What Goes On at a Transatlantic Station

By CARL DREHER

Drawings by TOM MONROE

THE popular idea of commercial high-power radio is highly romantic. People imagine a transatlantic station somewhat as follows: A lonely shack on the beach at 2 A. M. The operator sits with the telephones pressed to his ears and a strained expression on his features. Suddenly his face lights up. "Ha! A call!" The operator scribbles feverishly. After a few minutes he relaxes, and proudly contemplates his copy. A message from Europe! In some way, after that, the radiogram proceeds from the beach shack to its destination, inland, while the operator waits patiently to "catch" another communication on its westward flight. By a reversed but equally simple process, messages jump off from the States to Europe. Thus we have high-power radio.

This picture is in no wise exaggerated. In fact, far more fantastic notions are prevalent. Under ordinary conditions, all the west-bound commercial radio traffic over the Atlantic between Europe and the United States passes through the Radio Corporation's station at Riverhead, Long Island, and thence by wire to the Broad Street central telegraph office in New York City. Non-technical visitors to the station, being told this, almost always imagine that the Riverhead staff of four or five engineers, of whom usually only one is on duty actually copies at Riverhead the thousands of daily messages from England, France, Germany, and Norway, and relays them over the wires. In reality, of course, the traffic flows automatically through Riverhead, as through a telephone repeating station, and all the copying and recording takes place in New York. And some visitors have felt much injured when the man on watch was unable to let them hear music. They came to the station expecting to hear radio concerts, and were disappointed at being offered nothing except indecipherable buzzing noises, somewhat like those emitted by a water faucet when it needs a new washer.

When one considers the situation for a moment, it is obvious that trans-ocean radio communication must be systematized like any other business—like cable communication, for example—and that a highly specialized organization is necessary to perform its functions. But radio's long association with romance—rescues at sea, the exploits of war, and so on—has made it hard to realize that it is based, like any other engineering enterprise, on more or less humdrum machinery and a trained designing and operating personnel.

The equipment and upkeep of a trans-ocean radio circuit are so expensive that it cannot be maintained except on a basis of practically continuous service. If it were to be used only as often as the average ship station, for example, its owners could never hope for a return on their investment. The 2 A. M. beach shack of popular fancy might serve as a fair representation of shore-to-ship radio fifteen years ago. At that time messages were few, and if the operator heard nothing for an hour it may have been due to his silicon crystal jarring out of adjustment, but, just as likely, there were simply no ships within range. But a modern trans-ocean station is a different matter. The operating personnel consists, not of three recluses on a sand bar, but of a community approaching the size of an incorporated village, with its hotel, cottages, water supply, and heating system, perhaps a few hundred acres of land, and means of transportation to and from the near-by towns and railroad stations.

The plant itself, if it is a transmitting station, reminds one of nothing so much as one of the sub-stations of the electric light company in a large city, and its upkeep is commensurate with that of a good-sized electric power plant. The entire radio system consists of perhaps a dozen such stations, all of necessity connected by wire lines leased or owned outright, and in either case highly expensive in upkeep and initial outlay. Then there are urban telegraph offices for collection and distribution

of messages; the central offices of the concern with executive officers, accountants, and the usual business organization; and an associated manufacturing body. All this is very far removed from the free-lance-tour-the-world notion of the radio art.

The writer has no intention of discussing here, however, all these parts and ramifications of an international communication system. The object of this article is to give non-technical readers an idea of how messages are sent and received over long distances, how the stations—particularly the receiving stations—are operated, and to enable broadcast listeners to form some conception of what the life of an engineer or operator in high-power radio is like.

In a modern long-range system the functions of transmitting and receiving are entirely separated. In a ship station the transmitter and receiver are of necessity in the same cabin. But, as the two are entirely different in their functions and nature, it is expedient, when the thing is done on a grand scale, to separate them. The transmitter is a power apparatus, like the motor of an electric train. Its object is to generate power and to dissipate it in a certain way—specifically, in the case of radio, to make a noise at a distance. The receiver is a detection apparatus, somewhat on the order of a seismograph for detecting earthquakes, and its characteristic is sensitivity. When the transmitter and receiver are close together the operator cannot send and receive at the same time. But this factor of simultaneous transmission and reception, or duplex working, as it is termed, is essential in the high-power field, and so in general we find the receiving station located from twenty to several hundred miles from the transmitting station. The seismograph, that is, is not mounted in the same building with a rock-crusher.

