CIVIL TELECOMMUNICATIONS

3 March 1954

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INDUSTRIAL COLLEGE OF THE ARMED FORCES

Washington, D. C.

Mr. Charles M. Mapes, Assistant Chief Engineer of the American Telephone and Telegraph Company, was born on 14 March 1901 at Spring Valley, New York. He was graduated from Massachusetts Institute of Technology in 1923. He joined the American Telephone and Telegraph Company the same year and for 13 years was concerned with the provision and maintenance of central office and station equipment and with related work in connection with buildings. After three years with the Bell Telephone Company of Pennsylvania as general plant supervisor he returned to the American Telephone and Telegraph Company as maintenance engineer in the Operation and Engineering Department. World War II required his services in coordinating Bell System's activities with the various Government agencies involved in the allocation of materials and the construction of communications facilities. After World War II he was appointed systems engineer in charge of long-range planning and later held the positions of plant extension engineer and transmission Engineer. In January 1951 he was appointed defense activities engineer, coordinating activities relating to the national defense, and held that position until his present appointment in July of 1952.

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COLONEL PRICE: General Greeley, gentlemen: This morning we take up the subject of "Civil Telecommunications," another of the public services which have become a vital part in our economy. While advances in telecommunications have been in most cases almost fantastic, they have come so regularly that we take them as a matter of course.

This morning it is a pleasure to welcome again to the Industrial College Mr. Charles M. Mapes, Assistant Chief Engineer of the American Telephone and Telegraph Company, who will bring us up to date on the status of the science and art of communications.

Mr. Mapes.

MR. MAPES: Thank you, Colonel Price. Good morning, gentlemen. It is a great pleasure to be here again and to tell you a little something about the civil communications job in this country and something about how it fits in with the military job together with potentialities for the future.

The communications job in this country is handled by four groups of companies. The telephone communications, both domestic and international, are handled by the Bell System. This system is a grouping of about 20 companies plus a second group which is comprised of Independent telephone companies, of which there are something between 5,000 and 5,500. These latter are generally the smaller companies, although they handle some of the larger cities as well, which operate in the smaller communities. All of the cities and towns of these companies are completely interconnected with the Bell System. These two groups of companies also offer teletypewriter services for record communications.

The third group handling domestic communications is Western Union which does the public telegraph business and also offers private-line telegraph and teletypewriter service.

The fourth group of companies does the international record business. The Western Union, the Radio Corporation, American Cable and Radio, Press Wireless and others are in this group. They do the signal or telegraphic type of communications with the rest of the world.

I thought maybe first we might look at some statistics which cover the general telephone situation in America.

Table 1 tells us a little as to the present situation as compared to 1951 which was the first year in which we talked to this group. The changes since 1951 are of some interest. For example, the number of telephones in service was about 43 million in 1951; we now have about 50 million. About 41 million of these are operated by the Bell System and about 9 million are run by the 5,500 Independent companies. This represents about 60 percent of the world telephones. The actual population in this country is about 6 percent.

Table 1. Statistics on telephone situation in America

	1951	Today
Number of telephones in service in U. S.	43 million	50 million
Percent of world telephones	60	60
Percent of world population	6	6
Total telephone calls per average day	170 million	186 million
Toll telephone calls for average day	6.2	6.6
Percent telephones that are dial	76	81
Percent toll calls dialed by operators (directly to called telephone)	33	48
Miles of telephone private lines	650,000	1,500,000
Miles of teletypewriter private lines	3,100,000	4,000,000
One-way channel miles		
Broad band coaxial	46,000	68,000
Broad band radio relay	8,200	64,000

The total telephone calls per average day--that is, the number of times people pick up the telephone and talk--were about 170 million in 1951 and 186 million now. The toll telephone calls were about 6.2 million per day in 1951 and have gone up to 6.6 million. As the metropolitan areas grow--the Washington area, for example--more of the calls are classed as local, since you can call to your neighboring community without paying a toll charge. So this increase is not actually as great in figures as it is in numbers of calls.

The percent of telephones that are dial--that is, on our local dial systems--has gone up 81. Our objective is to get to 100 percent. The percent of toll calls dialed by operators directly to the called telephone--you have that here in Washington--has gone up from 33 to 48 percent. Again, our objective is to put the whole network on a dial basis.

The miles of telephone private lined in which the military are very much interested have gone up from 650,000 miles to 1.5 million. We will see a little more about that later. The teletypewriter private lines have gone from 3.1 million to 4 million.

Then we have what we call the broad-band channel facilities which handle the television network service in the country, as well as telephone message requirements where the concentration of calls, that is, the traffic volume, is very heavy. Underground cable providing broad-band coaxial facilities has gone up from 46,000 channel miles to 68,000. Then there's the radio relay, which no doubt many of you have seen as you drive through the country. These facilities have increased from 18,200 to 64,000 channel miles.

That gives you a general picture of the telephone situation. Next I would like to talk about the Bell System part of the communications job.

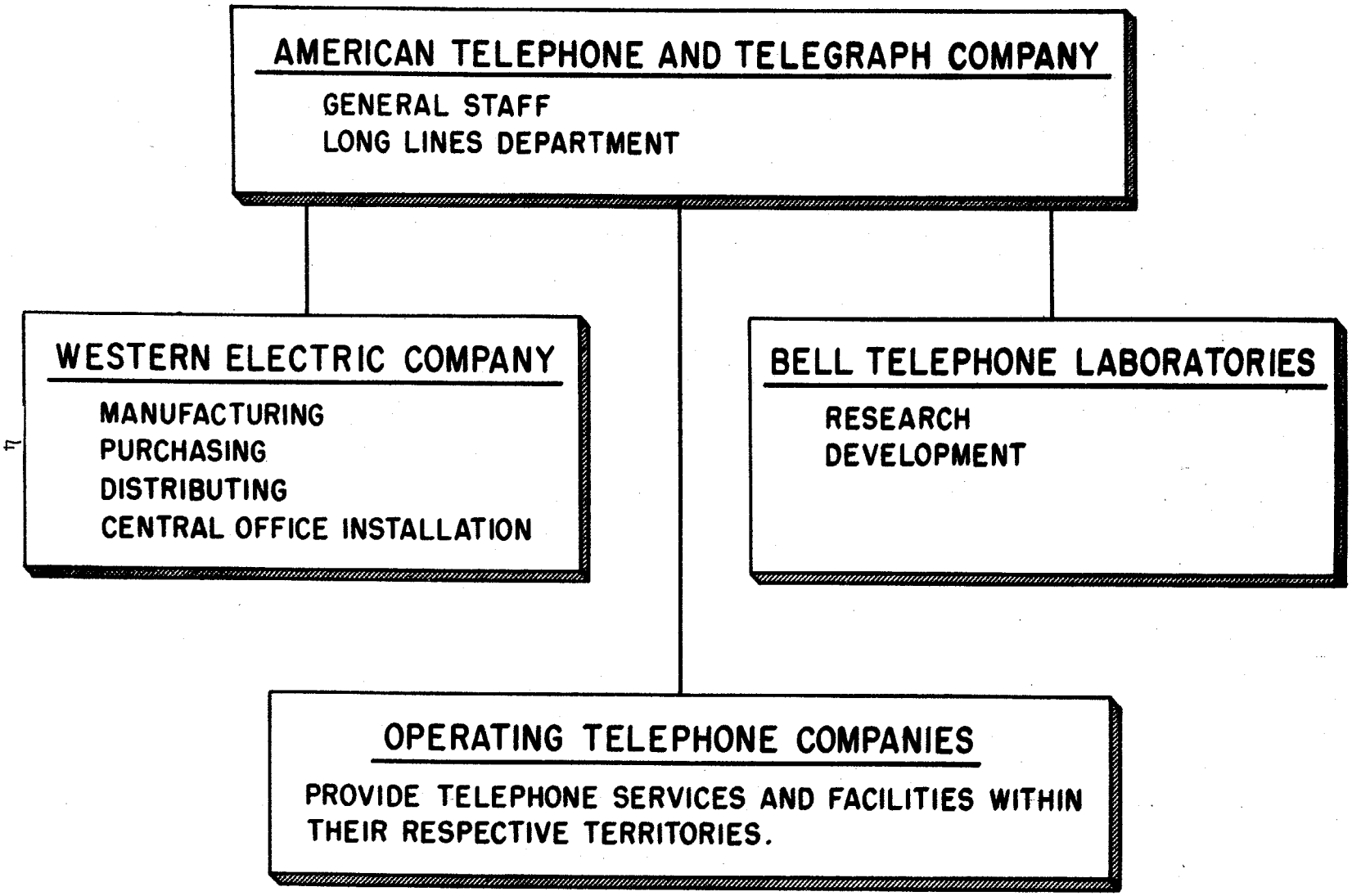
Chart 1, page 4.--In the Bell System, as is shown on this chart, we are organized with the American Telephone and Telegraph Company, having a general staff, of which I am a member, in New York City. This staff coordinates the activities of all the rest of the Bell System. In New York also is the headquarters of the Long Lines Department which handles the interstate business. They operate and own the lines, cables, and other plant which provides circuits between the various States. They, of course, work closely with the respective telephone companies--the Chesapeake and Potomac, the Southern Bell, the Pacific Companies, and so on, and with the independent companies to provide long-distance service.

Then we have two other groups in the Bell organization, one of which is the Western Electric Company, which handles the manufacturing, purchasing, distributing, and the central office installation work for the System. Western does substantially all of the purchasing for the System and the manufacturing of most of the strictly telephone equipment. The various companies construct their own buildings and buy their own building materials. Long experience with this arrangement has proven it to be a sound procedure both from the service and economic standpoints.

Another organization is the Bell Telephone Laboratories which handles the research and development job. We will talk a little more about that group later.

CHART 1

ORGANIZATION OF THE BELL SYSTEM



Shown down in the lower bracket are the operating telephone companies that do the job with which you are most familiar and which you encounter in making your day-to-day telephone conversations. There are about 20 of these companies in the Bell System.

Table 2 shows the plant investment of the operating companies which amounts to about 11.9 billion dollars. The Long Lines accounts for about 1.15 billion. The Western Electric Company is about 400 million. Western has factories in many States east of the Mississippi. Major plants are located in Massachusetts, New Jersey, Pennsylvania, New York, Illinous, Maryland, and down in North Carolina. These factories are part of the Bell System. The Bell Laboratories has about 50-million dollars invested in research facilities, buildings, and so on.

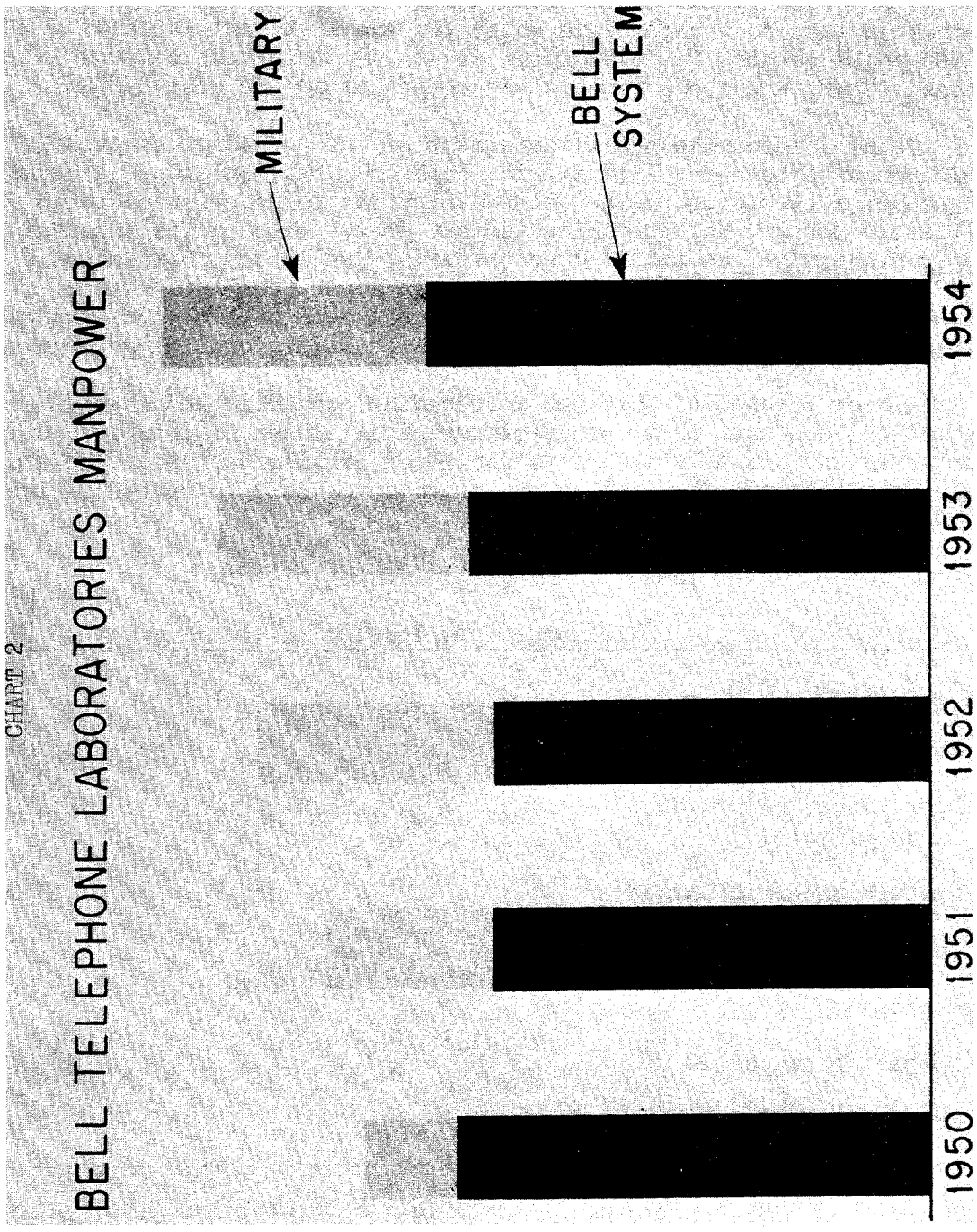
I made a guess of what the independent companies had in the way of investment and what their manufacturers had. These figures are not published and probably amount to another 2 billion dollars. The whole telephone communication job, then, amounts to about 15 or 16 billion dollars.

