TELEPHONES

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CHAPTER I.

INTRODUCTION.

Classes of telephone systems included.—The extensive use of the telephone has developed a number of different business methods for the organization and conduct of the industry. This census report covers all commercial and mutual or cooperative telephone systems, and also all independent farmer or rural lines that were in operation in the United States during any part of the year ending December 31, 1907; but does not include private lines used exclusively for communication between different rooms or departments of manufacturing or mercantile establishments, hotels, or private residences, systems operated for the benefit of Federal, state, and municipal governments, or those owned or leased by steam or electric railroads and operated by them for their own exclusive use. The companies for which statistics were collected have been divided into the following two classes:

(1) The American Telephone and Telegraph Company, and its subsidiary companies, commonly known as the "Bell system."

(2) Companies and systems operated independently of the Bell system and denominated "independent (non-Bell)" throughout this report.

All of the Bell companies have been considered as commercial, and the statistics for the entire system were obtained from the central office of the parent company at Boston, Mass.

The independent companies are divided into the following three classes:

(*a*) Commercial systems operated primarily for revenue.

(*b*) Mutual systems, or cooperative associations and companies, operated not primarily for revenue, but for the convenience of the patrons, who are assessed to pay expenses of maintenance, operation, and extensions. Many systems doing business on the mutual basis are organized as incorporated companies under the laws of the states in which they operate.

(*c*) Independent farmer or rural lines, which have no regular exchanges or centrals of their own, but which may or may not be connected with the exchange of a Bell or of a commercial or mutual system.

The term "independent," as used in connection with farmer or rural lines, does not relate to the distinction between Bell and independent (non-Bell) systems, but rather to a distinction between the farmer or rural lines and the lines owned by commercial and mutual companies. The practice of establishing short telephone lines connecting two or more houses in the rural districts has increased very rapidly during the past ten years. Frequently these lines have no distinctive names, and their existence is known only to the persons in their immediate vicinities. They are extended gradually as other persons desire to be connected and, if they are in the neighborhood of a telephone exchange, it frequently happens that arrangements are made for exchange service. The extension of the farmer lines by additions or consolidations leads gradually to the establishment of exchange systems and the formation of mutual or commercial systems. This method of development makes it difficult to establish a line of demarcation between farmer or rural lines and mutual systems and between mutual and commercial systems.

Some companies operate on a combined commercial and mutual basis. This is due to the fact that the lines were constructed under a mutual arrangement and that later additional subscribers were taken on a revenue basis. In such cases if the assessment income for the census year exceeded the revenue income, the companies are classed as mutual; but if the revenue income exceeded the assessment income, they are classed as commercial.

A statistical line of demarcation between the independent farmer or rural lines and the small mutual systems can not be established with a degree of accuracy that will enable a comparison of the statistics for 1907 with those for 1902. At the census of 1902 the statistics obtainable for these small lines were rather incomplete, and practically all of the farmer or rural lines that operated switchboards were counted, without regard to size or amount of business, either as commercial or as mutual companies. The fact that a switchboard was operated was found to be of little assistance in establishing the line of separation, and therefore for the census of 1907 a different policy has been adopted. In this report there are included in the class of independent farmer or rural lines systems operated on a combined mutual and revenue basis, where the combined income and assessments for the full census year amounted to less than $1,000, and small systems owned by individuals or firms and apparently operated for revenue having an income of less than $500 for the full year.

The contract agreements for exchange facilities between different companies or between companies and farmer or rural lines are made to meet local conditions. In some cases the company owning the exchange obtains virtual ownership or control of the connecting lines; in some a fixed rental per month or year is paid to the owning company; while in some the compensation depends upon the number of stations connected, and in others it depends upon the number of messages transmitted. In making the census report the actual ownership of each line is used, so far as possible, to determine whether to include it as a member of the Bell system or as one of the several forms of associations operated independently of the Bell system. The statistics for the Bell system, therefore, represent only the lines and stations reported by the company as owned by it or by its subsidiary companies. In addition, however, the American Telephone and Telegraph Company (Bell system) reported the number of stations on the lines that have contract agreements for service at its various exchanges.

At the census of 1902 great difficulty was experienced in securing a satisfactory enumeration of the small independent commercial and mutual telephone companies and systems and of the independent farmer or rural lines. Therefore a special effort was made at the present census to enumerate all lines of this character. In the first instance a card index was prepared containing the names and addresses of all telephone companies and independent farmer lines known to the Census Bureau. The basis of this index or list was the reports made at the census of 1902. But in order to make it complete other sources of information were utilized; the postmasters throughout the country were required to furnish the names and addresses of all telephone companies and of the owners of individual farmer or rural lines operating in their cities or immediate vicinities; state officials were requested to furnish lists of the telephone companies in their respective states, and fairly complete lists were received from most of the states; county officials were requested to furnish lists of the names and addresses of the owners of farmer or rural telephone lines in their respective counties, and a great deal of information was obtained from them; all of the independent telephone associations were requested to furnish the names and addresses of their members, of any other companies in the same neighborhood, and of the proprietors of near-by independent farmer or rural lines known to them; and the names and addresses of telephone companies were obtained from the city directories for all cities having a population of 50,000 or over, and from lists kindly furnished by the publishers of Telephony's Directory of the telephone industry.

Blank schedules soliciting the statistics required for the census were mailed to all the companies and to representatives of each of the independent farmer or rural lines named on the lists prepared from these sources, and in addition each company or person addressed was requested to give the names and addresses of all connecting farmer or rural lines and of all other companies or lines in the vicinity. Many additional names were secured by this means. The preliminary lists prepared from these various sources contained in the neighborhood of 35,000 names, a total which, of course, included quite a large number of duplications that had to be eliminated from the perfected card index. The Census Bureau, however, not yet satisfied that it had a complete list, divided the United States into eighty-four enumeration districts for making a personal canvass, and assigned one or more special agents to do the work in each district. They were given the names and addresses of all the telephone companies and of the proprietors of the independent farmer or rural lines located in their respective districts, and they were instructed not only to secure reports from each company or line whose name they had, but also to make careful inquiry for any other companies and lines in operation in the district during any portion of the year 1907.

It is believed that as a result of these efforts, returns were secured from practically every company or line that was in operation during any portion of the census year.

Period covered.—The statistics cover the year ending December 31, 1907, or the business year of each company which most nearly conforms to that calendar year. All statistics taken for a fixed date, such as cash on hand, number of telephones or stations, and wire mileage, are reported as of the last day of the business year covered by the report taken for each company. When possible, comparative data for the census year ending December 31, 1902, and for prior censuses are presented in connection with the data for 1907.

Since during the year 1907 many companies were organized and many systems were installed, and a number abandoned or absorbed by other companies, the statistics do not represent a full year's operation for every company reported. As the census can not be taken instantaneously and the number of telephones in operation changes daily, the numbers given in the annual reports of many companies do not agree with the number reported to the census for the date on which its report was obtained. These conditions should be considered in comparing the census figures with those compiled for other purposes.

Limitations of the statistics.—As small commercial systems owned by individuals and firms, many mutual systems, and the farmer or rural lines generally have no statistics concerning capitalization, and as many could furnish no data in regard to income and expenses, number of employees, salaries, wages, and some other subjects that are covered in the reports of the larger companies, it is impossible to compile for the entire industry totals showing all of the detail called for by the inquiries of the census schedule. In fact, the number

of telephones and the miles of wire are the only facts that could be collected for a great many of the independent farmer or rural lines and the small mutual systems. Statistics of capitalization, income, expenses, number of employees, salaries, wages, and other features presented in the detailed tables have been secured only for the commercial companies and the more important mutual systems. Therefore the statistics on these subjects do not represent all of the interests operating the 12,999,369 miles of wire and the 6,118,578 stations or telephones reported for all classes of companies, systems, and lines.

In the cases of some companies which keep no account books from which exact statistics concerning their incomes and expenses during the year could be obtained, estimates have been resorted to for approximate data. The employees of some of the smaller companies and systems do not devote their entire time to the telephone business, and so the wages reported by these companies are necessarily much lower than the wages reported by companies whose employees are paid for a full term of service.

The telephone companies do not limit their operations to the state, county, or city in which their principal offices are located, but extend their lines irrespective of the political subdivisions of the country. In compiling the statistics it is impossible, in many instances, to assign to each state the amount of capital, income, expenses, salaries, and wages that are incident to the operation of the wires and telephones within its limits. As a rule, the total for all items of this character is credited to the state in which the general office is located, but an exception is made in the case of the American Telephone and Telegraph Company, which segregated the statistics so as to assign to each state a portion of each item commensurate with the equipment located in it.

Systems or lines.—Throughout this report the designations "company," "system," and "line" are frequently used as synonymous terms. They represent a statistical unit, the connotation of which varies slightly to meet the requirements of the different methods of bookkeeping of the various companies and the practice of the office in the compilation of the data. There is an increasing tendency to bring independent telephone lines under one ownership and direct their operations from a central office. The industry is constantly undergoing changes in this respect. New companies are being organized and old systems consolidated or reorganized. On the whole these changes increase the number of cases in which several lines are considered as a single system.

As a rule, distinct ownership marks the separation of the statistical units, and all exchanges and lines operated under the same ownership are counted as a single system. Where several lines are combined under one ownership, or several properties have been brought under one management by purchase or stock control, they are counted as one system. The subsidiary companies of the American Telephone and Telegraph Company are, of course, counted as separate units, as are the subsidiary companies of some other large companies which furnished separate reports for their subsidiary companies. Each independent farmer or rural line and each independent commercial or mutual company, however small, also is counted as a separate system. The "number of lines" in the tabulation therefore represents consistently the number of separate ownerships, without regard to the character of the ownership, and does not represent the number of circuits or pole lines.

Since the meaning of the terms "system" and "line" is not always the same, the number is no indication of the magnitude of the interests nor is it a true guide as to the number of exchanges. The process of consolidation may have resulted in an actual decrease in the number of companies, but at the same time the number of exchanges, miles of wire, number of telephones, and amount of business transacted may have increased.

CHAPTER II.

DEVELOPMENT OF THE INDUSTRY—STATISTICAL.

Comparison with prior censuses.—In recent years all of the industries which depend upon the utilization of electricity have developed very rapidly in the United States, and have become intimately related to the industrial prosperity and social intercourse of every section of the country. Among these electrical industries none is of more general importance than the telephone and telegraph systems, for it is probable that they are closely allied to the daily business and social life of a larger proportion of the population than are either the electric railways or the electric light and power stations.

A few experimental telephone circuits were established in 1877, and from that year the telephone industry took commercial shape. The first statistics concerning it were gathered in connection with the census of 1880; a second report followed in 1890; and a third, contained in a Special Report on Telephones and Telegraphs, was presented for the calendar year 1902. The new data contained in the present report cover the year ending December 31, 1907, or the fiscal year of each system most nearly conforming to that year. The growth of the industry in number of systems or lines, miles of wire, number of stations or telephones, and income is shown by Table 1.

TABLE 1.—*All systems and lines—Comparative summary: 1880 to 1907.*

[Includes commercial and mutual systems and independent farmer or rural lines.]

	CENSUS.				Per cent of increase, 1902 to 1907
	1907	1902	[1] 1890	[1] 1880	
Number of systems and lines	22,971	9,136	53	148	151.4
Miles of wire	12,999,369	4,900,451	240,412	34,305	165.3
Number of stations or telephones	6,118,578	2,371,044	233,678	54,319	158.1
Income	[2] $186,245,205	[3] $86,825,536	$16,404,583	$3,098,081	114.5

[1] Independent farmer or rural lines not reported.
[2] Includes income for independent farmer or rural lines, $1,783,458
[3] Income for independent farmer or rural lines not reported.

The foregoing table is confined to the items for all systems and lines which are directly comparable for all censuses.

A more comprehensive view is secured by excluding the independent farmer or rural lines, data for which appear only in the returns for the censuses of 1902 and 1907, and Table 2 is a comparative summary of the leading statistics with these lines excluded.

TABLE 2.—ALL SYSTEMS AND LINES, EXCLUSIVE OF INDEPENDENT FARMER OR RURAL LINES—COMPARATIVE SUMMARY: 1880 TO 1907

[Includes commercial and mutual systems.]

	CENSUS.				Per cent of increase, 1902 to 1907
	1907	1902	1890	1880	
Number of systems and lines	5,269	4,151	53	148	26.9
Miles of wire	12,513,075	4,850,486	240,412	34,305	158.0
Number of stations or telephones	5,552,929	2,315,297	233,678	54,319	139.8
Number of public exchanges	15,527	10,361	1,241	437	49.9
Estimated number of messages or talks	11,372,605,063	5,070,554,553	453,200,000	[1]	124.3
Number of employees	144,169	78,752	8,645	3,338	83.1
Capital stock and funded debt outstanding, par value	$814,616,004	$348,031,058	$72,341,736	[2] $14,605,787	134.1
Income	184,461,747	86,825,536	16,404,583	[3] 3,098,081	112.5
Operating expenses and fixed charges, except interest on funded debt	128,486,196	61,652,823	[4] 11,143,871	[4] 2,373,703	108.4
Interest on funded debt	12,316,109	3,511,948	[5]	[5]	250.7
Assets	994,842,990	466,421,553	[1]	[6] 15,702,135	113.3

[1] Not reported.
[2] For 72 systems; 76 systems did not report this item.
[3] For 132 systems; 16 systems did not report this item.
[4] Includes interest on funded debt.
[5] Not reported separately.
[6] For 74 systems; 74 systems did not report this item.

At the beginning of the census year 1880 the industry was of little importance, but at the end of the year it represented one of the great interests of the country. The organization of many companies during the year and the rapid growth of systems already established made it impossible to collect statistics that are completely satisfactory. Hence the totals for the census of 1880 are only approximations to the exact conditions of the telephone-exchange industry at that time.

While the industry had become much more stable by 1890, the conditions under which it was then conducted and the census methods employed at that time lead to the conclusion that the statistics are not strictly comparable with those for subsequent censuses. Therefore percentages of increase are shown in Tables 1 and 2 only for 1907 as compared with 1902. At the earlier periods the telephone service was confined almost entirely to strictly urban areas, seldom extend-

ing beyond the city limits. It now extends to all sections, and in some localities it has developed more rapidly in the rural than in the urban districts.

Telephone and telegraph systems.—To appreciate the present magnitude of the telephone industry it is necessary to have some basis of comparison. The telegraph systems offer the most convenient one, and a comparative presentation of the telephone and the telegraph systems presents several interesting facts in this connection.

Table 3 gives the chief statistics for both systems for 1907 and 1902.

TABLE 3.—COMPARATIVE SUMMARY—TELEPHONE AND TELEGRAPH SYSTEMS: 1907 AND 1902.

	Census.	Total.	Telephone systems and lines.	Commercial telegraph systems.[1]	PER CENT OF TOTAL.	
					Telephone systems.	Commercial telegraph systems.
Number of systems and lines	1907	22,996	[2] 22,971	25	99.9	0.1
	1902	9,161	[3] 9,136	25	99.7	0.3
Per cent of increase		151.0	151.4			
Miles of wire	1907	14,570,142	12,999,369	[4] 1,570,773	89.2	10.8
	1902	6,218,801	4,900,451	[5] 1,318,350	78.8	21.2
Per cent of increase		134.3	165.3	19.1		
Salaried employees:						
Number	1907	29,470	25,298	4,172	85.8	14.2
	1902	14,953	14,124	829	94.5	5.5
Per cent of increase		97.1	79.1	403.3		
Salaries	1907	$22,093,360	$19,298,423	$2,794,937	87.3	12.7
	1902	11,048,518	9,885,886	1,162,632	89.5	10.5
Per cent of increase		100.0	95.2	140.4		
Wage-earners:						
Average number	1907	142,733	118,871	23,862	83.3	16.7
	1902	91,426	64,628	26,798	70.7	29.3
Per cent of increase		56.1	83.9	[6] 11.0		
Wages	1907	$63,994,016	$48,980,704	$15,013,312	76.5	23.5
	1902	40,246,776	26,369,735	13,877,041	65.5	34.5
Per cent of increase		59.0	85.7	8.2		
Capital stock and funded debt outstanding	1907	$1,034,909,579	$814,616,004	$220,293,575	78.7	21.3
	1902	510,977,583	348,031,058	162,946,525	68.1	31.9
Per cent of increase		102.5	134.1	35.2		
Income	1907	$236,045,615	[7] $184,461,747	$51,583,868	78.1	21.9
	1902	127,755,574	86,825,536	40,930,038	68.0	32.0
Per cent of increase		84.8	112.5	26.0		
Operating expenses and fixed charges, except interest on funded debt	1907	$167,714,298	$128,486,196	$39,228,102	76.6	23.4
	1902	90,651,707	61,652,823	28,998,884	68.0	32.0
Per cent of increase		85.0	108.4	35.3		
Interest on funded debt	1907	$14,967,620	$12,316,109	$2,651,511	82.3	17.7
	1902	5,461,098	3,511,948	1,949,150	64.3	35.7
Per cent of increase		174.1	250.7	36.0		

[1] Does not include wireless telegraph systems.
[2] Including 17,702 independent farmer or rural lines, with 486,294 miles of wire.
[3] Including 4,985 independent farmer or rural lines, with 49,965 miles of wire.
[4] Exclusive of 7,188 miles of leased wire and 46,301 nautical miles of ocean cable.
[5] Includes miles of wire operated by Western Union Telegraph Company outside of the United States.
[6] Decrease.
[7] Exclusive of $1,783,458 income and investments of independent farmer or rural lines.

The first telegraph line in the United States was opened for business in 1844, and thirty-two years later the telephone was introduced. In the early stages of its development the telephone industry was associated with the telegraph industry, but the two have now long been distinct, and the telephone is to some extent a competitor of the telegraph for the business of long-distance communication, although recently the leading telephone company has acquired a large stock interest in one of the leading telegraph companies. At the census of 1880 the telegraph companies reported the operation of 291,213 miles of wire as compared with 34,305 miles reported for the telephone companies. By the census of 1902 the amount of wire for the telegraph systems had increased to 1,318,350 miles and that for the telephone systems to 4,900,451 miles. Thus in 1902 the mileage of wire devoted to the transmission of telephone messages was almost four times as great as that used for telegraph purposes.

Both industries developed rapidly between 1902 and 1907, and by the end of that period the mileage of single wire devoted primarily to the telephone business was eight times as great as the mileage used for the commercial-telegraph business.

In the amount of business done in 1907, the amount paid in salaries and wages during the year, and the capital invested, the telephone business was more than three and one-half times as extensive as the telegraph industry, and during the year it furnished employment for more than five times as many persons.

In 1907 a total of 14,570,142 miles of wire was in use for the transmission of commercial messages, and of this total, 12,999,369 miles, or 89.2 per cent, were used primarily for telephone messages, and 1,570,773 miles, or 10.8 per cent, for the telegraph business. The telephone business has increased more rapidly than the other branch of the industry. Between 1902 and 1907 there was an addition of 8,098,918 miles of

wire for the use of the telephone systems of the country as compared with an increase of 259,611 in the mileage of owned and leased wire for the use of commercial telegraph systems. The increase in the wire mileage of the telephone systems during that period of five years is more than six times as great as the total amount of existing wire that has been added to the telegraph business since the date when the first statistics concerning the industry were gathered.

The development of the long-distance telephone system and the increasing use by railway companies of the telephone for the dispatch of business have necessarily had some effect on the extension of the use of the telegraph. Naturally the increase in the use of the telephone has greatly outdistanced the increase in the use of the telegraph.

Development, by states and geographic divisions.—The increase in the telephone facilities has been very general throughout the country, as shown by the figures in Table 4.

TABLE 4.—ALL SYSTEMS AND LINES—COMPARATIVE SUMMARY, BY STATES AND TERRITORIES AND GEOGRAPHIC DIVISIONS: 1907 AND 1902.

[Includes commercial and mutual systems and independent farmer or rural lines.[1]]

STATE OR TERRITORY.	Census.	Number of systems and lines.[1]	Miles of wire.[1]	Number of stations or telephones.[1]	Estimated number of messages or talks.	SALARIED EMPLOYEES.		WAGE-EARNERS.		Income.	Operating expenses and fixed charges, except interest on funded debt.	Interest on funded debt.
						Number.	Salaries.	Average number.	Wages.			
United States	1907	22,971	12,999,369	6,118,578	11,372,605,063	25,298	$19,298,423	118,871	$48,980,704	$184,461,747	$128,486,196	$12,316,109
	1902	9,136	4,900,451	2,371,044	5,070,554,553	14,124	9,885,886	64,628	26,369,735	86,825,536	61,652,823	3,511,948
North Atlantic division	1907	1,938	4,054,058	1,663,172	2,617,104,751	8,064	6,838,309	38,475	18,334,983	73,528,088	50,727,170	4,143,278
	1902	575	1,670,180	649,221	1,208,179,198	5,703	4,779,345	21,702	10,204,325	36,741,249	25,604,561	1,170,402
Maine	1907	153	94,073	53,134	78,827,917	186	109,505	953	381,101	1,443,904	1,160,835	83,853
	1902	29	25,451	14,070	21,923,915	55	31,730	357	173,986	597,204	427,341	20,815
New Hampshire	1907	58	49,448	28,920	42,402,448	96	51,838	603	235,695	793,708	656,034	33,475
	1902	16	18,390	9,949	16,987,012	41	22,333	238	114,785	396,639	314,525	13,760
Vermont	1907	100	36,419	30,833	41,363,210	111	48,948	570	225,392	622,567	529,331	16,305
	1902	39	16,379	12,151	19,075,847	62	29,475	237	98,296	322,369	243,293	9,193
Massachusetts	1907	38	534,220	209,383	299,944,477	953	776,350	5,914	2,922,144	10,806,086	8,176,446	468,359
	1902	10	257,461	96,512	183,115,320	1,155	1,182,216	3,524	1,742,820	6,127,452	4,605,698	204,345
Connecticut and Rhode Island.	1907	17	283,705	87,999	129,196,561	393	348,335	2,624	1,405,433	4,096,625	2,873,579	110,635
	1902	8	90,656	33,485	57,190,040	187	169,339	1,035	528,374	2,122,801	1,434,074	46,110
New York	1907	942	1,630,076	685,512	1,077,548,379	3,772	3,377,843	15,579	7,538,140	33,745,524	22,636,285	1,885,081
	1902	340	623,625	247,340	360,098,123	2,318	2,065,567	7,765	3,766,101	16,352,193	10,602,431	331,503
New Jersey	1907	33	338,608	116,988	142,190,149	854	610,342	2,876	1,500,209	5,867,217	4,334,297	162,614
	1902	28	136,617	48,980	56,171,223	410	277,707	1,864	932,623	2,738,695	2,112,247	94,576
Pennsylvania	1907	597	1,087,509	450,403	805,631,610	1,699	1,515,148	9,356	4,126,869	16,152,457	10,360,363	1,382,956
	1902	105	501,601	186,734	493,617,718	1,475	1,000,978	6,682	2,847,340	8,083,896	5,864,952	450,100
South Atlantic division	1907	1,373	875,173	365,764	827,266,700	1,614	1,271,731	8,188	2,806,280	11,224,294	8,163,894	824,594
	1902	869	328,022	146,765	353,559,870	1,015	645,107	4,025	1,453,419	4,530,560	3,608,796	254,922
Maryland, Delaware, and District of Columbia.	1907	26	312,282	110,282	169,770,089	434	379,871	2,329	948,386	4,236,529	3,088,747	381,627
	1902	23	107,827	36,383	70,981,973	327	237,054	1,501	710,974	1,706,948	1,401,446	145,408
Virginia	1907	290	108,588	55,541	130,358,981	212	125,068	1,111	351,273	1,438,324	1,012,403	84,825
	1902	242	46,678	25,762	65,494,626	142	73,182	522	150,702	609,276	484,877	16,978
West Virginia	1907	195	99,844	62,144	123,556,044	163	110,502	1,121	348,950	1,172,962	949,605	83,314
	1902	114	56,812	22,801	41,605,891	94	49,820	623	202,998	507,677	367,171	29,562
North Carolina	1907	400	83,251	37,104	93,987,510	161	92,141	854	226,754	932,864	633,901	28,811
	1902	206	26,120	17,036	36,485,398	81	43,752	400	105,190	346,472	269,118	7,374
South Carolina	1907	143	50,226	20,911	59,627,014	84	56,634	615	171,121	647,633	472,589	33,727
	1902	135	19,445	10,753	23,893,914	56	31,554	265	71,766	285,055	220,778	12,338
Georgia	1907	224	187,904	62,260	201,302,727	508	468,657	1,806	630,327	2,299,376	1,649,081	175,466
	1902	104	54,301	25,761	96,192,066	275	182,887	564	166,545	863,033	701,638	26,077
Florida	1907	95	33,078	17,522	48,664,335	52	38,858	352	129,469	496,606	357,568	36,824
	1902	45	16,839	8,269	18,906,002	40	26,858	150	45,244	212,099	163,768	17,185
North Central division	1907	14,563	5,351,409	2,963,945	5,369,401,249	10,625	7,077,262	47,909	17,483,271	64,362,595	44,101,507	4,605,670
	1902	6,739	2,054,435	1,139,914	2,446,257,875	4,768	2,961,686	25,445	8,986,075	29,682,263	20,807,636	1,603,995
Ohio	1907	984	986,053	495,636	1,069,034,291	1,514	880,460	8,794	3,081,341	11,158,207	7,566,598	1,057,105
	1902	420	515,892	224,083	558,707,801	809	488,757	5,469	1,963,779	6,192,640	4,224,910	590,765
Indiana	1907	883	530,044	289,452	598,205,608	1,236	740,777	4,892	1,506,617	5,340,994	3,827,271	450,111
	1902	1,301	213,157	136,561	294,657,565	476	230,339	2,860	858,711	2,816,509	1,961,477	202,587
Illinois	1907	1,817	986,949	558,585	915,293,975	2,364	1,809,129	10,008	3,909,806	15,956,124	11,082,964	746,600
	1902	1,201	428,304	221,008	541,161,932	1,415	959,193	6,066	2,301,144	7,308,885	5,361,974	175,819
Michigan	1907	534	494,612	209,842	437,804,153	984	578,713	3,511	1,275,648	4,866,997	3,363,337	476,310
	1902	190	197,863	95,415	237,695,112	324	217,135	2,175	690,281	2,444,051	1,901,690	307,265
Wisconsin	1907	704	310,363	158,875	354,109,878	697	418,162	2,656	973,770	3,604,923	2,520,134	262,489
	1902	269	110,929	62,992	101,594,728	314	171,138	1,465	518,353	1,599,833	1,095,513	22,945
Minnesota	1907	825	387,758	171,479	305,906,042	694	479,433	2,808	1,144,221	4,161,788	2,845,387	317,952
	1902	221	137,274	63,192	113,124,262	315	224,351	1,172	473,981	1,879,872	1,242,559	76,275

[1] The statistics of independent farmer or rural lines included are confined to the number of lines, miles of wire, and number of telephones: 1907—17,702 lines, 486,294 miles of wire, 565,649 telephones; 1902—4,985 lines, 49,965 miles of wire, 55,747 telephones.

TABLE 4.—ALL SYSTEMS AND LINES—COMPARATIVE SUMMARY, BY STATES AND TERRITORIES AND GEOGRAPHIC DIVISIONS: 1907 AND 1902—Continued.