Transmitting stations are characterized by their high aerials. To transmit effectively, no substitute has been found for a high, large antenna structure. Hence transmitting stations have towers from 400 to 800 feet high, built, usually, by contractors specializing in structural steel erection. Up to a few years ago radio engineers thought it necessary to use high antennas also for receiving; the plans for the 1913 Marconi receiving stations, for ex-

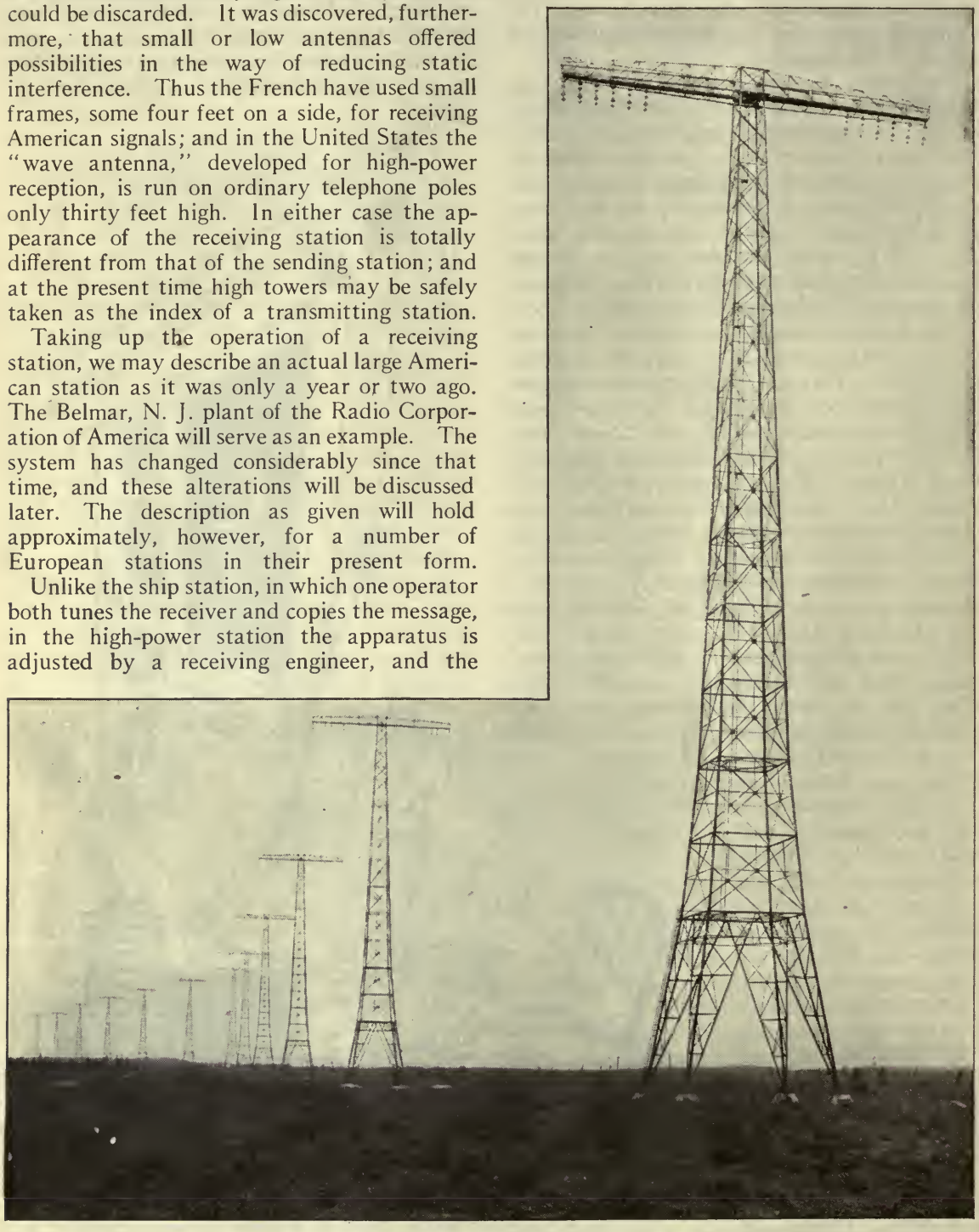
A MESSAGE FROM EUROPE!

