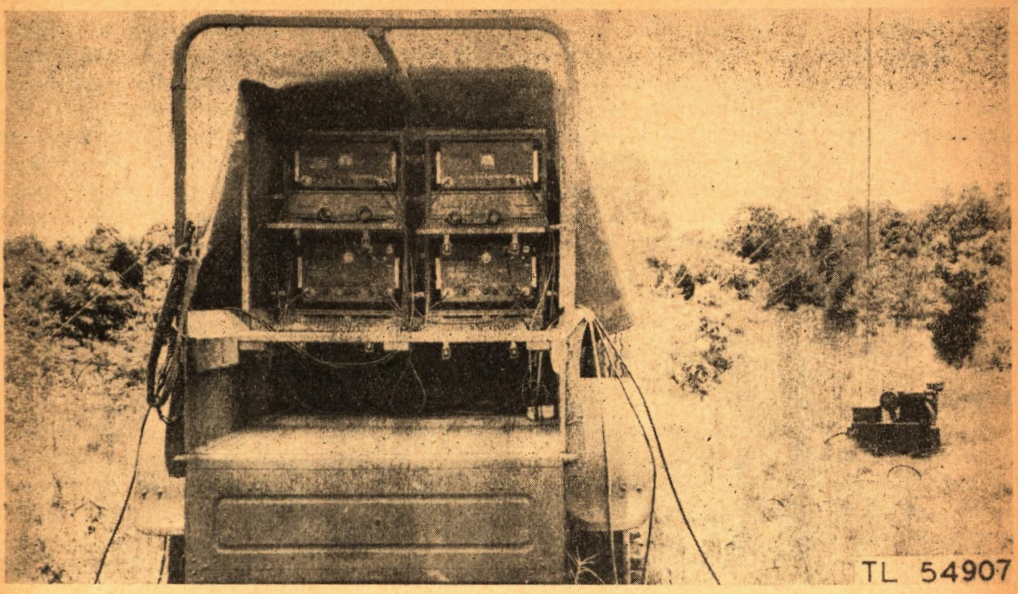

Figure 2.—Radio relay station in half-ton truck. The mast of one of the four antennas is seen in the right background; one antenna is for receiving and one for transmitting up the line and one of each for down the line. One of the two or more generators is shown to the right of the truck.

terminals but with a good line of transmission to each terminal. Traffic reached 20,000 words per day, furnishing instantaneous communications from Army to VI Corps and through the Corps teletype switchboard direct to the divisions in the Anzio operation.

Mention has already been made of the circuit acros sthe English Channel to the Normandy beachhead and of the sensation created by this first tactical use of multichannel radio relay. The Cross-Channel span was eighty-three miles although the calculated limiting distance for the 800 feet elevation of St. Catherines Hill and the 160 feet of the Normandy site is only fifty-eight miles. The value of these switchable telephone and teletype circuits and of the facsimile transmission of information and targets on aerial photographs was very great.

It became routine procedure early in the Normandy operations to install radio relay channels paralleling wire channels between Army Group and Armies and between Armies and their respective Corps. Whenever considerable distances separated Corps and Division command posts, radio relay channels were also used by Corps to assure communication with the distant Division command posts. There were hundreds of these forward area circuits installed. They were usually put in quickly, were operated as auxiliary circuits; sometimes, and especially immediately after a long move, as the sole speech circuits. When CP's moved again, these radio relay installations were pulled out and were reinstalled to serve the new locations in phase with the progress of the operations.

Radio relay was also vital for long circuits in the rear areas. Owing to battle damage and German demolition, it was frequently impossible to rehabilitate enough French, Belgian, or German cable or open wire circuits to carry the vast volume of message business. Radio relay proved an excellent solution, the sole solution in many cases, because priority in assignment of signal construction units was given the forward elements; their need for construction progressed