[Includes commercial and mutual systems and independent farmer or rural lines.[1]]

STATE OR TERRITORY.	Census.	Number of systems and lines.[1]	Miles of wire.[1]	Number of stations or telephones.[1]	Estimated number of messages or talks.	SALARIED EMPLOYEES.		WAGE-EARNERS.		Income.	Operating expenses and fixed charges, except interest on funded debt.	Interest on funded debt.
						Number.	Salaries.	Average number.	Wages.			
North Central division—Continued.												
Iowa	1907	3,445	360,884	332,545	415,073,771	754	$460,409	3,446	$1,245,600	$4,254,978	$2,879,989	$175,261
	1902	1,527	147,586	138,400	193,054,738	341	178,792	1,909	610,039	1,962,362	1,347,705	54,119
Missouri	1907	2,648	640,560	312,527	544,332,685	1,045	884,645	5,875	2,196,027	7,551,949	4,918,153	726,075
	1902	1,204	177,072	103,155	242,309,227	440	309,416	2,389	890,410	2,970,597	1,958,850	155,221
North Dakota	1907	259	61,733	34,087	48,750,894	129	90,290	557	218,654	841,565	601,269	33,873
	1902	32	9,532	6,762	14,106,733	22	12,371	147	59,117	235,371	148,784	1,726
South Dakota	1907	330	66,946	48,405	73,705,398	152	95,168	886	264,604	816,454	538,155	39,091
	1902	60	10,877	10,387	17,919,604	54	25,656	217	81,046	287,057	172,502	2,180
Nebraska	1907	891	257,812	152,279	290,560,744	540	363,332	2,000	880,717	3,068,060	2,129,500	117,449
	1902	130	53,285	36,766	73,227,030	117	70,851	756	311,662	1,107,303	831,378	6,353
Kansas	1907	1,243	267,695	200,233	316,623,810	516	276,744	2,476	786,266	2,740,556	1,828,750	203,354
	1902	184	52,664	41,193	58,699,143	141	73,687	820	227,552	877,783	560,294	8,740
South Central division	1907	3,540	1,514,477	585,489	1,510,432,721	2,984	2,216,062	13,443	4,621,228	17,835,731	12,531,232	1,299,759
	1902	820	541,973	227,790	681,497,626	1,266	841,390	7,060	2,419,070	7,941,911	5,494,975	292,887
Kentucky	1907	429	262,691	93,996	287,929,274	441	265,525	2,109	657,050	2,700,250	1,970,296	307,193
	1902	190	155,482	46,949	143,101,564	250	154,229	1,483	462,433	1,377,441	969,770	121,576
Tennessee	1907	214	202,505	71,130	239,587,035	589	445,036	1,770	628,509	2,493,489	1,677,498	133,036
	1902	83	86,640	36,392	128,274,719	342	216,730	1,399	469,942	1,252,438	939,130	49,371
Alabama	1907	297	134,337	40,481	107,545,457	145	112,076	1,022	326,203	1,392,209	1,045,218	134,378
	1902	65	32,966	14,170	46,158,943	65	39,081	309	92,200	528,821	398,597	5,960
Mississippi	1907	271	115,338	37,627	126,347,504	171	142,699	875	258,663	1,225,057	870,196	63,267
	1902	66	30,001	15,340	60,414,961	92	59,060	428	116,945	496,499	325,219	12,081
Louisiana	1907	69	101,325	35,692	122,225,846	204	167,727	1,144	368,783	1,713,895	1,079,693	60,169
	1902	34	49,588	17,543	68,083,915	88	64,564	601	214,004	803,399	458,950	21,554
Arkansas	1907	547	98,932	49,576	86,578,439	158	109,906	994	360,312	1,237,969	845,468	75,832
	1902	81	24,273	16,928	36,716,883	41	28,230	438	135,049	565,024	398,492	1,372
Oklahoma	1907	715	104,780	68,125	133,298,566	400	279,840	1,396	497,588	1,663,797	1,257,331	65,387
	1902	67	21,498	15,732	31,667,627	77	49,950	370	112,101	432,364	278,893	2,573
Texas	1907	998	494,569	188,862	406,920,600	876	693,253	4,133	1,524,120	5,409,065	3,785,532	460,497
	1902	234	141,525	64,736	167,079,014	311	229,546	2,032	816,396	2,485,925	1,725,924	78,400
Western division	1907	1,557	1,204,252	540,208	1,048,399,642	2,011	1,395,059	10,856	5,734,942	17,511,039	12,962,393	1,442,808
	1902	133	305,841	207,354	381,059,984	1,372	658,358	6,396	3,306,846	7,929,553	6,136,855	189,742
Montana	1907	97	28,386	17,168	25,503,905	69	57,689	257	153,135	518,488	418,344	27,256
	1902	17	8,609	5,451	11,352,976	61	34,136	122	66,656	304,979	225,468	964
Idaho	1907	82	37,364	16,394	26,047,495	65	65,675	360	161,367	521,446	425,500	34,292
	1902	10	6,366	3,886	6,451,762	65	22,311	170	100,656	178,282	141,544	4,478
Colorado	1907	104	173,633	65,908	139,641,301	298	288,301	1,404	730,106	2,613,214	1,766,678	85,078
	1902	13	52,115	24,533	60,258,533	136	130,312	960	467,210	1,137,263	797,400	3,416
New Mexico	1907	47	12,506	6,653	14,163,557	26	22,871	126	52,208	201,988	177,360	4,808
	1902	15	3,366	2,510	4,297,920	12	8,627	39	16,593	54,445	33,260	229
Arizona	1907	37	10,277	6,203	10,879,950	37	39,990	135	64,881	256,260	162,707	8,621
	1902	12	3,890	3,264	5,072,727	29	12,458	73	39,128	114,480	73,269	2,960
Utah and Wyoming	1907	83	92,396	37,134	88,437,258	295	247,237	822	333,503	1,229,324	989,042	216,654
	1902	9	13,106	7,258	13,531,312	103	54,663	241	131,972	364,940	285,355	1,489
Nevada	1907	21	10,043	4,601	7,103,245	30	35,930	96	69,780	263,159	212,236	5,273
	1902	8	1,394	1,165	1,409,134	14	648	23	9,228	35,006	19,137	1,269
Washington	1907	480	208,810	98,846	205,816,844	206	185,239	1,745	912,111	2,593,122	1,919,597	179,081
	1902	4	43,027	31,447	64,623,982	171	37,499	1,160	608,956	989,936	800,566	35,267
Oregon	1907	295	87,723	49,629	87,766,609	114	91,772	914	463,639	1,219,306	965,836	85,034
	1902	25	29,531	21,190	35,777,238	127	27,829	618	294,229	659,146	466,419	3,445
California	1907	311	543,114	237,672	443,039,478	871	860,355	4,997	2,794,212	8,094,732	5,925,093	796,711
	1902	20	144,437	106,650	178,284,400	654	329,875	2,990	1,572,218	4,091,076	3,294,437	136,225

[1] The statistics of independent farmer or rural lines included are confined to the number of lines, miles of wire, and number of telephones: 1907—17,702 lines, 486,294 miles of wire, 565,649 telephones; 1902—4,985 lines, 49,965 miles of wire, 55,747 telephones.

At the close of 1907 the amount of wire in use by the telephone systems of the country exceeded that in use in 1902 by more than 8,000,000 miles, and the other leading items showed proportionately large increases. It is especially interesting to learn that the industry gave regular employment to 65,417 more persons in 1907 than it did five years earlier, and that the amount expended in salaries and wages was greater by $32,023,506 in 1907 than in 1902.

Until recent years the field of operation of a telephone system was restricted to a comparatively small area, but the introduction of the long-distance lines and the arrangements for toll service between neighboring companies have made communication possible between widely separated sections of the country with a facility which of itself has contributed to increase the business of the industry.

Naturally the most extensive equipment and the greatest amount of business are found in the states that have the largest population.

The gains in equipment and service, however, were large for each of the geographic divisions and the rates of increase (except in the Western division) were comparatively uniform, as shown by Table 5.

TABLE 5.—*All systems and lines—Per cent of increase in miles of wire, stations, and messages, by geographic divisions: 1902 to 1907.*

DIVISION.	PER CENT OF INCREASE.		
	Miles of wire.	Stations or telephones.	Messages or talks.[1]
United States	165.3	158.1	124.3
North Atlantic	142.7	156.2	116.6
South Atlantic	166.8	149.2	134.0
North Central	160.5	160.0	119.5
South Central	179.4	157.0	121.6
Western	293.8	160.5	175.1

[1] Statistics for messages or talks on independent farmer or rural lines not included.

The industry is largely concentrated in the populous North Atlantic and North Central states, and the greatest amount of increase between the years 1902 and 1907 in wire mileage, telephones, and business is shown for these states. More rapid rates of increase occurred in other sections, however, and the largest percentages of gain for wire mileage are shown for the Western, South Central, and South Atlantic states, where, as a rule, the telephones are farther apart than in the other divisions. The Western states had the largest percentages of increase also in the number of telephones and messages or talks. In accepting the percentages of increase the relative size of the totals involved should be given due weight. Between 1902 and 1907 New York had the greatest increases in the number of telephones and in the miles of wire, the gains being 438,172 and 1,006,451, respectively; whereas the corresponding increases for the entire Western division, 332,854 telephones and 898,411 miles of wire, are less than those for the single state of New York. Yet the rate of increase for telephones in the Western division is nearly equal to that for New York state, the rates being 160.5 per cent for the division and 177.2 per cent for the state; while the rate of increase for miles of wire in the Western division, 293.8 per cent, far exceeds that for New York state, 161.4 per cent.

In 1907 eleven states had over 200,000 telephones each, while in 1902 only three states—New York, Ohio, and Illinois—had this number. Table 6 shows the states having 200,000 or more telephones in 1907, the number of telephones which each of them had in 1907 and in 1902, and the per cent of increase for each between the two dates.

TABLE 6.—*All systems and lines—Number of stations or telephones in states having over 200,000 stations or telephones in 1907: 1907 and 1902.*

STATE.	NUMBER OF STATIONS OR TELEPHONES.		
	1907	1902	Per cent of increase.
New York	685,512	247,340	177.2
Illinois	558,585	221,008	152.7
Ohio	495,636	224,083	121.2
Pennsylvania	450,403	186,734	141.2
Iowa	332,545	138,400	140.3
Missouri	312,527	103,155	203.0
Indiana	289,452	136,561	112.0
California	237,672	106,650	122.9
Michigan	209,842	95,415	119.9
Massachusetts	209,383	96,512	117.0
Kansas	200,233	41,193	386.1

The rate of increase was particularly large in the case of Kansas. The other leading states in order of proportionate increase are Missouri, New York, Illinois, and Pennsylvania.

Table 7 shows the per cent distribution, by geographic divisions, of miles of wire, number of telephones, and number of messages for 1907 and 1902.

TABLE 7.—*All systems and lines—Per cent distribution of miles of wire, stations, and messages, by geographic divisions: 1907 and 1902.*

DIVISION.	PER CENT DISTRIBUTION.					
	Miles of wire.		Stations or telephones.		Messages or talks.[1]	
	1907	1902	1907	1902	1907	1902
United States	100.0	100.0	100.0	100.0	100.0	100.0
North Atlantic	31.2	34.1	27.2	27.4	23.0	23.8
South Atlantic	6.7	6.7	6.0	6.2	7.3	7.0
North Central	41.2	41.9	48.4	48.1	47.2	48.2
South Central	11.7	11.1	9.6	9.6	13.3	13.4
Western	9.3	6.2	8.8	8.7	9.2	7.5

[1] Statistics for messages or talks on independent farmer or rural lines not included.

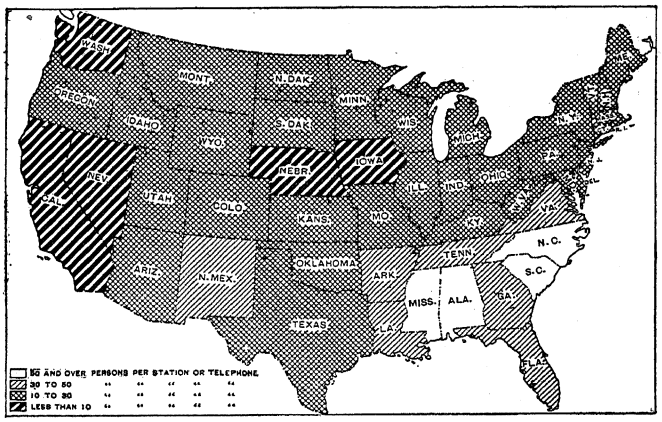
Notwithstanding the large absolute increases in the North Atlantic and North Central divisions for each of the three items shown in Table 7, the relative importance of these groups of states in the industry was the same in 1902 and 1907. The percentages in Tables 5 and 7 indicate that the development in all sections of the country has been at a nearly uniform rate. There is, however, a slight tendency for the relative importance of the North Atlantic and the North Central divisions to diminish, but this has resulted in little change in the proportions of the number of telephones, miles of wire, and the number of messages or talks pertaining to the different geographic divisions at the two censuses.

The relative importance of the states east of the Mississippi River has declined somewhat during the five years. In 1907 they contained 8,952,123 miles of wire and 3,984,560 telephones, or 68.9 and 65.1 per cent, respectively, of the totals for the entire country; while in 1902 they contained 3,769,436 miles of wire

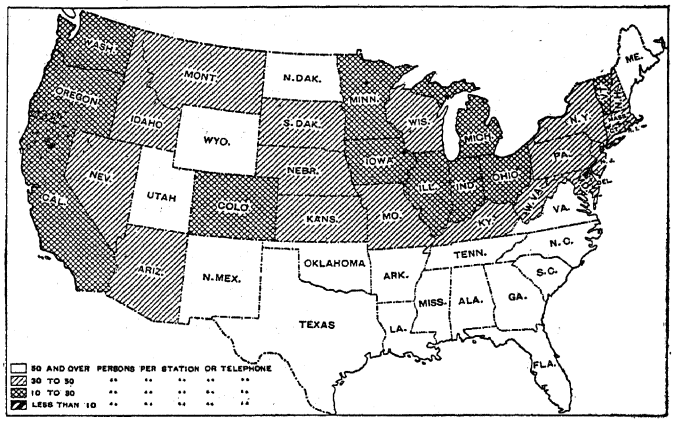
and 1,648,896 telephones, or 76.9 and 69.5 per cent, respectively, of the totals.

The states east of the Mississippi River and north of the Ohio, including the states north of the Mason and Dixon line in 1907 contained 7,362,079 miles of wire and 3,375,562 telephones, or 56.6 and 55.2 per cent, respectively, of the totals for the entire country; in 1902 they had 3,136,325 miles of wire and 1,389,280 telephones, or 64 and 58.6 per cent, respectively, of the totals.

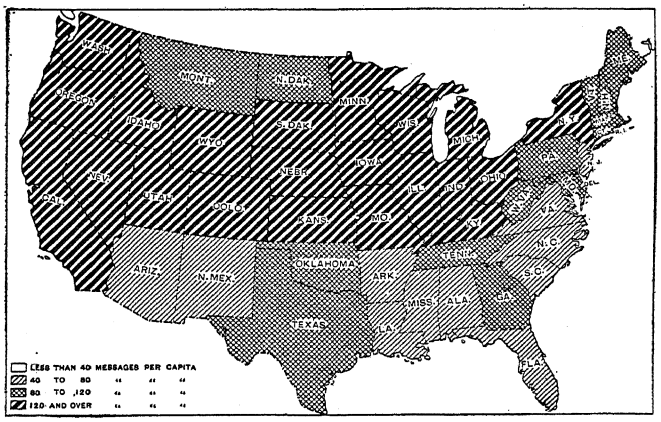
MAP 1.—*Average population per station or per telephone: 1907.*



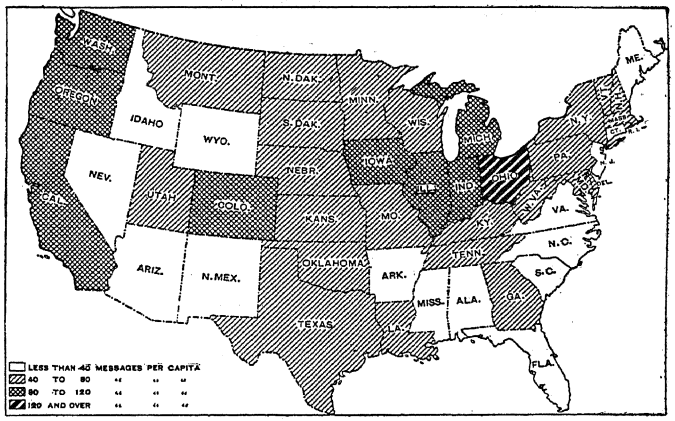
MAP 2.—*Average population per station or per telephone: 1902.*



MAP 3.—*Average number of messages per capita: 1907.*



MAP 4.—*Average number of messages per capita: 1902.*



The above series of maps illustrates the number of inhabitants per telephone and the number of messages per capita. Maps 1 and 2 distinguish the states with 50 or more inhabitants per telephone in 1907 and 1902, respectively; those with 30 but fewer than 50; those with 10 but fewer than 30; and those with fewer than 10, the last class representing the states of highest development. In like manner Maps 3 and 4 show the states reporting fewer than 40 messages or talks per capita in 1907 and in 1902; those with 40 but fewer than 80; those with 80 but fewer than 120; and those with 120 or more, the last class representing the states of highest development.

The distribution of telephones, by states, for the years 1907 and 1902, is shown by Diagram 1, page 20.

Development of the Bell and other systems.—Of the 22,971 telephone systems and lines for which statistics were gathered for the census of 1907, 175 represent the different units of ownership reported by the American Telephone and Telegraph Company, i. e., the Bell system. The principal business office of this company is in Massachusetts, but its lines or the lines of its subsidiary companies extend into all of the states and territories, so that in every state they come into competition with the lines operated under other ownerships. This condition has divided the telephone business of the country into two great classes of interests: one known as the "Bell" and the other as the "independent or non-Bell."

DIAGRAM 1.—NUMBER OF STATIONS OR TELEPHONES, BY STATES: 1907 AND 1902.

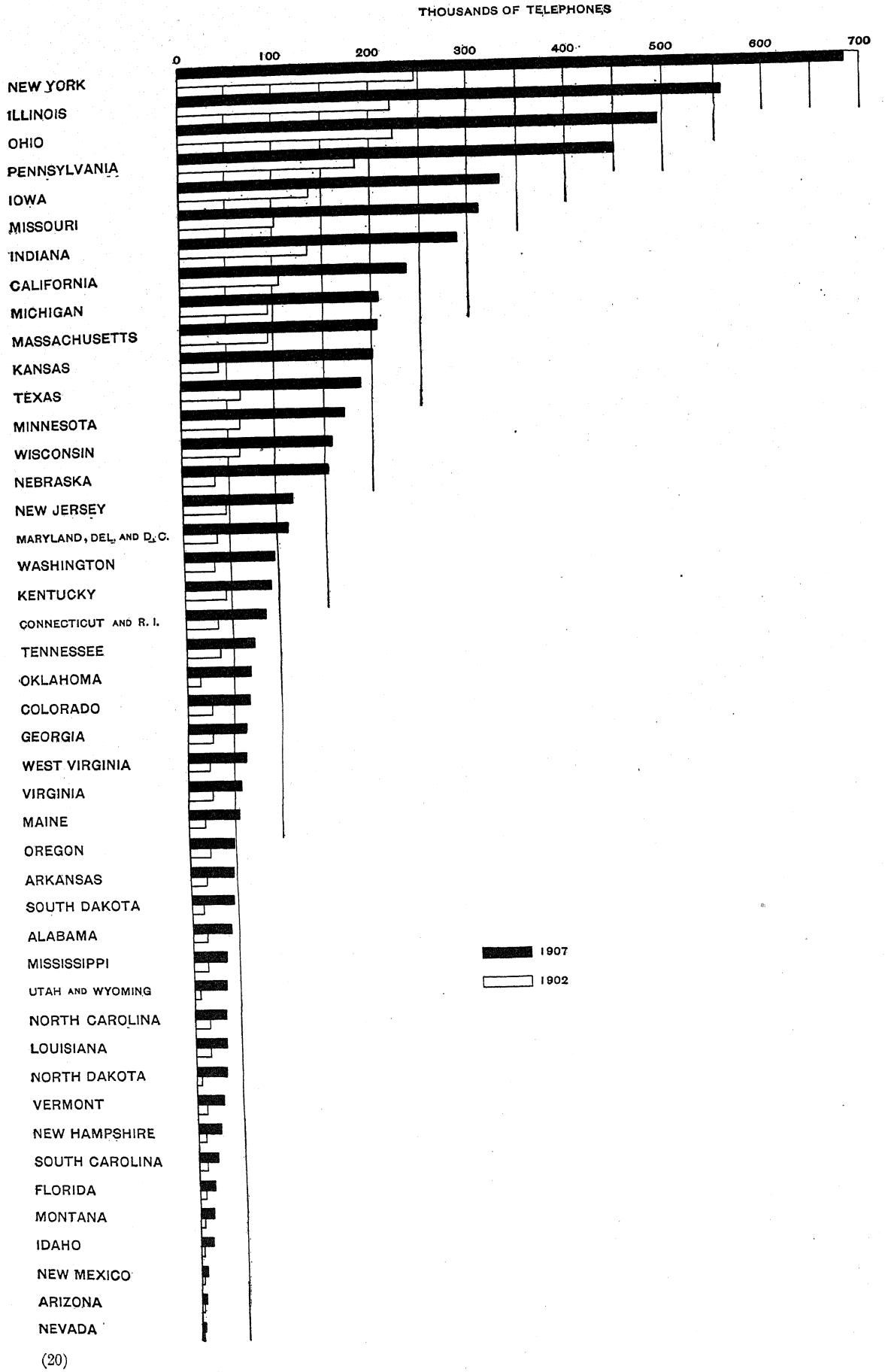


Table 8 gives a statement of the comparable statistics of the two classes of systems for all systems and lines in 1907 and 1902, and the percentages of increase and distribution; while Table 9 gives a more extended comparative statement of the statistics for the two classes of systems, exclusive of the independent farmer or rural lines, the latter being excluded for the reason that the available data therefor relate only to the number of systems and lines, miles of wire, and number of stations or telephones.

TABLE 8.—ALL SYSTEMS AND LINES, CLASSIFIED AS BELL AND INDEPENDENT (NON-BELL) SYSTEMS—COMPARATIVE SUMMARY: 1907 AND 1902.

[Includes commercial and mutual systems and independent farmer or rural lines.]

	ALL SYSTEMS AND LINES.			BELL SYSTEM (AMERICAN TELEPHONE AND TELEGRAPH CO.).			INDEPENDENT (NON-BELL) SYSTEMS AND LINES.			PER CENT OF TOTAL.			
										Bell.		Independent (non-Bell).	
	1907	1902	Per cent of increase.	1907	1902	Per cent of increase.	1907	1902	Per cent of increase.	1907	1902	1907	1902
Number of systems and lines	22,971	9,136	151.4	175	44	297.7	22,796	9,092	150.7	0.8	0.5	99.2	99.5
Miles of wire	12,999,369	4,900,451	165.3	8,947,266	3,387,924	164.1	4,052,103	1,512,527	167.9	68.8	69.1	31.2	30.9
Number of stations or telephones	6,118,578	2,371,044	158.1	3,132,063	1,317,178	137.8	2,986,515	1,053,866	183.4	51.2	55.6	48.8	44.4

TABLE 9.—ALL SYSTEMS AND LINES, EXCLUSIVE OF INDEPENDENT FARMER OR RURAL LINES, CLASSIFIED AS BELL AND INDEPENDENT (NON-BELL) SYSTEMS—COMPARATIVE SUMMARY: 1907 AND 1902.

[Includes commercial and mutual systems.]

	ALL SYSTEMS AND LINES.			BELL SYSTEM (AMERICAN TELEPHONE AND TELEGRAPH CO.).			INDEPENDENT (NON-BELL) SYSTEMS AND LINES.			PER CENT OF TOTAL.			
										Bell.		Independent (non-Bell).	
	1907	1902	Per cent of increase.	1907	1902	Per cent of increase.	1907	1902	Per cent of increase.	1907	1902	1907	1902
Number of systems and lines	5,269	4,151	26.9	175	44	297.7	5,094	4,107	24.0	3.3	1.1	96.7	98.9
Miles of wire	12,513,075	4,850,486	158.0	8,947,266	3,387,924	164.1	3,565,809	1,462,562	143.8	71.5	69.8	28.5	30.2
Number of stations or telephones	5,552,929	2,315,297	139.8	3,132,063	1,317,178	137.8	2,420,866	998,119	142.5	56.4	56.9	43.6	43.1
Number of public exchanges	15,527	10,361	49.9	5,418	3,753	44.4	10,109	6,608	53.0	34.9	36.2	65.1	63.8
Number of private-branch exchanges	28,292	7,883	258.9	24,702	7,266	240.0	3,590	617	481.8	87.3	92.2	12.7	7.8
Number of pay stations	157,232	80,870	94.4	127,118	55,656	128.4	30,114	25,214	19.4	80.8	68.8	19.2	31.2
Number of switchboards	16,065	10,896	47.4	5,424	3,820	42.0	10,641	7,076	50.4	33.8	35.1	66.2	64.9
Estimated number of messages or talks	11,372,605,063	5,070,554,553	124.3	6,401,044,799	3,074,530,060	108.2	4,971,560,264	1,996,024,493	149.1	56.3	60.6	43.7	39.4
Salaried employees:													
Number	25,298	14,124	79.1	17,039	10,341	64.8	8,259	3,783	118.3	67.4	73.2	32.6	26.8
Salaries	$19,298,423	$9,885,886	95.2	$14,501,916	$7,848,551	84.8	$4,796,507	$2,037,335	135.4	75.1	79.4	24.9	20.6
Wage-earners:													
Average number	118,871	64,628	83.9	78,772	46,064	71.0	40,099	18,564	116.0	66.3	71.3	33.7	28.7
Wages	$48,980,704	$26,369,735	85.7	$36,073,994	$21,026,257	71.6	$12,906,710	$5,343,478	141.5	73.6	79.7	26.4	20.3

For some years after the telephone business was established on commercial lines, it was controlled almost entirely by the Bell interests. The census of 1890 shows that between 1880 and that year there was a large increase in the industry in every particular, except as to number of systems or lines enumerated. Of these, there were 148 in 1880 and only 53 in 1890. The large numbers of systems shown for 1902 and 1907 are nearly all small companies and individual lines which have developed rapidly during the years since the taking of the 1890 census. Of the 44 companies reported as separate systems for the Bell interests in 1902, 4 went out of existence before 1907 by merger or consolidation; but during the five years between those censuses 135 properties were added to these interests by the formation of new corporations or the purchase of existing systems.

For the various items, with the exception of the number of systems or lines, miles of wire, and the number of pay stations, the independent interests show larger percentages of increase from 1902 to 1907 than the Bell. In the number of telephones the independent systems show a gain of 1,932,649 as compared with 1,814,885 for the Bell, although the Bell companies increased their wire mileage by 5,559,342, while the independent companies increased theirs by only 2,539,576.

Since no estimates could be made of the number of messages or talks over the farmer or rural lines, and since the estimates from many of the small mutual lines are largely conjectural, this item can not be accepted as indicating the magnitude of the business of the independent systems. Since the methods of business of the small telephone systems differ in many respects from those of the well-organized large companies, and the equipment of the different companies is adjusted to meet local requirements, there is natu-

rally a great variation in the rate of increase in the different items shown in Table 9. There are also marked differences in the proportions of the various items which must be credited to each of the two systems.

Although at both censuses the Bell interests controlled the larger portion of the telephone equipment of the country, the relative importance of the independent interests increased between 1902 and 1907 in the case of every item, except number of systems, miles of wire, and number of pay stations.

The number of telephones is probably the most satisfactory measurement by which to determine the relative importance of different companies. Exclusive of the independent farmer or rural lines, the relative increase during the five years was practically the same for the two classes, as shown by Table 9. Including the rural or farmer lines, the independents owned 44.4 per cent of the total in 1902 and 48.8 per cent in 1907. Table 10 gives the number of telephones for the Bell and independent systems, by states and geographic divisions, for 1907.

TABLE 10.—*All systems and lines, classified as Bell and independent (non-Bell) systems, and independent stations connected with the Bell system—Number of stations or telephones, by states and territories and geographic divisions: 1907.*

[Including independent farmer or rural lines.]

STATE OR TERRITORY.	NUMBER OF STATIONS OR TELEPHONES.				
	All systems and lines.	Bell (American Telephone and Telegraph Co.).	Independent (non-Bell).	Independent stations exchanging service with Bell system.	Connected for exchange of service, Bell and independent.
United States	6,118,578	3,132,063	2,986,515	[1] 835,880	3,967,943
North Atlantic division	1,663,172	1,244,959	418,213	55,302	1,300,261
Maine	53,134	37,110	16,024	7,830	44,940
New Hampshire	28,920	22,432	6,488	2,482	24,914
Vermont	30,833	16,916	13,917	7,020	23,936
Massachusetts	209,383	204,059	5,324	650	204,709
Connecticut and Rhode Island	87,999	86,014	1,985	521	86,535
New York	685,512	504,753	180,759	23,992	528,745
New Jersey	116,988	97,854	19,134	831	98,685
Pennsylvania	450,403	275,821	174,582	11,976	287,797
South Atlantic division	365,764	209,308	156,456	27,246	236,554
Maryland, Delaware, and District of Columbia	110,282	90,386	19,896	217	90,603
Virginia	55,541	31,423	24,118	4,447	35,870
West Virginia	62,144	15,535	46,609	3,238	18,773
North Carolina	37,104	16,507	20,597	4,714	21,221
South Carolina	20,911	13,039	7,872	1,867	14,906
Georgia	62,260	36,056	26,204	9,072	45,128
Florida	17,522	6,362	11,160	3,691	10,053
North Central division	2,963,945	1,000,178	1,963,767	608,108	1,608,286
Ohio	495,636	183,358	312,278	29,284	212,642
Indiana	289,452	72,462	216,990	50,065	122,527
Illinois	558,585	273,263	285,322	109,101	382,364
Michigan	209,842	103,793	106,049	30,933	134,726
Wisconsin	158,875	69,870	89,005	36,366	106,236
Minnesota	171,479	56,861	114,618	46,547	103,408
Iowa	332,545	52,772	279,773	74,806	127,578
Missouri	312,527	91,704	220,823	82,393	174,097
North Dakota	34,087	7,452	26,635	10,542	17,994
South Dakota	48,405	3,654	44,751	25,939	29,593
Nebraska	152,279	46,669	105,610	45,252	91,921
Kansas	200,233	38,320	161,913	66,880	105,200

[1] Figures furnished by American Telephone and Telegraph Co. and included in total for independent systems.