Table 2. Plant investment

(Millions of dollars)

Bell System	
Operating companies	11,900
Long Lines Department (interstate)	1,150
Western Electric Company	400
Bell Telephone Laboratories	50
Independent Telephone Companies	
Operating companies	2,000
Manufacturers	100

Chart 2, page 6.--Speaking of the Bell Laboratories, I thought you would be interested to get from this chart a picture of the work they do for the Bell System, as well as the work that is being done for the military forces. The military job comprises such things as guided missiles, of which NIKE is one, telephone instruments for the actual combat job in the Army, and numbers of other projects.


BELL TELEPHONE LABORATORIES MANPOWER
CHART 2
MILITARY
BELL SYSTEM
1950
1951
1952
1953
1954

The total manpower, which is currently running around 9,000, is presently divided about equally between the Bell System and military projects. You can see that the military has come up very substantially since Korea. We think that is good but we also feel that too large an allocation of effort to military work now would not be in the interest of the country should the situation become more critical. Generally the military people have come to the Laboratories and said, "This is a job that only you can do," and we are very happy to accept that kind of job. We are just as happy not to take jobs that some other organization can do as well or better, because we have a tremendous problem in the Bell System keeping ourselves moving ahead in research and development in the peacetime communications fields.

The transitor is a peacetime job which the laboratories have developed and which is going to be of tremendous interest and use in the military as well as the civilian job. We want to keep ahead with that kind of development.

Chart 3, page 8.--This chart shows the program of the Western Electric Company. You can see in black the Bell System sales; in gray, the military; and on top, sales to others. You can see, of course, how in the years of 1942, 1943, and 1944 Western devoted most of its capacity to the military job. As we got out of the war, Western went back to producing equipment for the System which was very badly needed due to wartime restrictions that prevented taking care of normal telephone service requirements. You can all probably remember trouble in getting telephone service after the war. We pitched in and put in a tremendous amount of plant, as you can see from the quantities we bought from Western.

After Korea the military orders again expanded substantially and this is the current picture. In 1954 I guess you would say there is a half-billion dollars that Western is providing for the military. Here again these are the jobs that Western, with its communications background, can do as well as or better than most other industrial concerns in the country.

Chart 4, page 9.--This chart represents the toll routes that are today available all over the country. These are the principal toll routes and do not include thousands of other connecting links. I guess maybe I jumped to toll a little before telling you that I am not going to spend any time talking about local service as such. This is just taken as a matter of course and you are all familiar with what we have to offer here. But the toll job is not quite so familiar to people generally. I am only going to try to present a general impression of what is available. Where you see the shaded part the route is radio relay. It represents the channel miles shown on a previous chart. Black is for coaxial cable. A black narrower line is the other cables and open-wire lines that feed the principal outlets in the country.

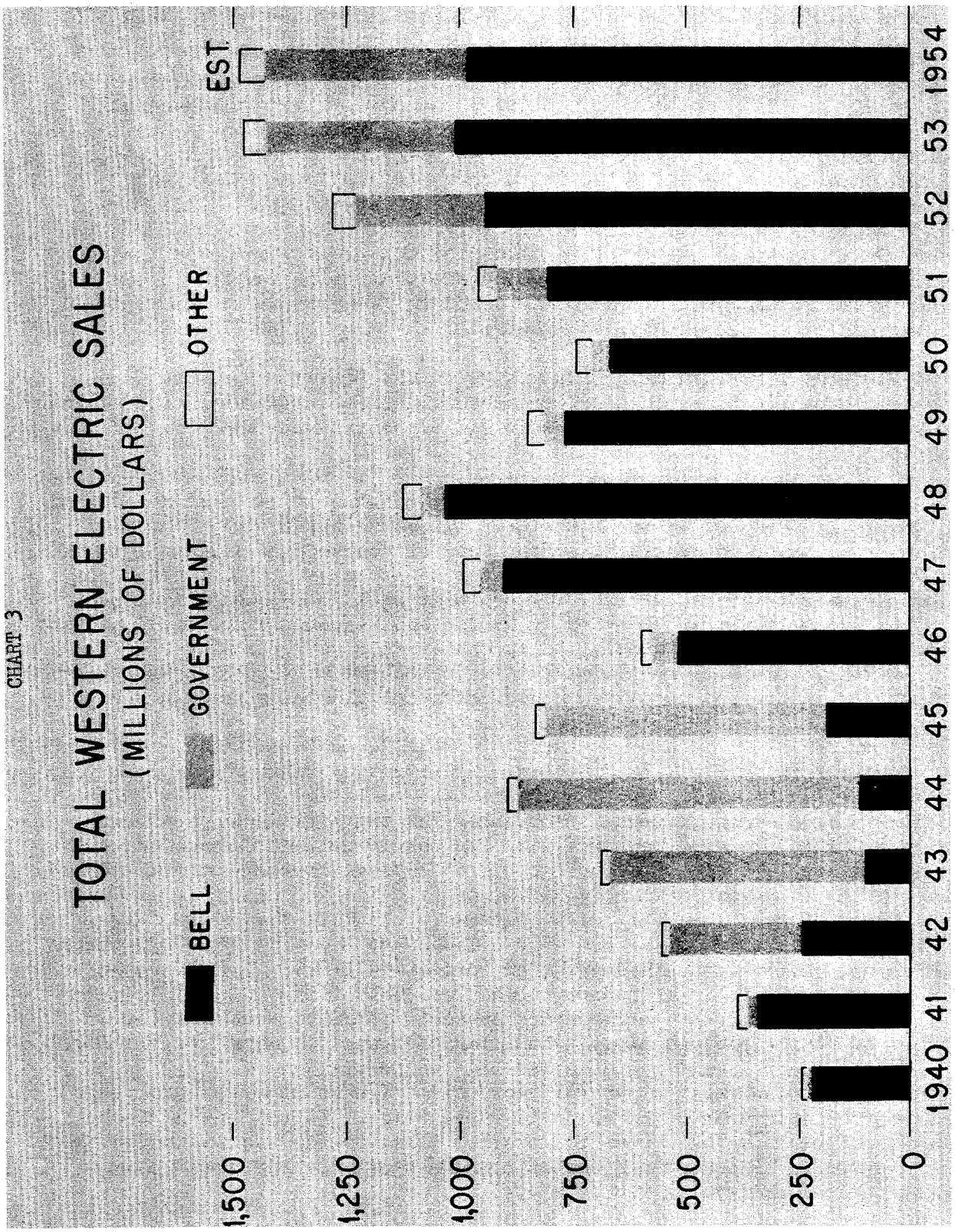


CHART 3
TOTAL WESTERN ELECTRIC SALES
(MILLIONS OF DOLLARS)
BELL
GOVERNMENT
OTHER
1,500
1,250
1,000
750
500
250
0
1940
41
42
43
44
45
46
47
48
49
50
51
52
53
EST
1954

CHART 4

PRINCIPAL TOLL ROUTES OF THE BELL SYSTEM AND CONNECTING COMPANIES

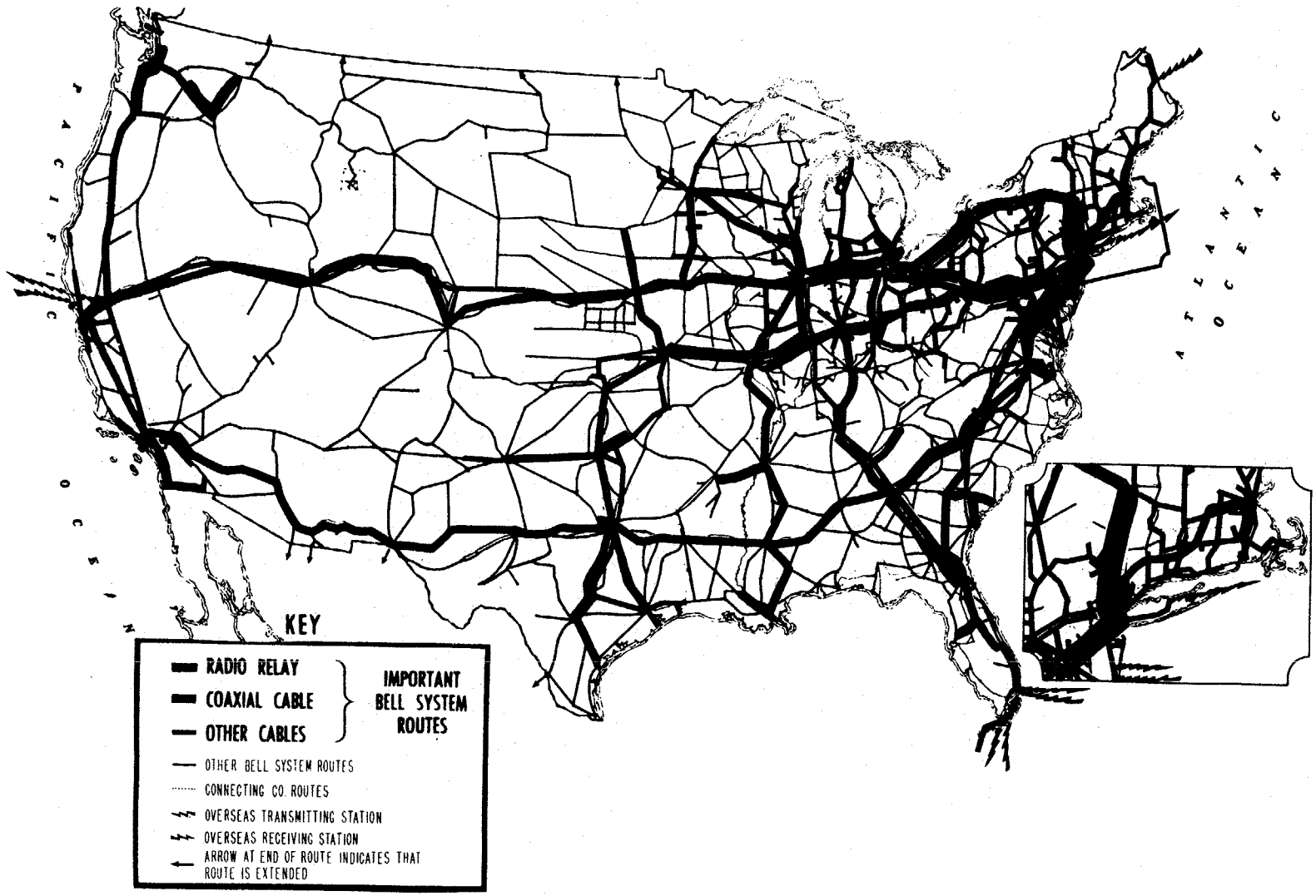


Chart 5, page 11.--It shows some detail on quantities of circuits in service. It is of very much interest when the country is in trouble to know how much you have. For example, taking the four routes that go from East to West, there are something like 3,600 circuits spanning the continent in these routes. When you get down into the more densely populated localities, for example, Washington to Philadelphia, there are circuits of somewhere around 6,000 in that route.

When I say "route" I don't mean that they all go in one trench. Our objective is to diversify to the extent that we can practically do it. Our feeling is that the real protection in communications is diversity and we are making every effort to gain that protection wherever we can. For example, we are putting a new major dial switching system for long distance outside New York City, about 20 miles or so, in White Plains. In Washington here we have done a number of things. As a matter of fact we have three offices here which have toll facilities outside the Washington center. On the average I would say they are six to eight miles outside the Washington center. These offices are not standby offices at all. They are working every day handling traffic. So there's no worry about activating these facilities in case we get into trouble in the Washington center.

Chart 6, page 12.--This chart shows our overseas telephone circuits. These are our radio channels from a center around New York--it is not actually in New York City--to the East; and from a center around Miami, down to the South; and from a center around San Francisco, to the West; and one from Seattle to the North. There are about 150 direct radio circuits shown. They interconnect with other locations on the various European, African, and Asiatic Continents by wire lines. We have communication to Moscow, and to many of the other cities around the world that are reasonably interesting today.