Scene: a lonely shack on the beach at 2 a. m. The operator (according to the romantic popular idea) sits with the telephones pressed to his ears and a strained expression on his features. When a call comes, he scribbles feverishly

ample, included a line of 400 foot towers. But with the development of sensitive vacuum-tube receivers the costly high receiving antenna could be discarded. It was discovered, furthermore, that small or low antennas offered possibilities in the way of reducing static interference. Thus the French have used small frames, some four feet on a side, for receiving American signals; and in the United States the "wave antenna," developed for high-power reception, is run on ordinary telephone poles only thirty feet high. In either case the appearance of the receiving station is totally different from that of the sending station; and at the present time high towers may be safely taken as the index of a transmitting station.

Taking up the operation of a receiving station, we may describe an actual large American station as it was only a year or two ago. The Belmar, N. J. plant of the Radio Corporation of America will serve as an example. The system has changed considerably since that time, and these alterations will be discussed later. The description as given will hold approximately, however, for a number of European stations in their present form.

Unlike the ship station, in which one operator both tunes the receiver and copies the message, in the high-power station the apparatus is adjusted by a receiving engineer, and the operator has nothing to do with the handling of the equipment. At Belmar the tuners and



THE TWELVE TOWERS AT ROCKY POINT, LONG ISLAND

These towers carry the antennas used in transmitting to European stations. The power which radiates from the antennas is controlled by delicate mechanism in New York City, 55 miles away

amplifiers, in fact, were in a separate room. The engineer had his own pair of telephones plugged in on the signal and thereby he could tell when anything went wrong in the set, adjust the static balance for optimum reception, and generally supervise the working of the circuit.

In the telegraph room messages were copied on the typewriter, one operator being assigned to each overseas circuit. Belmar, for example, at one time handled the circuits from Carnarvon, Wales; and Lyons, France. Accordingly there was an MUU (Carnarvon) operator, and a YN (Lyons) operator. Each man would copy as fast as conditions permitted, usually below thirty words a minute at that time, and throw the message blanks into a wire basket. At intervals a check clerk would come, count the number of words in each message, compare it with the check given in the preamble of the radiogram, and enter the figure in an abstract. If there was no discrepancy, the message was taken across to the wire operator, who sent it on an ordinary telegraph line, using a sounder with its click signal as distinguished from the buzzing or whistling signal of the radio circuit, to New York City. At the central telegraph office in New York the message was copied and re-dispatched via wire to the point of destination. The radio station, therefore, was in effect the junction of the radio circuit with the radio company's wire circuit, and the central telegraph office was the junction between the radio company's wire circuit and the land telegraph company's wires, and two receptions and two transmissions, with the attendant possible errors and certain delays, were necessary on this side of the water alone.

In the event that an error was discovered in the check of the message, or when the radio operator missed a certain word or was not sure of its correctness, an "RQ", or message of inquiry, was sent to the transmitting station. The answer to the "RQ" was termed a "BQ". These designations are still used and continue to puzzle a great many amateurs who listen in on the long-wave circuits and wonder what it is all about. Two operators, termed the RQ clerk and the BQ clerk, respectively, took care of the numbering, sending, and tabulating of these verification messages.