TABLE 10.—*All systems and lines, classified as Bell and independent (non-Bell) systems, and independent stations connected with the Bell system—Number of stations or telephones, by states and territories and geographic divisions: 1907*—Continued.

[Including independent farmer or rural lines.]

STATE OR TERRITORY.	NUMBER OF STATIONS OR TELEPHONES.				
	All systems and lines.	Bell (American Telephone and Telegraph Co.).	Independent (non-Bell).	Independent stations exchanging service with Bell system.	Connected for exchange of service, Bell and independent.
South Central division	585,489	294,208	291,281	108,978	403,186
Kentucky	93,996	42,200	51,796	9,038	51,238
Tennessee	71,130	45,372	25,758	9,241	54,613
Alabama	40,481	25,496	14,985	3,944	29,440
Mississippi	37,627	24,060	13,567	5,235	29,295
Louisiana	35,692	29,508	6,184	4,351	33,859
Arkansas	49,576	17,426	32,150	10,265	27,691
Oklahoma	68,125	30,116	38,009	36,570	66,686
Texas	188,862	80,030	108,832	30,334	110,364
Western division	540,208	383,410	156,798	36,246	[1] 419,656
Montana	17,168	9,050	8,118	846	9,896
Idaho	16,394	10,640	5,754	1,288	11,928
Colorado	65,908	61,435	4,473	1,620	63,055
New Mexico	6,653	3,177	3,476	759	3,936
Arizona	6,203	3,055	3,148	.....	.....
Utah and Wyoming	37,134	25,238	11,896	1,549	26,787
Nevada	4,601	2,520	2,081	734	3,254
Washington	98,846	63,194	35,652	9,168	72,362
Oregon	49,629	33,406	16,223	10,675	44,081
California	237,672	171,695	65,977	9,607	181,302

[1] Including the 3,055 stations or telephones of Bell system in Arizona available for connection with independent stations or telephones in other states or territories exchanging service.

The tabular statement on page 23 accompanies the foregoing table and gives the per cent distribution of the number of stations or telephones of each class.

In 1907 the Bell systems controlled more than one-half of the telephones in the North Atlantic, South Atlantic, South Central, and Western divisions, and in twenty-eight of the states and territories, counting the District of Columbia. In the North Central division, however, two-thirds of the telephones belong to non-Bell systems.

In many instances commercial companies have agreements with each other and with smaller systems of mutual and farmer or rural lines for the interchange of business, and these agreements result in the practical formation of large systems, so that all such telephones might be counted as belonging to one system.

The American Telephone and Telegraph Company reported 835,880 telephones on the independently owned lines that had exchange arrangements with its subsidiary companies. Thus 13.7 per cent of the total number of telephones in the United States were independent telephones operating under arrangements with the Bell system. The distribution of these telephones in Table 10 is shown separately, but these instruments are also included in the totals shown for the independent companies. It may be noted that most of the larger independent companies have similar

agreements for the interchange of business with smaller systems.

STATE OR TERRITORY.	PER CENT OF TOTAL NUMBER OF STATIONS OR TELEPHONES.			
	Bell (American Telephone and Telegraph Co.).	Independent (non-Bell).	Independent stations exchanging service with Bell system.	Connected for exchange of service, Bell and independent.
United States	51.2	48.8	13.7	64.9
North Atlantic division	74.9	25.1	3.3	78.2
Maine	69.8	30.2	14.7	84.6
New Hampshire	77.6	22.4	8.6	86.1
Vermont	54.9	45.1	22.8	77.6
Massachusetts	97.5	2.5	0.3	97.8
Connecticut and Rhode Island	97.7	2.3	0.6	98.3
New York	73.6	26.4	3.5	77.1
New Jersey	83.6	16.4	0.7	84.4
Pennsylvania	61.2	38.8	2.7	63.9
South Atlantic division	57.2	42.8	7.4	64.7
Maryland, Delaware, and District of Columbia	82.0	18.0	0.2	82.2
Virginia	56.6	43.4	8.0	64.6
West Virginia	25.0	75.0	5.2	30.2
North Carolina	44.5	55.5	12.7	57.2
South Carolina	62.4	37.6	8.9	71.3
Georgia	57.9	42.1	14.6	72.5
Florida	36.3	63.7	21.1	57.4
North Central division	33.8	66.2	20.5	54.3
Ohio	37.0	63.0	5.9	42.9
Indiana	25.0	75.0	17.3	42.3
Illinois	48.9	51.1	19.5	68.5
Michigan	49.5	50.5	14.7	64.2
Wisconsin	44.0	56.0	22.9	66.9
Minnesota	33.2	66.8	27.1	60.3
Iowa	15.9	84.1	22.5	38.4
Missouri	29.3	70.7	26.4	55.7
North Dakota	21.9	78.1	30.9	52.8
South Dakota	7.5	92.5	53.6	61.1
Nebraska	30.6	69.3	29.7	60.4
Kansas	19.1	80.9	33.4	52.5
South Central division	50.2	49.8	18.6	68.9
Kentucky	44.9	55.1	9.6	54.5
Tennessee	63.8	36.2	13.0	76.8
Alabama	63.0	37.0	9.7	72.7
Mississippi	63.9	36.1	13.9	77.9
Louisiana	82.7	17.3	12.2	94.9
Arkansas	35.2	64.8	20.7	55.9
Oklahoma	44.2	55.8	53.7	97.9
Texas	42.4	57.6	16.1	58.4
Western division	71.0	29.0	6.7	77.7
Montana	52.7	47.3	4.9	57.6
Idaho	64.9	35.1	7.9	72.8
Colorado	93.2	6.8	2.5	95.7
New Mexico	47.8	52.2	11.4	59.2
Arizona	49.3	50.7	.....	.....
Utah and Wyoming	68.0	32.0	4.1	72.1
Nevada	54.8	45.2	16.0	70.7
Washington	63.9	36.1	9.3	73.2
Oregon	67.3	32.7	21.5	88.8
California	72.2	27.8	4.0	76.3

Relative development of commercial systems and of mutual systems and independent farmer or rural lines.—At the census of 1902 the reports showed 4,985 farmer or rural lines with 49,965 miles of wire and 55,747 telephones, but (for the reason given on page 11) it is not strictly correct to compare these statistics with the 17,702 lines, 486,294 miles of wire, and 565,649 telephones reported for the farmer or rural lines in 1907. The independent farmer or rural lines for 1907 include some small lines that were classed as mutual and a few classed as commercial systems in 1902, and it is also probable that a more thorough canvass was made at the 1907 than at the 1902 census. Therefore the statistics for the mutual systems and the farmer or rural lines should be combined for comparison with commercial systems. Table 11 offers a summary of the commercial systems as compared with the mutual systems and independent rural lines for 1907 and 1902. There is also given in detail the mutual systems and the independent farmer or rural lines to show the relation of these two groups under the different classifications of the two censuses and the portions they respectively form of the combined group, though it is to be borne in mind that they are not individually comparable.

The mutual systems and the independent farmer or rural lines represent the equipment that is operated primarily for the convenience of the subscribers rather than for profit. Between 1902 and 1907 the wire of these lines increased by 460,447 miles, or 380.9 per cent, and the number of telephones by 546,542, or 376.8 per cent. In 1907 the miles of wire and the telephones of the mutual systems and the independent farmer or rural lines together formed 4.5 and 11.3 per cent, respectively, of the total wire and telephones for all systems, whereas in 1902 they formed 2.5 and 6.1 per cent, respectively.

While the miles of wire and the number of telephones for the mutual systems and farmer or rural lines formed comparatively small parts of the totals for all systems, they constituted larger proportions of the totals in 1907 than in 1902. Comparisons of this character, however, in an industry that is increasing so rapidly and undergoing such radical changes in organization and equipment, are apt to be misleading, and the fact should be emphasized that the greater completeness of the census for 1907 makes the increase with respect to some items appear greater than it probably is in fact.

Although the mutual companies and farmer or rural lines are characteristic of the telephone service in the rural districts and small communities, most of the commercial companies serve such districts also. In order to determine as nearly as possible the total extent of telephone service in rural districts, all companies operating commercial lines were required to report separately the number of farmer or rural lines owned and the miles of wire and number of telephones pertaining to each. As a rule, these lines serve purely rural districts or small towns, and they can properly be considered as representing the same class of service as the mutual systems and the independent farmer or rural lines.

TABLE 11.—COMMERCIAL SYSTEMS, MUTUAL SYSTEMS, AND INDEPENDENT FARMER OR RURAL LINES—COMPARABLE ITEMS: 1907 AND 1902.

	NUMBER OF SYSTEMS OR LINES.			MILES OF WIRE.			NUMBER OF STATIONS OR TELEPHONES.			PER CENT OF TOTAL.					
										Number of systems or lines.		Miles of wire.		Number of stations or telephones.	
	1907	1902	Per cent of increase.	1907	1902	Per cent of increase.	1907	1902	Per cent of increase.	1907	1902	1907	1902	1907	1902
All systems and lines	22,971	9,136	151.4	12,999,369	4,900,451	165.3	6,118,578	2,371,044	158.1	100.0	100.0	100.0	100.0	100 0	100.0
Commercial systems	4,901	3,157	55.2	12,418,042	4,779,571	159.8	5,426,973	2,225,981	143.8	21.3	34.6	95.5	97.5	88.7	93.9
Mutual systems and independent farmer or rural lines	18,070	5,979	202.2	581,327	120,880	380.9	691,605	145,063	376.8	78.7	65.4	4.5	2.5	11.3	6.1
Mutual systems	368	994	(1)	95,033	70,915	(1)	125,956	89,316	(1)	1.6	10.9	0.7	1.4	2.1	3.8
Independent farmer or rural lines	17,702	4,985	(1)	486,294	49,965	(1)	565,649	55,747	(1)	77.1	54.6	3.7	1.0	9 2	2.4

[1] Increase or decrease not comparable.

Table 12 gives the statistics for the rural lines, by classes and by geographic divisions, for the censuses of 1907 and 1902. The classes comprise the rural lines owned by the commercial systems, together with all mutual systems (which are practically without exception rural lines), and all independent farmer or rural lines.

TABLE 12.—RURAL LINES, CLASSIFIED AS COMMERCIAL, MUTUAL, AND INDEPENDENT FARMER OR RURAL—NUMBER OF LINES, MILES OF WIRE, AND NUMBER OF STATIONS OR TELEPHONES, BY GEOGRAPHIC DIVISIONS: 1907 AND 1902.

DIVISION.	Census.	NUMBER OF LINES.				MILES OF WIRE.				NUMBER OF STATIONS OR TELEPHONES.			
		Total.	Commercial lines.	Mutual systems.	Independent farmer or rural lines.	Total.	Commercial lines.	Mutual systems.	Independent farmer or rural lines.	Total.	Commercial lines.	Mutual systems.	Independent farmer or rural lines.
United States	1907	124,847	106,777	[1] 368	17,702	1,591,240	1,009,913	95,033	486,294	1,464,773	773,168	125,956	565,649
	1902	21,577	15,598	[2] 994	4,985	259,306	138,426	70,915	49,965	266,968	121,905	89,316	55,747
North Atlantic	1907	19,749	18,391	15	1,343	180,445	141,259	6,687	32,499	164,932	112,601	8,725	43,606
	1902	1,151	947	119	85	18,069	14,152	2,985	932	18,706	12,499	4,656	1,551
South Atlantic	1907	5,201	4,221	15	965	87,520	47,207	7,456	32,857	64,149	25,542	12,273	26,334
	1902	1,195	674	73	448	17,824	7,629	4,549	5,646	11,268	3,822	3,995	3,451
North Central	1907	83,566	71,876	316	11,374	1,086,263	701,485	75,142	309,636	1,057,043	562,545	99,272	395,226
	1902	18,069	13,186	712	4,171	205,660	108,475	57,837	39,348	226,606	100,856	77,004	48,746
South Central	1907	9,926	7,195	13	2,718	146,548	71,827	2,925	71,796	115,905	41,143	3,603	71,159
	1902	958	634	69	255	13,889	6,564	3,699	3,626	7,829	3,546	2,492	1,791
Western	1907	6,405	5,094	9	1,302	90,464	48,135	2,823	39,506	62,744	31,337	2,083	29,324
	1902	204	157	21	26	3,864	1,606	1,845	413	2,559	1,182	1,169	208

[1] Mutual companies reported 12,378 party lines.

[2] Mutual companies reported 9,258 party lines.

The wire mileage and the number of telephones of the commercial rural lines are included in the wire mileage and the number of telephones given in other tables for the commercial systems. The statistics for the mutual systems and for the independent farmer or rural lines present in full the number of systems, the wire mileage, and the number of telephones for each class. Mutual systems reported 12,378 party lines in 1907 and 9,258 party lines in 1902, and the statistics for these lines would be analogous in the main to those for the rural lines owned by the commercial systems and to those for the independent farmer and rural lines. However, they would not include the total wire mileage and the total number of telephones reported for the mutual systems, as many of the telephones are on single lines. Hence, as in the report for the census of 1902, the total number of mutual systems is used as the basis of comparison.

From Table 12 it appears that the greatest development of the rural telephone service of the country has been reached in the North Central states. By the end of 1907 these states contained 68.3 per cent of the wire and 72.2 per cent of the telephones employed in the rural service. While larger percentages of increase during the past five years are shown for other geographic divisions, the amounts involved are not so large.

Table 13 compares the statistics for the six states in which rural lines have had the greatest development.

TABLE 13.—RURAL LINES—NUMBER OF LINES, MILES OF WIRE, AND NUMBER OF STATIONS OR TELEPHONES IN THE SIX STATES LEADING IN NUMBER OF STATIONS OR TELEPHONES IN 1907, WITH RANK OF STATES: 1907 AND 1902.

STATE.	NUMBER OF STATIONS OR TELEPHONES.		NUMBER OF LINES.		MILES OF WIRE.		RANK OF STATE.					
							Number of stations or telephones.		Number of lines.		Miles of wire.	
	1907	1902	1907	1902	1907	1902	1907	1902	1907	1902	1907	1902
Iowa	174,155	58,364	9,998	2,958	122,531	40,251	1	1	4	4	4	2
Illinois	170,343	49,440	12,711	3,883	166,647	47,463	2	2	2	1	1	1
Ohio	131,164	24,236	15,074	3,056	158,650	22,757	3	5	1	3	2	5
Indiana	115,086	28,190	12,491	3,255	125,625	28,380	4	3	3	2	3	3
Missouri	113,528	26,510	6,327	1,712	96,311	25,094	5	4	5	5	5	4
Kansas	96,455	3,509	5,526	365	89,115	3,347	6	[1] 14	6	[2] 13	6	[3] 16

[1] Wisconsin ranked sixth in 1902 and eleventh in 1907. [2] Michigan ranked sixth in 1902 and seventh in 1907. [3] Michigan ranked sixth in 1902 and eighth in 1907.

Table 14 is a summary of all commercial and mutual systems combined, by geographic divisions, for 1907 and 1902, and shows the percentage of the increase for each item during the five years. It is exclusive of the independent farmer or rural lines.

TABLE 14.—COMMERCIAL AND MUTUAL SYSTEMS COMBINED—COMPARATIVE SUMMARY, BY GEOGRAPHIC DIVISIONS: 1907 AND 1902.

[Exclusive of independent farmer or rural lines.]

DIVISION.	Census.	Number of systems.	Miles of wire.	Number of stations or telephones.	Number of public exchanges.	Number of switchboards.	Estimated number of messages or talks.	SALARIED EMPLOYEES.		WAGE-EARNERS.		Income.	Operating expenses and fixed charges, except interest on funded debt.	Interest on funded debt.
								Number.	Salaries.	Average number.	Wages.			
United States	1907	5,269	12,513,075	5,552,929	15,527	16,065	11,372,605,063	25,298	$19,298,423	118,871	$48,980,704	$184,461,747	$128,486,196	$12,316,109
	1902	4,151	4,850,486	2,315,297	10,361	10,896	5,070,554,553	14,124	9,885,886	64,628	26,369,735	86,825,536	61,652,823	3,511,948
Per cent of increase		26.9	158.0	139.8	49.9	47.4	124.3	79.1	95.2	83.9	85.7	112.5	108.4	250.7
North Atlantic	1907	595	4,021,559	1,619,566	3,049	3,123	2,617,104,751	8,064	6,838,309	38,475	18,334,983	73,528,088	50,727,170	4,143,278
	1902	490	1,669,248	647,670	2,330	2,480	1,208,179,198	5,703	4,779,345	21,702	10,204,325	36,741,249	25,604,561	1,170,402
Per cent of increase		21.4	140.9	150.1	30.9	25.9	116.6	41.4	43.1	77.3	79.7	100.1	98.1	254.0
South Atlantic	1907	408	842,316	339,430	1,241	1,282	827,266,700	1,614	1,271,731	8,188	2,806,280	11,224,294	8,163,894	824,594
	1902	421	322,376	143,314	791	830	353,559,870	1,015	645,107	4,025	1,453,419	4,530,560	3,608,796	254,922
Per cent of increase		[1] 3.1	161.3	136.8	56.9	54.5	134.0	59.0	97.1	103.4	93.1	147.7	126.2	223.5
North Central	1907	3,189	5,041,773	2,568,719	7,422	7,778	5,369,401,249	10,625	7,077,262	47,909	17,483,271	64,362,595	44,101,507	4,605,670
	1902	2,568	2,015,087	1,091,168	5,212	5,500	2,446,257,875	4,768	2,961,686	25,445	8,986,075	29,682,263	20,807,636	1,603,995
Per cent of increase		24.2	150.2	135.4	42.4	41.4	119.5	122.8	139.0	88.3	94.6	116.8	111.9	187.1
South Central	1907	822	1,442,681	514,330	2,304	2,354	1,510,432,721	2,984	2,216,062	13,443	4,621,228	17,835,731	12,531,232	1,299,759
	1902	565	538,347	225,999	1,144	1,199	681,497,626	1,266	841,390	7,060	2,419,070	7,941,911	5,494,975	292,887
Per cent of increase		45.5	168.0	127.6	101.4	96.3	121.6	135.7	163.4	90.4	91.0	124.6	128.0	343.8
Western	1907	255	1,164,746	510,884	1,511	1,528	1,048,399,642	2,011	1,895,059	10,856	5,734,942	17,511,039	12,962,393	1,442,808
	1902	107	305,428	207,146	884	887	381,059,984	1,372	658,358	6,396	3,306,846	7,929,553	6,136,855	189,742
Per cent of increase		138.3	281.3	146.6	70.9	72.3	175.1	46.6	187.8	69.7	73.4	120.8	111.2	660.4

[1] Decrease.

It has been explained before that the mutual systems for 1907 and 1902 are not strictly comparable, because in 1902 they included all farmer or rural mutual lines operating switchboards and in 1907 they did not include such lines if the total receipts from assessments, tolls, or rentals were less than $1,000. Hence, the statistics for mutual systems for 1902 are slightly too large. A similar slight discrepancy exists in the classification of commercial systems at the two censuses. In 1902 some farmer or rural lines were classed as commercial systems; but in 1907 not only was this policy abandoned, but all commercial systems having an annual income of less than $500 were classed as farmer or rural lines. Consequently there was a tendency to enlarge the items for commercial systems in 1902, whereas in 1907 the tendency was in the opposite direction. The effect of these differences extends to Tables 15 and 16, but, except in the matter of the number of systems or lines, it is small.

The commercial systems are operated as business enterprises for profit and now control much the larger portion of the telephone equipment of the country. Most of them keep book accounts, from which more

satisfactory statistics were obtained than it was possible to secure for the mutual companies and farmer or rural lines. As the commercial systems controlled 88.7 per cent of the telephones and 95.5 per cent of the wire reported for all lines in 1907, the conditions prevailing among them represent approximately the industry as a whole.

Table 15 is a comparative summary of commercial systems, by geographic divisions, for 1907 and 1902.

TABLE 15.—COMMERCIAL SYSTEMS—COMPARATIVE SUMMARY, BY GEOGRAPHIC DIVISIONS: 1907 AND 1902.

[Exclusive of mutual systems and independent farmer or rural lines.]

DIVISION.	Census.	Number of systems.	Miles of wire.	Number of stations or telephones.	Number of public exchanges.	Number of switchboards.	Estimated number of messages or talks.	SALARIED EMPLOYEES.		WAGE-EARNERS.		Income.	Operating expenses and fixed charges, except interest on funded debt.	Interest on funded debt.
								Number.	Salaries.	Average number.	Wages.			
United States	1907	4,901	12,418,042	5,426,973	14,702	15,232	11,230,581,856	24,959	$19,245,349	117,477	$48,660,223	$183,784,037	$127,910,817	$12,315,579
	1902	3,157	4,779,571	2,225,981	9,419	9,954	4,971,413,070	13,958	9,871,596	63,630	26,206,065	86,522,211	61,371,002	3,511,768
Per cent of increase		55.2	159.8	143.8	56.1	53.0	125.9	78.8	95.0	84.6	85.7	112.4	108.4	250.7
North Atlantic	1907	580	4,014,872	1,610,841	2,922	2,996	2,609,273,944	8,042	6,835,879	38,332	18,314,611	73,486,574	50,694,044	4,143,228
	1902	371	1,666,263	643,014	2,256	2,406	1,203,979,018	5,693	4,778,888	21,643	10,197,916	36,723,783	25,588,847	1,170,402
Per cent of increase		56.3	141.0	150.5	29.5	24.5	116.7	41.3	43.0	77.1	79.6	100.1	98.1	254.0
South Atlantic	1907	393	834,860	327,157	1,141	1,182	815,169,135	1,586	1,268,552	8,029	2,789,817	11,187,507	8,132,005	824,594
	1902	348	317,827	139,319	729	768	349,373,521	1,012	644,946	3,977	1,449,047	4,515,004	3,593,855	254,922
Per cent of increase		12.9	162.7	134.8	56.5	53.9	133.3	56.7	96.7	101.9	92.5	147.8	126.3	223.5
North Central	1907	2,873	4,966,631	2,469,447	6,861	7,209	5,254,744,199	10,348	7,033,157	46,877	17,216,986	63,799,390	43,623,213	4,605,190
	1902	1,856	1,957,250	1,014,164	4,442	4,730	2,361,506,911	4,626	2,950,741	24,605	8,842,764	29,437,516	20,580,686	1,603,815
Per cent of increase		54.8	153.8	143.5	54.5	52.4	122.5	123.7	138.4	90.5	94.7	116.7	112.0	187.1
South Central	1907	809	1,439,756	510,727	2,279	2,329	1,506,155,426	2,974	2,213,422	13,403	4,610,516	17,813,810	12,511,174	1,299,759
	1902	496	534,648	223,507	1,121	1,176	677,517,694	1,261	839,505	7,029	2,414,545	7,927,428	5,481,034	292,887
Per cent of increase		63.1	169.3	128.5	103.3	98.0	122.3	135.8	163.7	90.7	90.9	124.7	128.3	343.8
Western	1907	246	1,161,923	508,801	1,499	1,516	1,045,239,152	2,009	1,894,339	10,836	5,728,293	17,496,756	12,950,381	1,442,808
	1902	86	303,583	205,977	871	874	379,035,926	1,366	657,516	6,376	3,301,793	7,918,480	6,126,580	189,742
Per cent of increase		186.0	282.7	147.0	72.1	73.5	175.8	47.1	188.1	69.9	73.5	121.0	111.4	660.4

The commercial telephone systems naturally have the largest equipment and do the greatest amount of business in the populous North Atlantic and North Central states. These states in 1907 contained three-fourths of the telephones and nearly three-fourths of the wire reported for all of the commercial systems in operation during the year. The greatest percentages of increase in the number of telephones wired for service is shown for the North Atlantic states, while the largest percentage of increase in the length of wire is shown for the Western states. The equipment of the long-distance telephone companies has added greatly to the wire mileage in some sections. A large part of the increase in the wire mileage is due to the increased substitution of cable for open wire in the cities and larger towns; wherever this substitution is made a greater wire capacity is installed, in anticipation of future needs, than is actually used at the outset.

Table 16 is a summary, by geographic divisions, for the mutual systems for 1907.

TABLE 16.—MUTUAL SYSTEMS—SUMMARY, BY GEOGRAPHIC DIVISIONS: 1907.

[Exclusive of commercial systems and independent farmer or rural lines.]

DIVISION.	Number of systems.	Miles of wire.	Number of stations or telephones.	Number of public exchanges.	Number of switchboards.	Estimated number of messages or talks.	SALARIED EMPLOYEES.		WAGE-EARNERS.		Income.	Operating expenses and fixed charges, except interest on funded debt.	Interest on funded debt.
							Number.	Salaries.	Average number.	Wages.			
United States	368	95,033	125,956	825	833	142,023,207	339	$53,074	1,394	$320,481	$677,710	$575,379	$530
North Atlantic	15	6,687	8,725	127	127	7,830,807	22	2,430	143	20,372	41,514	33,126	50
South Atlantic	15	7,456	12,273	100	100	12,097,565	28	3,179	159	16,463	36,787	31,889	.....
North Central	316	75,142	99,272	561	569	114,657,050	277	44,105	1,032	266,285	563,205	478,294	480
South Central	13	2,925	3,603	25	25	4,277,295	10	2,640	40	10,712	21,921	20,058	.....
Western	9	2,823	2,083	12	12	3,160,490	2	720	20	6,649	14,283	12,012	.....

The greatest development of the mutual companies and associations has occurred in the North Central division. This division had 78.8 per cent of the total number of telephones belonging to the mutual systems and 79.1 per cent of the wire. For the entire country the telephones of the mutual systems con-

stituted 2.1 per cent of all telephones combined. In the North Central division the telephones of the mutual systems formed 3.3 per cent of all telephones, and in the South Atlantic division, 3.4 per cent; but in the North Atlantic, South Central, and Western divisions each they formed less than 1 per cent.

Table 17 is a summary of the independent farmer or rural lines, by geographic divisions, for 1907.

TABLE 17.—INDEPENDENT FARMER OR RURAL LINES—SUMMARY, BY GEOGRAPHIC DIVISIONS: 1907.

DIVISION.	Number of lines.	Miles of wire.	Number of stations or telephones.	INCOME AND ASSESSMENTS.				
				Lines reporting.		Total.	Income.	Assessments.
				Number.	Per cent of total.			
United States	17,702	486,294	565,649	12,430	70.2	$1,783,458	$460,653	$1,322,805
North Atlantic	1,343	32,499	43,606	849	63.2	140,129	67,604	72,525
South Atlantic	965	32,857	26,334	559	57.9	105,386	43,505	61,881
North Central	11,374	309,636	395,226	8,651	76.1	1,225,288	241,351	983,937
South Central	2,718	71,796	71,159	1,602	58.9	204,005	69,776	134,229
Western	1,302	39,506	29,324	769	59.1	108,650	38,417	70,233

In 1907 a large majority of the independent farmer or rural lines were in the states of the North Central division. This division had 64.3 per cent of the lines, 63.7 per cent of the wire, and 69.9 per cent of the telephone instruments reported by all independent rural lines in the United States, and the independent rural line telephones in this division formed 13.3 per cent of all telephones in the division.

Table 18 shows the number of telephones on independent farmer or rural lines in states having 10,000 or more telephones on such lines in 1907, and the percentages the number their instruments formed of the total number of telephones in the respective states.

TABLE 18.—*States having 10,000 or more telephones on independent farmer or rural lines—Total number of telephones and number on independent farmer or rural lines: 1907.*

STATE.	STATIONS OR TELEPHONES.		
	Total number.	On independent farmer or rural lines.	
		Number.	Per cent of total.
Iowa	332,545	83,407	25.1
Missouri	312,527	70,883	22.7
Illinois	558,585	60,864	10.9
Kansas	200,233	40,686	20.3
Indiana	289,452	30,131	10.4
Ohio	495,636	26,340	5.3
Minnesota	171,479	19,608	11.4
Nebraska	152,279	19,566	12.8
Texas	188,862	19,262	10.2
New York	685,512	18,998	2.8
Pennsylvania	450,403	16,660	3.7
Wisconsin	158,875	16,490	10.4
Oklahoma	68,125	15,698	23.0
Michigan	209,842	13,912	6.6
Kentucky	93,996	10,163	10.8

It will be seen that ten of these fifteen states belong to the North Central division, and that in the case of four of the states—Iowa, Missouri, Kansas, and Oklahoma—more than one-fifth of the telephones were on independent rural lines.

Systems under construction in 1907.—Although no inquiry was made of companies in operation concerning the line additions or other new physical equipment installed during the year 1907, reports were received from twenty-four systems that were in process of construction during 1907 but had not commenced actual operations at the end of the year. The statistics for these companies are given in Table 19.