The radio facilities are not completely reliable. They use the lower part of the frequency spectrum and no matter what we have been able to do in the way of design, power, and location of our transmitters and receivers, we cannot maintain continuous communications. Consequently, some years ago we decided we had to put a cable across the Atlantic that you can talk on. There are a substantial number of cables available now that you can signal on--take the telegraph type of signal. But when you come to transmitting voice, you get into considerable additional technical difficulties. Nevertheless, we decided we had to do it. I think you might be interested in our present plans in this connection.

Chart 7, page 13.--As shown on this chart we plan to place a cable from Oban in Scotland in the British Isles to Newfoundland, down to Nova Scotia, and provide radio on into Portland in the United States. The

CHART 5

EQUIPPED INTERCITY TELEPHONE CIRCUIT FACILITIES ON CERTAIN PRINCIPAL TOLL ROUTES

ASSUMING COMPLETION OF 1953 CONSTRUCTION PROGRAM

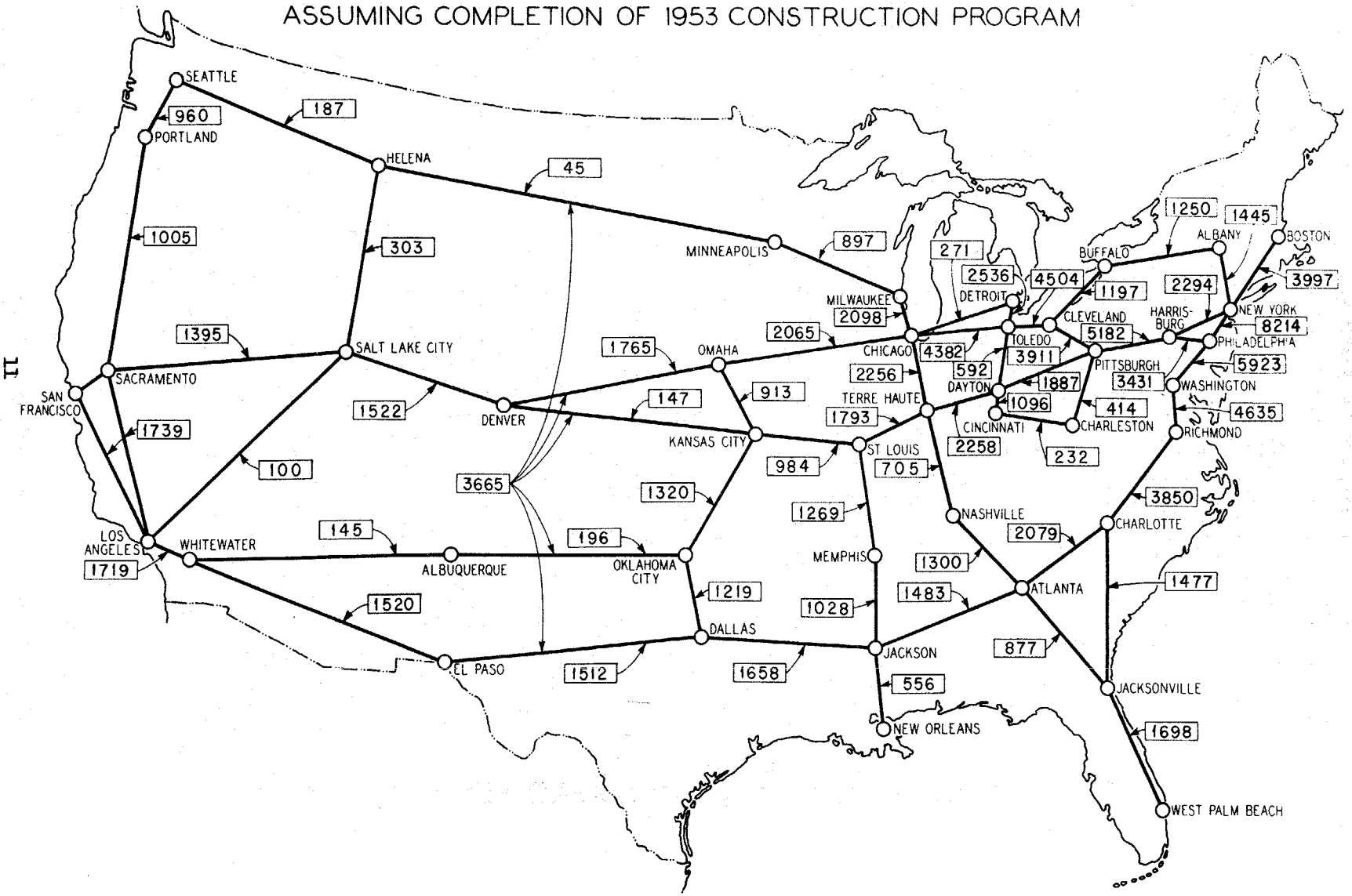


CHART 6

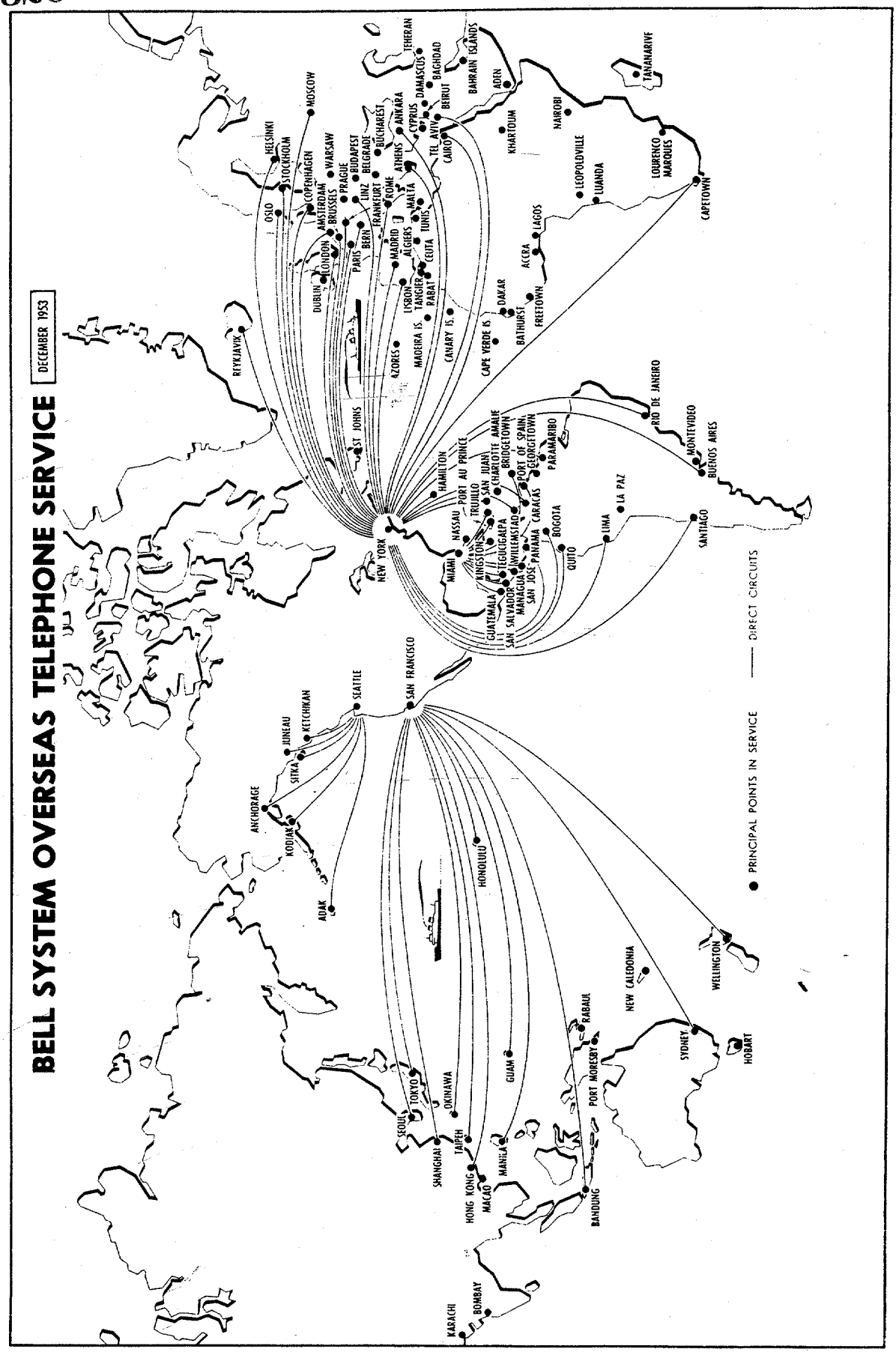
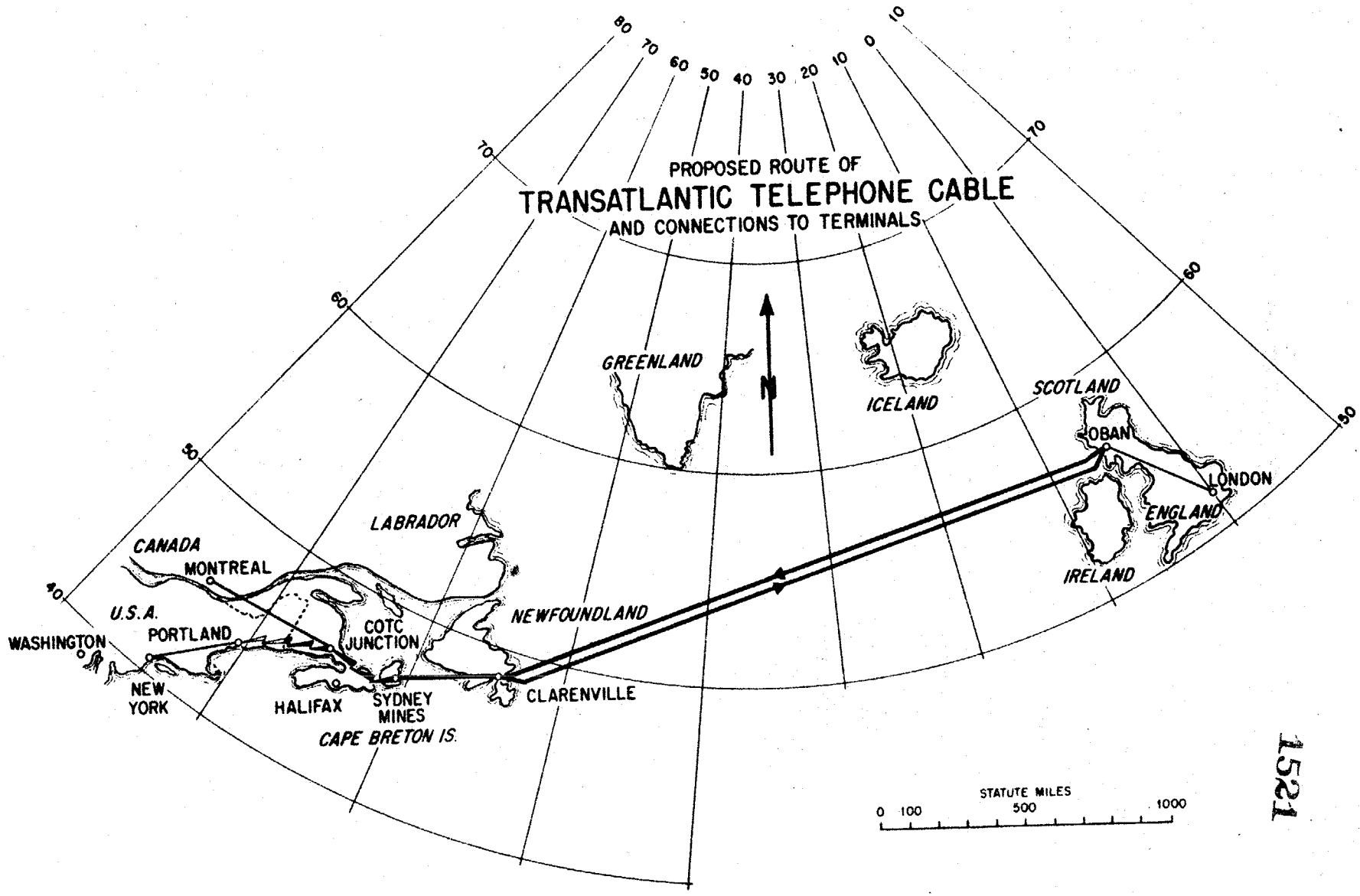