across the Continent and was never ending. From D-day to VE-day and afterward, the ETO Signal Office received daily pleas from Armies and Army Groups, "Send us more line material, more construction troops." A few construction units had to be allotted the Base Sections of the Communication Zone in order that they might be able to maintain the rear area lines on which supply to the front depended and in order that they might furnish communications to new ports and depots as the operations moved eastward, but there were seldom any construction units available to build new lines in the rear. Consequently, reliance had to be placed upon rehabilitated civilian lines. These were often too meager to provide the circuits required and when this was the case we often resorted to radio relay. There were radio relay circuits from Paris to Cherbourg, to Deauville, to London, to Nemur, and to Vittel. The Air Force also had a considerable network of radio relay circuits tying in from Headquarters at Chantilly, near Paris, to their Advanced Headquarters, to their Tactical Headquarters, to Bombardment and to Fighter Wing. The Ninth Air Force had the distinction of having the longest radio relay circuit in the ETO, that between Chantilly and Bad Kissingen, Germany. This circuit used two terminal stations and eight relay stations. The sum of the distances between stations was 410 miles and the direct air line distance between the terminals was 390 miles. In spite of the long distance and eight relays this circuit was "in service" about ninety per cent of the time.

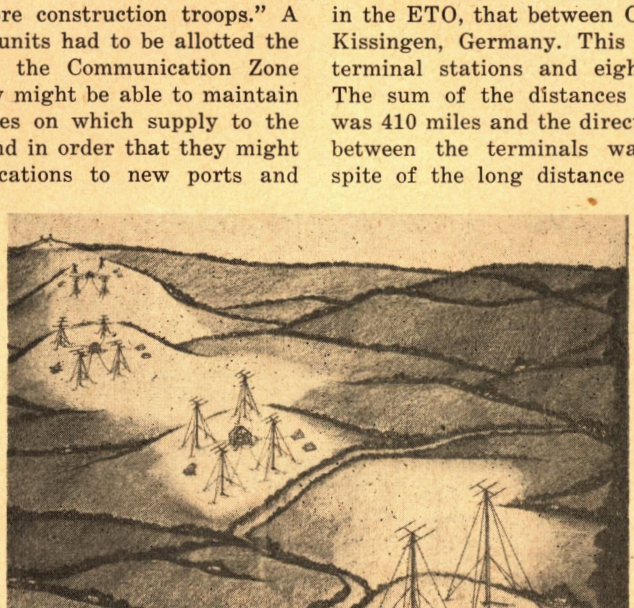

Figure 3.—Pictorial view of multi-channel radio relay system, showing two terminal stations, one in the right foreground and one on the skyline in left background and three relay stations between the two terminals.

Another use of radio relay resulted from a bitter experience at ETO Headquarters. Our big 40-kilowatt radio station for communication with Washington was located about twenty miles southwest of Paris. It was keyed from the Signal Center Blockhouse in Paris by French circuits in the Paris-LeMans cable. Unfortunately, this cable skirts the edge of the railroad yards at Trappes and this yard had been heavily bombed by our Air Force. French and

American cable splicers had repaired this cable when the headquarters of ETO moved from Valognes to Paris early in September 1944. The cable was put into service; the circuits operated well and we settled ourselves to what we hoped and expected would be an indefinite and uninterrupted use of the cable. We felt our U.S. link secure. But such was not the case. A heavy rain, a thorough soaking of the ground, moisture in the cable through two unsuspected cracks in the sheath and out went our vital keying circuits. The obvious remedy, and one quickly applied, was to place an additional radio relay station atop the Eiffel Tower, another at the big radio station, and thus to restore the direct keying circuits. Losing them once was enough. When the cable was restored we went back to wire circuits but we did not remove our radio relay paralleling link and it saved our Washington communications when the cable failed the next time. We learned in September 1944 that new troubles may occur at any time in a bombed cable. One might think that a thorough soaking would penetrate every crack or pin hole of a buried cable and that all prospective troubles might be thus revealed and repaired at one time; but such was not the case. A prospective trouble might survive the first heavy rain and succumb to the second or to the third or fourth. Troubles were unpredictable. Ability to bridge a gap, such as this twenty-mile link from signal center to radio station, was a most valuable asset to a signal officer and, in the ETO, we all tried to keep two or three radio relay stations in reserve for such an emergency.