TABLE 19.—*Telephone systems under construction: 1907.*

Number of systems	[1] 24
Character of ownership:	
Firm or partnership	4
Mutual and cooperative	4
Incorporated	16
Line construction, miles:	
Pole line for wires or cables	240
Pole line for farmer or rural lines	196
Overhead cable	181.9
Subways or conduits (street miles)	44.7
Duct, owned	223.4
Cable in underground subways or conduits	62.7
Submarine cable	0.9
Miles of single wire, total	188,258
Open wire on pole or roof line	2,700
On farmer or rural lines	519
In overhead cables	76,319
In subways or conduits	108,627
In submarine cables	93
Exchanges of all kinds	77
Stations or telephones	17,629

[1] Includes systems distributed as follows: Three each in New York, Oklahoma, and Pennsylvania; two each in California, Michigan, Minnesota, Nebraska, and Washington; and one each in Missouri, Ohio, Oregon, Texas, and Virginia.

Undoubtedly many lines for which the census secured no report were being constructed during 1907 by small companies and independent interests. The twenty-four systems covered by Table 19 represent only the most important, and some of these had installed comparatively few telephones by the end of the year.

Telephones in Alaska, Hawaii, and Porto Rico.—The statistics for Alaska, Hawaii, and Porto Rico are not included in the totals for the United States, but they are presented in Table 20 for consideration in connection with the general growth of the industry.

TABLE 20.—*Telephone systems in Alaska, Hawaii, and Porto Rico—Comparative summary: 1907 and 1902.*

	1907	1902
Number of systems and lines	[1] 17	[2] 8
Miles of wire	13,536	4,732
Number of stations or telephones	6,359	2,493
Number of public exchanges	55	13
Number of pay stations	149	8
Number of party lines (city or town)	631	796
Number of stations on party lines	1,875	1,595
Manual switchboards, total number	59	13
Common-battery	9	1
Magneto	50	12
Estimated number of messages or talks	8,860,572	3,461,000
Salaried employees:		
Number	41	16
Salaries	$56,972	$21,700
Wage-earners:		
Average number	232	87
Wages	$130,239	$34,198
Capitalization:		
Common stock authorized, par value	842,000	342,000
Common stock outstanding, par value	766,035	279,045
Funded debt authorized, par value	88,000	----
Funded debt outstanding, par value	85,400	----
Total income	418,883	112,068
Operating expenses and fixed charges, except interest on funded debt	288,214	76,307
Interest on funded debt	5,202	----
Dividends	8,800	25,858

[1] Includes systems distributed as follows: Alaska, 7; Hawaii, 7; Porto Rico, 3.
[2] Includes systems distributed as follows: Alaska, 1; Hawaii, 7.

The telephone systems in these outlying districts are not extensive, and it was impossible to apply to the collection of statistics concerning them the same methods that were followed in the canvass of continental United States. The canvass of Hawaii and Porto Rico was exhaustive, but it is possible that some small lines in Alaska escaped enumeration. The greatest increase is shown for Alaska, where the wire mileage increased from 150 in 1902 to 2,198 in 1907. There were seven companies or systems reported for Hawaii at each census, but the amount of wire increased from 4,582 miles in 1902 to 9,874 miles in 1907 and the number of telephones from 2,368 to 3,052. No telephone statistics were reported for Porto Rico at the census of 1902, although there were some lines in operation at that time. The telephone systems on the island in 1907 are described in the separate report of the Electrical Industries of Porto Rico.

At the census of 1902 the Philippine Islands reported one telephone system, with 786 miles of wire and 398 telephones; but since no report was obtained from them for 1907, the statistics of the former enumeration are not included in Table 20.

CHAPTER III.

PHYSICAL EQUIPMENT.

EXCHANGES.

For census purposes the "exchange," or "central," is defined as the place or office in which lines for the use of the general public are interconnected by means of a switchboard. The equipment covers all of the apparatus used to enable the different lines to be rapidly connected and disconnected for the convenience of the subscribers. The word exchange, when used by itself in this report, refers to public exchanges, and does not include the private-branch exchange, which consists of a switchboard located within a business building, apartment house, hotel, or private establishment, and serving as a means of connection for wires between buildings, departments, offices, or rooms.

Table 21 shows (excluding independent farmer or rural lines) the number of public Bell and independent exchanges and the number of private-branch exchanges having connections with public exchanges, distributed by states and geographic divisions.

TABLE 21.—COMMERCIAL AND MUTUAL SYSTEMS COMBINED—NUMBER OF EXCHANGES, BY STATES AND TERRITORIES AND GEOGRAPHIC DIVISIONS: 1907 AND 1902.

[Exclusive of independent farmer or rural lines.]

STATE OR TERRITORY.	Census.	NUMBER OF EXCHANGES.							Per cent of aggregate.	
		Aggregate.	Public.					Private-branch.		
			Total.	Bell system (A. T. and T. Co.).	Independent (non-Bell) systems and lines.	Per cent of total.			Public.	Private-branch.
						Bell.	Independent (non-Bell).			
United States	1907	43,819	15,527	5,418	10,109	34.9	65.1	28,292	35.4	64.6
	1902	18,244	10,361	3,753	6,608	36.2	63.8	7,883	56.8	43.2
North Atlantic division	1907	20,633	3,049	1,581	1,468	51.9	48.1	17,584	14.8	85.2
	1902	7,368	2,330	1,419	911	60.9	39.1	5,038	31.6	68.4
Maine	1907	310	243	158	85	65.0	35.0	67	78.4	21.6
	1902	113	112	80	32	71.4	28.6	1	99.1	0.9
New Hampshire	1907	158	139	101	38	72.7	27.3	19	88.0	12.0
	1902	88	87	75	12	86.2	13.8	1	98.9	1.1
Vermont	1907	189	167	53	114	31.7	68.3	22	88.4	11.6
	1902	104	103	39	64	37.9	62.1	1	99.0	1.0
Massachusetts	1907	2,067	274	250	24	91.2	8.8	1,793	13.3	86.7
	1902	641	233	221	12	94.8	5.2	408	36.3	63.7
Connecticut and Rhode Island	1907	549	89	81	8	91.0	9.0	460	16.2	83.8
	1902	159	64	58	6	90.6	9.4	95	40.3	59.7
New York	1907	12,093	896	414	482	46.2	53.8	11,197	7.4	92.6
	1902	4,520	713	408	305	57.2	42.8	3,807	15.8	84.2
New Jersey	1907	834	222	144	78	64.9	35.1	612	26.6	73.4
	1902	387	246	175	71	71.1	28.9	141	63.6	36.4
Pennsylvania	1907	4,433	1,019	380	639	37.3	62.7	3,414	23.0	77.0
	1902	1,356	772	363	409	47.0	53.0	584	56.9	43.1
South Atlantic division	1907	2,372	1,241	406	835	32.7	67.3	1,131	52.3	47.7
	1902	1,206	791	138	653	17.4	82.6	415	65.6	34.4
Maryland, Delaware, and District of Columbia	1907	1,045	178	122	56	68.5	31.5	867	17.0	83.0
	1902	487	114	34	80	29.8	70.2	373	23.4	76.6
Virginia	1907	283	209	43	166	20.6	79.4	74	73.9	26.1
	1902	147	139	14	125	10.1	89.9	8	94.6	5.4
West Virginia	1907	347	284	48	236	16.9	83.1	63	81.8	18.2
	1902	197	180	27	153	15.0	85.0	17	91.4	8.6
North Carolina	1907	217	198	50	148	25.3	74.7	19	91.2	8.8
	1902	125	125	7	118	5.6	94.4	.....	100.0	.....
South Carolina	1907	122	107	54	53	50.5	49.5	15	87.7	12.3
	1902	88	82	15	67	18.3	81.7	6	93.2	6.8
Georgia	1907	272	198	81	117	40.9	59.1	74	72.8	27.2
	1902	124	113	33	80	29.2	70.8	11	91.1	8.9
Florida	1907	86	67	8	59	11.9	88.1	19	77.9	22.1
	1902	38	38	8	30	21.1	78.9	.....	100.0	.....

TABLE 21.—COMMERCIAL AND MUTUAL SYSTEMS COMBINED—NUMBER OF EXCHANGES, BY STATES AND TERRITORIES AND GEOGRAPHIC DIVISIONS: 1907 AND 1902—Continued.

[Exclusive of independent farmer or rural lines.]

STATE OR TERRITORY.	Census.	NUMBER OF EXCHANGES.								
		Aggregate.	Public.					Private-branch.	Per cent of aggregate.	
			Total.	Bell system (A. T. and T. Co.).	Independent (non-Bell) systems and lines.	Per cent of total.			Public.	Private-branch.
						Bell.	Independent (non-Bell).			
North Central division	1907	13,781	7,422	1,431	5,991	19.3	80.7	6,359	53.9	46.1
	1902	7,107	5,212	944	4,268	18.1	81.9	1,895	73.3	26.7
Ohio	1907	2,379	1,039	259	780	24.9	75.1	1,340	43.7	56.3
	1902	1,204	757	158	599	20.9	79.1	447	62.9	37.1
Indiana	1907	1,074	796	163	633	20.5	79.5	278	74.1	25.9
	1902	705	621	91	530	14.7	85.3	84	88.1	11.9
Illinois	1907	2,891	1,137	242	895	21.3	78.7	1,754	39.3	60.7
	1902	1,683	912	177	735	19.4	80.6	771	54.2	45.8
Michigan	1907	1,121	604	217	387	35.9	64.1	517	53.9	46.1
	1902	626	511	185	326	36.2	63.8	115	81.6	18.4
Wisconsin	1907	662	438	90	348	20.5	79.5	224	66.2	33.8
	1902	414	342	88	254	25.7	74.3	72	82.6	17.4
Minnesota	1907	1,306	453	91	362	20.1	79.9	853	34.7	65.3
	1902	454	246	23	223	9.3	90.7	208	54.2	45.8
Iowa	1907	902	751	73	678	9.7	90.3	151	83.3	16.7
	1902	716	710	68	642	9.6	90.4	6	99.2	0.8
Missouri	1907	1,594	650	91	559	14.0	86.0	944	40.8	59.2
	1902	656	482	41	441	8.5	91.5	174	73.5	26.5
North Dakota	1907	242	212	22	190	10.4	89.6	30	87.6	12.4
	1902	49	49	4	45	8.2	91.8	.....	100.0	.....
South Dakota	1907	256	255	10	245	3.9	96.1	1	99.6	0.4
	1902	103	103	9	94	8.7	91.3	.....	100.0	.....
Nebraska	1907	690	507	98	409	19.3	80.7	183	73.5	26.5
	1902	237	220	77	143	35.0	65.0	17	92.8	7.2
Kansas	1907	664	580	75	505	12.9	87.1	84	87.3	12.7
	1902	260	259	23	236	8.9	91.1	1	99.6	0.4
South Central division	1907	3,157	2,304	918	1,386	39.8	60.2	853	73.0	27.0
	1902	1,291	1,144	472	672	41.3	58.7	147	88.6	11.4
Kentucky	1907	671	342	166	176	48.5	51.5	329	51.0	49.0
	1902	295	203	96	107	47.3	52.7	92	68.8	31.2
Tennessee	1907	415	261	144	117	55.2	44.8	154	62.9	37.1
	1902	174	158	95	63	60.1	39.9	16	90.8	9.2
Alabama	1907	181	135	83	52	61.5	38.5	46	74.6	25.4
	1902	72	69	31	38	44.9	55.1	3	95.8	4.2
Mississippi	1907	185	177	116	61	65.5	34.5	8	95.7	4.3
	1902	95	95	64	31	67.4	32.6	.....	100.0	.....
Louisiana	1907	229	105	63	42	60.0	40.0	124	45.9	54.1
	1902	82	60	45	15	75.0	25.0	22	73.2	26.8
Arkansas	1907	253	241	42	199	17.4	82.6	12	95.3	4.7
	1902	123	123	19	104	15.4	84.6	.....	100.0	.....
Oklahoma	1907	351	294	111	183	37.8	62.2	57	83.8	16.2
	1902	102	102	4	98	3.9	96.1	.....	100.0	.....
Texas	1907	872	749	193	556	25.8	74.2	123	85.9	14.1
	1902	348	334	118	216	35.3	64.7	14	96.0	4.0
Western division	1907	3,876	1,511	1,082	429	71.6	28.4	2,365	39.0	61.0
	1902	1,272	884	780	104	88.2	11.8	388	69.5	30.5
Montana	1907	80	54	32	22	59.3	40.7	26	67.5	32.5
	1902	38	32	19	13	59.4	40.6	6	84.2	15.8
Idaho	1907	116	100	51	49	51.0	49.0	16	86.2	13.8
	1902	33	33	28	5	84.8	15.2	.....	100.0	.....
Colorado	1907	338	158	130	28	82.3	17.7	180	46.7	53.3
	1902	120	96	80	16	83.3	16.7	24	80.0	20.0
New Mexico	1907	45	41	15	26	36.6	63.4	4	91.1	8.9
	1902	13	12	2	10	16.7	83.3	1	92.3	7.7
Arizona	1907	45	38	14	24	36.8	63.2	7	84.4	15.6
	1902	30	30	12	18	40.0	60.0	.....	100.0	.....
Utah and Wyoming	1907	198	96	65	31	67.7	32.3	102	48.5	51.5
	1902	38	36	35	1	97.2	2.8	2	94.7	5.3
Nevada	1907	32	26	11	15	42.3	57.7	6	81.2	18.8
	1902	11	11	8	3	72.7	27.3	.....	100.0	.....
Washington	1907	881	247	173	74	70.0	30.0	634	28.0	72.0
	1902	191	140	135	5	96.4	3.6	51	73.3	26.7
Oregon	1907	359	206	155	51	75.2	24.8	153	57.4	42.6
	1902	137	118	99	19	83.9	16.1	19	86.1	13.9
California	1907	1,782	545	436	109	80.0	20.0	1,237	30.6	69.4
	1902	661	376	362	14	96.3	3.7	285	56.9	43.1

In 1902 the private-branch exchanges formed 43.2 per cent of all exchanges, but in 1907 they formed 64.6 per cent of the total number. At both censuses the private-branch exchanges were in the minority in the South Atlantic, North Central, and South Central states, but in the North Atlantic states they largely exceeded the public exchanges. In 1902 the public exchanges in the Western states largely exceeded in number the private ones, but in 1907 they were in the minority. The greatest development of private exchanges was found in New York, where they outnumbered the public exchanges 12 to 1 in 1907 as compared with 5 to 1 in 1902.

Table 22 shows, by geographic divisions, the percentages of increase in the number of exchanges in 1907 as compared with 1902.

TABLE 22.—*Commercial and mutual systems combined—Per cent of increase in number of public and private exchanges, by geographic divisions: 1902 to 1907.*

DIVISION.	PER CENT OF INCREASE IN NUMBER OF EXCHANGES.				
	All exchanges.	Public exchanges.			Private-branch exchanges.
		Total.	On Bell systems (A. T. and T. Co.).	On independent (non-Bell) systems and lines.	
United States	140.2	49.9	44.4	53.0	258.9
North Atlantic	180.0	30.9	11.4	61.1	249.0
South Atlantic	96.7	56.9	194.2	27.9	172.5
North Central	93.9	42.4	51.6	40.4	235.6
South Central	144.5	101.4	94.5	106.3	480.3
Western	204.7	70.9	38.7	312.5	509.5

It is to be understood that these statistics with respect to private-branch exchanges relate solely to those having connections with public exchanges and do not include isolated exchanges or private lines, but the great increase in the number of private-branch exchanges indicates the extent to which the telephone is being used for conversation between the different rooms and departments of establishments.

Two or more public exchanges operated in the same city by one company have been counted as separate public exchanges in compiling the statistics. The largest number of public exchanges and the greatest increase in the number is found in the systems that are operated independently of the American Telephone and Telegraph Company. From 1902 to 1907 the number of these independent public exchanges increased 3,501, or 53 per cent, whereas the exchanges of the American Telephone and Telegraph Company increased 1,665, or 44.4 per cent. Illinois, Ohio, and Pennsylvania, in the order named, reported the largest numbers of public exchanges, and in each of these states the number reported for the independent systems is greatly in excess of that reported for the Bell system. The states showing the largest number of public exchanges of the Bell system are California, with 436; New York, with 414; and Pennsylvania, with 380; while the leading states with respect to the number of independent public exchanges are Illinois, with 895; Ohio, with 780; and Iowa, with 678. In only two states—New Jersey and Delaware—the numbers of public exchanges reported were smaller for 1907 than for 1902.

In the North Atlantic and the Western divisions the public exchanges of the Bell system predominated both in 1902 and in 1907; but in the other divisions—the South Atlantic, North Central, and South Central—the independent public exchanges outnumbered the Bell.

TABLE 23.—STATES AND TERRITORIES GROUPED ACCORDING TO MAJOR PER CENT OF BELL OR INDEPENDENT (NON-BELL) PUBLIC EXCHANGES: 1907 AND 1902.

1907				1902			
Bell.		Independent (non-Bell).		Bell.		Independent (non-Bell).	
State or territory.	Per cent.	State or territory.	Per cent.	State or territory.	Per cent.	State or territory.	Per cent.
Massachusetts	91.2	South Dakota	96.1	Utah and Wyoming	97.2	Oklahoma	96.1
Connecticut and Rhode Island	91.0	Iowa	90.3	Washington	96.4	North Carolina	94.4
Colorado	82.3	North Dakota	89.6	California	96.3	North Dakota	91.8
California	80.0	Florida	88.1	Massachusetts	94.8	Missouri	91.5
Oregon	75.2	Kansas	87.1	Connecticut and Rhode Island	90.6	South Dakota	91.3
New Hampshire	72.7	Missouri	86.0	New Hampshire	86.2	Kansas	91.1
Washington	70.0	West Virginia	83.1	Idaho	84.8	Minnesota	90.7
Maryland, Delaware, and District of Columbia	68.5	Arkansas	82.6	Oregon	83.9	Iowa	90.4
Utah and Wyoming	67.7	Nebraska	80.7	Colorado	83.3	Virginia	89.9
Mississippi	65.5	Minnesota	79.9	Louisiana	75.0	Indiana	85.3
Maine	65.0	Indiana	79.5	Nevada	72.7	West Virginia	85.0
New Jersey	64.9	Wisconsin	79.5	Maine	71.4	Arkansas	84.6
Alabama	61.5	Virginia	79.4	New Jersey	71.1	New Mexico	83.3
Louisiana	60.0	Illinois	78.7	Mississippi	67.4	South Carolina	81.7
Montana	59.3	Ohio	75.1	Tennessee	60.1	Illinois	80.6
Tennessee	55.2	North Carolina	74.7	Montana	59.4	Ohio	79.1
Idaho	51.0	Texas	74.2	New York	57.2	Florida	78.9
South Carolina	50.5	Vermont	68.3			Wisconsin	74.3
		Michigan	64.1			Georgia	70.8
		New Mexico	63.4			Maryland, Delaware, and District of Columbia	70.2
		Arizona	63.2			Nebraska	65.0
		Pennsylvania	62.7			Texas	64.7
		Oklahoma	62.2			Michigan	63.8
		Georgia	59.1			Vermont	62.1
		Nevada	57.7			Arizona	60.0
		New York	53.8			Alabama	55.1
		Kentucky	51.5			Pennsylvania	53.0
						Kentucky	52.7

In Table 23 the states and territories are grouped according to the major percentage of Bell or independent public exchanges for 1907 and for 1902. It indicates for each census in which states more than half of the exchanges were of the Bell system, and in which more than half were independent, the states being arranged in the order of percentage controlled.

The only shifting of states occurs in the cases of Nevada and New York, which had more than 50 per cent of Bell public exchanges in 1902 and more than 50 per cent of independent in 1907, and in the cases of Alabama, South Carolina, and the group of Maryland, Delaware, and the District of Columbia, which in 1902 had more than 50 per cent of independent and in 1907 more than 50 per cent of Bell exchanges. A change in the ownership of systems operating in a state seems to result in a rearrangement of the equipment. As a rule, the establishment of new exchanges must precede every great extension of a system, though the more modern exchanges are being equipped for the purpose of meeting all normal growth. Exchanges differ greatly in size and in amount of equipment, but it is interesting to note that, exclusive of the farmer or rural lines, there was an average of 358 telephones and 806 miles of wire to each public exchange in 1907 as compared with 223 telephones and 468 miles of wire in 1902.

Only the commercial and the mutual systems were requested to furnish statistics concerning the equipment of the central, or exchange. While some of the independent farmer or rural lines operated switchboards and had a small amount of central-office equipment, the statistics of these are so unimportant that the omission of them can have no appreciable effect upon the results.

Switchboards.—The success of a telephone system depends almost entirely upon the proper working of the switchboard, which is the most important single piece of equipment in the exchange. Table 24 gives the statistics in regard to switchboards in public exchanges.

TABLE 24.—*Commercial and mutual systems combined—Kind, number, and capacity of subscribers' switchboards: 1907 and 1902.*

[Exclusive of independent farmer or rural lines.]

	1907	1902	Per cent of increase.
Number of systems	5,269	4,151	26.9
Subscribers' switchboards:			
Number	16,065	10,896	47.4
Manual	15,947	10,842	47.1
Common-battery	2,146	837	156.4
Magneto	13,801	10,005	37.9
Automatic	118	54	118.5
Total equipped capacity of subscribers' switchboards, drops or jacks	4,223,309	2,447,403	72.6
Total capacity in use of switchboards, drops or jacks	3,228,394	(1)	.....

[1] Not reported separately.

Three kinds of boards are shown: The manual common-battery, the manual magneto, and the automatic. Manual switchboards are in use in the great majority of exchanges. Such switchboards formed 99.3 per cent of the total number of boards in operation during 1907, the number reported in that year being an increase of 5,105 over the number reported for 1902. The magneto board is especially serviceable in systems that have comparatively few and widely scattered subscribers, and as a large number of small exchanges have been established in the rural districts since 1902, the actual increase has been much larger in this style of board than in any other. The common-battery board is used to the greatest advantage by the large companies in cities where the number of subscribers is large, and although the demand for this style of board, as compared with that for the magneto board, is limited, the number in use in 1907 is an increase of 1,309 over the corresponding total for 1902.

While the number of automatic switchboards in use in 1907 was comparatively small, being only 118, it was more than double the number in 1902.

The total capacity of all switchboards was reported for 1902 as 2,447,403 lines, but it is evident that the inquiry on this subject was not clearly understood. Some companies gave the total possible installation equipment, while others reported the number of lines actually in use. In 1907 the capacity was obtained for drops or jacks both in use and equipped ready for use.

In addition to the 4,223,309 drops or jacks equipped ready for use in the exchanges of the commercial and mutual systems, there were 39,947 drops or jacks in use on separate toll switchboards of commercial systems, making a total equipped capacity of 4,263,256 drops or jacks. The number of drops or jacks in use in 1907 on each class of switchboard is shown in Table 25.

TABLE 25.—*Commercial and mutual systems combined—Drops or jacks in use, by kind of switchboard: 1907.*

[Exclusive of independent farmer or rural lines.]

KIND.	Number of switchboards.	Number of drops or jacks in use.
Subscribers' switchboards, total	16,065	3,228,394
Manual	15,947	3,137,275
Common-battery	2,146	1,917,106
Magneto	13,801	1,220,169
Automatic	118	91,119

The average number of drops or jacks in use per switchboard was 893 for the common-battery type, 88 for the magneto style, 772 for the automatic variety, and 201 for all subscribers' switchboards. The average per switchboard for the total number equipped was 263 in 1907 as compared with 225 in 1902. In addition to the foregoing there were 514 incoming trunk switchboards and 1,387 separate toll switchboards, the latter having 39,947 drops, or an average of 29 per switchboard. The existence of party lines, private-branch exchanges on which there are a number of telephones connected with the public exchange by a single wire, independent farmer or rural lines, and other

small systems which have no switchboards makes it impossible to establish any relation between the equipment of switchboards and the number of telephones installed for use.

Power-plant equipment.—The power-plant equipment of the central office pertains almost exclusively to the exchanges of the commercial companies. The only items reported by the mutual systems for 1907 were 958 ringers and 11,273 primary-battery cells. In the small systems and the independent farmer or rural lines the amount of current used is so small and the primary equipment employed so unimportant that no effort was made to collect statistics for such systems and lines.

Table 26 presents the comparative statistics for the chief elements of the physical equipment of the exchanges or central offices, other than switchboards.

TABLE 26.—*Commercial and mutual systems combined—Exchange or central office power-plant equipment: 1907 and 1902.*

[Exclusive of independent farmer or rural lines.]

	1907	1902	Per cent of increase.
Engines, horsepower	5,493.1	2,750.5	99.7
Dynamos, horsepower	12,122.7	5,459.1	122.1
Electric motors, horsepower	10,592.7	4,209.8	151.6
Hand magneto generators, and power-driven ringers in central offices, number	25,453	14,931	70.5
Batteries:			
Primary, number of cells	525,710	110,648	375.1
Storage, number of cells	42,234	19,001	122.3

The larger common-battery offices have a complicated and elaborate equipment, of which only the principal units are shown in the census statistics. In 1902, 26 companies reported 196 steam, gas, or gasoline engines as the primary power employed in the generation of the electric current required for their lines. In 1907, 81 companies reported 488 of these engines, and an increase of 2,742.6 horsepower over that of 1902.

Between 1902 and 1907 gas engines came into common use. In 1907 only 16 of the engines, with a combined horsepower amounting to 851.3, were steam, while 472, with a combined horsepower amounting to 4,641.8, were gas. In 1902 there were 196 engines, all told, in use. The engines are of small capacity, the average for 1902 being 14 horsepower and that for 1907, 11.3 horsepower. The steam engines in use in 1907 averaged 53.2 horsepower and the gas engines 9.8 horsepower.

The dynamos and electric motors are not to be taken as interdependent nor are the dynamos to be considered in relation to the engine power. In many cases motor generators or dynamotors using purchased current were employed, and there is much uncertainty as to whether they were reported as motors or generators, or under both heads. Primary and storage batteries are in more common use than either dynamos or motors. The total number of cells reported for both varieties of batteries in 1902 was 129,649. In 1907 batteries were used by 4,950 companies, and the number of cells had increased to 567,944. In 1907, 4,706 companies reported the use of 525,710 primary-battery cells and 515 companies the use of 42,234 storage-battery cells.

Hand magneto generators and power-driven ringers were reported as used by 4,927 companies in 1907, and the number of such machines increased by 10,522, or 70.5 per cent, in that year as compared with 1902.

WIRE AND LINE CONSTRUCTION.

The wire and line construction includes the electrical conductors which connect the substations with the central offices, the poles and other structures for their support, and the cables, underground conduits, and subways in which they are carried. The comparative statistics relating to these items for 1907 and 1902 are given in Table 27.

TABLE 27.—*Commercial and mutual systems combined—Number of stations or telephones and miles of wire and line construction: 1907 and 1902.*

[Exclusive of independent farmer or rural lines.]

	1907	1902	Per cent of increase.
Number of systems	5,269	4,151	26.9
Number of stations or telephones	5,552,929	2,315,297	139.8
Wire miles, total	12,513,075	4,850,486	158.0
Open single wire on pole or roof line	4,605,929	2,369,914	94.4
In overhead cables	2,917,114	780,530	273.7
In underground subways or conduits	4,969,302	1,690,502	194.0
In submarine cables	20,730	9,540	117.3
Overhead line construction, miles:			
Pole line for wires or cables	772,873	421,828	83.2
Cable	25,108.1	8,104.5	209.8
Underground construction, miles:			
Subways or conduits (street miles)	6,679.9	2,660.2	151.1
Duct—			
Owned	33,487.7	15,748.9	112.6
Leased	1,344.1	726.0	85.1
Cable in subways or conduits	13,772.0	7,290.6	88.9
Submarine cable, miles	306.0	262.6	16.5

Nearly 13,000,000 miles of wire were in use by the telephone systems of the country at the close of the year 1907. Between 1902 and that year the development was unprecedented. The tendency to eliminate party lines in the cities and give a separate wire to each subscriber, and the extension of the service into rural districts where the subscribers are widely separated, has resulted in a more rapid increase in the amount of wire than in any other item of equipment.

Two interesting points are disclosed by the statistics for commercial and mutual systems, given in Table 27—a large increase in underground wire and a greatly increased use of cables. In 1902 the wire in overhead construction constituted 65 per cent of all wire for these systems; the wire in underground construction, 34.9 per cent; and the submarine wire, two-tenths of 1 per cent. In 1907 the proportion of wire in overhead construction had decreased to 60.1 per cent of all wire and the proportion of underground wire had increased to 39.7 per cent; whereas the submarine wire retained the same ratio as in 1902. Wire in the overhead cables shows the highest percentage of increase for any class of wire, namely, 273.7 per cent. Protected wire, in cables of all kinds, whether overhead, underground, or subma-

rine, increased from 2,480,572 miles in 1902 to 7,907,146 miles in 1907, or 218.8 per cent, while open wire increased only 94.4 per cent, the lowest rate for any class.

The telephone wire mileage of the state of New York exceeds the telegraph wire mileage for the entire country, and in 1907 there were eight states each with more than 500,000 miles of telephone wire. Table 28 gives the telephone wire mileage, including independent farmer or rural lines, of these leading states in 1907 and in 1902.