BELL SYSTEM OVERSEAS TELEPHONE SERVICE
DECEMBER 1953
PRINCIPAL POINTS IN SERVICE
DIRECT CIRCUITS
REYKJAVIK
OSLO
HELSINKI
STOCKHOLM
COPENHAGEN
MOSCOW
AMSTERDAM
BRUSSELS
WARSAW
PRAGUE
BUDAPEST
DUBLIN
LONDON
PARIS
BERN
LINZ
BELGRADE
BUCHAREST
FRANKFURT
ROME
ATHENS
ANKARA
CYPRUS
TEHERAN
DAMASCUS
BAGHDAD
BEIRUT
TEL AVIV
CAIRO
BAHRAIN ISLANDS
ADEN
KHARTOUM
NAIROBI
TANANARIVE
LEOPOLDVILLE
LUANDA
LOURENCO MARQUES
CAPETOWN
MADRID
ALGIERS
CEUTA
TUNIS
MALTA
AZORES
LISBON
TANGIER
RABAT
MADEIRA IS.
CANARY IS.
CAPE VERDE IS.
DAKAR
BATHURST
FREETOWN
ACCRA
LAGOS
ST JOHNS
HAMILTON
PORT AU PRINCE
SAN JUAN
TRUJILLO
CHARLOTTE AMALIE
BRIDGETOWN
PORT OF SPAIN
GEORGETOWN
PARAMARIBO
RIO DE JANEIRO
MONTEVIDEO
BUENOS AIRES
NEW YORK
NASSAU
KINGSTON
TEGUCIGALPA
WILLEMSTAD
CARACAS
BOGOTA
QUITO
LIMA
LA PAZ
SANTIAGO
MIAMI
GUATEMALA
SAN SALVADOR
MANAGUA
SAN JOSE
PANAMA
SAN FRANCISCO
SEATTLE
JUNEAU
KETCHIKAN
SITKA
ANCHORAGE
KODIAK
ADAK
HONOLULU
WELLINGTON
NEW CALEDONIA
NOUMEA
SYDNEY
HOBART
PORT MORESBY
RABAUL
GUAM
TOKYO
SEOUL
OKINAWA
SHANGHAI
TAIPEH
MANILA
HONG KONG
MACAO
BANDUNG
KARACHI
BOMBAY

CHART 7


PROPOSED ROUTE OF
TRANSATLANTIC TELEPHONE CABLE
AND CONNECTIONS TO TERMINALS
80 70 60 50 40 30 20 10 0 10
70
60
50
40
GREENLAND
N
ICELAND
SCOTLAND
OBAN
LONDON
ENGLAND
IRELAND
LABRADOR
CANADA
MONTREAL
U.S.A.
WASHINGTON
PORTLAND
NEW YORK
COTC JUNCTION
NEWFOUNDLAND
HALIFAX
SYDNEY MINES
CAPE BRETON IS.
CLARENVILLE
STATUTE MILES
0 100 500 1000

1521

plan is to lay two cables, one cable in each direction. We can transmit better with less difficulty if we send in one direction in one cable and in the other direction in another cable. These cables are what we call single coaxial. There is a single solid conductor covered by insulation and an outer copper tube to provide the two conductors required for an electrical circuit. This coaxial unit is further covered by suitable armor wire and insulation. The cables are about an inch in diameter out in midocean and substantially heavier--two, two and one-half, or three inches--close to the shoreline where you are apt to get fouling from anchors and other hazards of that character.

Electronic gear is necessary in these cables to provide suitable amplification of the voice currents. There has to be one of these units, called repeaters, about every 30 or 40 miles. The repeater consists of three vacuum tubes and other electronic devices. It has to go down and stay for a long time since it would be extremely difficult to bring it up to change the vacuum tubes. Consequently, the design of the three tubes has been done with great care and has been tried over the last 10 years in the laboratory and in an installation from Key West to Havana. We are anticipating that when the cable goes down, it will be there for at least 20 years without further attention.

You will notice that the two cables change to one at Newfoundland. This whole project is a joint endeavor between the British Post Office, the Canadian communications people, and ourselves--the Bell System. Actually, this particular piece is going to be of British design, and then from Nova Scotia on it will be the microwave radio that we saw in one of the other charts. The total project will cost about 35 million dollars. We hope to start laying the first cable next year and the second cable in the year following, with service somewhere around the end of 1956. The initial cable will handle 36 telephone conversations after the cut-over. We are hoping, by changes in the design of terminal equipment, to increase this figure.

The next thing I would like to tell you a little about is what we have to sell, other than just ordinary local and long-distance telephone service. We really sell space. That sounds funny, but we really do. What we sell in the way of private-line facilities is frequency space, and chart 8 I think will illustrate what I mean.

Table 3, page 15.--Signals over electrical circuits can be classified by the number of times per second the current is "on" or "off" (d.c. signaling) or by the number of changes in direction of flow per second (a.c. signaling). The greater amount of information you want to put over a circuit in a given time the more "cycles" per second you must transmit. Each of the uses of private-line service has been classified according to the cycles per second (band width) it requires. You take the ordinary teletypewriter circuit--it requires only 100 cycles. You

can think of it as about the lower two octaves on your piano. An ordinary telephone conversation requires about 2,800 cycles. The radio broadcasting industry uses frequencies of 3,500 to 5,000 cycles. To get music of the better quality than an ordinary radio program, they would use 8,000 cycles and 15,000 cycles. There is very little use for these wider bands at the present time.

Table 3. Private-line channels

Approximate band width cycles per sec.	Type of service for which channel is suited	Typical monthly interexchange line charge-dollars per airline mile
100	Telegraph, teletypewriter, D-C telemetering	1.50
2,800	Full period telephone	3.00
3,500	Minimum quality program	4.00
5,000	Medium quality program	6.00
8,000	High quality program	8.00
15,000	High quality program	10.00
4,000,000	Present standard video	35.00
8,000,000-10,000,000	High definition video	Under development

Then comes television. Television requires band width of 4 million cycles to get the picture back and forth across the country. The Bell System is ready to go to 8 and 10 million cycles if the need should develop. If any military projects should come along that need a band width of that kind, we would be ready to do it. I have no knowledge that there are any at present since most of the military requirements are down in the lower ranges.

As to cost--100 cycles for a teletypewriter is only about a dollar and one-half per airline mile per month. Running down the figures on the chart, 2,800 cycles is about three dollars; 5,000 cycles, which is the greater part of the broadcasting job, runs about six dollars. Video runs about 35 dollars.

There are some additional charges for the station connections where the studio or transmitter drops off. I know you are probably going to ask

me later, what about color? Color will go over exactly the same 4-million-cycle band as black and white but it requires considerably more attention and the design of additional electronic gear to transmit the color signal from one end to the other. The rate will be higher but it has not yet been filed.

That roughly is what we have to sell in the way of private-line service. Perhaps you would like to see a little of what the military is using today in this category. Table 4 shows a total of roughly 38 million intercity telephone circuit miles. Currently the military uses about 580,000 of those, or 1.5 percent--in other words, a rather small usage, under existing conditions. But there is a tremendous reservoir, in case you need more.

Table 4. Private-line intercity telephone circuit miles

	Total	Approximate usage by military	Percent military
Intercity telephone circuit miles	38,000,000	580,000	1.5
Intercity telegraph circuit miles	8,400,000	300,000	3.6
Total telephones	50,000,000	400,000	0.8
Total teletypewriters	73,000	7,200	9.9

The total telegraph circuit miles are about 8.4 million, of which you are using about 300,000, or 3.6 percent. The total telephones are about 50 million, the military using 400,000, or four-fifths of 1 percent. In teletypewriters, we have installed about 73,000. The military is using about 7,200, or 10 percent. Perhaps you would be interested in some of the military groups that are using these facilities.

Table 5, page 17.--The Air Defense Command has about 132,500 telephone circuit miles and 27,200 teletypewriter miles. I would like to call your attention to the word "engineered." The military, of course, particularly the Air Force, does not need circuits all the time for its general administrative business--but if trouble develops, it is going to need a tremendous increase in mileage very quickly. We have set up with the military arrangements whereby it can call us and say, "Put up networks A, B, and C" and we will take the circuits out of the regular message layout and hook them up as networks A, B, and C. Our objective is to get that done within one hour. We haven't quite accomplished this yet in test exercises but are

getting mighty close. The Army has 25,000 miles of telephone circuits and 48,000 miles for teletypewriters. The Navy has 1,000 for telephone and 22,800 for teletypewriters. The Federal Civil Defense Administration has the warning network--that is, the network that starts at the Air Defense Command and spreads out the warnings. They are using quite a lot of the private-line telephone circuits to do this. CAA, of course, is also using private-line networks to run the air business.

Table 5. Principal military and related private-line networks

Network	Approximate intercity circuit mileages telephone	teletypewriter
Air Defense Command		
Full time	132,500	27,200
Engineered	73,500	-
U. S. Air Force (other)	48,600	84,100
U. S. Army	25,000	48,000
U. S. Navy	1,000	22,800
F. C. D. A.	14,000	-
Civil Aeronautics Administration	71,700	75,800

Chart 8, page 18.--I am not going to try to confuse you with this chart, but the Air Defense Command has to connect to so many places that it is a real problem. This is merely a schematic of the kind of locations they have to interconnect. The Air Defense Command is the main center of the various air defense forces. The Air Defense Control Center, which is one of the key points in deciding the character of an enemy attack, is fed by the Air Defense Direction Center which has radar and all the other necessary gear to detect incoming planes. All of these have to be connected to so many things--the ground observation corps, the military (Navy and Army) liaison locations, and to CONELRAD control points. CONELRAD is the arrangement whereby radio broadcasting stations are put on one of two frequencies as soon as there is evidence of trouble in order to prevent attacking planes from "homing" on a city by its broadcast transmitters. The stations go on 640 KC or 1240 KC and stay there and broadcast whatever the local civil or military forces want them to broadcast for that period.

Chart 9, page, 19.--This chart shows the general complexity of the Air Defense Command installations today. They are scattered all over the country. The dots merely indicate the locations which are installations of the Air

CHART 8

AIR DEFENSE SYSTEM
TYPICAL VOICE COMMUNICATIONS NETWORK

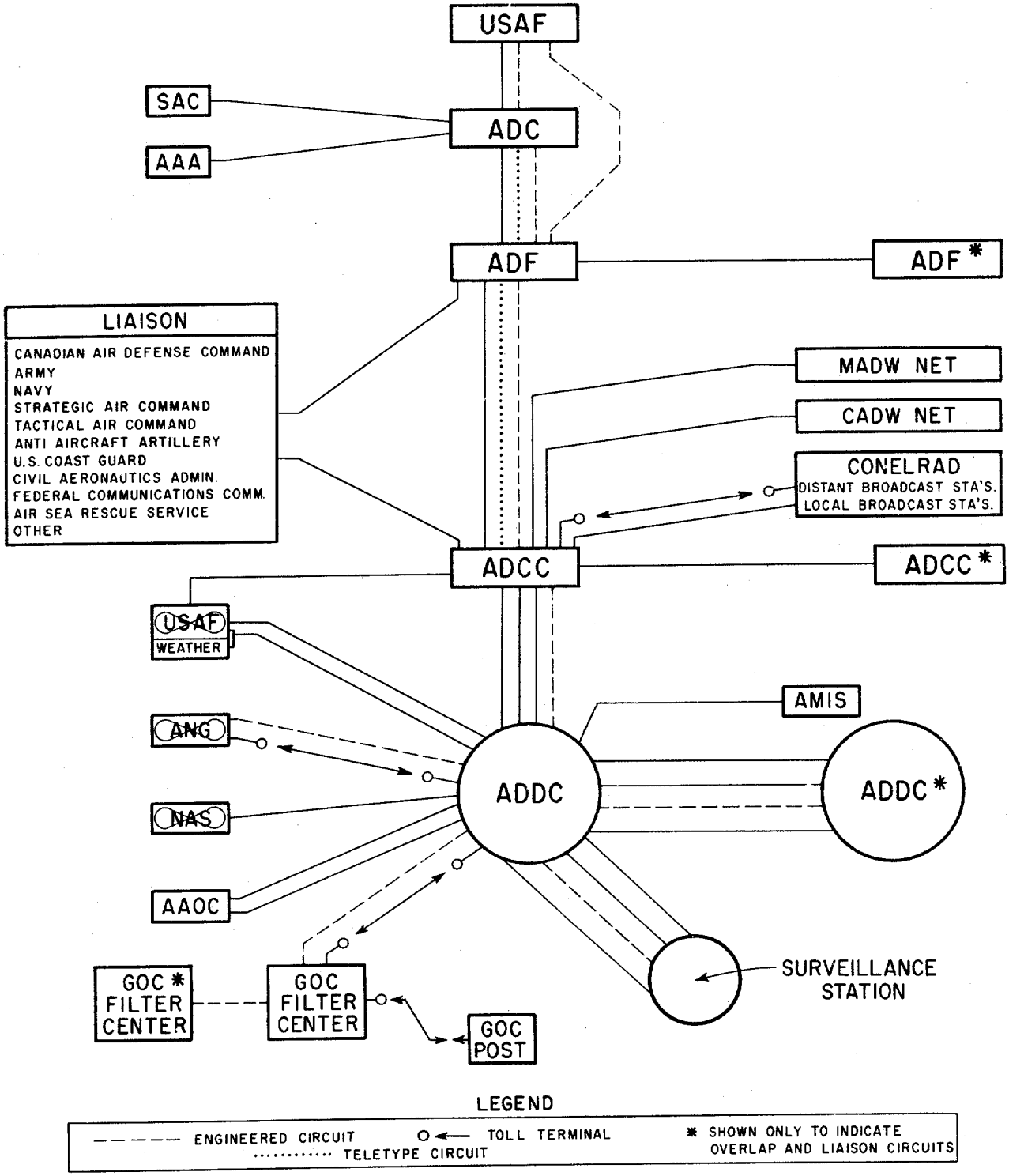
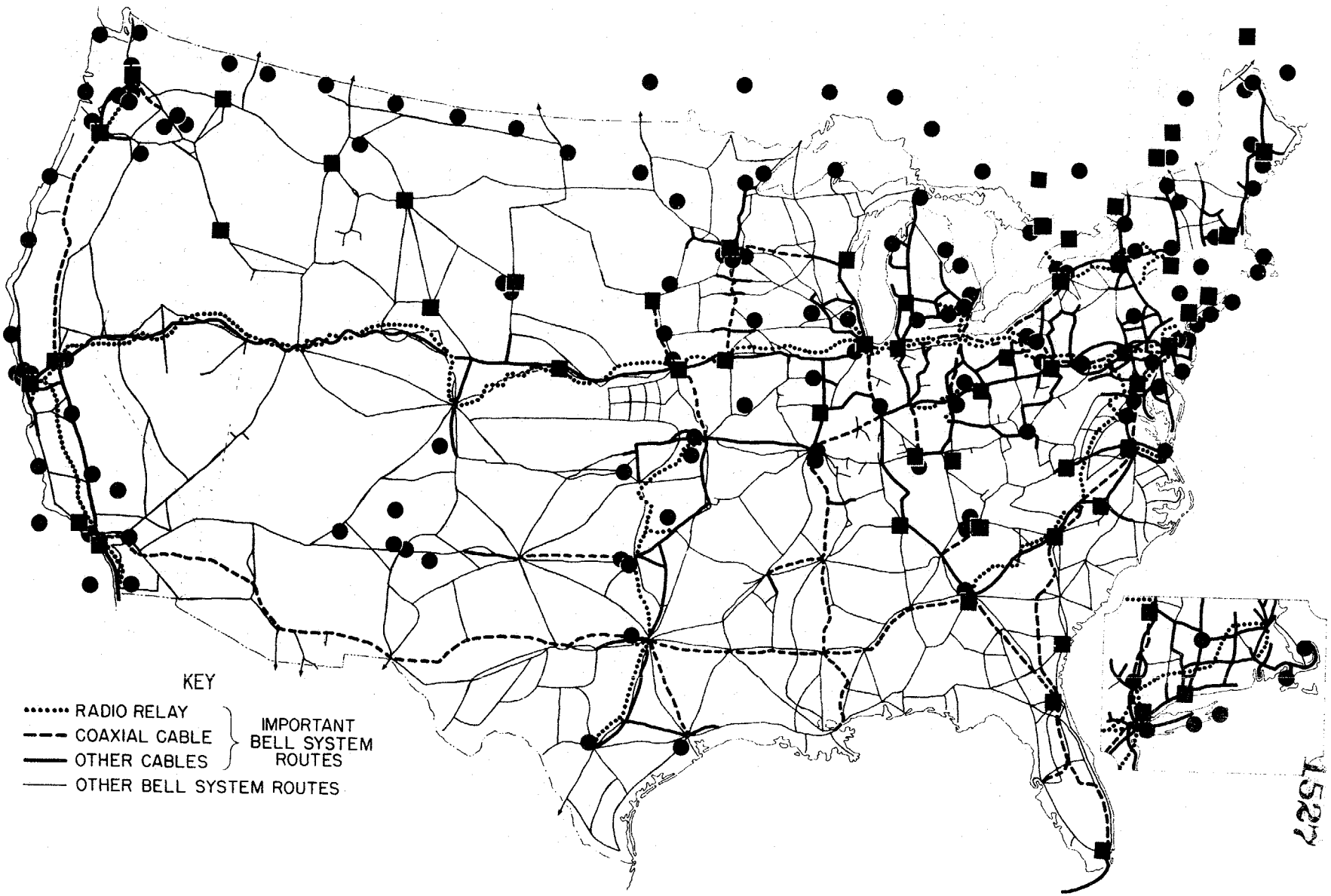