The transmitting station, which in the case of Belmar was located at New Brunswick, N. J., fifty miles away, was controlled from Belmar by means of a wire line. The Belmar operator,

TRANSATLANTIC WORK AT LAKEWOOD, N. J.
This picture was taken three years ago, before all the Radio Corporation's messages to and from Europe were handled at one central station in New York. In this picture, the man at the left is copying a message from Carnarvon, Wales, on the typewriter. The operator on the other side of the supervisor is sending to England on a key which controls the New Brunswick, N.J. transmitter

that is, controlled the dots and dashes sent into the air from New Brunswick directly with his key. Messages came by wire line to Belmar and were thence dispatched to Europe. Belmar could also "break" the European sending operator, when a word was missed in reception on this side, by making the symbol "BK", whereupon the distant operator would re-send the last word correctly received and proceed. At an early date, direct control of the transmitters from New York was instituted, but the outlying receiving stations continued to possess an auxiliary control for "breaks" only. "Breaks" save RQ's, which take longer and are more costly to the service. A "break" is like saying, "I beg your pardon," to a man with whom one is talking; an RQ is like writing him a letter afterward to verify what he said.

In charge of the operators was a supervisor, who saw to it that all the circuits were worked to capacity, that no disputes occurred on the wires—nothing is easier than to fight with a man at the other end of a cable if one does not fancy his style of sending—and that the busi-

ONE OF THE "LONELY SHACKS"
Which used to house the long-distance receiving apparatus, but which now exist only in the popular imagination, at least as far as transatlantic work is concerned

ness of the station was transacted efficiently during his tour of duty. Under the supervisor there were as many as twenty operators during busy stretches.

There were three daily watches: Midnight to 8 A. M., 8 A. M. to 4 P. M., and 4 P. M. to midnight. Each watch had its staff of operators and supervisor, and the watches were changed every week, so that a man did not have to stand the graveyard watch, as it is called in steel mills, more than seven days in succession. This placated the operators' wives by widowing them not over a week at a stretch.

The station was in charge of a superintendent, who in turn reported to the New York office, discharging the usual functions and assuming the ordinary responsibilities of an official in charge of an outlying factory or branch office of a corporation. As there might be as many as fifty skilled operators at a receiving station, with power house and radio engineers, linemen, cooks, servants, gardeners, and other help, this was quite a sizeable job.

The unmarried men lived at a large brick hotel maintained by the company on its property. There were cottages in which the superintendent and other officers lived. The social life of the place was much livelier than that of the average small community, for inasmuch as almost all professional radio men have served an apprenticeship on shipboard, the men at the stations were generally well-traveled and often highly interesting in conversation. There was always a fair percentage of Britishers, as is usual in any communication enterprise, for England has a far-flung empire, whose natives learn communication as a matter of course, and go wherever cables are laid or wires are strung. The atmosphere of the recreation rooms was highly cosmopolitan. At one of the stations, for example, there was a supervisor who had sailed with William McFee, and had heard Titta Ruffo sing "Hamlet" at the Milan opera, which is more than many literary and operatic critics can boast of. All this is a far cry from the lonely beach shack. And as for isolation, it was nothing for the staff to have twenty girls, vigilantly chaperoned and matroned, down from New York for a week-end party, and not a few of them were quite at home in the smart supper clubs of the town to which all the wires run and where all good circuits, line and radio, find their end.

But efficiency required that the signals be received in New York City directly, and to-day Belmar is only an experimental station. All the operators are now at the Broad Street Central Telegraph Office. At the same time it would not be expedient to pick up the signals in New York, for an urban receiving location is generally inferior to a rural one, and the present system of static elimination requires a large amount of space—specifically an eight-mile line on poles, which of course could not be readily obtained in the city. The problem was solved by the development of line-transfer apparatus. That is, the signals as they come out of the audio-frequency amplifiers at the receiving stations, are put through repeating coils on to metallic wire circuits, and at Broad Street re-amplified and given to the operators. In short, there is a system of audio-frequency tones sent along wires, following the radio-frequency oscillations sent through space. Under normal conditions the operator in New York hears exactly the same signal that the engineer in Riverhead, say, listens to. This system, of course, is subject to the usual troubles of a wire telegraph under bad weather conditions, but by the use of good lines, spare pairs, and other standard expedients, serious delays are obviated, and the advantages of a single central telegraph office and an outlying receiving station effectively combined.