California shows the largest rate of increase among these leading states, followed by Missouri, New York, Indiana, and Illinois, in the order named.

TABLE 28.—*All systems and lines—Miles of wire in states having over 500,000 miles of wire in 1907: 1907 and 1902.*

STATE.	1907	1902	Per cent of increase.
New York	1,630,076	623,625	161.4
Pennsylvania	1,087,509	501,601	116.8
Illinois	986,949	428,304	130.4
Ohio	986,053	515,892	91.1
Missouri	640,560	177,072	261.8
California	543,114	144,437	276.0
Massachusetts	534,220	257,461	107.5
Indiana	530,044	213,157	148.7

The miles of wire, including farmer or rural lines, in the geographic divisions and the several states in 1907 and 1902 and the increases are graphically shown by the following diagrams:

DIAGRAM 2.—MILES OF WIRE, BY GEOGRAPHIC DIVISIONS: 1907 AND 1902.

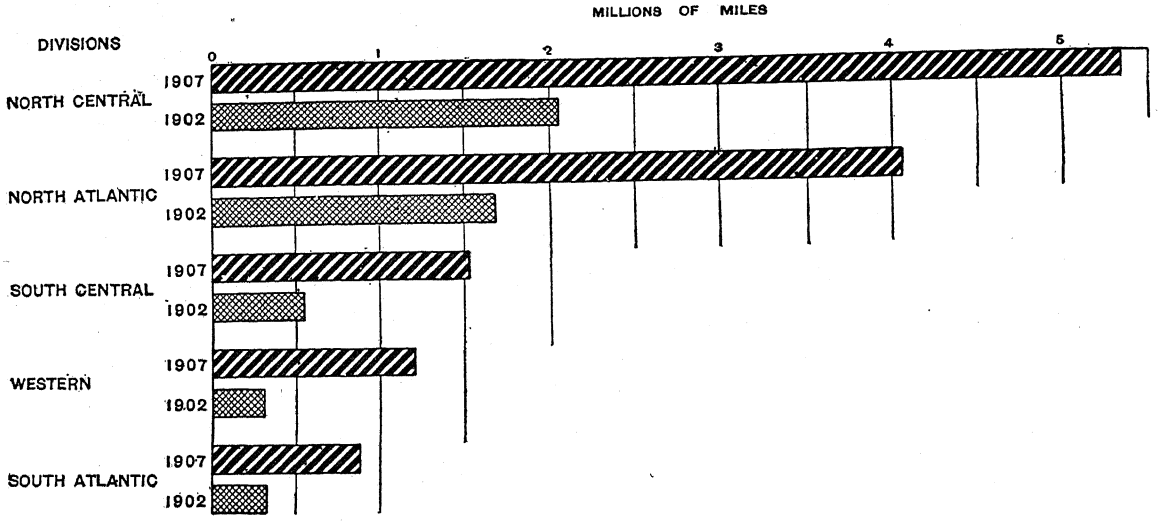
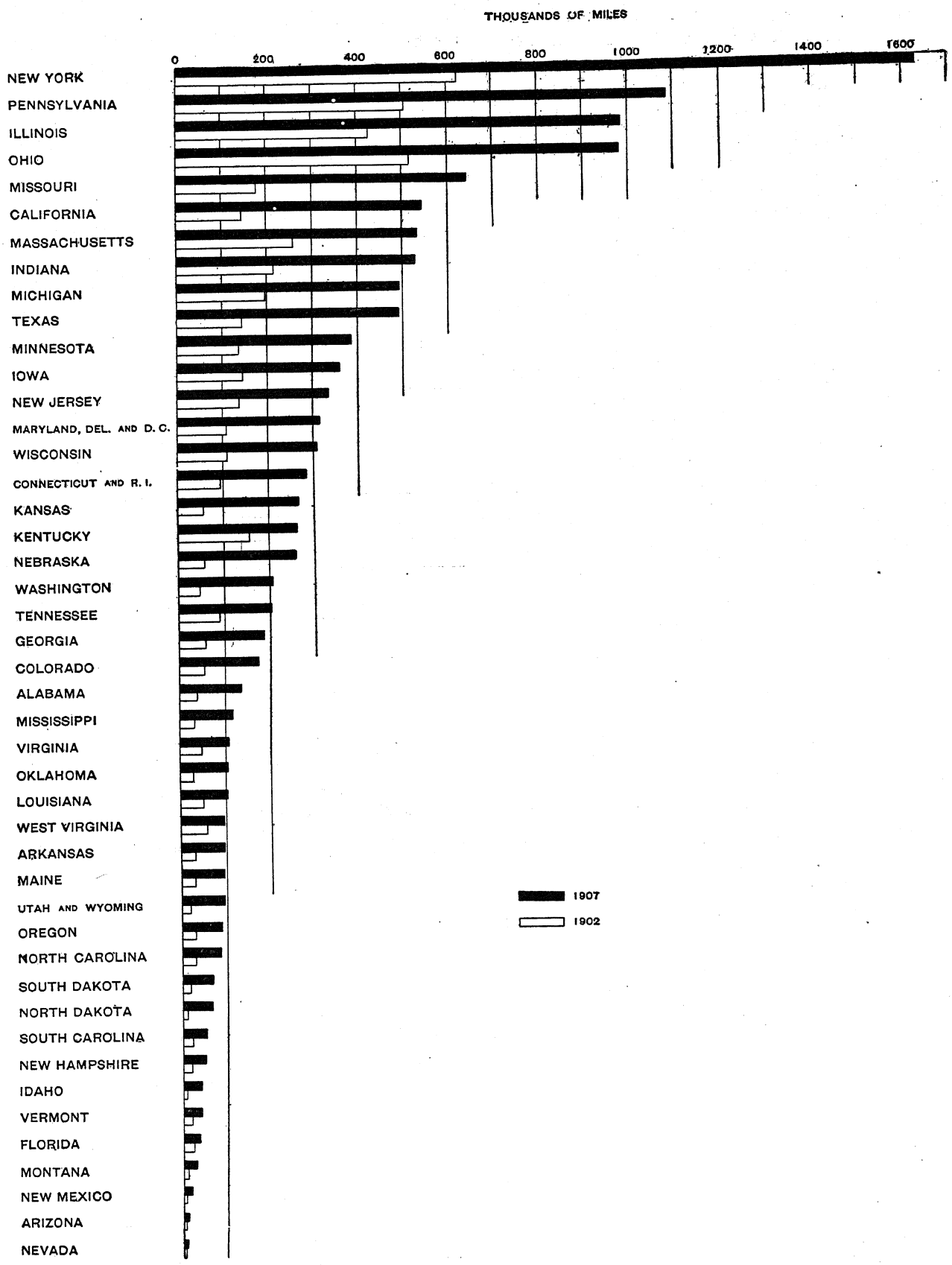


DIAGRAM 3.—MILES OF WIRE, BY STATES: 1907 AND 1902.



Overhead, underground, and submarine wires.—Not including the 486,294 miles of wire on the independent farmer or rural lines, the largest amount, 7,523,043 miles, is of overhead construction. This includes 4,605,929 miles of open wire and 2,917,114 miles of wire in cables. This overhead wire is supported by 772,873 miles of pole line; but some of it is on houses and other structures, concerning which no statistics could be gathered. The miles of wire per mile of pole line increased from 5.6 in 1902 to 6 in 1907. Their overhead wire is being removed rapidly by the companies operating in the large cities, and their underground construction, therefore, is being increased proportionately. The amount of single wire underground was 3,278,800 miles greater in 1907 than in 1902.

In 1907, 6,679.9 miles of street were occupied by subways or conduits used for telephone wires compared with 2,660.2 miles so occupied in 1902, and the miles of single duct also had more than doubled within the five years.

Practically all of the wire underground and a large proportion of that overhead is now carried in cables. This method of carrying a number of wires to some central or convenient point for distribution is becoming very general in the urban districts, and in 1907 the total amount of cable in use was more than two and a half times as great as it was in 1902. Not only has the length of cable increased greatly since 1902, but there has apparently been a material increase in its size, the average miles of wire per mile of cable, in overhead cables, being 96 for 1902 and 116 for 1907. The increase in miles of submarine cable is comparatively small, but the increase in miles of wire in submarine cables shows the use of larger cables, the average miles of wire per mile of submarine cable being 68 in 1907 compared with 36 in 1902.

Wire on urban and rural lines.—Municipalities having a population of 4,000 or over in 1900 are classed as urban districts. Of the 368 mutual companies, only six had their principal central offices or exchanges in cities or towns of this size; and of the 2,993 telephones of these six companies, all but 183 were on rural lines. The installations of mutual companies in places with a population of at least 4,000 are, therefore, so small that they may be disregarded, and statistics for urban districts may be considered as confined to commercial companies, as was the case in the report for 1902.

In Table 29 the miles of wire in urban and in rural districts are shown for 1907 and 1902, the statistics for rural lines including the miles of wire for the six mutual companies mentioned above in the case of 1907, and for similarly situated companies in the case of the previous census.

TABLE 29.—*All systems and lines—Miles of wire in urban and in rural districts: 1907 and 1902.*

CLASS OF DISTRICT.	MILES OF WIRE.		
	1907	1902	Per cent of increase.
Total	12,999,369	4,900,451	165.3
Urban[1]	11,294,797	4,361,013	159.0
Rural	1,704,572	539,438	216.0

[1] Systems in cities having a population of 4,000 and over in 1900.

Wire on nonrural and rural lines.—Another differentiation of the statistics is that for rural and nonrural lines, the latter comprising practically all of the lines of the commercial systems, except the farmer or rural lines owned by them. As before explained, so nearly all of the mutual systems are rural that all of them have been counted so. Table 30 presents the statistics of the mileage of wire for the nonrural commercial lines and for all rural lines.

TABLE 30.—ALL SYSTEMS AND LINES, CLASSIFIED AS NONRURAL (COMMERCIAL) AND RURAL LINES—MILES OF WIRE, BY STATES AND TERRITORIES AND GEOGRAPHIC DIVISIONS: 1907 AND 1902.

STATE OR TERRITORY.	Census.	MILES OF WIRE.					Per cent of aggregate.	
		All systems and lines.	Nonrural (commercial) lines.	Rural lines.			Nonrural (commercial).	Rural.
				Total.	Owned by commercial companies.	Mutual and independent farmer or rural lines.		
United States	1907	12,999,369	11,408,129	1,591,240	1,009,913	581,327	87.8	12.2
	1902	4,900,451	4,641,145	259,306	138,426	120,880	94.7	5.3
North Atlantic division	1907	4,054,058	3,873,613	180,445	141,259	39,186	95.5	4.5
	1902	1,670,180	1,652,111	18,069	14,152	3,917	98.9	1.1
Maine	1907	94,073	73,290	20,783	17,742	3,041	77.9	22.1
	1902	25,451	21,582	3,869	3,776	93	84.8	15.2
New Hampshire	1907	49,448	39,716	9,732	8,741	991	80.3	19.7
	1902	18,390	17,391	999	999	.....	94.6	5.4
Vermont	1907	36,419	22,684	13,735	10,078	3,657	62.3	37.7
	1902	16,379	13,054	3,325	3,203	122	79.7	20.3
Massachusetts	1907	534,220	526,728	7,492	7,245	247	98.6	1.4
	1902	257,461	257,313	148	148	.....	99.9	0.1
Connecticut and Rhode Island	1907	283,705	281,674	2,031	1,896	135	99.3	0.7
	1902	90,656	90,587	69	59	10	99.9	0.1
New York	1907	1,630,076	1,556,410	73,666	60,300	13,366	95.5	4.5
	1902	623,625	618,933	4,692	2,382	2,310	99.2	0.8
New Jersey	1907	338,608	334,674	3,934	3,839	95	98.8	1.2
	1902	136,617	136,617	.....	.....	.....	100.0	.....
Pennsylvania	1907	1,087,509	1,038,437	49,072	31,418	17,654	95.5	4.5
	1902	501,601	496,634	4,967	3,585	1,382	99.0	1.0
South Atlantic division	1907	875,173	787,653	87,520	47,207	40,313	90.0	10.0
	1902	328,022	310,198	17,824	7,629	10,195	94.6	5.4
Maryland, Delaware, and District of Columbia	1907	312,282	302,975	9,307	9,031	276	97.0	3.0
	1902	107,827	107,665	162	81	81	99.8	0.2
Virginia	1907	108,588	92,318	16,270	5,962	10,308	85.0	15.0
	1902	46,678	39,063	7,615	3,391	4,224	83.7	16.3
West Virginia	1907	99,844	75,645	24,199	12,671	11,528	75.8	24.2
	1902	56,812	54,767	2,045	555	1,490	96.4	3.6
North Carolina	1907	83,251	67,316	15,935	6,077	9,858	80.9	19.1
	1902	26,120	22,628	3,492	1,419	2,073	86.6	13.4
South Carolina	1907	50,226	43,389	6,837	2,895	3,942	86.4	13.6
	1902	19,445	16,951	2,494	1,337	1,157	87.2	12.8
Georgia	1907	187,904	179,265	8,639	5,262	3,377	95.4	4.6
	1902	54,301	52,890	1,411	622	789	97.4	2.6
Florida	1907	33,078	26,745	6,333	5,309	1,024	80.9	19.1
	1902	16,839	16,234	605	224	381	96.4	3.6
North Central division	1907	5,351,409	4,265,146	1,086,263	701,485	384,778	79.7	20.3
	1902	2,054,435	1,848,775	205,660	108,475	97,185	90.0	10.0
Ohio	1907	986,053	827,403	158,650	130,511	28,139	83.9	16.1
	1902	515,892	493,135	22,757	17,983	4,774	95.6	4.4
Indiana	1907	530,044	404,419	125,625	92,220	33,405	76.3	23.7
	1902	213,157	184,777	28,380	15,602	12,778	86.7	13.3
Illinois	1907	986,949	820,302	166,647	106,402	60,245	83.1	16.9
	1902	428,304	380,841	47,463	26,516	20,947	88.9	11.1
Michigan	1907	494,612	416,700	77,912	65,106	12,807	84.2	15.8
	1902	197,863	186,892	10,971	7,293	3,678	94.5	5.5
Wisconsin	1907	310,363	259,820	50,543	33,457	17,086	83.7	16.3
	1902	110,929	102,061	8,868	4,212	4,656	92.0	8.0
Minnesota	1907	387,758	321,458	66,300	47,791	18,509	82.9	17.1
	1902	137,274	128,964	8,310	5,593	2,717	93.9	6.1
Iowa	1907	360,884	238,353	122,531	57,275	65,256	66.0	34.0
	1902	147,586	107,335	40,251	14,516	25,735	72.7	27.3

TABLE 30.—ALL SYSTEMS AND LINES, CLASSIFIED AS NONRURAL (COMMERCIAL) AND RURAL LINES—MILES OF WIRE, BY STATES AND TERRITORIES AND GEOGRAPHIC DIVISIONS: 1907 AND 1902—Continued.

STATE OR TERRITORY.	Census.	MILES OF WIRE.					Per cent of aggregate.	
		All systems and lines.	Nonrural (commercial) lines.	Rural lines.			Nonrural (commercial).	Rural.
				Total.	Owned by commercial companies.	Mutual and independent farmer or rural lines.		
North Central division—Continued.								
Missouri	1907	640,560	544,249	96,311	30,949	65,362	85.0	15.0
	1902	177,072	151,978	25,094	6,746	18,348	85.8	14.2
North Dakota	1907	61,733	34,289	27,444	21,685	5,759	55.5	44.5
	1902	9,532	8,880	652	612	40	93.2	6.8
South Dakota	1907	66,946	44,896	22,050	12,805	9,245	67.1	32.9
	1902	10,877	10,165	712	395	317	93.5	6.5
Nebraska	1907	257,812	174,677	83,135	57,787	25,348	67.8	32.2
	1902	53,285	44,430	8,855	6,625	2,230	83.4	16.6
Kansas	1907	267,695	178,580	89,115	45,498	43,617	66.7	33.3
	1902	52,664	49,317	3,347	2,382	965	93.6	6.4
South Central division	1907	1,514,477	1,367,929	146,548	71,827	74,721	90.3	9.7
	1902	541,973	528,084	13,889	6,564	7,325	97.4	2.6
Kentucky	1907	262,691	249,095	13,596	4,195	9,401	94.8	5.2
	1902	155,482	152,807	2,675	471	2,204	98.3	1.7
Tennessee	1907	202,505	186,726	15,779	8,896	6,883	92.2	7.8
	1902	86,640	83,429	3,211	1,083	2,128	96.3	3.7
Alabama	1907	134,337	128,345	5,992	792	5,200	95.5	4.5
	1902	32,966	32,295	671	263	408	98.0	2.0
Mississippi	1907	115,338	106,682	8,656	2,861	5,795	92.5	7.5
	1902	30,001	28,728	1,273	655	618	95.8	4.2
Louisiana	1907	101,325	99,596	1,729	280	1,449	98.3	1.7
	1902	49,588	49,160	428	199	229	99.1	0.9
Arkansas	1907	98,932	84,641	14,291	4,757	9,534	85.6	14.4
	1902	24,273	23,916	357	274	83	98.5	1.5
Oklahoma	1907	104,780	83,291	21,489	7,349	14,140	79.5	20.5
	1902	21,498	21,098	400	265	135	98.1	1.9
Texas	1907	494,569	429,553	65,016	42,697	22,319	86.9	13.1
	1902	141,525	136,651	4,874	3,354	1,520	96.6	3.4
Western division	1907	1,204,252	1,113,788	90,464	48,135	42,329	92.5	7.5
	1902	305,841	301,977	3,864	1,606	2,258	98.7	1.3
Montana	1907	28,386	23,730	4,656	1,440	3,216	83.6	16.4
	1902	8,609	8,397	212	.....	212	97.5	2.5
Idaho	1907	37,364	29,727	7,637	5,803	1,834	79.6	20.4
	1902	6,366	6,221	145	10	135	97.7	2.3
Colorado	1907	173,633	162,101	11,532	8,022	3,510	93.4	6.6
	1902	52,115	51,784	331	261	70	99.4	0.6
New Mexico	1907	12,506	10,958	1,548	828	720	87.6	12.4
	1902	3,366	3,192	174	91	83	94.8	5.2
Arizona	1907	10,277	9,199	1,078	509	569	89.5	10.5
	1902	3,890	3,696	194	146	48	95.0	5.0
Utah and Wyoming	1907	92,396	86,016	6,380	4,140	2,240	93.1	6.9
	1902	13,106	13,011	95	.....	95	99.3	0.7
Nevada	1907	10,043	8,847	1,196	992	204	88.1	11.9
	1902	1,394	1,220	174	.....	174	87.5	12.5
Washington	1907	208,810	189,606	19,204	7,569	11,635	90.8	9.2
	1902	43,027	42,903	124	124	.....	99.7	0.3
Oregon	1907	87,723	74,629	13,094	3,473	9,621	85.1	14.9
	1902	29,531	28,523	1,008	535	473	96.6	3.4
California	1907	543,114	518,975	24,139	15,359	8,780	95.6	4.4
	1902	144,437	143,030	1,407	439	968	99.0	1.0

By a comparison of the nonrural wire mileage of Table 30 with the urban wire mileage for cities of 4,000 population and over in the preceding table, it is seen that the differences between the two are not large for either 1902 or 1907, and that with the exception of 113,332 miles, which represents practically the wire of commercial companies having their exchanges in towns of less than 4,000 inhabitants and forms less than 1 per cent of the total mileage of wire reported in 1907, all nonrural (commercial) wire was in urban districts of 4,000 inhabitants or over.

Table 31 gives the percentages of the increase between the years 1902 and 1907 for the nonrural and the rural wire, by geographic divisions.

TABLE 31.—*All systems and lines, classified as nonrural (commercial) and rural lines—Per cent of increase in miles of wire, by geographic divisions: 1902 to 1907.*

DIVISION.	PER CENT OF INCREASE, MILES OF WIRE.				
	All systems and lines.	Nonrural (commercial) lines.	Rural lines.		
			Total.	Owned by commercial companies.	Mutual and independent farmer or rural lines.
United States	165.3	145.8	513.7	629.6	380.9
North Atlantic	142.7	134.5	898.6	898.2	900.4
South Atlantic	166.8	153.9	391.0	518.8	295.4
North Central	160.5	130.7	428.2	546.7	295.9
South Central	179.4	159.0	955.1	994.3	920.1
Western	293.8	268.8	2,241.2	2,897.2	1,774.6

In every division a large preponderance of rural increase is apparent, and in every division, except the North Atlantic, the growth of the rural lines owned by the commercial companies was more rapid than that of the mutual and independent farmer or rural lines.

In the Western division the increase of mileage of the rural systems is very remarkable. While the increase of rural mileage in the South Central division, the one which shows the second largest increase, was 955.1 per cent, the increase of rural mileage in the Western division shows the phenomenal rate of 2,241.2 per cent. In this division also the rural increase for commercial companies exceeded that for mutual and independent farmer or rural lines, being 2,897.2 per cent for the former as against 1,774.6 per cent for the latter.

Consumption of poles.—To keep up and supply extensions to the many thousands of miles of pole line reported for the commercial and mutual telephone systems requires a large annual expenditure for the purchase of poles. It was impossible to secure any data concerning the number or cost of the poles used on the independent farmer or rural lines, but Table 32 presents the statistics for the poles purchased by all other telephone systems during the year 1907.

TABLE 32.—COMMERCIAL AND MUTUAL SYSTEMS COMBINED—WOODEN POLES PURCHASED, NUMBER AND COST, BY KIND OF WOOD AND LENGTH OF POLE: 1907.

[Exclusive of independent farmer or rural lines.]

LENGTH OF POLE.	Total.	KIND OF WOOD.									
		Cedar.	Chestnut.	Oak.	Pine.	Cypress.	Juniper.	Tamarack.	Fir.	Redwood.	All other.
Total:											
Number	1,860,937	1,341,053	244,292	66,422	48,043	22,981	17,857	12,827	6,691	6,598	94,173
Cost at point of purchase	$2,843,765	$2,106,954	$488,850	$23,100	$47,472	$24,647	$29,242	$6,615	$3,964	$10,047	$102,874
Average cost per pole	$1.53	$1.57	$2.00	$0.35	$0.99	$1.07	$1.64	$0.52	$0.59	$1.52	$1.09
Under 20 feet:											
Number	294,647	176,947	4,674	44,548	19,526	3,220	1,155	760	805	3,221	39,791
Cost at point of purchase	$172,894	$122,033	$2,818	$14,248	$8,840	$2,747	$706	$883	$584	$3,892	$16,143
Average cost per pole	$0.59	$0.69	$0.60	$0.32	$0.45	$0.85	$0.61	$1.16	$0.73	$1.21	$0.41
20 feet but under 25 feet:											
Number	761,932	608,630	55,426	20,323	20,337	10,512	6,382	8,948	870	3,302	27,202
Cost at point of purchase	$651,856	$539,059	$47,146	$7,750	$15,369	$7,147	$6,344	$3,723	$335	$5,854	$19,129
Average cost per pole	$0.86	$0.89	$0.85	$0.38	$0.76	$0.68	$0.99	$0.42	$0.39	$1.77	$0.70
25 feet but under 30 feet:											
Number	518,156	367,583	106,119	1,283	5,710	6,507	5,637	2,965	4,689	25	17,638
Cost at point of purchase	$748,255	$538,900	$150,560	$807	$12,305	$6,607	$7,045	$1,660	$2,764	$63	$27,544
Average cost per pole	$1.44	$1.47	$1.42	$0.63	$2.15	$1.02	$1.25	$0.56	$0.59	$2.52	$1.56
30 feet but under 35 feet:											
Number	147,087	102,382	36,320	230	1,748	817	1,499	45	225	48	3,773
Cost at point of purchase	$456,698	$344,243	$88,621	$159	$6,526	$1,376	$3,292	$51	$176	$227	$12,027
Average cost per pole	$3.10	$3.36	$2.44	$0.69	$3.73	$1.68	$2.20	$1.13	$0.78	$4.73	$3.19
35 feet but under 40 feet:											
Number	84,008	56,213	21,682	25	563	865	1,123	109	102	2	3,324
Cost at point of purchase	$427,944	$328,302	$75,878	$26	$2,890	$2,832	$3,096	$298	$105	$11	$14,506
Average cost per pole	$5.09	$5.84	$3.50	$1.04	$5.13	$3.27	$2.76	$2.73	$1.03	$5.50	$4.36
40 feet but under 45 feet:											
Number	32,596	18,418	11,180	8	49	807	835	.....	.....	.....	1,299
Cost at point of purchase	$192,675	$128,717	$52,790	$80	$435	$2,245	$2,950	.....	.....	.....	$5,458
Average cost per pole	$5.91	$6.99	$4.72	$10.00	$8.88	$2.78	$3.53	.....	.....	.....	$4.20
45 feet but under 50 feet:											
Number	12,228	5,984	4,667	5	110	144	675	.....	.....	.....	643
Cost at point of purchase	$85,698	$49,030	$28,562	$30	$1,107	$558	$2,878	.....	.....	.....	$3,533
Average cost per pole	$7.01	$8.19	$6.12	$6.00	$10.06	$3.88	$4.26	.....	.....	.....	$5.49
50 feet but under 55 feet:											
Number	6,569	3,208	2,482	.....	.....	56	547	.....	.....	.....	276
Cost at point of purchase	$58,179	$31,269	$21,601	.....	.....	$461	$2,891	.....	.....	.....	$1,957
Average cost per pole	$8.86	$9.75	$8.70	.....	.....	$8.23	$5.29	.....	.....	.....	$7.09
55 feet but under 60 feet:											
Number	2,063	770	1,100	.....	.....	53	.....	.....	.....	.....	140
Cost at point of purchase	$22,393	$10,544	$10,005	.....	.....	$674	.....	.....	.....	.....	$1,170
Average cost per pole	$10.85	$13.69	$9.10	.....	.....	$12.72	.....	.....	.....	.....	$8.36
60 feet and over:											
Number	1,651	918	642	.....	.....	.....	4	.....	.....	.....	87
Cost at point of purchase	$27,173	$14,857	$10,869	.....	.....	.....	$40	.....	.....	.....	$1,407
Average cost per pole	$16.46	$16.18	$16.93	.....	.....	.....	$10.00	.....	.....	.....	$16.17

No statistics concerning the consumption of poles were collected at the census of 1902. The statistics contained in this table form a part of the annual report of the Bureau of the Census on the consumption of forest products. The report on forest products for 1906 shows the purchase of 2,395,722 poles by the telephone and telegraph companies during that year, but does not show separately the number of poles used by the telephone companies. For 1907, however, a separate enumeration was made for each industry. The total number of poles purchased by the telephone and telegraph companies was found to be 2,311,651, and of these, 1,860,937, or 80.5 per cent, were purchased by the telephone companies, and 450,714, or 19.5 per cent, by the telegraph companies. Of the poles purchased by the telephone companies, 1,585,345, or 85.2 per cent, were cedar or chestnut, and the cost of these two varieties represented 91.3 per cent of the total cost of poles, and an average cost per pole of $1.64. While the poles of the other varieties of wood form comparatively small proportions of the total, in the aggregate they amount to 275,592 poles, valued at $247,961. Two-fifths, 40.9 per cent, of the poles had a length of 20 feet and over but under 25 feet, the number of such poles being 761,932. Their cost, however, amounted to only $651,856, or 22.9 per cent of the total cost.

Table 33 shows the per cent distribution, by lengths, of the number and cost of poles.

TABLE 33.—*Commercial and mutual systems combined—Per cent distribution, by lengths, of the number and cost of poles purchased: 1907.*

LENGTH OF POLE.	PER CENT DISTRIBUTION.	
	Number of poles.	Cost of poles.
Total	100.0	100.0
Under 20 feet	15.8	6.1
20 feet but under 25 feet	40.9	22.9
25 feet but under 30 feet	27.8	26.3
30 feet but under 35 feet	7.9	16.1
35 feet but under 40 feet	4.5	15.0
40 feet and over	3.0	13.6

STATIONS OR TELEPHONES.

The term "station" or "telephone" is intended to cover the complete instrument or the telephone set of transmitter and receiver. A comparative summary of all telephones, distributed by kind of system and kind of station, is given in Table 34.

The largest proportionate increase, 376.8 per cent, is in the telephones of the mutual systems and farmer or rural lines. The telephones on these lines formed 11.3 per cent of all of the telephones in the revenue-producing service in 1907 as compared with 6.1 per cent in 1902.

TABLE 34.—*All systems and lines—Number of stations or telephones, by class of service, kind of system, and kind of station: 1907 and 1902.*

CLASS OF SERVICE, KIND OF SYSTEM, AND KIND OF STATION.	NUMBER OF STATIONS OR TELEPHONES.		
	1907	1902	Per cent of increase.
For use of public	6,118,578	2,371,044	158.1
On commercial systems	5,426,973	2,225,981	143.8
Local and outlying toll	156,720	80,468	94.8
For regular exchange subscribers	4,753,983	2,145,513	145.6
On private-branch exchanges	459,083		
All other	57,187		
On mutual systems and farmer or rural lines	691,605	145,063	376.8
For exclusive use of companies	49,106	(1)	.....
On commercial systems	49,033	.....	.....
On mutual systems	73	.....	.....