CHART 9

PRINCIPAL TOLL ROUTES OF THE BELL SYSTEM AND CONNECTING COMPANIES



Defense Command primarily on this job of detecting enemy aircraft coming into the country. As you can see, there is a considerable concentration of radar sites up there along the northern border. You say, "Well, all right; we can see these places are generally on important toll network leads, but what protection do we have from interruption?"

Chart 10, page 21.--It shows--for a section of this previous map--the circuits that are used. This is actually the circuit routes that are used to connect the Air Defense Command installations. You can see that there are any number of ways to go between the various installations. Our experience is that, if you do lose a lead, you can very easily go around the break even to the extent of thousands of miles out of your way if you have the spider-web type of network that is shown on the chart.

The transmission design of our long distance facilities today is good for almost any distance. You can go around the country a couple of times without any special arrangements other than those which are currently installed. You can see, if we lose this lead down here (indicating), there are other ways to get to this radar station. If we lose some of the ones extending into Canada, it is not quite as simple. Some of these stations are out in the country on rather light routes and in some cases only a single line is available for some installations. In these cases we may have to do something special.

Chart 11, page 22.--On this chart for example, is a problem we had to solve. You recognize Massachusetts and in Cape Cod there was a very important installation which was served by only one cable. We discussed the matter with the Air Force authorities and they decided that the installation was important enough to add a radio relay link--chart 12, page 23--to that location, as well as the cable.

Chart 13, page 24.--This chart shows a military base, it can be any base, feeding into a toll center--our toll office. We would like to have the military base fed by two cables, this (indicating) representing a cable, and this (indicating) representing another cable to our toll office. Then, you say, "All right; the toll office goes out, so what good are the two cables?"

Chart 14, page 25.--On this chart you will see that we have arrangements whereby this cable (indicating), for example, comes through a manhole in getting to the toll office. We can put relays in that manhole which will switch the circuits to distant points if the toll office is bombed out. All of our knowledge from the atomic tests, including some on actual telephone installations which were put under test in one of the last series, shows that anything underground is fairly safe unless you happen to be right under the bomb. We feel manholes are pretty safe places to be, even under atomic attack, as far as equipment is concerned. This is an additional safeguard that can be done to further insure that we keep communications solid.