The Radio Corporation's main receiving station is at Riverhead, L. I., at the head of Peconic Bay, about eighty miles east of New York City. The antenna runs southwest to Eastport, a distance of about nine miles. This collecting system, the invention and development of Mr. H. H. Beverage of the Radio Corporation and Messrs. Chester Rice and

E. W. Kellogg of the General Electric Company, has been described at considerable length in non-technical publications, and a technical account has appeared in the A. I. E. E. Proceedings, so that only a brief description is warranted here. The salient feature of the wave antenna, as it is known, is that it will pick up signals from the northeast, say, if properly oriented, and be sensibly "deaf" to the southwest. By suitable adjustments, therefore, in the United States, it may be made receptive for the European stations to the northeast, while blocking out station interference and static from the southwest. In this way the wave antenna makes the radio circuits proof against practically all forms of disturbance except local lightning, which is seldom of serious duration. At the same time, by virtue of its length, the antenna collects a great amount of signal energy, and as it is not in itself tuned to any wavelength, any number of tuned receiving sets, within reason, may be connected to it. It is thus possible to terminate six or a dozen radio circuits in one small building and to transfer the signals to wire lines at this point.

The visitor to Riverhead sees, in a room twenty-five feet square, three long open cabinets slightly higher than a man, each holding three shelves. A receiving set is placed on each tier. The component parts of these sets—tuning apparatus and amplifiers—were built by the General Electric Company. They are designed for hard, continuous service in a fixed installation. The various units are enclosed in large iron cases, and the appearance is that of power apparatus rather than the usual laboratory impression given by radio instruments.

By means of plug and jack boards, somewhat like those in a telephone exchange, any signal may be put on any pair of wires to New York, a

A VIEW OF THE CONTROL STATION AT BROAD STREET, NEW YORK CITY

In the foreground is a modified typewriter keyboard used in conjunction with a perforating machine which punches out dots and dashes on the tape. The tape is later fed into an automatic transmitter which controls the key circuit of the transatlantic transmitter according to the dots and dashes on the tape

signal may be duplicated on two or more tone channels, wires may be tested, sets changed, and all the other possibilities of a highly flexible arrangement realized.

The stations at present handled via Riverhead are MUU, Carnarvon, Wales; LCM, Stavanger, Norway; OUI, Hanover, Germany; POZ, Nauen, Germany; and UFT, Saint Assize, France. Thus five receiving sets are continuously in service, with a sufficient number of spares in case of breakdown. When, occasionally, the European station has no traffic—is "running idle" or is "out"—the set is left on until the station resumes traffic. The tubes are not turned off and a set may be in use continuously for months.

These stations all operate on long wavelengths—between 12,000 and 15,000 meters. People often inquire whether the multitude of local broadcasting stations do not interfere with transatlantic reception. Inasmuch as the broadcasters do not go above 400 meters, it is obvious that they are not likely to "jam" stations whose waves are thirty or forty times as long.

Power is supplied to the station from a 2200-volt transmission line. The filament and plate supply to the tubes is from storage batteries "floating" on A. C.-to-D. C. motor generators. When the A. C. power is interrupted, the amplifiers will run on the storage battery reserve for a period of about a day, which is sufficient to tide the station over any conceivable breakdown in the power supply.

Communication between the engineers at Riverhead and the traffic personnel at Broad Street is maintained over a wire telegraph line. The engineer at Riverhead must therefore also be a competent wire operator, so that instructions and information may be rapidly sent over the line and good contact maintained between the two parties. The Broad Street end of the wire is manned by the Office Electrician on watch. Personal calls are used in order to secure the maximum degree of coöperation between the two departments. The system has proved very effective and is practically equivalent to the antedating arrangement wherein the engineer and sets were in the next room.