[1] Not reported.

The reports for 1902 did not show the number of the telephones that were used by the companies in their own service and consequently did not produce revenue. The number of such telephones in 1907 was 49,106. The proportionate increase in local pay and outlying toll stations is smaller than that for any other class. The "all-other" class consists chiefly of extension sets for house, office, or desk and the extra telephones on lines having two telephones. In 1902 stations of the "all-other" class and those on private-branch exchanges were not reported separately, but were included with those of regular exchange subscribers.

Table 35 shows the number of urban and rural telephones in 1907 and in 1902 and the percentages of increase during the five years.

TABLE 35.—*All systems and lines—Number of stations or telephones in urban and in rural districts: 1907 and 1902.*

CLASS OF DISTRICT.	NUMBER OF STATIONS OR TELEPHONES.		
	1907	1902	Per cent of increase.
Total	6,118,578	2,371,044	158.1
Urban [1]	4,290,160	1,823,956	135.2
Rural	1,828,418	547,088	234.2

[1] Systems in cities having a population of 4,000 and over in 1900.

The percentage of increase for the rural telephones is larger than that for the urban, and telephones of the former class have increased from 23.1 per cent of the total number in 1902 to 29.8 per cent in 1907.

A comparison for urban and rural districts of the number of stations or telephones with the miles of wire gives an average of 2.6 miles of wire per telephone for the urban districts in 1907 as against 2.4 miles in 1902; and an average of 0.9 mile of wire per telephone for rural districts in 1907 as against 1 mile in 1902.

The large excess in miles of wire per telephone for urban districts compared with rural districts is due in part to the general use of complete metallic cir-

cuits for urban lines, whereas rural lines as a rule are grounded, and to a considerable extent to the use of cables in urban service, the wire line mileage of a cable when installed being generally considerably in excess of immediate requirements in order to provide for increase in service.

There is no clear line of demarcation between urban and rural telephone equipment. The statistics for the systems which have their principal offices in places with a population of 4,000 and over are given above as representing the urban districts. The classification, however, is unsatisfactory, because many of these systems extend their lines into the surrounding rural districts. The commercial companies naturally establish systems in the cities, where there is the greatest amount of traffic. They, however, reported separately the number of telephones on their rural lines and these, combined with the instruments of the mutual systems and the farmer or rural lines, give the number that may be accepted as the approximate equipment for the smaller towns and the country districts. This separation is made in Table 36.

TABLE 36.—ALL SYSTEMS AND LINES, CLASSIFIED AS NONRURAL (COMMERCIAL) AND RURAL LINES—NUMBER OF STATIONS OR TELEPHONES, BY STATES AND TERRITORIES AND GEOGRAPHIC DIVISIONS: 1907 AND 1902.

STATE OR TERRITORY.	Census.	NUMBER OF STATIONS OR TELEPHONES.						
		Aggregate.	Nonrural (commercial) lines.	Rural lines.			Per cent of aggregate.	
				Total.	Owned by commercial companies.	Mutual and independent farmer or rural lines.	Nonrural (commercial).	Rural.
United States	1907	6,118,578	4,653,805	1,464,773	773,168	691,605	76.1	23.9
	1902	2,371,044	2,104,076	266,968	121,905	145,063	88.7	11.3
North Atlantic division	1907	1,663,172	1,498,240	164,932	112,601	52,331	90.1	9.9
	1902	649,221	630,515	18,706	12,499	6,207	97.1	2.9
Maine	1907	53,134	35,994	17,140	12,713	4,427	67.7	32.3
	1902	14,070	10,161	3,909	3,778	131	72.2	27.8
New Hampshire	1907	28,920	20,969	7,951	6,908	1,043	72.5	27.5
	1902	9,949	9,045	904	904	.....	90.9	9.1
Vermont	1907	30,833	17,648	13,185	8,207	4,978	57.2	42.8
	1902	12,151	8,584	3,567	3,355	212	70.6	29.4
Massachusetts	1907	209,383	200,655	8,728	8,311	417	95.8	4.2
	1902	96,512	96,315	197	197	.....	99.8	0.2
Connecticut and Rhode Island	1907	87,999	86,805	1,194	1,013	181	98.6	1.4
	1902	33,485	33,372	113	68	45	99.7	0.3
New York	1907	685,512	615,640	69,872	48,743	21,129	89.8	10.2
	1902	247,340	240,762	6,578	2,404	4,174	97.3	2.7
New Jersey	1907	116,988	112,460	4,528	4,396	132	96.1	3.9
	1902	48,980	48,980	.....	.....	.....	100.0	.....
Pennsylvania	1907	450,403	408,069	42,334	22,310	20,024	90.6	9.4
	1902	186,734	183,296	3,438	1,793	1,645	98.2	1.8
South Atlantic division	1907	365,764	301,615	64,149	25,542	38,607	82.5	17.5
	1902	146,765	135,497	11,268	3,822	7,446	92.3	7.7
Maryland, Delaware, and District of Columbia	1907	110,282	105,209	5,073	4,646	427	95.4	4.6
	1902	36,383	36,289	94	42	52	99.7	0.3
Virginia	1907	55,541	40,386	15,155	4,491	10,664	72.7	27.3
	1902	25,762	20,163	5,599	1,626	3,973	78.3	21.7
West Virginia	1907	62,144	37,910	24,234	7,217	17,017	61.0	39.0
	1902	22,801	20,962	1,839	531	1,308	91.9	8.1
North Carolina	1907	37,104	28,114	8,990	3,004	5,986	75.8	24.2
	1902	17,036	15,203	1,833	668	1,165	89.2	10.8
South Carolina	1907	20,911	17,815	3,096	1,621	1,475	85.2	14.8
	1902	10,753	9,733	1,020	550	470	90.5	9.5
Georgia	1907	62,260	56,444	5,816	3,278	2,538	90.7	9.3
	1902	25,761	25,113	648	267	381	97.5	2.5
Florida	1907	17,522	15,737	1,785	1,285	500	89.8	10.2
	1902	8,269	8,034	235	138	97	97.2	2.8
North Central division	1907	2,963,945	1,906,902	1,057,043	562,545	494,498	64.3	35.7
	1902	1,139,914	913,308	226,606	100,856	125,750	80.1	19.9
Ohio	1907	495,636	364,472	131,164	94,132	37,032	73.5	26.5
	1902	224,083	199,847	24,236	16,884	7,352	89.2	10.8
Indiana	1907	289,452	174,366	115,086	74,390	40,696	60.2	39.8
	1902	136,561	108,371	28,190	14,428	13,762	79.4	20.6
Illinois	1907	558,585	388,242	170,343	87,757	82,586	69.5	30.5
	1902	221,008	171,568	49,440	22,788	26,652	77.6	22.4
Michigan	1907	209,842	152,940	56,902	40,863	16,039	72.9	27.1
	1902	95,415	85,607	9,808	4,984	4,824	89.7	10.3
Wisconsin	1907	158,875	112,111	46,764	26,571	20,193	70.6	29.4
	1902	62,992	52,543	10,449	4,639	5,810	83.4	16.6

TABLE 36.—ALL SYSTEMS AND LINES, CLASSIFIED AS NONRURAL (COMMERCIAL) AND RURAL LINES—NUMBER OF STATIONS OR TELEPHONES, BY STATES AND TERRITORIES AND GEOGRAPHIC DIVISIONS: 1907 AND 1902—Continued.

STATE OR TERRITORY.	Census.	NUMBER OF STATIONS OR TELEPHONES.						
		Aggregate.	Nonrural (commercial) lines.	Rural lines.			Per cent of aggregate.	
				Total.	Owned by commercial companies.	Mutual and independent farmer or rural lines.	Nonrural (commercial).	Rural.
North Central division—Continued.	1907	171,479	120,585	50,894	29,912	20,982	70.3	29.7
	1902	63,192	55,589	7,603	4,282	3,321	88.0	12.0
Minnesota	1907	332,545	158,390	174,155	72,295	101,860	47.6	52.4
	1902	138,400	80,036	58,364	18,626	39,738	57.8	42.2
Iowa	1907	312,527	198,999	113,528	31,404	82,124	63.7	36.3
	1902	103,155	76,645	26,510	5,764	20,746	74.3	25.7
Missouri	1907	34,087	21,187	12,900	7,161	5,739	62.2	37.8
	1902	6,762	6,093	669	598	71	90.1	9.9
North Dakota	1907	48,405	26,596	21,809	12,092	9,717	54.9	45.1
	1902	10,387	9,807	580	239	341	94.4	5.6
South Dakota	1907	152,279	85,236	67,043	42,371	24,672	56.0	44.0
	1902	36,766	29,518	7,248	4,991	2,257	80.3	19.7
Nebraska	1907	200,233	103,778	96,455	43,597	52,858	51.8	48.2
	1902	41,193	37,684	3,509	2,633	876	91.5	8.5
Kansas	1907	585,489	469,584	115,905	41,143	74,762	80.2	19.8
	1902	227,790	219,961	7,829	3,546	4,283	96.6	3.4
South Central division	1907	93,996	80,945	13,051	2,201	10,850	86.1	13.9
	1902	46,949	44,752	2,197	443	1,754	95.3	4.7
Kentucky	1907	71,130	61,067	10,063	3,463	6,600	85.9	14.1
	1902	36,392	34,430	1,962	577	1,385	94.6	5.4
Tennessee	1907	40,481	35,062	5,419	826	4,593	86.6	13.4
	1902	14,170	13,879	291	89	202	97.9	2.1
Alabama	1907	37,627	30,654	6,973	2,056	4,917	81.5	18.5
	1902	15,340	14,699	641	332	309	95.8	4.2
Mississippi	1907	35,692	34,432	1,260	218	1,042	96.5	3.5
	1902	17,543	17,411	132	91	41	99.2	0.8
Louisiana	1907	49,576	37,173	12,403	3,112	9,291	75.0	25.0
	1902	16,928	16,769	159	123	36	99.1	0.9
Arkansas	1907	68,125	43,251	24,874	7,182	17,692	63.5	36.5
	1902	15,732	15,462	270	204	66	98.3	1.7
Oklahoma	1907	188,862	147,000	41,862	22,085	19,777	77.8	22.2
	1902	64,736	62,559	2,177	1,687	490	96.6	3.4
Texas	1907	540,208	477,464	62,744	31,337	31,407	88.4	11.6
	1902	207,354	204,795	2,559	1,182	1,377	98.8	1.2
Western division	1907	17,168	14,779	2,389	937	1,452	86.1	13.9
	1902	5,451	5,390	61	----------	61	98.9	1.1
Montana	1907	16,394	12,381	4,013	2,458	1,555	75.5	24.5
	1902	3,886	3,793	93	9	84	97.6	2.4
Idaho	1907	65,908	56,928	8,980	6,983	1,997	86.4	13.6
	1902	24,533	24,279	254	226	28	99.0	1.0
Colorado	1907	6,653	6,076	577	419	158	91.3	8.7
	1902	2,510	2,432	78	49	29	96.9	3.1
New Mexico	1907	6,203	5,669	534	264	270	91.4	8.6
	1902	3,264	3,059	205	128	77	93.7	6.3
Arizona	1907	37,134	33,548	3,586	2,489	1,097	90.3	9.7
	1902	7,258	7,225	33	----------	33	99.5	0.5
Utah and Wyoming	1907	4,601	3,673	928	830	98	79.8	20.2
	1902	1,165	1,143	22	----------	22	98.1	1.9
Nevada	1907	98,846	83,785	15,061	4,811	10,250	84.8	15.2
	1902	31,447	31,330	117	117	----------	99.6	0.4
Washington	1907	49,629	36,921	12,708	3,868	8,840	74.4	25.6
	1902	21,190	20,348	842	268	574	96.0	4.0
Oregon	1907	237,672	223,704	13,968	8,278	5,690	94.1	5.9
	1902	106,650	105,796	854	385	469	99.2	0.8
California								

According to this basis of distribution, the distribution for the United States was 76.1 per cent for nonrural and 23.9 per cent for rural districts in 1907, and 88.7 per cent and 11.3 per cent for nonrural and rural districts, respectively, in 1902. The majority of the rural telephones are on lines owned and operated by commercial companies. In 1907 these companies reported 52.8 per cent and the mutual systems and farmer or rural lines, 47.2 per cent of the 1,464,773 instruments shown for the country districts. The rural telephones were more numerous in the North Central than in any other geographic division and the greatest number in any one state (174,155) was reported for Iowa. The North Central division also contained the greatest number (1,906,902) of nonrural (commercial) telephones; but the state of New York contained 615,640 of the telephones of this class, this number being considerably larger than that reported for any other state.

The changes in the per cent distribution of the aggregate between 1902 and 1907 shows the proportionately larger increase in the rural telephones in all states. This is further shown by Table 37, which gives, by geographic divisions, the percentages of increase of the nonrural and rural telephones.

TABLE 37.—*All systems and lines, classified as nonrural (commercial) and rural lines—Per cent of increase in number of stations or telephones, by geographic divisions: 1902 to 1907.*

DIVISION.	PER CENT OF INCREASE IN NUMBER OF STATIONS OR TELEPHONES.				
	All systems and lines.	Nonrural (commercial) lines.	Rural lines.		
			Total.	Owned by commercial companies.	Mutual and independent farmer or rural lines.
United States..	158.1	121.2	448.7	534.2	376.8
North Atlantic.....	156.2	137.6	781.7	800.9	743.1
South Atlantic.....	149.2	129.6	469.3	568.3	418.5
North Central.....	160.0	108.8	366.5	457.8	293.2
South Central.....	157.0	113.5	1,380.5	1,060.3	1,645.6
Western.....	160.5	133.1	2,351.9	2,551.2	2,180.8

High rates of increase are shown by the telephones on the mutual and the farmer or rural lines, as well as by those on the rural lines of the commercial companies. These rates of increase, while high for all geographic divisions, were especially high in the Western and the South Central states.

On the average there was for both 1907 and 1902 about one telephone station to every 2 miles of wire reported. In the North and South Atlantic and South Central divisions there was at each census practically one telephone to every 2½ miles of wire, and in the North Central states there was one telephone to every 2 miles of wire in both 1907 and 1902. In the Western states, although both the number of telephones and the miles of wire increased rapidly, the wire increased more rapidly than the telephones and the ratio changed from one telephone to every 1½ miles of wire in 1902 to one to every 2⅕ miles in 1907.

ANALYSIS OF PHYSICAL EQUIPMENT.

Analysis of the physical equipment of the commercial systems, by states and territories and geographic divisions for 1907 and 1902, is given in Table 38.

The comparative figures for commercial companies are indicative of the general tendencies of the industry in most of the states. The miles of wire and the number of stations or telephones, the average miles of wire per telephone, and the number of telephones per line and per switchboard indicate the extent of the facilities for the telephone traffic in each state; but the comparison made in Table 46 of the number of telephones with the population is a more satisfactory indication of the diffusion of the telephone facilities. There are considerable differences in the averages, due largely to the density of the population, the number of party and farmer or rural lines, and the number of branch exchanges. From 1902 to 1907 there was an increase of 0.2 of a mile in the average number of miles of wire per telephone for commercial systems in the United States. This is the combined result of increases in the averages for thirty-five of the states and territories, decreases for thirteen, and an unchanged average in one state—Montana. This is on the assumption that changes in averages for state groups hold good for the constituent states of the groups. Three or more miles of wire per telephone were in use in 1907 on the commercial systems in Alabama, Connecticut and Rhode Island, Georgia, Kentucky, Mississippi, and Tennessee, and with the exception of Kentucky the average in each of these states increased between 1902 and 1907. The highest average per telephone, 3.6 miles, is shown for Alabama.

In the North Atlantic division as a whole there was a slight decrease in the average miles of wire per telephone; but in every other division there was an increase, the largest being in the Western division.

TABLE 38.—COMMERCIAL SYSTEMS—PHYSICAL EQUIPMENT, BY STATES AND TERRITORIES AND GEOGRAPHIC DIVISIONS: 1907 AND 1902.

[Exclusive of mutual systems and independent farmer or rural lines.]

STATE OR TERRITORY.	Census.	Number of systems.	MILES OF WIRE.		Number of stations or telephones.	PARTY LINES (CITY AND TOWN).[1]			FARMER OR RURAL LINES OWNED.			SWITCHBOARDS.		Stations or telephones per switchboard.
			Total.	Per station or telephone.		Number.	Stations or telephones.	Stations or telephones per line.	Number.	Stations or telephones.	Stations or telephones per line.	Number.	Equipped capacity in drops or jacks.	
United States	1907	4,901	12,418,042	2.3	5,426,973	854,908	2,036,583	2.4	106,777	773,168	7.2	15,232	4,179,106	356
	1902	3,157	4,779,571	2.1	2,225,981	248,908	808,571	3.2	15,598	121,905	7.8	9,954	2,395,794	224
North Atlantic division	1907	580	4,014,872	2.5	1,610,841	334,470	827,208	2.5	18,391	112,601	6.1	2,996	1,126,301	538
	1902	371	1,666,263	2.6	643,014	97,917	332,020	3.4	947	12,499	13.2	2,406	626,109	267
Maine	1907	49	91,032	1.9	48,707	7,835	27,061	3.5	1,309	12,713	9.7	233	24,709	209
	1902	23	25,358	1.8	13,939	2,349	11,493	4.9	59	3,778	64.0	112	8,513	124
New Hampshire	1907	27	48,457	1.7	27,877	5,206	17,681	3.4	784	6,908	8.8	139	13,098	201
	1902	16	18,390	1.8	9,949	1,648	7,446	4.5	42	904	21.5	87	11,057	114
Vermont	1907	34	32,762	1.3	25,855	2,740	14,600	5.3	1,022	8,207	8.0	127	9,375	204
	1902	31	16,257	1.4	11,939	2,039	8,895	4.4	209	3,355	16.1	103	6,903	116
Massachusetts	1907	19	533,973	2.6	208,966	46,959	135,254	2.9	962	8,311	8.6	289	125,631	723
	1902	10	257,461	2.7	96,512	15,034	69,922	4.7	11	197	17.9	235	69,455	411
Connecticut and Rhode Island.	1907	10	283,570	3.2	87,818	20,172	58,014	2.9	148	1,013	6.8	91	57,461	965
	1902	7	90,646	2.7	33,440	5,897	24,605	4.2	9	68	7.6	67	21,569	499
New York	1907	265	1,616,710	2.4	664,383	101,608	235,933	2.3	9,391	48,743	5.2	929	479,279	715
	1902	179	621,315	2.6	243,166	27,316	86,200	3.2	320	2,404	7.5	691	241,606	352
New Jersey	1907	28	338,513	2.9	116,856	27,815	70,764	2.5	870	4,396	5.1	223	91,602	524
	1902	28	136,617	2.8	48,980	7,618	28,236	3.7	.....	.....	.....	249	44,423	197
Pennsylvania	1907	148	1,069,855	2.5	430,379	122,135	267,901	2.2	3,905	22,310	5.7	965	325,146	446
	1902	77	500,219	2.7	185,089	36,016	95,223	2.6	297	1,793	6.0	862	222,583	215
South Atlantic division	1907	393	834,860	2.6	327,157	46,948	96,158	2.0	4,221	25,542	6.1	1,182	317,406	277
	1902	348	317,827	2.3	139,319	13,501	34,177	2.5	674	3,822	5.7	768	169,983	181
Maryland, Delaware, and District of Columbia.	1907	19	312,006	2.8	109,855	19,738	40,361	2.0	668	4,646	7.0	179	99,148	614
	1902	19	107,746	3.0	36,331	6,374	14,331	2.2	12	42	3.5	111	33,596	327
Virginia	1907	66	98,280	2.2	44,877	5,474	11,398	2.1	822	4,491	5.5	194	43,527	231
	1902	65	42,454	1.9	21,789	1,610	3,905	2.4	232	1,626	7.0	124	26,539	176
West Virginia	1907	53	88,316	2.0	45,127	7,052	19,254	2.7	932	7,217	7.7	213	43,804	212
	1902	62	55,322	2.6	21,493	1,577	6,254	4.0	55	531	9.7	163	28,839	132
North Carolina	1907	90	73,393	2.4	31,118	3,251	6,549	2.0	715	3,004	4.2	204	33,571	153
	1902	71	24,047	1.5	15,871	559	1,544	2.8	144	668	4.6	124	21,145	128
South Carolina	1907	39	46,284	2.4	19,436	3,103	4,861	1.6	210	1,621	7.7	111	20,186	175
	1902	36	18,288	1.8	10,283	575	1,582	2.8	155	550	3.5	89	11,614	116
Georgia	1907	83	184,527	3.1	59,722	7,356	11,756	1.6	550	3,278	6.0	212	58,762	282
	1902	72	53,512	2.1	25,380	2,395	5,618	2.3	41	267	6.5	118	35,790	215
Florida	1907	43	32,054	1.9	17,022	974	1,979	2.0	324	1,285	4.0	69	18,408	247
	1902	23	16,458	2.0	8,172	411	943	2.3	35	138	3.9	39	12,460	210
North Central division	1907	2,873	4,966,631	2.0	2,469,447	335,724	765,498	2.3	71,876	562,545	7.8	7,209	1,840,664	343
	1902	1,856	1,957,250	1.9	1,014,164	82,462	264,959	3.2	13,186	100,856	7.6	4,730	1,212,154	214
Ohio	1907	334	957,914	2.1	458,604	85,706	186,792	2.2	14,424	94,132	6.5	1,114	320,081	412
	1902	236	511,118	2.4	216,731	18,467	60,541	3.3	2,872	16,884	5.9	796	243,953	272
Indiana	1907	349	496,639	2.0	248,756	22,672	49,596	2.2	11,957	74,390	6.2	785	212,970	317
	1902	261	200,379	1.6	122,799	7,787	31,087	4.0	2,215	14,428	6.5	538	147,302	228
Illinois	1907	345	926,704	1.9	475,999	74,340	205,039	2.8	11,239	87,757	7.8	1,085	319,058	439
	1902	243	407,357	2.1	194,356	20,660	66,475	3.2	2,925	22,788	7.8	782	240,629	249
Michigan	1907	116	481,805	2.5	193,803	23,212	50,674	2.2	5,852	40,863	7.0	595	151,107	326
	1902	77	194,185	2.1	90,591	4,983	13,208	2.7	868	4,984	5.7	479	106,142	189
Wisconsin	1907	216	293,277	2.1	138,682	28,724	67,530	2.4	3,210	26,571	8.3	423	98,122	328
	1902	140	106,273	1.9	57,182	7,737	23,466	3.0	468	4,639	9.9	304	58,409	188
Minnesota	1907	203	369,249	2.5	150,497	18,383	37,446	2.0	2,925	29,912	10.2	449	109,074	335
	1902	120	134,557	2.2	59,871	7,175	17,181	2.4	454	4,282	9.4	274	79,439	219
Iowa	1907	348	295,628	1.3	230,685	28,823	66,356	2.3	6,901	72,295	10.5	696	149,993	331
	1902	241	121,851	1.2	98,662	4,932	17,649	3.6	1,672	18,626	11.1	561	105,959	176
Missouri	1907	274	575,198	2.5	230,403	25,898	41,602	1.6	3,953	31,404	7.9	594	218,786	388
	1902	227	158,724	1.9	82,409	4,615	15,911	3.4	735	5,764	7.8	387	124,445	213
North Dakota	1907	87	55,974	2.0	28,348	2,954	5,652	1.9	658	7,161	10.9	201	24,295	141
	1902	29	9,492	1.4	6,691	847	1,701	2.0	58	598	10.3	47	7,404	142
South Dakota	1907	94	57,701	1.5	38,688	4,731	10,241	2.2	942	12,092	12.8	253	27,754	153
	1902	47	10,560	1.1	10,046	1,063	2,768	2.6	21	239	11.4	105	13,735	96
Nebraska	1907	189	232,464	1.8	127,607	9,416	20,187	2.1	5,214	42,371	8.1	481	87,074	265
	1902	74	51,055	1.5	34,509	2,904	10,589	3.6	556	4,991	9.0	199	33,070	173
Kansas	1907	318	224,078	1.5	147,375	10,865	24,383	2.2	4,601	43,597	9.5	533	122,350	277
	1902	161	51,699	1.3	40,317	1,292	4,383	3.4	342	2,633	7.7	258	51,667	156

[1] Including party lines on single-line service at time of reporting.

TABLE 38.—COMMERCIAL SYSTEMS—PHYSICAL EQUIPMENT, BY STATES AND TERRITORIES AND GEOGRAPHIC DIVISIONS: 1907 AND 1902—Continued.

[Exclusive of mutual systems and independent farmer or rural lines.]

STATE OR TERRITORY.	Census.	Number of systems.	MILES OF WIRE.		Number of stations or telephones.	PARTY LINES (CITY AND TOWN).[1]			FARMER OR RURAL LINES OWNED.			SWITCHBOARDS.		Stations or telephones per switchboard.
			Total.	Per station or telephone.		Number.	Stations or telephones.	Stations or telephones per line.	Number.	Stations or telephones.	Stations or telephones per line.	Number.	Equipped capacity in drops or jacks.	
South Central division	1907	809	1,439,756	2.8	510,727	35,673	80,406	2.3	7,195	41,143	5.7	2,329	523,886	219
	1902	496	534,648	2.4	223,507	18,541	49,483	2.7	634	3,546	5.6	1,176	285,013	190
Kentucky	1907	103	253,290	3.0	83,146	11,066	26,392	2.4	475	2,201	4.6	347	79,854	240
	1902	84	153,278	3.4	45,195	4,264	11,118	2.6	34	443	13.0	197	65,570	229
Tennessee	1907	44	195,622	3.0	64,530	7,395	15,379	2.1	752	3,463	4.6	260	69,093	248
	1902	30	84,512	2.4	35,007	3,320	8,648	2.6	96	577	6.0	151	48,199	232
Alabama	1907	37	129,137	3.6	35,888	4,805	7,707	1.6	156	826	5.3	139	47,324	258
	1902	43	32,558	2.3	13,968	1,329	3,022	2.3	11	89	8.1	70	17,876	200
Mississippi	1907	39	109,543	3.3	32,710	2,755	6,670	2.4	258	2,056	8.0	180	33,257	182
	1902	32	29,383	2.0	15,031	1,457	3,730	2.6	61	332	5.4	94	21,059	160
Louisiana	1907	22	99,876	2.9	34,650	3,255	6,860	2.1	41	218	5.3	107	31,743	324
	1902	14	49,359	2.8	17,502	2,543	6,958	2.7	12	91	7.6	62	17,847	282
Arkansas	1907	98	89,398	2.2	40,285	723	2,931	4.1	536	3,112	5.8	243	42,493	166
	1902	76	24,190	1.4	16,892	652	1,617	2.5	48	123	2.6	125	20,620	135
Oklahoma	1907	135	90,640	1.8	50,433	1,861	3,029	1.6	625	7,182	11.5	282	49,248	179
	1902	60	21,363	1.4	15,666	65	179	2.8	27	204	7.6	131	20,622	120
Texas	1907	331	472,250	2.8	169,085	3,813	11,438	3.0	4,352	22,085	5.1	771	170,874	219
	1902	157	140,005	2.2	64,246	4,911	14,211	2.9	345	1,687	4.9	346	73,220	186
Western division	1907	246	1,161,923	2.3	508,801	102,093	267,313	2.6	5,094	31,337	6.2	1,516	370,849	336
	1902	86	303,583	1.5	205,977	36,487	127,932	3.5	157	1,182	7.5	874	102,535	236
Montana	1907	21	25,170	1.6	15,716	2,981	5,676	1.9	115	937	8.1	55	14,497	286
	1902	4	8,397	1.6	5,390	956	3,169	3.3	.....	.....	.....	32	4,730	168
Idaho	1907	14	35,530	2.4	14,839	3,017	7,666	2.5	355	2,458	6.9	103	18,008	144
	1902	6	6,231	1.6	3,802	456	1,615	3.5	3	9	3.0	33	6,322	115
Colorado	1907	19	170,123	2.7	63,911	12,974	33,529	2.6	1,105	6,983	6.3	157	44,676	407
	1902	10	52,045	2.1	24,505	4,256	16,303	3.8	37	226	6.1	96	21,472	255
New Mexico	1907	25	11,786	1.8	6,495	1,000	2,124	2.1	100	419	4.2	42	7,990	155
	1902	12	3,283	1.3	2,481	54	177	3.3	9	49	5.4	12	2,535	207
Arizona	1907	14	9,708	1.6	5,933	800	2,405	3.0	60	264	4.4	38	7,254	156
	1902	10	3,842	1.2	3,187	295	1,136	3.9	11	128	11.6	29	2,581	110
Utah and Wyoming	1907	19	90,156	2.5	36,037	8,781	18,771	2.1	406	2,489	6.1	97	29,793	372
	1902	6	13,011	1.8	7,225	1,294	5,255	4.1	.....	.....	.....	36	5,330	201
Nevada	1907	10	9,839	2.2	4,503	700	2,301	3.3	242	830	3.4	26	3,290	173
	1902	6	1,220	1.1	1,143	205	803	3.9	.....	.....	.....	10	418	114
Washington	1907	30	197,175	2.2	88,596	20,484	56,563	2.8	863	4,811	5.6	244	49,872	363
	1902	4	43,027	1.4	31,447	5,910	20,543	3.5	14	117	8.4	140	11,037	225
Oregon	1907	35	78,102	1.9	40,789	9,602	26,885	2.8	396	3,868	9.8	203	23,631	201
	1902	16	29,058	1.4	20,616	3,426	12,229	3.6	22	268	12.2	114	9,114	181
California	1907	59	534,334	2.3	231,982	41,754	111,393	2.7	1,452	8,278	5.7	551	171,838	421
	1902	12	143,469	1.4	106,181	19,635	66,702	3.4	61	385	6.3	372	38,996	285
Outlying districts	1907	17	13,536	2.1	6,359	631	1,875	3.0	39	228	5.8	59	5,595	108
	1902	8	4,732	1.9	2,493	796	1,595	2.0	1	1	1.0	13	2,850	192
Alaska	1907	7	2,198	1.5	1,512	97	325	3.4	2	2	1.0	17	1,300	89
	1902	1	150	1.2	125	.....	.....	.....	1	1	1.0	1	150	125
Hawaii	1907	7	9,874	3.2	3,052	510	1,490	2.9	36	221	6.1	12	2,075	254
	1902	7	4,582	1.9	2,368	796	1,595	2.0	.....	.....	.....	12	2,700	197
Porto Rico[2]	1907	3	1,464	0.8	1,795	24	60	2.5	1	5	5.0	30	2,220	60

[1] Including party lines on single-line service at time of reporting.