CHART 10

PRINCIPAL TOLL ROUTES OF THE BELL SYSTEM AND CONNECTING COMPANIES

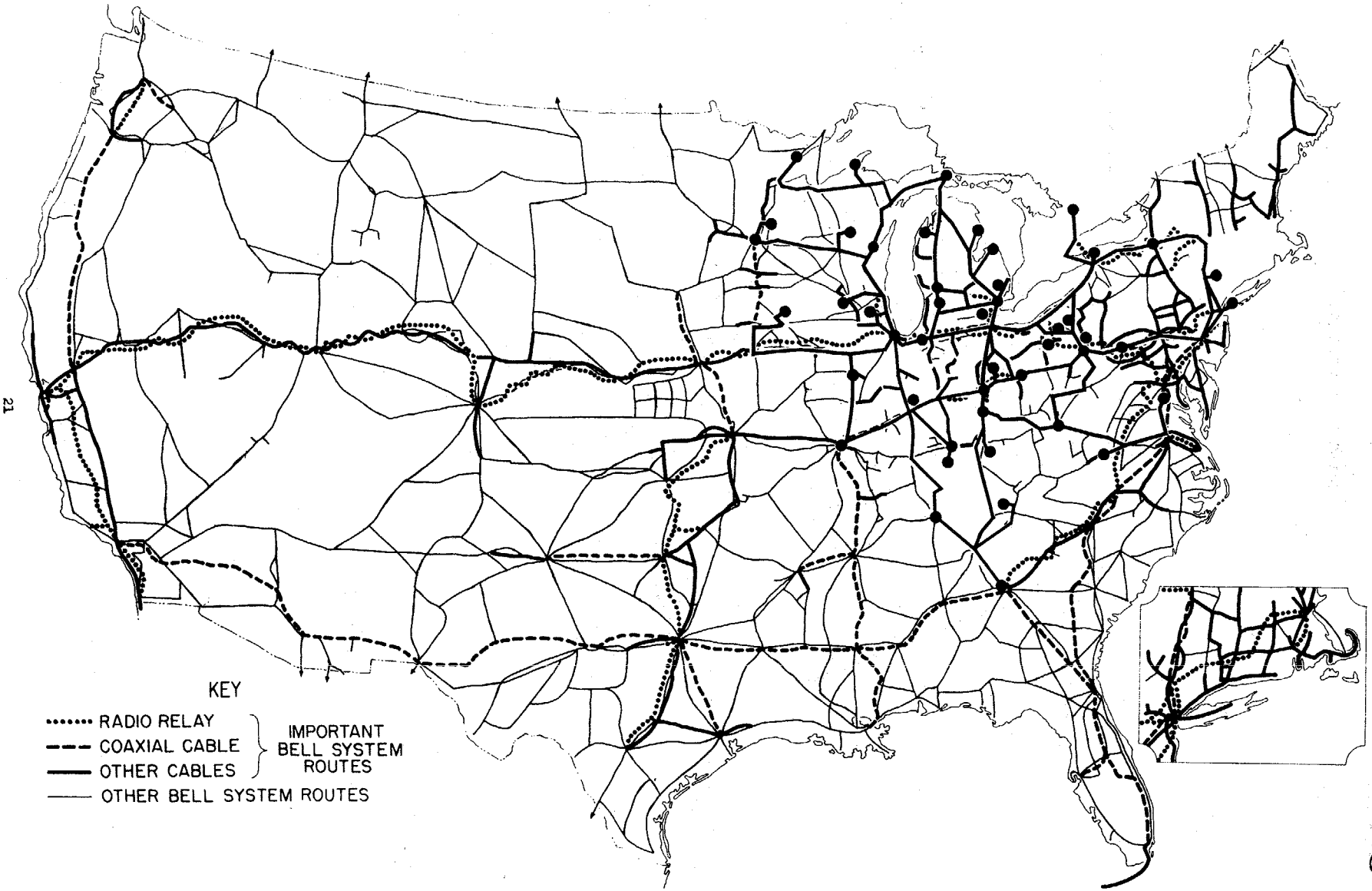


CHART 11

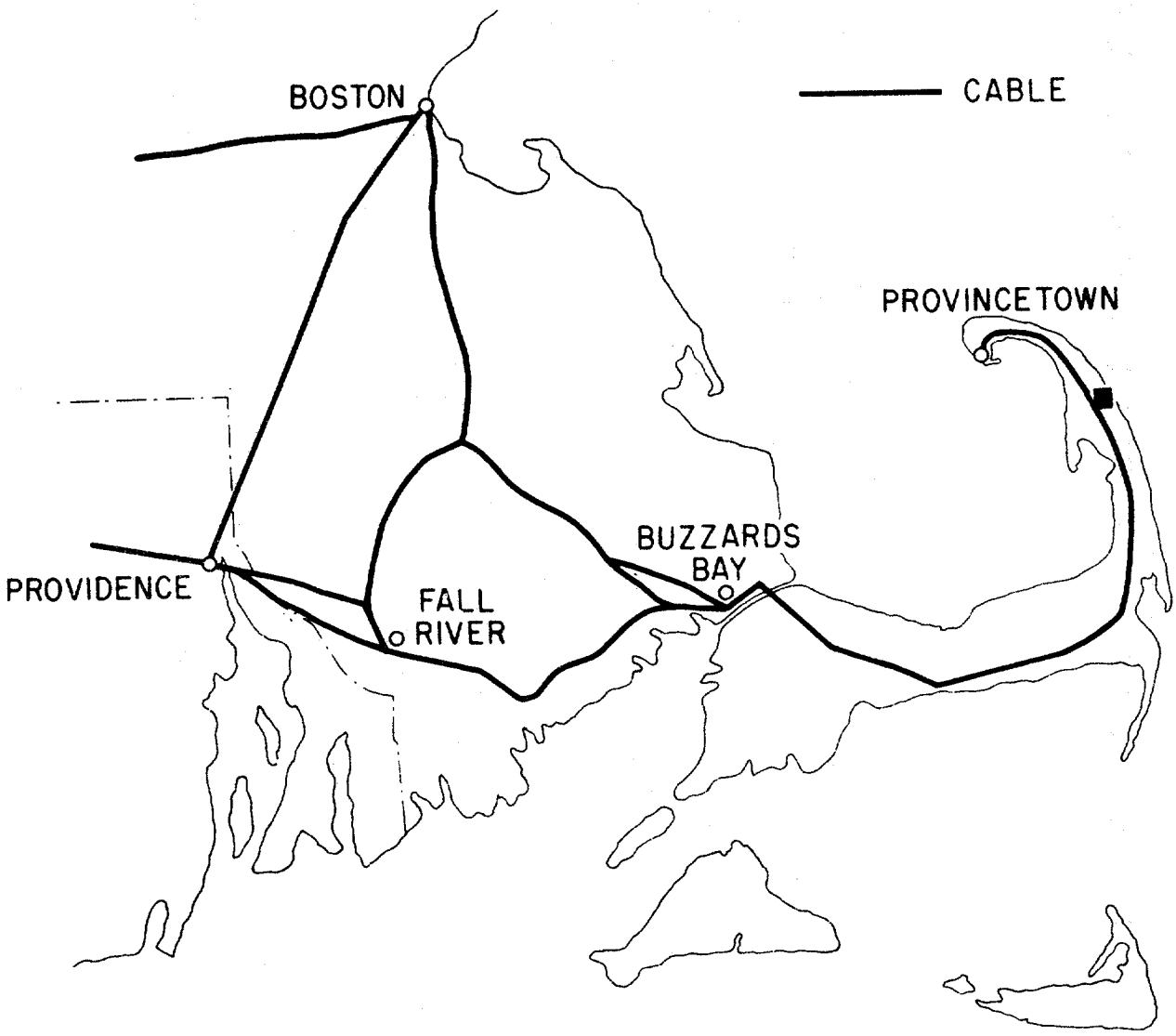

BOSTON
CABLE
PROVINCETOWN
BUZZARDS
BAY
PROVIDENCE
FALL
RIVER

CHART 12

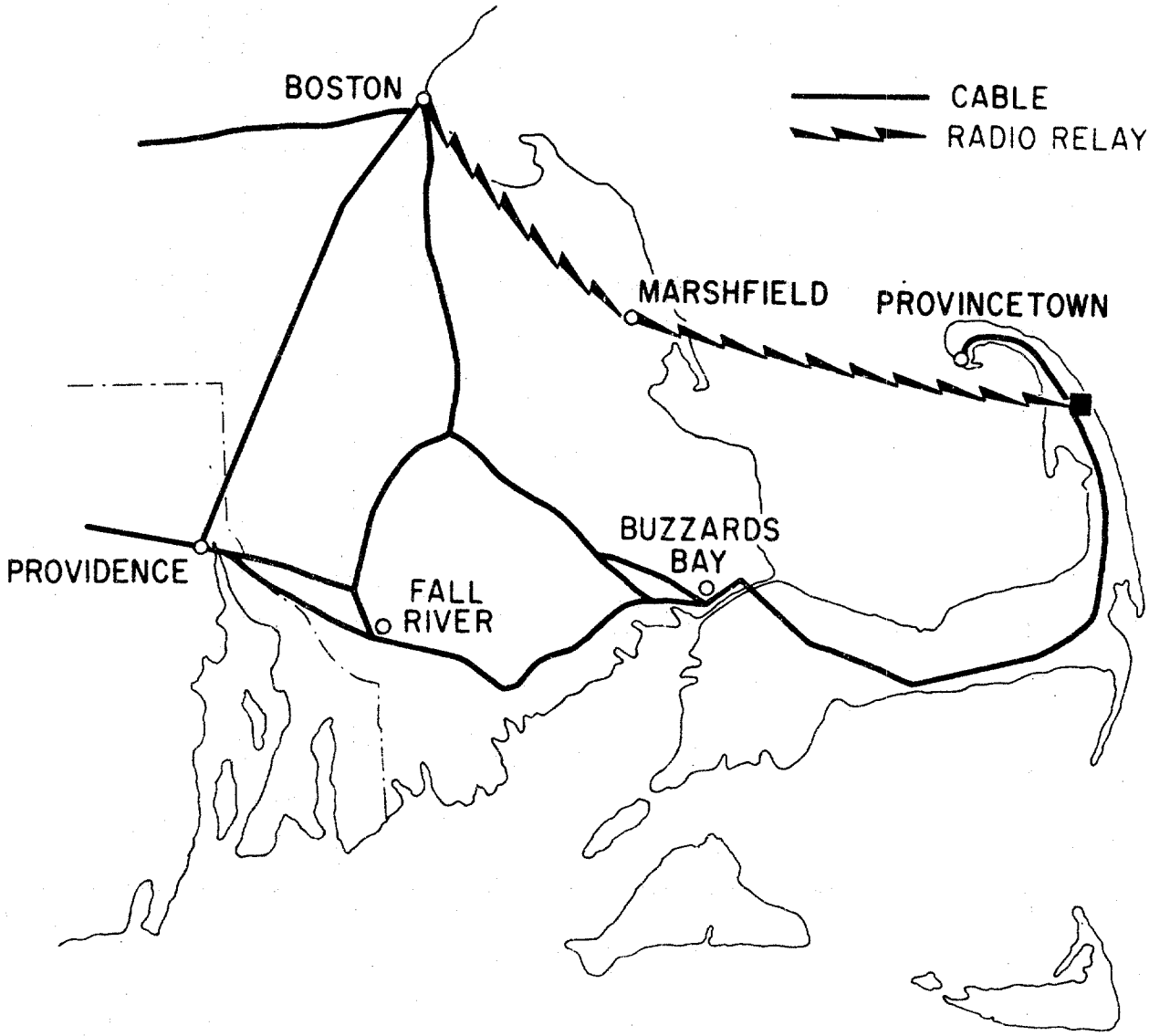

BOSTON
CABLE
RADIO RELAY
MARSHFIELD
PROVINCETOWN
PROVIDENCE
BUZZARDS BAY
FALL RIVER

CHART 13

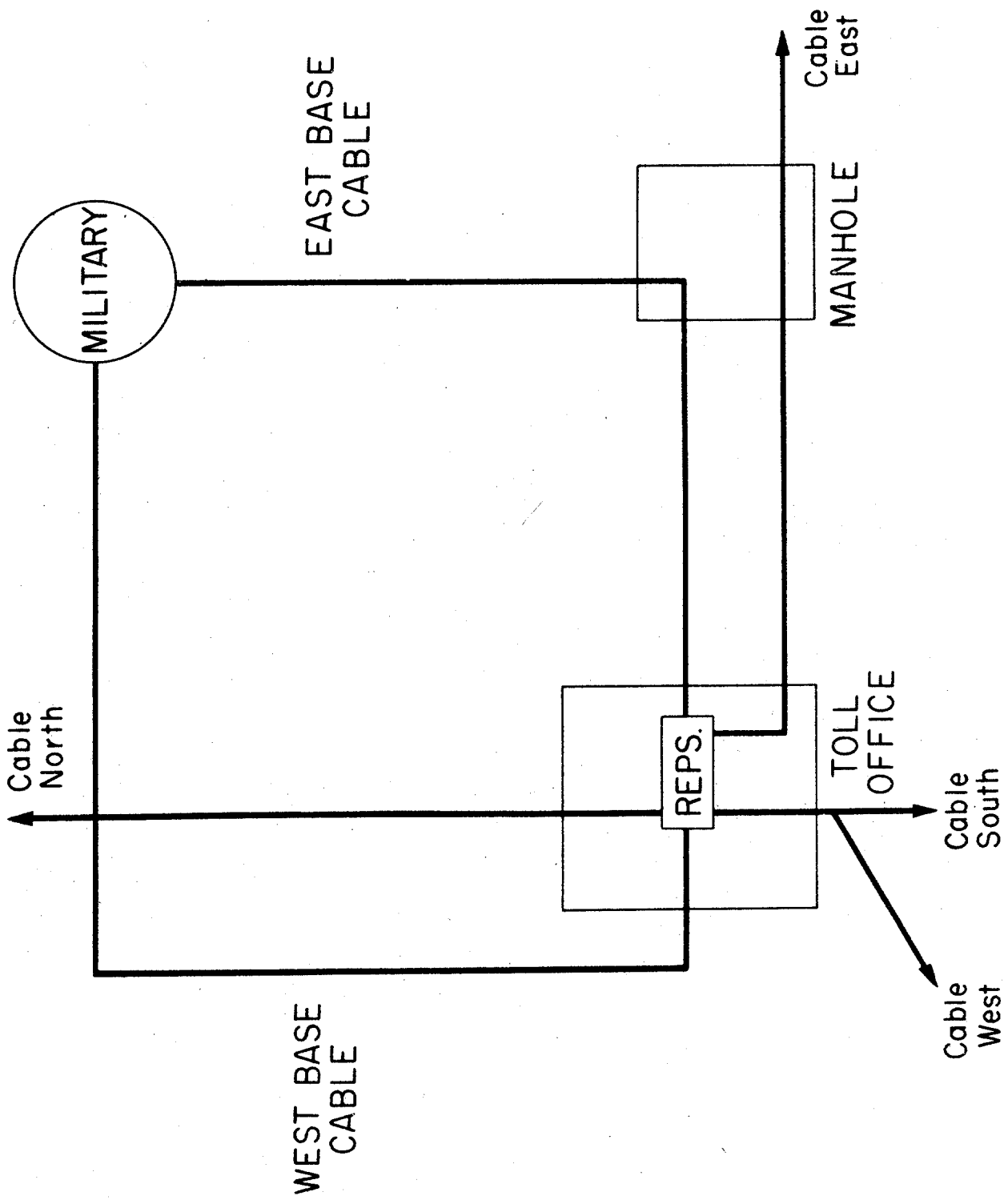

MILITARY
EAST BASE CABLE
Cable East
MANHOLE
Cable North
REPS.
TOLL OFFICE
Cable South
Cable West
WEST BASE CABLE

CHART 14

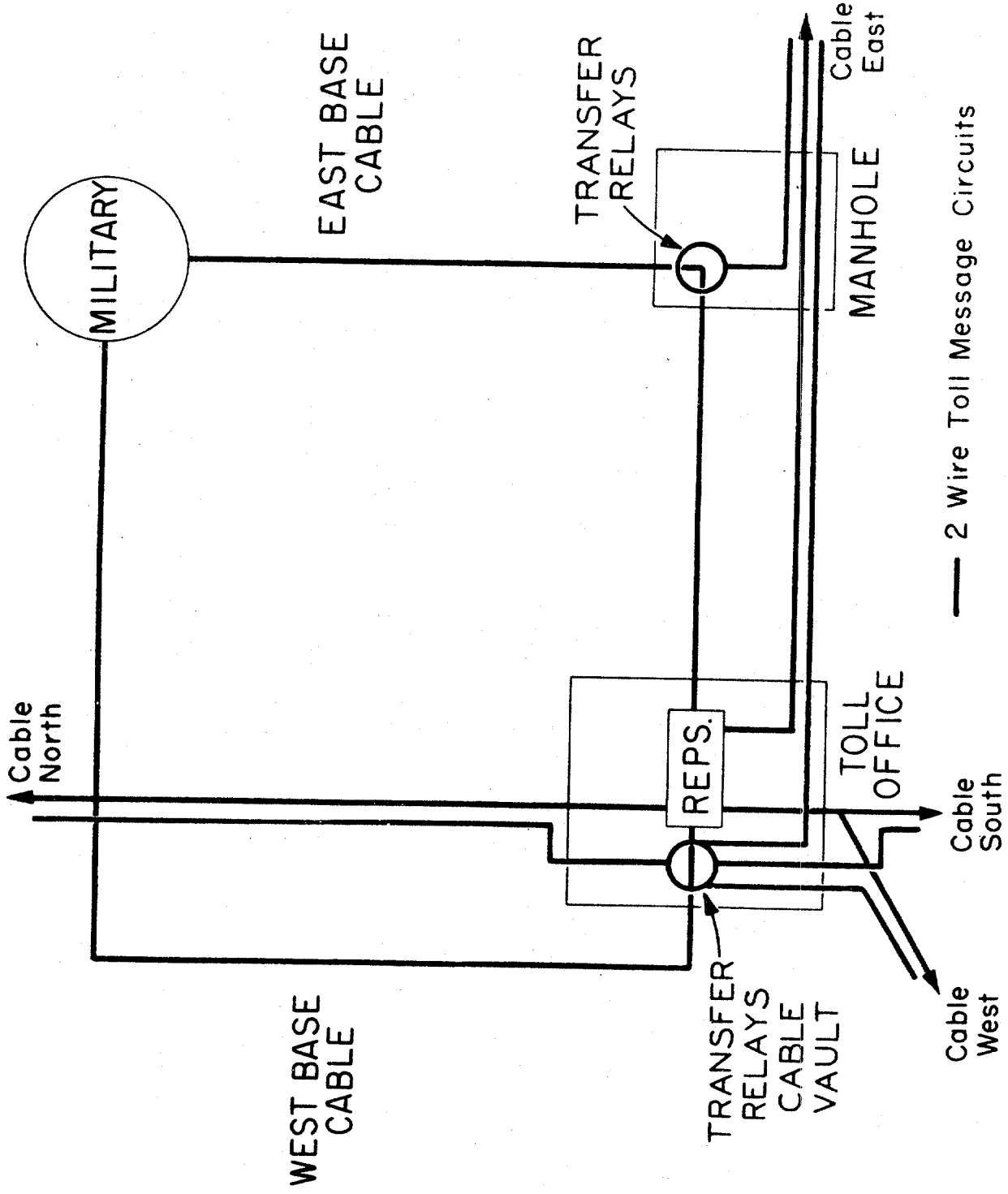

MILITARY
EAST BASE CABLE
TRANSFER RELAYS
Cable East
MANHOLE
2 Wire Toll Message Circuits
Cable North
REPS.
TOLL OFFICE
Cable South
Cable West
WEST BASE CABLE
TRANSFER RELAYS CABLE VAULT

Chart 15, page 27.--This chart shows another problem that we have with the antiaircraft defense. One of the important cities, say Chicago, has an antiaircraft operation center somewhere in Chicago. They have decided to run the operation on what they call a sector basis and split Chicago into a pie, this (indicating) being one segment of the pie; and they have delegated to a subordinate operations center the control for this particular sector.

They need communications back and forth to the regular antiaircraft batteries and the NIKE. NIKE is actually going in at a number of locations now. The communications they have decided on we think will do the job in the best way since they will use two kinds of communication circuits for all important points. This is the diversity principal again. In this case one group of circuits will use wire and cable and the other will use radio. There are two ways to do it under all circumstances. Again, these circuits are not standby, they are working.