A corrupted form of Phillips's Code is used in conversation on the Riverhead-Broad Street wire. Phillips' Code is the system of symbols and abbreviated spelling used on commercial press wires and fast bonus circuits. Of course when one has to spell out every word, as one does in telegraphing, one is apt to be in favor of highly simplified spelling. "That" becomes "tt", "ing" is cut to "g", "what" is "wt" and so on. The Phillips' on the Riverhead wire, however, is somewhat unique and may be compared to Ward Line Spanish, familiar to every good radio man. Also, while most of the communication is of necessity terse, during light periods, flashes of fancy have been known to slip through, as the following at four o'clock one morning:

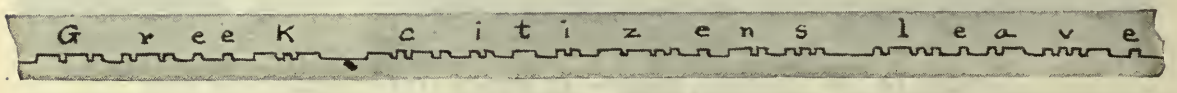
"Hey, brush off the Swede," which, translated, means, "Clear up the LCM (Norway) signal."

Over the water, most of the service messages and traffic directions are in English, but occasionally the English is a little unsteady, and may be abandoned altogether, as once when the French operator delivered himself of the following:

"Pse Mr OM we have much msgs o h can you take a grande vitesse?" which means, "Please Mister Old Man we have much messages on hand—can you take high speed?"

Many such gems could be picked up by anyone listening for them, but in the press of traffic they go unnoticed and are lost.

Curious incidents sometimes occur to break up the routine of operation. Wire trouble, for example, sometimes originates in unusual ways. In one case three tone channels were thrown out of service for twenty hours by a piece of haywire slung over the line by some boys at an isolated spot. On another occasion an ice-house some five stories high, and large in proportion, caught fire and fell over upon the main telephone trunk line in the middle of Long Island, carrying the Radio Corporation's wires down with the rest. All circuits went out with an unprecedented bang. One or two telephone pairs were left intact, and soon Broad Street and Riverhead were in communication by telephone. But not for



A PRESS BROADCAST FROM POZ, NAUEN, GERMANY

This strip is part of a message received at the Riverhead, L. I. station on an ink recorder. The letters have been written in above the lines representing dots and dashes of the Continental telegraph code

"DIT DIT DAH DAH DIT DIT"

It it related that when the Broad Street official began to warble and chant into the telephone, the office broke into a commotion and he narrowly escaped being rushed to a psychopathic ward

long. The surviving pairs began to be affected by the heat, terrific crackling noises and roars broke up the conversation, and, while voices could still be heard, the speech was unintelligible. The single engineer left at Riverhead—the rest of the staff having rushed to the scene of the fire in cars—then conceived the idea of howling code mouth signals into the telephone transmitter, thus:

"Dah dah dit dah—dit dah dit—dah dah—dit dit dah dah dit dit" (QRM—Interference—Repeat, repeat).

The Broad Street Office Electrician replied in kind, and communication was maintained through the wire noises until the regular wires were patched temporarily with twisted pair lying on the ground. The Riverhead man, being by himself, had nothing to lose, but it is related that when the Broad Street official began to warble and chant into the telephone, the office broke into a commotion and he narrowly escaped being rushed to the psychopathic ward. So a man may be misunderstood when he is behaving most rationally.

The receiving engineers' time is normally taken up keeping the sets accurately in tune (a transmitting station's frequency may shift slightly, necessitating compensating changes at the receiving end); balancing static; keeping a log of observations on the conditions of the circuits and the rate at which traffic is moving, and taking care of contingencies which arise, such as trouble on the tone lines, or interference between transmitters whose wavelengths are not far separated. In this respect a radio man's business differs greatly from selling shoes or running a movie house, occupations subject only to local disturbances, for when one is receiving from Europe some arc transmitter in Hawaii or the Philippines may, under certain conditions, cause one as much trouble as a fire next door. Again, while many other occupations are subject to only minor variations from day to day, in a radio station one may have little to do one minute, and the next instant trouble may start, and one is listening to Europe with one phone on and the other ear turned to the sounder, twirling knobs with both hands, and trying to open a switch with one's feet. But the man whose temperament is not adjusted to rapid changes belongs in some other business than radio. . . . No doubt a few specialists in the broadcasting end of the industry can be found to second this.