[2] No reports received from Porto Rico in 1902.

There has also been a marked increase in the average miles of wire per company or system, as shown by Table 39, which presents data for the commercial systems, by geographic divisions.

TABLE 39.—*Commercial systems—Miles of wire per system, by geographic divisions: 1907 and 1902.*

DIVISION.	MILES OF WIRE PER SYSTEM.		
	1907	1902	Per cent of increase.
United States	2,534	1,514	67.4
North Atlantic	6,922	4,491	54.1
South Atlantic	2,124	913	132.6
North Central	1,729	1,055	63.9
South Central	1,780	1,078	65.1
Western	4,723	3,530	33.8

This analysis is not extended to the states, principally because in many cases the lines of companies extend outside of the limits of the states to which the companies are credited and, inversely, in some states extensive telephone lines are owned by companies credited to other states.

The reduction for commercial systems of 25 per cent in the average number of telephones per party line in 1907 as compared with 1902 supports the conclusion that there is a tendency to reduce this class of service to a two-party basis. It will be noticed that for several states in 1907 the average number of telephones per party line was less than two, which indicates that a considerable number of lines reported as party lines were on a single-line service at the time the reports were made. The explanation is that in many cases new lines built as party lines and charged for at party-line rates have at first but one subscriber. In every state, except Arkansas, Texas, and Vermont, the average number of telephones per party line decreased between 1902 and 1907. In 1907 the largest numbers of telephones per party line were found in Vermont (5.3), Arkansas (4.1), and Maine (3.5). In that year only seven states had an average of three or more, while in 1902, twenty-six states averaged three or over.

The average number of telephones per rural line for the country as a whole shows a decrease of 7.7 per cent; in twenty-four states the averages decreased, while in sixteen states they increased. In 1907 the largest average numbers of telephones per rural line were in South Dakota (12.8), Oklahoma (11.5), and North Dakota (10.9).

The per cent distribution of the telephones of the commercial companies on single lines, party lines, and rural lines, by geographic divisions, is given in Table 40.

TABLE 40.—*Commercial systems—Per cent distribution of stations or telephones on single, party, and rural lines, by geographic divisions: 1907 and 1902.*

DIVISION.	Census.	PER CENT OF TOTAL NUMBER OF STATIONS OR TELEPHONES ON—		
		Single lines.	Party lines.	Rural lines.
United States	1907	48.2	37.5	14.2
	1902	58.2	36.3	5.5
North Atlantic	1907	41.7	51.4	7.0
	1902	46.4	51.6	1.9
South Atlantic	1907	62.8	29.4	7.8
	1902	72.7	24.5	2.7
North Central	1907	46.2	31.0	22.8
	1902	63.9	26.1	9.9
South Central	1907	76.2	15.7	8.1
	1902	76.3	22.1	1.6
Western	1907	41.3	52.5	6.2
	1902	37.3	62.1	0.6

In the South Central and South Atlantic divisions telephones on single lines constituted more than one-half of all telephones at each census, while in the Western and North Atlantic divisions telephones on party lines were in the majority. In the North Central states the single-line telephones were in a majority in 1902, but by 1907 the percentage of single-line telephones had been materially reduced, and the telephones on the rural lines owned by the commercial companies had increased from 9.9 per cent of the whole to 22.8 per cent.

The increase of 132 in the average number of telephones per switchboard for the country as a whole is supported by an increase in every state, except North Dakota, which shows practically the same average for both censuses, and New Mexico, which shows a decided decrease. The largest average equipped switchboard capacity, 631 drops or jacks, in 1907 is shown for Connecticut and Rhode Island combined, and the smallest, 74, for Vermont. There were five states in 1907 in which the average equipped capacity per switchboard exceeded 400 drops and sixteen in which it was less than 200 drops. In 1902 no state had an average of more than 400, and twenty-two states showed averages of less than 200. In thirty states the average number in 1907 is in excess of the average for 1902, and in fifteen states it is less. Table 41 gives the average equipped capacity in drops or jacks per switchboard, for the geographic divisions, in 1907 and in 1902.

TABLE 41.—*Commercial systems—Average equipped capacity per switchboard in drops or jacks, by geographic divisions: 1907 and 1902.*

DIVISION.	1907	1902
United States	274	241
North Atlantic	376	260
South Atlantic	269	221
North Central	255	256
South Central	225	242
Western	245	117

Table 42 gives the statistics of the physical equipment of the mutual systems by states and geographic divisions for 1907.

As a rule, the mutual systems are much smaller than the commercial. The reports for 1907 showed only 0.8 of a mile of wire per telephone for them as compared with 2.3 miles for the commercial companies, and the switchboard average was 151 telephones for mutual systems as compared with 356 for commercial systems.

The average for miles of wire per mutual system was 258 for the United States, and ranged from 225 miles for the South Central states to 497 for the South Atlantic.

The average number of drops or jacks per switchboard, 53, is correspondingly small.

TABLE 42.—MUTUAL SYSTEMS—PHYSICAL EQUIPMENT, BY STATES AND GEOGRAPHIC DIVISIONS: 1907.

[Exclusive of commercial systems and independent farmer or rural lines.]

STATE.	Number of systems.	MILES OF WIRE.		Number of stations or telephones.	PARTY LINES (CITY AND TOWN) AND FARMER OR RURAL LINES OWNED.			SWITCHBOARDS.		Stations or telephones per switchboard.
		Total.	Per station or telephone.		Number.	Stations or telephones.	Stations or telephones per line.	Number.	Equipped capacity in drops or jacks.	
United States	368	95,033	0.8	125,956	12,378	106,966	8.6	833	44,203	151
North Atlantic division	15	6,687	.8	8,725	763	8,592	11.3	127	1,339	69
Vermont and Maine	5	2,441	.8	3,230	342	3,230	9.4	53	529	61
New York	7	1,422	.7	2,131	124	2,076	16.7	12	230	178
Pennsylvania	3	2,824	.8	3,364	297	3,286	11.1	62	580	54
South Atlantic division	15	7,456	.6	12,273	1,263	11,604	9.2	100	2,376	123
Virginia	6	2,490	.9	2,812	208	2,343	11.3	28	865	100
West Virginia	9	4,966	.5	9,461	1,055	9,261	8.8	72	1,511	131
North Central division	316	75,142	.8	99,272	9,772	81,848	8.4	569	38,291	174
Ohio	24	7,309	.7	10,692	1,547	10,004	7.4	71	3,042	151
Indiana	42	10,595	1.0	10,565	1,513	9,109	6.0	60	5,140	176
Illinois	63	16,367	.8	21,722	2,168	18,637	8.6	132	7,480	165
Michigan	10	1,247	.6	2,127	198	1,739	8.8	16	1,015	133
Wisconsin	13	3,026	.8	3,703	324	3,177	9.8	21	1,215	176
Minnesota	6	1,153	.8	1,374	98	1,105	11.3	9	690	153
Iowa	68	11,426	.6	18,453	1,645	15,046	9.1	72	6,766	256
Missouri	30	7,511	.7	11,241	1,151	8,017	7.0	67	4,745	168
North Dakota	3	725	.9	774	53	447	8.4	11	638	70
South Dakota	6	1,413	1.1	1,343	74	980	13.2	6	412	224
Nebraska	19	4,468	.9	5,106	417	4,163	10.0	35	1,971	146
Kansas	32	9,902	.8	12,172	784	9,424	12.0	69	5,177	176
South Central division	13	2,925	.8	3,603	369	3,013	8.2	25	1,452	144
Kentucky and Tennessee	3	445	.5	891	132	831	6.3	4	264	223
Oklahoma and Arkansas	7	1,745	.8	2,197	169	1,810	10.7	18	888	122
Texas	3	735	1.4	515	68	372	5.5	3	300	172
Western division	9	2,823	1.4	2,083	211	1,909	9.0	12	745	174
Washington	3	1,405	1.6	855	101	845	8.4	4	175	214
Oregon	3	703	.9	756	56	596	10.6	3	420	252
California and Colorado	3	715	1.5	472	54	468	8.7	5	150	94

CHAPTER IV.

TELEPHONE TRAFFIC.

Messages or talks.—The purpose of a telephone system is to afford communication between distant points, and the amount or quantity of its business is usually expressed by the number of separate messages or talks that pass over the wires. This, however, is an unsatisfactory means of measurement. A message may represent either a few words or a long conversation and, therefore, does not indicate the extent to which the equipment is used. Further, it is impossible to obtain even an estimate of the number of conversations over the private-branch wires and the party lines which do not require interconnection at the public or central exchanges. To avoid duplications, only originating calls were counted, and local-exchange and long-distance or toll messages were reported separately. Each exchange reporting messages reported all talks originating within its system during the year, and each call was counted as a single message irrespective of its length. All long-distance and toll connections were counted, but free talks were not included. Talks or messages from stations within the same central-office or exchange district were counted as exchange messages, as they do not include any interchange of business between separate companies or separate exchange systems. Long-distance messages are those between exchange systems of different companies, and toll messages are those between the different exchange systems of the same company.

Pay stations are used indiscriminately for exchange and long-distance messages, but it was hoped that all of the commercial companies would have records that would enable the separation to be made between simple exchange connections and extraterritorial work. This, however, was not the case; in fact, 891 commercial and 74 mutual companies preserved no records of messages and prepared no estimate of the number of messages passing over their lines during the year. The special agents who secured the reports for these companies could obtain no data on which to base such an estimate, and therefore figures for them were prepared in the Census Bureau, the computation being based on the average number of messages per telephone as given by the companies which reported both number of telephones and number of messages. Of the 10,978,853,618 exchange messages shown for the commercial companies in 1907, 424,964,754, or 4 per cent, were estimated in this manner, and of the 141,013,554 exchange messages reported for the mutual systems, 25,643,150, or 18 per cent, were estimated. In the case of 752 commercial and 62 mutual companies no reports were made for long-distance and toll messages. The figures reported by the other companies were tabulated, but there is no satisfactory method of estimating these messages, and the companies which failed to report them were as a rule comparatively small and unimportant, and no estimates for them are included. At the census of 1902, however, in the case of both classes, when the number of messages was not reported by the company, estimates were made in the office.

The two principal omissions in the traffic statistics are the interior-service messages or talks over the private-exchange wires and those over the independent farmer or rural lines. Many of the independent farmer or rural lines are connected with the exchanges of commercial and mutual systems, and their messages are in this way accounted for, as well as the messages emanating on private-exchange systems and passing through public exchanges.

Table 43 is a comparative presentation of the number of messages or talks, by geographic divisions, for 1907 and 1902.

From the statistics of traffic, it is evident that the increase in business has been in keeping with the increase in equipment. Notwithstanding the fact that the number of long-distance and toll talks reported for 1907 does not include an estimate of such talks for 814 companies, the number shown is a large increase over that for 1902.

The very common substitution of the measured service, or the unit of a "talk" as regulating the charge for telephone service, in place of the "flat" rate, or monthly rental, has undoubtedly tended to reduce the average number of messages per telephone. Table 43 shows that for commercial and mutual systems such a reduction has occurred in the exchange messages for the United States as a whole and for four of the geographic divisions, and in long-distance and toll messages for the United States and each geographic division. The only increase in exchange messages per telephone is in the Western states.

TABLE 43.—COMMERCIAL AND MUTUAL SYSTEMS COMBINED—NUMBER OF STATIONS OR TELEPHONES AND MESSAGES OR TALKS, BY GEOGRAPHIC DIVISIONS: 1907 AND 1902.

[Exclusive of independent farmer or rural lines.]

DIVISION.	NUMBER OF STATIONS OR TELEPHONES.		ESTIMATED NUMBER OF MESSAGES OR TALKS.			
			Total.		Exchange.	
	1907	1902	1907	1902	1907	1902
United States	5,552,929	2,315,297	11,372,605,063	5,070,554,553	11,119,867,172	4,949,849,709
North Atlantic	1,619,566	647,670	2,617,104,751	1,208,179,198	2,480,150,802	1,148,790,742
South Atlantic	339,430	143,314	827,266,700	353,559,870	816,532,071	348,316,683
North Central	2,568,719	1,091,168	5,369,401,249	2,446,257,875	5,300,180,655	2,406,919,140
South Central	514,330	225,999	1,510,432,721	681,497,626	1,488,482,137	670,995,269
Western	510,884	207,146	1,048,399,642	381,059,984	1,034,521,507	374,827,875

DIVISION.	ESTIMATED NUMBER OF MESSAGES OR TALKS—continued.					AVERAGE ANNUAL NUMBER OF MESSAGES OR TALKS PER TELEPHONE.					
	Long-distance and toll.		Per cent of increase.			Total.		Exchange.		Long-distance and toll.	
	1907	1902	Total.	Exchange.	Long-distance and toll.	1907	1902	1907	1902	1907	1902
United States	252,737,891	120,704,844	124.3	124.7	109.4	2,048	2,190	2,003	2,138	46	52
North Atlantic	136,953,949	59,388,456	116.6	115.9	130.6	1,616	1,865	1,531	1,774	85	92
South Atlantic	10,734,629	5,243,187	134.0	134.4	104.7	2,437	2,467	2,406	2,430	32	37
North Central	69,220,594	39,338,735	119.5	120.2	76.0	2,090	2,242	2,063	2,206	27	36
South Central	21,950,584	10,502,357	121.6	121.8	109.0	2,937	3,015	2,894	2,969	43	46
Western	13,878,135	6,232,109	175.1	176.0	122.7	2,052	1,840	2,025	1,809	27	30

The estimated number of messages and the number per station or telephone per day are given in Table 44 for commercial systems, by states and geographic divisions, for 1907 and 1902.

TABLE 44.—COMMERCIAL SYSTEMS—ESTIMATED NUMBER OF MESSAGES OR TALKS AND NUMBER PER STATION PER DAY, BY STATES AND TERRITORIES AND GEOGRAPHIC DIVISIONS: 1907 AND 1902.

STATE OR TERRITORY.	Census.	Number of stations or telephones.	ESTIMATED NUMBER OF MESSAGES OR TALKS.	
			Total.	Per station or telephone per day.[1]
United States	1907	5,426,973	11,230,581,856	6.4
	1902	2,225,981	4,971,413,070	6.9
North Atlantic division	1907	1,610,841	2,609,273,944	5.0
	1902	643,014	1,203,979,018	5.8
Maine	1907	48,707	78,080,627	4.9
	1902	13,939	21,807,915	4.8
New Hampshire	1907	27,877	42,402,448	4.7
	1902	9,949	16,987,012	5.3
Vermont	1907	25,855	39,524,210	4.7
	1902	11,939	18,911,897	4.9
Massachusetts	1907	208,966	299,944,477	4.4
	1902	96,512	183,115,320	5.8
Connecticut and Rhode Island	1907	87,818	129,196,561	4.5
	1902	33,440	57,154,040	5.3
New York	1907	664,383	1,075,575,362	5.0
	1902	243,166	357,638,366	4.5
New Jersey	1907	116,856	142,190,149	3.7
	1902	48,980	56,171,223	3.5
Pennsylvania	1907	430,379	802,360,110	5.7
	1902	185,089	492,193,245	8.2
South Atlantic division	1907	327,157	815,169,135	7.7
	1902	139,319	349,373,521	7.7
Maryland, Delaware, and District of Columbia	1907	109,855	169,770,089	4.8
	1902	36,331	70,923,773	6.0
Virginia	1907	44,877	128,267,680	8.8
	1902	21,789	63,210,726	8.9
South Atlantic divison—Continued. West Virginia	1907	45,127	113,549,780	7.7
	1902	21,493	40,700,517	5.8
North Carolina	1907	31,118	93,987,510	9.3
	1902	15,871	35,891,998	7.0
South Carolina	1907	19,436	59,627,014	9.4
	1902	10,283	23,732,914	7.1
Georgia	1907	59,722	201,302,727	10.4
	1902	25,380	96,079,566	11.6
Florida	1907	17,022	48,664,335	8.8
	1902	8,172	18,834,027	7.1
North Central division	1907	2,469,447	5,254,744,199	6.5
	1902	1,014,164	2,361,506,911	7.2
Ohio	1907	458,604	1,057,477,447	7.1
	1902	216,731	552,344,151	7.8
Indiana	1907	248,756	581,106,347	7.2
	1902	122,799	285,297,532	7.1
Illinois	1907	475,999	892,982,798	5.8
	1902	194,356	516,214,961	8.2
Michigan	1907	193,803	434,276,785	6.9
	1902	90,591	234,515,840	8.0
Wisconsin	1907	138,682	350,601,432	7.8
	1902	57,182	98,033,972	5.3
Minnesota	1907	150,497	304,767,066	6.2
	1902	59,871	111,464,762	5.7
Iowa	1907	230,685	394,151,672	5.3
	1902	98,662	172,778,419	5.4
Missouri	1907	230,403	532,582,305	7.1
	1902	82,409	229,844,532	8.6

[1] Computation for 325 days to the year.

TABLE 44.—COMMERCIAL SYSTEMS—ESTIMATED NUMBER OF MESSAGES OR TALKS AND NUMBER PER STATION PER DAY, BY STATES AND TERRITORIES AND GEOGRAPHIC DIVISIONS: 1907 AND 1902—Continued.

STATE OR TERRITORY.	Census.	Number of stations or telephones.	ESTIMATED NUMBER OF MESSAGES OR TALKS. Total.	Per station or telephone per day.[1]
North Central division—Continued.				
North Dakota	1907	28,348	47,495,544	5.2
	1902	6,691	14,015,733	6.4
South Dakota	1907	38,688	72,980,308	5.8
	1902	10,046	17,674,604	5.4
Nebraska	1907	127,607	283,999,990	6.8
	1902	34,509	71,150,107	6.3
Kansas	1907	147,375	302,322,505	6.3
	1902	40,317	58,172,298	4.4
South Central division	1907	510,727	1,506,155,426	9.1
	1902	223,507	677,517,694	9.3
Kentucky	1907	83,146	287,586,344	10.6
	1902	45,195	141,829,819	9.7
Tennessee	1907	64,530	239,360,155	11.4
	1902	35,007	125,995,719	11.1
Alabama	1907	35,888	107,545,457	9.2
	1902	13,968	46,049,758	10.1
Mississippi	1907	32,710	126,347,504	11.9
	1902	15,031	60,369,711	12.4
Louisiana	1907	34,650	122,225,846	10.9
	1902	17,502	68,076,915	12.0
Arkansas	1907	40,285	86,213,439	6.6
	1902	16,892	36,716,883	6.7
Oklahoma	1907	50,433	130,912,291	8.0
	1902	15,666	31,617,627	6.2
Texas	1907	169,085	405,964,390	7.4
	1902	64,246	166,861,262	8.0
Western division	1907	508,801	1,045,239,152	6.3
	1902	205,977	379,035,926	5.7
Montana	1907	15,716	25,503,905	5.0
	1902	5,390	11,319,476	6.5
Idaho	1907	14,839	26,047,495	5.4
	1902	3,802	6,399,762	5.2
Colorado	1907	63,911	139,516,301	6.7
	1902	24,505	60,237,513	7.6
New Mexico	1907	6,495	14,163,557	6.7
	1902	2,481	4,297,920	5.3
Arizona	1907	5,933	10,879,950	5.6
	1902	3,187	4,952,727	4.8
Utah and Wyoming	1907	36,037	88,437,258	7.6
	1902	7,225	13,524,312	5.8
Nevada	1907	4,503	7,103,245	4.9
	1902	1,143	1,385,874	3.7
Washington	1907	88,596	204,542,894	7.1
	1902	31,447	64,623,982	6.3
Oregon	1907	40,789	86,966,609	6.6
	1902	20,616	34,843,668	5.2
California	1907	231,982	442,077,938	5.9
	1902	106,181	177,450,692	5.1
Outlying districts	1907	6,359	8,860,572	4.3
	1902	2,493	3,461,000	4.3
Alaska	1907	1,512	1,243,548	2.5
	1902	125	200,000	4.9
Hawaii	1907	3,052	3,937,985	4.0
	1902	2,368	3,261,000	4.2
Porto Rico[2]	1907	1,795	3,679,039	6.3

[1] Computation for 325 days to the year.

[2] No reports received from Porto Rico in 1902.

The comparative figures for the commercial companies are indicative of the general tendencies of the industry in most of the states.

While the equipment has a bearing on the traffic, local conditions, social and business customs, telephone charges, and perfection of facilities are important factors controlling the traffic. These and the fact that the number of messages is largely an estimate must be given due consideration. In 1907 as compared with 1902 the total number of messages on commercial lines increased in every state, but the average number per telephone per day, as shown by Table 44, decreased in twenty-four and increased in twenty-five of the states, assuming that the change in a state group holds good for the individual states of the group.

The increase in number of messages for the commercial lines was comparatively uniform for all sections. For the United States the rate of increase from 1902 to 1907 was 125.9 per cent, and for the separate geographic divisions it ranged from a minimum of 116.7 per cent for the North Atlantic states to a maximum of 175.8 per cent for the Western states.

In computing the average number of messages per day 325 has been used as the divisor, because it represents, as a rule, the number of days on which the switchboards are operated to their full capacity during a year. The average thus obtained is probably a better indication of the actual conditions prevailing in the commercial companies than it is of those in the mutual systems.

TABLE 45.—*Mutual systems—Estimated number of messages or talks and number per station per day, by states and geographic divisions: 1907.*

STATE.	Number of stations or telephones.	ESTIMATED NUMBER OF MESSAGES OR TALKS. Total.	Per station or telephone per day.[1]
United States	125,956	142,023,207	3.5
North Atlantic division	8,725	7,830,807	2.8
Vermont and Maine	3,230	2,586,290	2.5
New York	2,131	1,973,017	2.8
Pennsylvania	3,364	3,271,500	3.0
South Atlantic division	12,273	12,097,565	3.0
Virginia	2,812	2,091,301	2.3
West Virginia	9,461	10,006,264	3.3
North Central division	99,272	114,657,050	3.6
Ohio	10,692	11,556,844	3.3
Indiana	10,565	17,099,261	5.0
Illinois	21,722	22,311,177	3.2
Michigan	2,127	3,527,368	5.1
Wisconsin	3,703	3,508,446	2.9
Minnesota	1,374	1,138,976	2.6
Iowa	18,453	20,922,099	3.5
Missouri	11,241	11,750,380	3.2
North Dakota	774	1,255,350	5.0
South Dakota	1,343	725,090	1.7
Nebraska	5,106	6,560,754	4.0
Kansas	12,172	14,301,305	3.6
South Central division	3,603	4,277,295	3.7
Kentucky and Tennessee	891	569,810	2.0
Oklahoma and Arkansas	2,197	2,751,275	3.9
Texas	515	956,210	5.7
Western division	2,083	3,160,490	4.7
Washington	855	1,273,950	4.6
Oregon	756	800,000	3.3
California and Colorado	472	1,086,540	7.1

[1] Computation for 325 days to the year.

In 1907 twenty-two states and territories, including the District of Columbia, reported no mutual systems, but statistics for such systems for the twenty-seven states reporting them are given in Table 45, page 50.

For the reasons given on page 11 it is impossible to make satisfactory comparisons of the statistics of traffic for the mutual systems as reported for 1907 and 1902.

Traffic in relation to population.—The fact that the number of conversations over the independent farmer or rural lines was not directly or fully reported affects to some extent the ratios between the telephones, the messages, and the population. Yet the comparisons between telephones, messages, and population in Table 46, though confined to the commercial and mutual systems, may be accepted as fairly indicating actual conditions, since in some states the independent farmer or rural lines were not numerous, and since certain of their messages were indirectly reported because of connections with commercial and mutual switchboards.

TABLE 46.—COMMERCIAL AND MUTUAL SYSTEMS COMBINED—STATIONS OR TELEPHONES, MESSAGES, AND POPULATION, BY STATES AND TERRITORIES AND GEOGRAPHIC DIVISIONS: 1907 AND 1902.

[Exclusive of independent farmer or rural lines.]