Chart 16, page 28.--This chart shows another job which is being done for FCDA. I think Mr. Peterson, Head of the FCDA, talked to you fellows here within the last week or so. While he may not have gotten into communications, we have done a great deal of work with him, and his people, in developing suitable communications for the civil defense job.

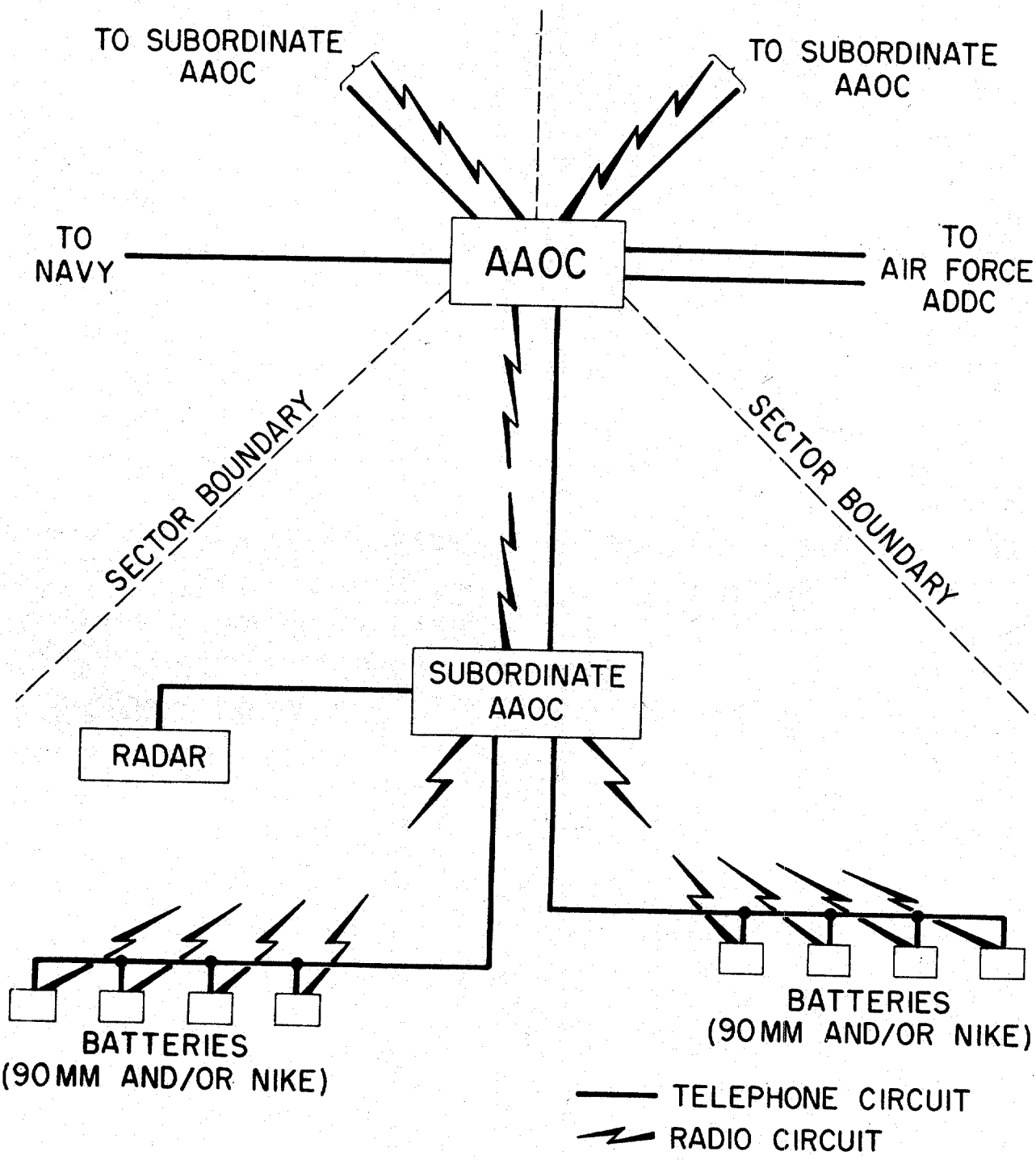
This chart represents a city. This represents (indicating) our central office locations in that city. The Civil Defense people usually establish at least two control centers in a big city, from which they plan to run the job in case there is an attack. They also have numbers of other locations, hospitals, assembly points, and various places which are vital to the civil defense job. This chart shows the kind of network that we have set up to serve, for example, the control center. Each of these places, is served out of the central office nearest it. Then you say, "Let's see what happens in case we get hit here."

Chart 17, page 29.--In this chart you see that in case we do lose all of the central area of this city, including a number of civil defense locations and the telephone central office, the other locations would be served by other central offices that were not hit. In this case neither of the control centers was hurt, but, if we had lost one control center, the other would go on and operate.

That is about the story on the communications job. It has really been an inspiration to work with the fellows in the military services and to try to give them what they want. I think we can say we are ready to do whatever you fellows think is necessary as you get further along in the communications field.

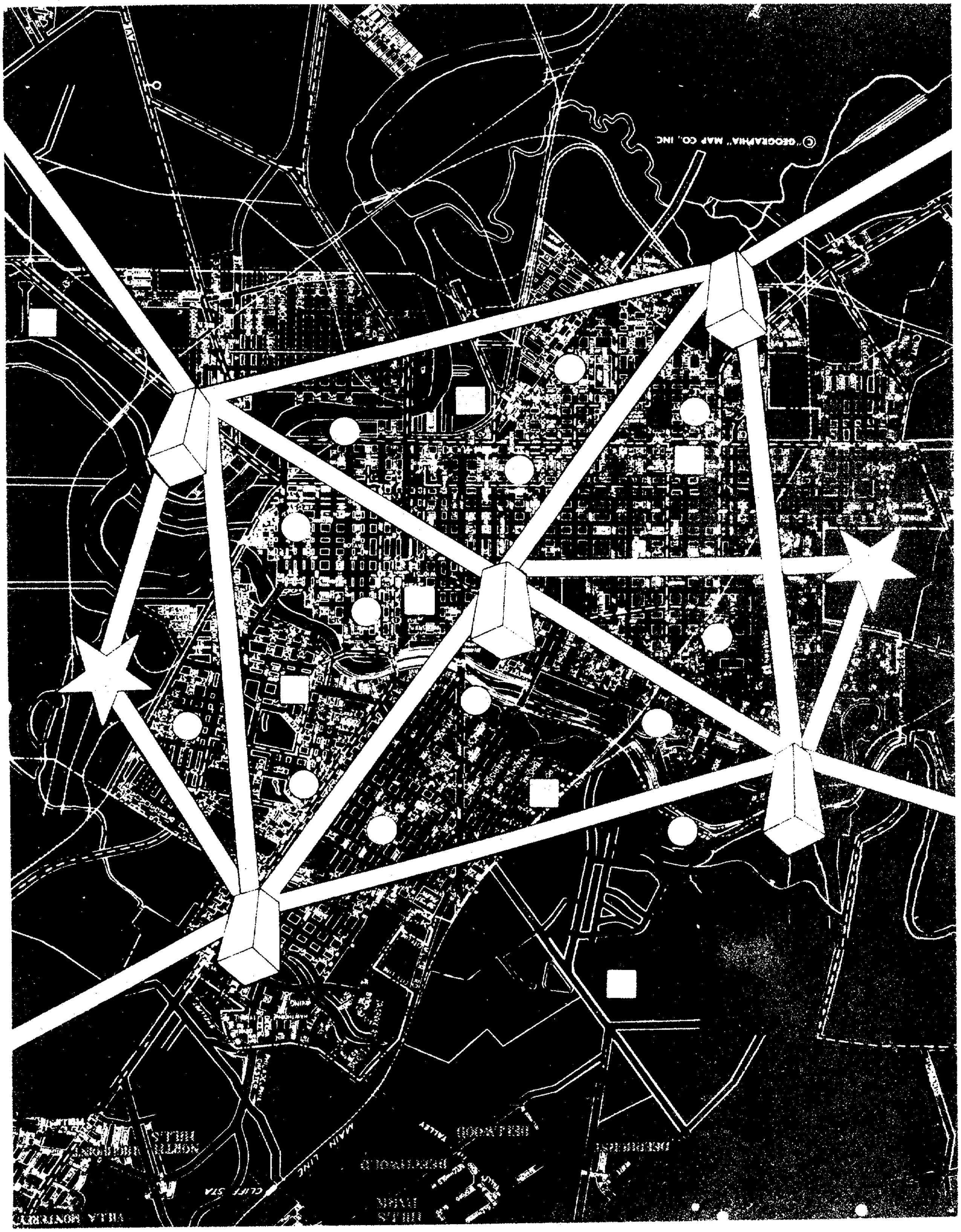
Colonel Price, I think that is it.

ARMY ANTI-AIRCRAFT ARTILLERY DEFENDED AREA WITH SECTOR CONTROL



1536

CHART 16



COLONEL PRICE: Gentlemen, Mr. Mapes is ready for your questions.

QUESTION: You spoke of the use of the transistor as an added piece of equipment in your organization. When do you expect that to be in production sufficiently to use it throughout the system?

MR. MAPES: In the telephone part of our system we are currently using it in some special applications in our toll dialing offices. We are also using transistors today in some of the electrical switching work. We are also using them in some signaling arrangements. Generally, the transistor is in the production today both for us and for the military and is being used to quite a large extent. Also, we have made our technical know-how available to other companies that want it so that these devices are being produced by the Radio Corporation and many other companies today.

QUESTION: Mr. Mapes, on the first map you had there you showed a number of early warning installations up north of the Canadian border. I noticed on the map there were no connecting links shown there into your system, and that was a condition that existed some time ago. How far has the connection gone into some of those more remote sites? That is land-line communication.

Mr. Mapes: We have land-line communications to practically all of the radar sites today. We also have radio, alternate radio connections to some of them. That is a program being worked on with the Air Defense Command and it is a program on which they decide what should be done depending on the particular situation. Maybe I missed it, but I thought there were lines to all points shown since we actually have connections to these locations.

QUESTION: Mr. Mapes, I was interested in your air defense circuits and the considerable mileage of engineered circuits to be brought up in an emergency. You said some had been tested. It has been my observation that you can bring up a reasonably small number quite quickly; but, when you bring up the whole great percentage of your mileage, there is a tendency to be snowed under. Will you tell us in the test about what number of that 73,000 miles was tested simultaneously and brought in in any way? You could bring in one-third of them in hours, perhaps.

MR. MAPES: I think we ought to bring the whole network in in about an hour. So far, as I said, we haven't quite accomplished that in the tests but we have accomplished 80 to 90 percent of that part of the 73,000 miles which was being tested. That has been generally within an hour and the rest within two hours. I think we ought to shoot for one hour as an objective.

QUESTION: Mr. Mapes, from where I sit it looks like your outfit and the sources have about a complete monopoly on the communications system of this country. Are you running afoul of the antitrust laws in that connection? If so, how do you manage to get around them?

MR. MAPES: That's a very good question. We are a monopoly. I don't think there's much question about that; but we are a monopoly which is being very well regulated by appropriate Government bodies. The Federal Communications Commission controls, you might way, our rates for interstate calls and in each of the 48 States except Texas and Iowa there are state public service commissions to which we have to go if we want any change in our rates. We have to get approval of those commissions before we can change our rates. Also, they have jurisdiction over certain other phases of our service. If we don't like the administration of the FCC or the state commissions, we can, of course, go to the courts.

As you probably know, we have had to raise telephone rates over the last few years because our costs have gone up, just as other costs have gone up, but in all cases we have to go to a public body to get approval.

I think that the communications job needs to be a monopoly if it is to be done efficiently. Having two telephone companies in the same city has not proven out very well in the past. If some of you are from Philadelphia, you will remember that we had a duplicate system, the Keystone System, in Philadelphia for many years. It did not work out to the benefit of the public.

QUESTION: Mr. Mapes, you have related some of the successful aspects of the telephone system. Would you care to discuss any of the blind alleys you might have run up in the past, or any of the problems that you have no immediate solution for at present?

MR. MAPES: Well, blind alleys that we have run into in the past--I don't believe I can think of any offhand. That doesn't mean we haven't run into them, but I don't recall any of any importance. For the future, there are many things that could be done. For example, we will get suggestions: "Why don't we have television on our telephones so we can see the other fellow as well as hear him?"

That's technically possible. There is no difficulty about it but the trouble is with present techniques it would cost a tremendous amount of money and currently we don't believe it would make too much sense to expend our development and our laboratory manpower on that kind of activity. So, frankly, we are just not doing anything about that today.

We do have nationwide customer dialing as our objective. We currently have three offices--one in Englewood, New Jersey; one in Birmingtom, Michigan; and one outside Pittsburgh where customers can dial any one of 14 million telephones ranging from San Francisco to Boston. They can do that today. They dial 10 digits; they dial the area number, like 212, and then dial the subscriber's own number. This is all there is to it. That's one of our big objectives for the future.

Of course, we are always struggling to get things designed that are more economical so that we can do the technical job better and provide adequate returns to our stockholders and still avoid having to ask for rate increases to the extent possible. This is another of our major jobs.