Colonel Grant Williams, Signal Officer, First Army, thus describes the use of radio relay at Bastogne: "In November we had done some experimenting using the Radio Link, AN/TRC-3, in a moving vehicle. We had a complete terminal set with CF-1 and 2 carrier equipment and a teletype machine mounted in a truck. When it looked as if the 101st Division was going to be surrounded at Bastogne, the Corps Signal Officer (whose young assistants had done the building) sent the truck towing a trailer (with an additional terminal set as a spare installed) into Bastogne. It was the last vehicle to enter the town before the Germans completed their encirclement. The trailer was hit and destroyed. However, the truck was undamaged, and throughout the entire period until they were relieved, the Corps had telephone and teletype communication with General McAulliffe. Wire communications would have been impossible, as naturally the Germans would have cut the lines. Ordinarily, now, I keep the Radio Link as a stand-by, but whenever, due to line failures, the number of channels to any of my units falls below a fixed standard that I have set, the Radio Link is placed in service and remains in service until the wire facilities are completely restored. It is the best agency we have to meet the unusual, the unexpected and the difficult situation. Going back further, I may say that the rapid advance of late last summer across France and Belgium would have been much more difficult and certainly slower if we had not been able to maintain an adequate scale of communications by its use. Never had field armies like the First and Third had communications on such an adequate and successful scale, entirely due to unimaginable hard work and such equipment."

Radio relay was also valuable in the Pacific. Used at Hollandia in May 1944, it furnished circuits quickly. While the links involved were short (six, two and fourteen-mile jumps) the terrain was rugged or swampland and the roads were narrow; the radio relay circuits served well until replaced by pole lines. Prior to the Leyte landing, several small ships had been allotted as floating communication centers and had been equipped with radio relay and associated carrier equipment; also a 1½-ton truck had been made into a radio relay terminal. At H+2 hours, LCM's carrying this truck and additional radio relay equipment for other shore-based stations, headed for Red Beach; within twenty-five minutes the truck station was in communication with the ship stations. At H+5 hours, General MacArthur went ashore and made his famous "I have returned" broadcast. This speech was picked up from shore by General Headquarters afloat

and was rebroadcast to the Philippines. A Signal Corps communication ship recorded the broadcast and it was retransmitted to the United States later that day. Twenty-two radio relay terminals were used in the Leyte operations, handling telephone and teletype operational traffic and broadcasts.

In preparation for the Luzon operation, six 2½-ton trucks with trailers were fitted as mobile radio relay terminals; these performed indispensable service in the landing at Lingayen Gulf and in the subsequent rapid advance to Manila. Dagupan, twenty-five miles to Camiling, twenty-seven miles to Tarlac, twenty-four miles to San Fernando, twenty-two miles to Malolos, thirty-two miles to Manila, each was first the forward terminal and later, by back-to-back installations, became the relay station along the route of reconquest. By 10 March 1945, sixteen radio relay terminals were handling seventy-five percent of voice and teletype traffic in and out of Manila to remote points on Luzon.

These examples show that in World War II, radio relay has furnished thousands of vital circuits which could not have been provided as quickly by wire construction even though our forces had been provided unlimited numbers of signal construction troops and even though these troops had been given "clear the road" priority for bringing up their poles and wire. Four battalions, a total of 1,820 men, would require about ten days to construct a four-wire pole line one hundred miles long; radio relay teams totaling forty-four men can install their equipment and provide equivalent circuits in less than two days. These figures—2 days against 10; 44 men against 1,820; 88 man-days against 18,200—show why radio relay, competing for the title against many items of new and marvelous communication equipment, both wire and radio, is called the communication sensation of World War II.

With the great strides being made in the means of making war, whereby an enemy may strike swiftly and in great strength, I feel that we should have the means to insure better and quicker action. On my experience as a combat commander in the field only, I am convinced that we must have unified command in time of war. That experience, viewed against the background of varied service during the peacetime years when it was my responsibility to participate in the training of our ground forces, impels me to conclude that unless there is unity of control at the top in peacetime, there can be no immediately effective unity of field command in wartime. In peacetime the theaters of war cease to exist and the domestic establishment becomes the principal military agency. The form of the home organization becomes even more important in peace than during war when pressure and the necessity for survival forces cooperation. It is inconceivable to me that there can be any serious question as to the need for unity of administration and direction at the top in the form of a single executive department to preside over three fighting arms which exist only for a single purpose—the national defense.

—General Omar N. Bradley