QUESTION: My question involves civil defense and I would like to use two examples to illustrate it. Would it be possible for your system to have something similar to the time number that we dial to get the time or the weather number? By dialing a certain number the civilians, after attack, could be kept informed of the progress in civil defense. The second example is: Would it be possible for your system to inaugurate some sort of a warning system, perhaps a panic button that would be pushed to ring all the bells in the community?

MR. MAPES: As to the question of dialing a specified weather number or a similar number, I don't believe that is practical. If every customer in the city of Washington should try to dial at the same time, our equipment would not handle the business adequately and, therefore, we do not believe that it is practical to do that. It seems to us that the arrangements that have been made with CONELRAD, whereby all anybody with a radio set has to do is turn the knob to 640 or 1240 kilocycles, are practical. If he has the power. If your power is gone your radio set is too, unless you have a local battery.

You very definitely could have a telephone when you don't have power. We provide emergency power to our offices with standby Diesel or gasoline units to keep the centers running if we lose the power. We don't use them except in emergencies. We use commercial power generally. I think the answer to the first question is, it would be very difficult technically and the CONELRAD system seems to do a pretty good job today in the tests we have observed.

Your second question is why couldn't we alert all telephones by ringing the telephone bell with some kind of special signal. We have thought of that too. I think the main reason that it is not very practical is that if you take the number of bells that are rung at any one time in a community, you would be surprised how small it is. The bell usually rings for maybe 15 or 20 seconds before you get an answer. The length of the bell ring is so short and there are so few that have to be rung at the same time that our generating machines that send out the ringing current are designed for the simultaneous ringing of a small percentage of the total telephones. The amount of current we would have to produce to ring the maximum number of bells--all at once--would mean very substantial increases in the ringing generating equipment and we have some doubt whether it would be effective.

Furthermore, we want people to stay away from the telephone during alerts in order that it can be kept for the civil defense people. In all our advertising and talking we have said, "keep away from the telephone."

QUESTION: Mr. Mapes, my question may tie into the last one. I was interested in the alternate systems of emergency relays and the measures you have taken. Can you give us an idea of the finance? How much Federal aid in the way of tax amortization do you get? How is that handled?

MR. MAPES: On the financing, let us take the question of charges to our customers first. We are just like any private corporation in dealing with the military people. We have standard rates for most of the services we offer. They are generally filed as tariffs with the regulatory commissions. When it comes to certain special things of a character peculiar to the military job, we say to the military people, "If you feel that you need this arrangement because of your special circumstances, we will be glad to offer it to you at a rate of so and so," and we will quote a rate based on the cost to us. The dealing is the same as the dealing would be with General Motors Corporation or any other company as far as obtaining special services is concerned.

I think I ought to make one other point. Do you remember the Cape Cod case where we put in a radio alternate link? In a case of that kind what we usually do is say, "If you wish to have 16 circuits of that character and will guarantee to keep them for ten years, we will charge you only the regular tariff rates. If, however, you put them in and then abandon them in a year, the extra added expense, we feel, ought to accrue to the military job." That's the arrangement we customarily make.

QUESTION: I was thinking also, sir, of such capital investment you have dispensed in the line stations which you said you moved out of town.

MR. MAPES: The expense for dispersion of our switching centers and main cable routes is done on our own account. We do not use tax amortization arrangements currently and never have.

QUESTION: My question carries on with that point. Do you have a policy in your company to build these relay stations or other stations outside the city and to make them invulnerable? Will you elaborate on that?

MR. MAPES: The radio relay stations have to be built on what we call a "line of sight" basis. You have to put these stations at points where you can actually see the receiving unit at the other end, if you can look that far. In other words it has to be clear of the horizon. Therefore, on level ground they have to be about 30 miles apart. When they come to a terminal point in a city, which is the one I think you have in mind, it is the general practice to put the tower on some high building in the middle of the city--as in the middle of New York City.

That is not always the case, but it is generally done that way and in some cases alternate arrangements are provided to get from the last point to some other tower, if the one in the city has failed or gets

knocked out. In Washington here, we didn't do that. We have the terminal point at Garden City which is two or three miles from the Pentagon. The radio relay is only one of a number of routes that feed our larger cities.

STUDENT: I didn't have reference to that specifically. You mentioned White Plains and Washington here, that they are outside the more vulnerable areas in the cities. That has been deliberate. Do you have deliberate policy across the board, as far as your company is concerned, in making your installations less vulnerable?

MR. MAPES: Oh, definitely. That is our policy as we go ahead. We can't do it all at once but it is our aim in every case as we build new things to consider the question of vulnerability and to take such steps as are practical in each case.

QUESTION: Mr. Mapes, has your company ever been asked by the Air Force to operate any of these radar screens? Have you considered that?

MR. MAPES: The radar installation, I think you might say, divides into two parts. One is the operation of the actual radar job, the radar itself, and the mechanics that go along with it. The other is the communications that go on within and to the radar site.

We have never been asked to do the former. There has been some talk of possibility of the latter which are generally telephone key-type arrangements with which we are familiar. I don't believe, however, we have actually completed any arrangements of that kind. We are working on the early warning line in Alaska and the Western Electric Company is currently building and operating three pilot units up there. These are prototypes of what might be done for the whole northern line of defense.

QUESTION: To get back to the vulnerable question again, Mr. Mapes, it has been noted in the paper that GE is having trouble getting rid of some of its workers who belong to that Communist led workers' union. I wonder whether or not the Bell System has had any difficulty in that line?

MR. MAPES: We have had a policy since and during the last war of obtaining citizenship information from our employees as most every industry that is at all vital has done. We have also had a policy of screening the people by supervision, that is, by being constantly aware of what a fellow does, what his associations are, and so forth. So far we have been fairly successful in not, so far as we know, having too much in the way of trouble. We have had a few cases in recent months where some evidence of Communist leaning was indicated. In those cases we have had a thorough investigation made by a competent agency and then taken the proper steps. I think within the last year, maybe, there have been

three cases or so in the whole Bell System of 700,000 people. That doesn't say that one of these very active committees won't find some more.

QUESTION: My question follows the Colonel's. What is the susceptibility to internal sabotage by a few well-placed individuals whose objective is largely disruption prior to or immediately following an attack?

MR. MAPES: Our susceptibility to internal sabotage--let us say the fellows were smart and we didn't know about them. The fact that we have a very tremendous diversity of circuits would mean that it would take a lot of people--it would really mean a young regiment, I think, to do an effective job. I don't believe two or three people, or a half dozen people, could cut enough cables--I don't just mean by taking some kind of cutting action but by bombs or otherwise--to seriously damage the entire communications network; and it is the total network that is important in this country.

We can reestablish local service very quickly with switchboard positions as the military does when it moves positions from one place to another. It is the total network we would most like to keep intact. You remember the map where we showed the routes across the country? Some of these are radio relay. You would have to knock out a radio relay station, which, if we get into trouble, could be protected fairly well. You would also have to knock out all the cables. Then, if we really get pressed, we can reverse the transoceanic stations on the east coast and connect them to the west coast. Please don't take that as being one of our fundamental plans because it is not. I am just saying we have thought that far.

QUESTION: Can you tell us the effect on the telephone system of a complete blackout of all public power in a 500-square-mile area around a given city? Would that affect your telephone system?

MR. MAPES: We have that all the time. In fact, we have it in West Virginia right now. In this storm we had there the day before yesterday, the power blacked out in large sections of West Virginia. There are some high-tension power lines still on the ground. But we have not lost any offices because we have emergency power in the offices. I would say we could lose 500 square miles and have no effect on keeping our offices running.

I don't want to be misunderstood that all of our lines would be up. A storm or a bomb, or anything else of that kind, is going to take out some lines. As far as the central offices are concerned, they can continue to operate because we have installed Diesel or gasoline engines in the important points. In the New Jersey storm about three years ago, there were 400 offices that did not have power. None of them stopped working.

QUESTION: Are you gradually gathering these independent companies into the Bell fold?

MR. MAPES: No. There are occasional cases where an independent company can't carry on financially any more and where the local people ask the Bell System to take over the control. That is very infrequent and, more generally, the independent companies are merging with other independent companies where mergers are contemplated.

QUESTION: What is your policy, sir, about putting lines underground, as opposed to on the surface?

MR. MAPES: Practically all of our toll cables are now put underground. All of our important routes are already underground, that is the toll, the interstate stuff. We are building practically no open wire. As far as a city itself is concerned, all of the major cables and major routes are underground. When you get into the suburbs you naturally get into the air for the cables that feed the local residences and scattered business concerns. Our policy is to put the important facilities underground.

QUESTION: Mr. Mapes, to what extent is the radio communication system vulnerable to jamming, or interferences of that kind?

MR. MAPES: The radio communication system is a very directive type of thing. It projects a radio wave from one of these towers to the next one in a very closely held direction. Two or three degrees is all it can vary or we don't get a good signal at the other end. Jamming, outside this narrow band is not effective. In other words general attempts to jam by random generation of signals won't hurt us. If you got directly in the path and put up a particular kind of station to buck the radio signal, you could do it but that could be found very easily. You have only to run a line and you have it. Generally, jamming can't be done to hurt the radio relay.

QUESTION: In the general stage of the future developments of the civil communications of this country, are there any legislative restrictions or restrictive measures that the AT&T are working on at the present time to try to get revised ways to further promote your development throughout the country in civil telecommunications? I was just thinking that as we travel from State to State in the military service we find that in certain areas there is, it seems, a propaganda approach to this business of taxation. They enclose with the bill a slip saying, "You must remember so much of this is taxes, Federal and State." What is the purpose behind this? Or is it that you feel that taxation for these causes, if reduced, would increase the chances for lower costs and therefore permit you to expand?

MR. MAPES: I will answer the last question first. I think I can answer it by the fact that today Congress is considering reducing the

excise taxes on long-distance telephone calls from 25 to 10 percent and on the local calls from 15 to 10 percent.

We have worked for that by telling our customers what the facts are. We want to pay taxes; we completely agree that taxes are necessary and we want to pay our full share. In this case we have felt that the tax was out of balance. Actually, it was put on during World War II to be somewhat of a detriment to calling, and that was fine in those days when we wanted to keep all of the calling lines for defense production and so forth.

Today we think it is out of balance with the rest of the items which are subject to excise taxes. The long distance tax is one of the highest excise taxes on the books. Telephone service is not, as we see it, a luxury. Telephone conversations are a necessity to carry on business and the social life of the country. We paid about 800 million dollars direct taxes last year and I think there was another 675 million that resulted from excise levies. In other words 1.5 billion came out of the telephone business. We think some of that is good, we ought to do it. But when it gets out of balance, we think we have the right to protest.

QUESTION: Does facsimile have any place in this?

MR. MAPES: We don't offer facsimile as such, that is, a complete service from one end to the other. We do offer channels so that customers can connect their facsimile equipment on the ends.

STUDENT: That's practically it. How does that fit with the highway chart you showed?

MR. MAPES: On highways, as I remember it, facsimile can be accommodated on a voice channel of 2,800 cycles.

QUESTION: I have always thought that taxation and perhaps the cost of the instrument could be greatly reduced if there were some way to control the use of the telephone by teenagers and women.

MR. MAPES: I have three teenagers and I know what you mean.

STUDENT: They spend their social life on the phone. I was wondering if you could have some way of controlling that.

MR. MAPES: We do something like that for toll calls. There we charge for the time a person talks. In the local business we don't. In some cities we charge for the number of calls. In other words every call you make clicks a register and the calls are charged for at the end of the month. In other cities it is a flat rate and you can make as many calls as you want.

That is a very good question. May I say that there is some disagreement among telephone people on that point. We have thought of devices that would cut off a call in, say, five minutes or in other ways suggest to the user that he let somebody else use the telephone.

However, we think that the telephone should be something to use freely and as long as we can compensate for the use of the telephone by adequate rates fairly apportioned between the various types of users, we believe the customer ought to use it as much as he desires. Therefore, we are reluctant, from a policy standpoint, to cut him off which would certainly increase the many sources of frustration already in our modern scheme of living. Even when it is your daughter talking and you are trying to call your wife about coming home, we feel that it would be wrong to break in. The telephone is something people ought to use as they wish and we hope they get all the pleasure they can in using it.

QUESTION: In previous talks I believe you reported that you were having trouble keeping up with the demand for service and had a backlog of requests. Can you tell us what is the status today? Are you building to meet requirements?

MR. MAPES: Yes, we are still behind. We have today something just under 400,000 customers who are asking for telephone service which we cannot presently provide. They are not all over the country. The major concentrations are in the South, in the Southwest and some on the Pacific Coast. This is 400,000 out of over 40-million--less than 1 percent. We are continuing to work on that situation and one of our objectives is to get out of that condition this year if we can.

We also have about 1 million customers who want a better grade of service; they want to go from four-party to two-party or from two-party to individual lines. We believe it is our duty to give people the kind of service they want. That is the reason we are going to spend about 1.4 billion of new money this year to try to catch up with the demand.

COLONEL PRICE: Mr. Mapes, time has caught up with us. We wish to express our appreciation to you for taking your valuable time to come and give us this lecture.

MR. MAPES: I am glad to be here.

(13 Apr 1954--750)S/mmg