STATE OR TERRITORY.	NUMBER OF STATIONS OR TELEPHONES.			ESTIMATED NUMBER OF MESSAGES OR TALKS.			POPULATION.[1]			STATIONS OR TELEPHONES PER 1,000 OF POPULATION.		NUMBER OF MESSAGES PER CAPITA.		NUMBER OF MESSAGES OR TALKS PER STATION OR TELEPHONE PER YEAR.	
	1907	1902	Per cent of increase.	1907	1902	Per cent of increase.	1907	1902	Per cent of increase.	1907	1902	1907	1902	1907	1902
United States	5,552,929	2,315,297	139.8	11,372,605,063	5,070,554,553	124.3	85,532,761	78,576,436	8.9	65	29	133	65	2,048	2,190
North Atlantic division	1,619,566	647,670	150.1	2,617,104,751	1,208,179,198	116.6	23,779,013	21,778,196	9.2	68	30	110	55	1,616	1,865
Maine	49,414	14,045	251.8	78,827,917	21,923,915	259.6	717,832	700,072	2.5	69	20	110	31	1,595	1,561
New Hampshire	27,877	9,949	180.2	42,402,448	16,987,012	149.6	436,128	418,602	4.2	64	24	97	41	1,521	1,707
Vermont	28,378	12,112	134.3	41,363,210	19,075,847	116.8	351,495	345,885	1.6	81	35	118	55	1,458	1,575
Massachusetts	208,966	96,512	116.5	299,944,477	183,115,320	63.8	3,083,013	2,917,796	5.7	68	33	97	63	1,435	1,897
Connecticut and Rhode Island	87,818	33,485	162.3	129,196,561	57,190,040	125.9	1,522,625	1,387,122	9.8	58	24	85	41	1,471	1,708
New York	666,514	246,015	170.9	1,077,548,379	360,098,123	199.2	8,386,673	7,533,011	11.3	79	33	128	48	1,617	1,464
New Jersey	116,856	48,980	138.6	142,190,149	56,171,223	153.1	2,248,332	1,969,821	14.1	52	25	63	29	1,217	1,147
Pennsylvania	433,743	186,572	132.5	805,631,610	493,617,718	63.2	7,032,915	6,505,887	8.1	62	29	115	76	1,857	2,646
South Atlantic division	339,430	143,314	136.8	827,266,700	353,559,870	134.0	11,574,988	10,770,414	7.5	29	13	71	33	2,437	2,467
Maryland, Delaware, and District of Columbia	109,855	36,383	201.9	169,770,089	70,981,973	139.2	1,798,652	1,693,019	6.2	61	21	94	42	1,545	1,951
Virginia	47,689	24,130	97.6	130,358,981	65,494,626	99.0	1,992,925	1,899,440	4.9	24	13	65	34	2,734	2,714
West Virginia	54,588	22,376	144.0	123,556,044	41,605,891	197.0	1,096,006	998,004	9.8	50	22	113	42	2,263	1,859
North Carolina	31,118	16,252	91.5	93,987,510	36,485,398	157.6	2,086,912	1,948,984	7.1	15	8	45	19	3,020	2,245
South Carolina	19,436	10,467	85.7	59,627,014	23,893,914	149.5	1,472,734	1,378,150	6.9	13	8	40	17	3,068	2,283
Georgia	59,722	25,490	134.3	201,302,727	96,192,066	109.3	2,481,617	2,298,713	8.0	24	11	81	42	3,371	3,774
Florida	17,022	8,216	107.2	48,664,335	18,906,002	157.4	646,142	554,104	16.6	26	15	75	34	2,859	2,301
North Central division	2,568,719	1,091,168	135.4	5,369,401,249	2,446,257,875	119.5	29,026,645	27,087,206	7.2	88	40	185	90	2,090	2,242
Ohio	469,296	222,767	110.7	1,069,034,291	558,707,801	91.3	4,497,198	4,252,372	5.8	104	52	238	131	2,278	2,508
Indiana	259,321	132,489	95.7	598,205,608	294,657,565	103.0	2,743,305	2,581,575	6.3	95	51	218	114	2,307	2,224
Illinois	497,721	211,187	135.7	915,293,975	541,161,932	69.1	5,518,190	5,019,628	9.9	90	42	166	108	1,839	2,562
Michigan	195,930	93,961	108.5	437,804,153	237,695,112	84.2	2,611,790	2,480,764	5.3	75	38	168	96	2,234	2,530
Wisconsin	142,385	61,145	132.9	354,109,878	101,594,728	248.6	2,292,911	2,127,974	7.8	62	29	154	48	2,487	1,662
Minnesota	151,871	62,039	144.8	305,906,042	113,124,262	170.4	2,071,318	1,822,106	13.7	73	34	148	62	2,014	1,823
Iowa	249,138	120,017	107.6	415,073,771	193,054,738	115.0	2,201,331	2,301,427	[2]4.3	113	52	189	84	1,666	1,609
Missouri	241,644	93,371	158.8	544,332,685	242,309,227	124.6	3,405,901	3,187,031	6.9	71	29	160	76	2,253	2,595
North Dakota	29,122	6,762	330.7	48,750,894	14,106,733	245.6	487,890	344,778	41.5	60	20	100	41	1,674	2,086
South Dakota	40,031	10,305	288.5	73,705,398	17,919,604	311.3	476,631	429,808	10.9	84	24	155	42	1,841	1,739
Nebraska	132,713	36,153	267.1	290,560,744	73,227,030	296.8	1,068,849	1,087,526	[2]1.7	124	33	272	67	2,189	2,025
Kansas	159,547	40,972	289.4	316,623,810	58,699,143	439.4	1,651,331	1,452,217	13.7	97	28	192	40	1,985	1,433
South Central division	514,330	225,999	127.6	1,510,432,721	681,497,626	121.6	16,368,558	14,651,535	11.7	31	15	92	47	2,937	3,015
Kentucky	83,833	46,266	81.2	287,929,274	143,101,564	101.2	2,349,152	2,202,804	6.6	36	21	123	65	3,435	3,093
Tennessee	64,734	36,060	79.5	239,587,035	128,274,719	86.8	2,197,785	2,070,354	6.2	29	17	109	62	3,701	3,557
Alabama	35,888	14,077	154.9	107,545,457	46,158,943	133.0	2,049,407	1,891,755	8.3	18	7	52	24	2,997	3,279
Mississippi	32,710	15,069	117.1	126,347,504	60,414,961	109.1	1,734,439	1,603,604	8.2	19	9	73	38	3,863	4,009
Louisiana	34,650	17,509	97.9	122,225,846	68,083,915	79.5	1,565,752	1,434,033	9.2	22	12	78	47	3,527	3,889
Arkansas	40,488	16,892	139.7	86,578,439	36,716,883	135.8	1,439,910	1,347,934	6.8	28	13	60	27	2,138	2,174
Oklahoma	52,427	15,716	233.6	133,298,566	31,667,627	320.9	1,414,177	897,748	57.5	37	[3]18	94	[4]35	2,543	2,015
Texas	169,600	64,410	163.3	406,920,600	167,079,014	143.5	3,617,936	3,203,303	12.9	47	20	112	52	2,399	2,594
Western division	510,884	207,146	146.6	1,048,399,642	381,059,984	175.1	4,783,557	4,289,085	11.5	107	48	219	89	2,052	1,840
Montana	15,716	5,421	189.9	25,503,905	11,352,976	124.6	313,615	266,120	17.8	50	20	81	43	1,623	2,094
Idaho	14,839	3,862	284.2	26,047,495	6,451,762	303.7	213,028	176,416	20.8	70	22	122	37	1,755	1,671
Colorado	64,016	24,533	160.9	139,641,301	60,258,533	131.7	628,216	559,715	12.2	102	44	222	108	2,181	2,456
New Mexico	6,495	2,481	161.8	14,163,557	4,297,920	229.5	219,830	202,316	8.7	30	12	64	21	2,181	1,732
Arizona	5,933	3,259	82.0	10,879,950	5,072,727	114.5	147,214	129,869	13.4	40	25	74	39	1,834	1,557
Utah and Wyoming	36,037	7,232	398.3	88,437,258	13,531,312	553.6	428,458	388,046	10.4	84	19	206	35	2,454	1,871
Nevada	4,503	1,165	286.5	7,103,245	1,409,134	404.1	42,335	41,331	2.4	106	28	168	34	1,577	1,210
Washington	89,451	31,447	184.5	205,816,844	64,623,982	218.5	630,712	558,055	13.0	142	56	326	116	2,301	2,055
Oregon	41,545	21,172	96.2	87,766,609	35,777,238	145.3	484,938	429,380	12.9	86	49	181	83	2,113	1,690
California	232,349	106,574	118.0	443,039,478	178,284,400	148.5	1,675,211	1,537,837	8.9	139	69	264	116	1,907	1,673
Outlying districts	6,359	2,493	155.1	8,860,572	3,461,000	156.0	1,334,396	236,703	.....	5	11	7	15	1,393	1,388
Alaska	1,512	125	1,109.6	1,243,548	200,000	521.8	85,670	69,900	22.6	18	2	15	3	822	1,600
Hawaii	3,052	2,368	28.9	3,937,985	3,261,000	20.8	198,808	166,803	19.2	15	14	20	20	1,290	1,377
Porto Rico [5]	1,795	.....	.....	3,679,039	.....	.....	1,049,918	.....	.....	2	.....	4	.....	2,050	.....

[1] Official estimates of the Bureau of the Census.
[2] Decrease.
[3] Oklahoma and Indian Territory combined: Oklahoma, 22; Indian Territory, 12.
[4] Oklahoma and Indian Territory combined: Oklahoma, 50; Indian Territory, 19.
[5] No reports received from Porto Rico in 1902.

It is necessary to use the total population in making the comparisons, although this includes many persons too young to use the telephone, as well as those who live in remote districts to which there are no immediate prospects of the service being extended.

Since the number of telephones installed increased much more rapidly than the population, the average number of stations or telephones per 1,000 of population in the United States increased, the increase being from 29 in 1902 to 65 in 1907. Table 47 shows the percentages of increase for the geographic divisions in 1907 and 1902.

TABLE 47.—*Commercial and mutual systems combined—Stations or telephones per 1,000 of population, by geographic divisions and per cent of increase: 1907 and 1902.*

DIVISION.	STATIONS OR TELEPHONES PER 1,000 OF POPULATION.		
	1907	1902	Per cent of increase.
United States	65	29	124.1
North Atlantic	68	30	126.7
South Atlantic	29	13	123.1
North Central	88	40	120.0
South Central	31	15	106.7
Western	107	48	122.9

In both 1902 and 1907 the states of the Western division had the largest number of telephones per 1,000 of population, and for both census years the North Central, North Atlantic, South Central, and South Atlantic divisions follow in the order named. The largest percentage of increase in the ratio of telephones to population is shown for the North Atlantic division, with the South Atlantic, Western, North Central, and South Central following in the order given.

The rank of the states according to telephones per 1,000 of population is of interest as showing their standing with regard to the distribution of telephone facilities. This is shown in Table 48 for 1907 and 1902.

The very general growth of telephone facilities is shown by the facts that in twenty states in 1907 the number of telephones per 1,000 of population was higher than the highest for any state in 1902, and that in 1902 but one state (California) shows an average as high as the average for the United States in 1907. The states showing the highest ratios of increase are Utah and Wyoming combined, 342.1 per cent; Nevada, 278.6 per cent; Nebraska, 275.8 per cent; South Dakota, 250 per cent; and Kansas, 246.4 per cent.

TABLE 48.—*Commercial and mutual systems combined—States and territories ranked according to number of stations or telephones per 1,000 of population: 1907 and 1902.*

1907			1902		
Rank of state or territory.	State or territory.	Stations or telephones per 1,000 of population.	Rank of state or territory.	State or territory.	Stations or telephones per 1,000 of population.
1	Washington	142	1	California	69
2	California	139	2	Washington	56
3	Nebraska	124	3	Iowa	52
4	Iowa	113	3	Ohio	52
5	Nevada	106	4	Indiana	51
6	Ohio	104	5	Oregon	49
7	Colorado	102	6	Colorado	44
8	Kansas	97	7	Illinois	42
9	Indiana	95	8	Michigan	38
10	Illinois	90	9	Vermont	35
11	Oregon	86	10	Minnesota	34
12	Utah and Wyoming	84	11	Massachusetts	33
12	South Dakota	84	11	Nebraska	33
13	Vermont	81	11	New York	33
14	New York	79	12	Missouri	29
15	Michigan	75	12	Pennsylvania	29
16	Minnesota	73	12	Wisconsin	29
17	Missouri	71		United States	29
18	Idaho	70	13	Kansas	28
19	Maine	69	13	Nevada	28
20	Massachusetts	68	14	Arizona	25
	United States	65	14	New Jersey	25
21	New Hampshire	64	15	Connecticut and Rhode Island	24
22	Wisconsin	62			
22	Pennsylvania	62	15	New Hampshire	24
23	Maryland, Delaware, and District of Columbia	61	15	South Dakota	24
			16	West Virginia	22
			16	Idaho	22
24	North Dakota	60	17	Maryland, Delaware, and District of Columbia	21
25	Connecticut and Rhode Island	58			
26	New Jersey	52	17	Kentucky	21
27	Montana	50	18	Montana	20
27	West Virginia	50	18	Maine	20
28	Texas	47	18	Texas	20
29	Arizona	40	18	North Dakota	20
30	Oklahoma	37	19	Utah and Wyoming	19
31	Kentucky	36	20	Oklahoma	18
32	New Mexico	30	21	Tennessee	17
33	Tennessee	29	22	Florida	15
34	Arkansas	28	23	Virginia	13
35	Florida	26	23	Arkansas	13
36	Georgia	24	24	Louisiana	12
36	Virginia	24	24	New Mexico	12
37	Louisiana	22	25	Georgia	11
38	Mississippi	19	26	Mississippi	9
39	Alabama	18	27	North Carolina	8
40	North Carolina	15	27	South Carolina	8
41	South Carolina	13	28	Alabama	7

The comparison of the number of telephones with the population is the most satisfactory comparison that can be made to show the development which telephone traffic has reached; but the comparisons based on the number of messages, as illustrated by Table 49, page 53, are also instructive. They indicate that the increase in the number of telephones has been accompanied by a greater average number of messages per capita, and that the average number of messages per capita for the country as a whole was more than twice as large in 1907 as in 1902.

The highest rate of increase (146.1 per cent) is shown for the Western division and the lowest (95.7 per cent) for the South Central division.

TABLE 49.—*Commercial and mutual systems combined—Number of messages per capita, by geographic divisions: 1907 and 1902.*

DIVISION.	NUMBER OF MESSAGES PER CAPITA.		
	1907	1902	Per cent of increase.
United States	133	65	104.6
North Atlantic	110	55	100.0
South Atlantic	71	33	115.2
North Central	185	90	105.6
South Central	92	47	95.7
Western	219	89	146.1

The rank of the states according to the average number of messages per capita in 1907 and 1902 is shown by Table 50.

TABLE 50.—*Commercial and mutual systems combined—States and territories ranked according to number of messages per capita: 1907 and 1902.*

1907			1902		
Rank of state or territory.	State or territory.	Number of messages per capita.	Rank of state or territory.	State or territory.	Number of messages per capita.
1	Washington	326	1	Ohio	131
2	Nebraska	272	2	California	116
3	California	264	2	Washington	116
4	Ohio	238	3	Indiana	114
5	Colorado	222	4	Colorado	108
6	Indiana	218	4	Illinois	108
7	Utah and Wyoming	206	5	Michigan	96
8	Kansas	192	6	Iowa	84
9	Iowa	189	7	Oregon	83
10	Oregon	181	8	Missouri	76
11	Michigan	168	8	Pennsylvania	76
11	Nevada	168	9	Nebraska	67
12	Illinois	166	10	Kentucky	65
13	Missouri	160		United States	65
14	South Dakota	155	11	Massachusetts	63
15	Wisconsin	154	12	Minnesota	62
16	Minnesota	148	12	Tennessee	62
	United States	133	13	Vermont	55
17	New York	128	14	Texas	52
18	Kentucky	123	15	New York	48
19	Idaho	122	15	Wisconsin	48
20	Vermont	118	16	Louisiana	47
21	Pennsylvania	115	17	Montana	43
22	West Virginia	113	18	Georgia	42
23	Texas	112	18	Maryland, Delaware, and District of Columbia	42
24	Maine	110			
25	Tennessee	109			
26	North Dakota	100	18	South Dakota	42
27	Massachusetts	97	18	West Virginia	42
27	New Hampshire	97	19	Connecticut and Rhode Island	41
28	Maryland, Delaware, and District of Columbia	94	19	New Hampshire	41
			19	North Dakota	41
28	Oklahoma	94	20	Kansas	40
29	Connecticut and Rhode Island	85	21	Arizona	39
			22	Mississippi	38
30	Georgia	81	23	Idaho	37
30	Montana	81	24	Oklahoma	35
31	Louisiana	78	24	Utah and Wyoming	35
32	Florida	75	25	Florida	34
33	Arizona	74	25	Nevada	34
34	Mississippi	73	25	Virginia	34
35	Virginia	65	26	Maine	31
36	New Mexico	64	27	New Jersey	29
37	New Jersey	63	28	Arkansas	27
38	Arkansas	60	29	Alabama	24
39	Alabama	52	30	New Mexico	21
40	North Carolina	45	31	North Carolina	19
41	South Carolina	40	32	South Carolina	17

The foregoing table further illustrates the striking growth in telephone traffic and the pronounced increase in the use of telephones in Western states. In 1907 the averages for eighteen states and that for the United States as a whole ranked above the average for the leading state (Ohio) of 1902. The highest number of messages per capita for 1907 (326) is shown for Washington state, where there was a high development and a large number of stations per 1,000 of population and where the measured system of payment was not in general use. The lowest average (40) was reported for South Carolina, a state in which telephone development was relatively low and the number of telephones per 1,000 of population was lowest. The increase in the per capita use of the telephones was accompanied by a slight decrease in the average number of times that each set of instruments was used during the year. The decrease in the number of messages per telephone, however, is shown for less than one-half of the states.

It is probable that the averages would be materially changed in a number of the states if it were possible to include all of the traffic over the independent farmer or rural lines. To illustrate this, Table 51 is introduced, showing the average number of stations or telephones per 1,000 of population for all systems and lines.

TABLE 51.—*All systems and lines—Stations or telephones per 1,000 of population, by states and territories and geographic divisions: 1907 and 1902.*

STATE OR TERRITORY.	Census.	Number of systems and lines.	Number of stations or telephones.	Population.[1]	Stations or telephones per 1,000 of population.
United States	1907	22,971	6,118,578	85,532,761	72
	1902	9,136	2,371,044	78,576,436	30
North Atlantic division	1907	1,938	1,663,172	23,779,013	70
	1902	575	649,221	21,778,196	30
Maine	1907	153	53,134	717,832	74
	1902	29	14,070	700,072	20
New Hampshire	1907	58	28,920	436,128	66
	1902	16	9,949	418,602	24
Vermont	1907	100	30,833	351,495	88
	1902	39	12,151	345,885	35
Massachusetts	1907	38	209,383	3,083,013	70
	1902	10	96,512	2,917,796	33
Connecticut and Rhode Island	1907	17	87,999	1,522,625	58
	1902	8	33,485	1,387,122	24
New York	1907	942	685,512	8,386,673	82
	1902	340	247,340	7,533,011	33
New Jersey	1907	33	116,988	2,248,332	52
	1902	28	48,980	1,969,821	25
Pennsylvania	1907	597	450,403	7,032,915	64
	1902	105	186,734	6,505,887	29
South Atlantic division	1907	1,373	365,764	11,574,988	32
	1902	869	146,765	10,770,414	14
Maryland, Delaware, and District of Columbia	1907	26	110,282	1,798,652	61
	1902	23	36,383	1,693,019	21
Virginia	1907	290	55,541	1,992,925	28
	1902	242	25,762	1,899,440	14
West Virginia	1907	195	62,144	1,096,006	57
	1902	114	22,801	998,004	23
North Carolina	1907	400	37,104	2,086,912	18
	1902	206	17,036	1,948,984	9
South Carolina	1907	143	20,911	1,472,734	14
	1902	135	10,753	1,378,150	8
Georgia	1907	224	62,260	2,481,617	25
	1902	104	25,761	2,298,713	11
Florida	1907	95	17,522	646,142	27
	1902	45	8,269	554,104	15

[1] Official estimates of the Bureau of the Census.

TABLE 51.—*All systems and lines—Stations or telephones per 1,000 of population, by states and territories and geographic divisions: 1907 and 1902*—Continued.

STATE OR TERRITORY.	Census.	Number of systems and lines.	Number of stations or telephones.	Population.[1]	Stations or telephones per 1,000 of population.
North Central division	1907	14,563	2,963,945	29,026,645	102
	1902	6,739	1,139,914	27,087,206	83
Ohio	1907	984	495,636	4,497,198	110
	1902	420	224,083	4,252,372	53
Indiana	1907	883	289,452	2,743,305	106
	1902	1,301	136,561	2,581,575	53
Illinois	1907	1,817	558,585	5,518,190	101
	1902	1,201	221,008	5,019,628	44
Michigan	1907	534	209,842	2,611,790	88
	1902	190	95,415	2,480,764	38
Wisconsin	1907	704	158,875	2,292,911	69
	1902	269	62,992	2,127,974	30
Minnesota	1907	825	171,479	2,071,318	83
	1902	221	63,192	1,822,106	35
Iowa	1907	3,445	332,545	2,201,331	151
	1902	1,527	138,400	2,301,427	60
Missouri	1907	2,648	312,527	3,405,901	92
	1902	1,204	103,155	3,187,031	32
North Dakota	1907	259	34,087	487,890	70
	1902	32	6,762	344,778	20
South Dakota	1907	330	48,405	476,631	102
	1902	60	10,387	429,808	24
Nebraska	1907	891	152,279	1,068,849	142
	1902	130	36,766	1,087,526	34
Kansas	1907	1,243	200,233	1,651,331	121
	1902	184	41,193	1,452,217	28
South Central division	1907	3,540	585,489	16,368,558	36
	1902	820	227,790	14,651,535	16
Kentucky	1907	429	93,996	2,349,152	40
	1902	190	46,949	2,202,804	21
Tennessee	1907	214	71,130	2,197,785	32
	1902	83	36,392	2,070,354	18
Alabama	1907	297	40,481	2,049,407	20
	1902	65	14,170	1,891,755	7
Mississippi	1907	271	37,627	1,734,439	22
	1902	66	15,340	1,603,604	10
Louisiana	1907	69	35,692	1,565,752	23
	1902	34	17,543	1,434,033	12
Arkansas	1907	547	49,576	1,439,910	34
	1902	81	16,928	1,347,934	12
Oklahoma	1907	715	68,125	1,414,177	48
	1902	67	15,732	897,748	18
Texas	1907	998	188,862	3,617,936	52
	1902	234	64,736	3,203,303	20
Western division	1907	1,557	540,208	4,783,557	48
	1902	133	207,354	4,289,085	11
Montana	1907	97	17,168	313,615	55
	1902	17	5,451	266,120	20
Idaho	1907	82	16,394	213,028	77
	1902	10	3,886	176,416	22
Colorado	1907	104	65,908	628,216	105
	1902	13	24,533	559,715	44
New Mexico	1907	47	6,653	219,830	30
	1902	15	2,510	202,316	12
Arizona	1907	37	6,203	147,214	42
	1902	12	3,264	129,869	25
Utah and Wyoming	1907	83	37,134	428,458	87
	1902	9	7,258	388,046	19
Nevada	1907	21	4,601	42,335	109
	1902	8	1,165	41,331	28
Washington	1907	480	98,846	630,712	157
	1902	4	31,447	558,055	56
Oregon	1907	295	49,629	484,938	102
	1902	25	21,190	429,380	49
California	1907	311	237,672	1,675,211	142
	1902	20	106,650	1,537,837	69

[1] Official estimates of the Bureau of the Census.

By comparing the average number of stations or telephones per 1,000 of population for the several states in Table 51, which included telephones on the independent farmer or rural lines, with the state averages for commercial and mutual systems shown in Table 46, it is seen that the inclusion of the instruments on the farmer or rural lines increases the average number of telephones per unit of population in a number of states: The average for Iowa changes from 113 to 151 in 1907 and from 52 to 60 in 1902, and that for Illinois from 90 to 101 in 1907 and from 42 to 44 in 1902. The differences, though not large, are more marked for 1907 than for 1902 on account of the great expansion of the farmer or rural lines during the five years; in 1907, for example, Oklahoma had an average of 37 stations or telephones per 1,000 of population for commercial and mutual systems and of 48 for all systems and lines, whereas in 1902, 18 stations or telephones per 1,000 of population are shown for both cases. In states of lesser telephone density the difference is apparently less: In 1907 North Carolina had an average of 15 stations or telephones per 1,000 of population, exclusive of farmer or rural lines, and 18 when such lines are included; in 1902 it showed an average of 8, excluding the telephones on farmer or rural lines, and an average of 9, including them.

Urban and rural traffic.—While the commercial telephone companies were able to report the number of stations or telephones on their farmer or rural lines, it was impossible for them or the mutual systems to give estimates of the number of messages that originated on the rural as distinct from urban lines. It would manifestly be incorrect to credit all of the traffic of the commercial companies to the cities. In compiling Table 52 the systems having their principal central offices or exchanges in municipalities with a population of 4,000 and over at the census of 1900 were counted as urban and all other systems as rural. This presentation is confined to the commercial systems and therefore the figures do not accurately represent the magnitude of either the urban or the rural business. The comparison, however, is of value because it indicates roughly the relative importance and increase of the two branches of commercial service.

The ratios of increase from 1902 to 1907 are larger for the rural commercial systems than for the urban, and in every particular the former constituted a somewhat larger proportionate part in 1907 than in 1902.

Conditions surrounding the telephone traffic in large cities are entirely different from those in the small towns and the country. It was impossible to obtain complete statistics of income, expenses, and equipment corresponding to the operations within the corporate limits of any city. However, the comparison made in Table 53 of the number of stations or tele-

phones and the population of certain of the principal cities indicates the relative development of the telephone facilities in these cities.

These twelve cities had a telephone ratio ranging in 1907 from 113 telephones per 1,000 of inhabitants in Cleveland to 45 in New Orleans, and in 1902 from 62 in Cleveland to 24 in New Orleans. On a population basis Philadelphia, Pittsburg, and San Francisco rank with the cities shown in the table, but proper data could not be obtained for Philadelphia and Pittsburg, and the new development in San Francisco was so upset by the earthquake and fire of April, 1906, as to make any comparison misleading. More than 50,000 telephones were put out of service by the fire in San Francisco, and by the close of 1907 only about a two-thirds recovery had been made.

Although the development of the rural telephone lines has led to a very general distribution of the service, the principal cities still contain a large portion of the telephones. The development within the cities is dependent largely on business requirements and the character of the population. As a rule the immigrant population does not use the telephone as freely as the natives.

TABLE 52.—COMMERCIAL SYSTEMS, CLASSIFIED AS IN URBAN AND IN RURAL DISTRICTS—COMPARATIVE SUMMARY: 1907 AND 1902.

[Exclusive of mutual systems and independent farmer or rural lines.]

	TOTAL.			IN URBAN DISTRICTS.			IN RURAL DISTRICTS.			PER CENT OF TOTAL.			
										Urban.		Rural.	
	1907	1902	Per cent of increase.	1907	1902	Per cent of increase.	1907	1902	Per cent of increase.	1907	1902	1907	1902
Number of systems	4,901	3,157	55.2	685	530	29.2	4,216	2,627	60.5	14.0	16.8	86.0	83.2
Miles of wire	12,418,042	4,779,571	159.8	11,294,797	4,361,013	159.0	1,123,245	418,558	168.4	91.0	91.2	9.0	8.8
Number of stations or telephones	5,426,973	2,225,981	143.8	4,290,160	1,823,956	135.2	1,136,813	402,025	182.8	79.1	81.9	20.9	18.1
Number of public exchanges	14,702	9,419	56.1	7,637	5,480	39.4	7,065	3,939	79.4	51.9	58.2	48.1	41.8
Estimated number of messages or talks	11,230,581,856	4,971,413,070	125.9	9,389,177,548	4,351,724,325	115.8	1,841,404,308	619,688,745	197.1	83.6	87.5	16.4	12.5
Salaried employees:													
Number	24,959	13,958	78.8	20,650	12,393	66.6	4,309	1,565	175.3	82.7	88.8	17.3	11.2
Salaries	$19,245,349	$9,871,596	95.0	$17,271,126	$9,263,356	86.4	$1,974,223	$608,240	224.6	89.7	93.8	10.3	6.2
Wage-earners:													
Average number	117,477	63,630	84.6	99,925	56,262	77.6	17,552	7,368	138.2	85.1	88.4	14.9	11.6
Wages	$48,660,223	$26,206,065	85.7	$43,716,663	$24,343,526	79.6	$4,943,560	$1,862,539	165.4	89.8	92.9	10.2	7.1
Income	183,784,037	86,522,211	112.4	166,637,109	79,963,998	108.4	17,146,928	6,558,213	161.5	90.7	92.4	9.3	7.6
Operating expenses and fixed charges, except interest on funded debt	127,910,817	61,371,002	108.4	116,598,227	57,391,972	103.2	11,312,590	3,979,030	184.3	91.2	93.5	8.8	6.5
Interest on funded debt	12,315,579	3,511,768	250.7	12,076,374	3,453,473	249.7	239,205	58,295	310.3	98.1	98.3	1.9	1.7

TABLE 53.—COMMERCIAL SYSTEMS IN TWELVE SELECTED LARGE CITIES—NUMBER OF STATIONS OR TELEPHONES, POPULATION, AND STATIONS OR TELEPHONES PER 1,000 OF POPULATION: 1907 AND 1902.

CITY.	NUMBER OF STATIONS OR TELEPHONES.			POPULATION.[1]			STATIONS OR TELEPHONES PER 1,000 OF POPULATION.	
	1907	1902	Per cent of increase.	1907	1902	Per cent of increase.	1907	1902
New York	308,869	93,301	231.0	4,225,681	3,623,160	16.6	73	26
Chicago	161,419	60,948	164.8	2,107,620	1,815,445	16.1	77	34
St. Louis	60,290	19,228	213.6	661,666	599,932	10.3	91	32
Boston	58,179	30,202	92.6	609,175	583,376	4.4	96	52
Baltimore	42,201	15,181	178.0	561,120	523,861	7.1	75	29
Cleveland	53,815	24,809	116.9	475,864	403,032	18.1	113	62
Buffalo	36,596	12,385	195.5	386,724	371,731	4 0	95	33
Detroit	28,835	12,536	130.0	367,494	301,670	21.8	78	42
Cincinnati	30,416	13,627	123.2	347,123	329,590	5.3	88	41
Milwaukee	25,451	10,765	136.4	322,513	304,965	5.8	79	35
New Orleans	14,397	7,158	101.1	318,652	296,118	7.6	45	24
Washington	20,701	8,051	157.1	312,548	288,384	8.4	66	28

[1] Official estimates of the Bureau of the Census.

Traffic of Bell and independent (non-Bell) commercial systems.—A comparison between the traffic statistics of the Bell and the independent (non-Bell) systems is given in Table 54. However, the full magnitude of the independent (non-Bell) interests is not shown, as the traffic of the mutual systems and independent farmer or rural lines could not be included.

For neither the Bell nor the independent (non-Bell) commercial systems does the average number of messages or talks of all kinds per station or telephone differ materially from the average number for local-exchange messages at either the 1907 or the 1902 census. Between the two censuses there was a decrease in the averages for both items for the Bell companies, and a very slight increase for the independent (non-Bell) systems. On the basis of 325 days to a year the Bell system had an average of 6.3 messages per telephone per day for 1907 and 7.2 for 1902,

while the corresponding averages for the independent systems were 6.5 and 6.4. In long-distance and toll messages a considerable increase is shown for the Bell companies, the average number per telephone rising from 58 in 1902 to 61 in 1907; but in the case of the independent companies the average of long-distance and toll messages fell from 48 per station or telephone in 1902 to 26 in 1907.

TABLE 54.—COMMERCIAL SYSTEMS, CLASSIFIED AS BELL AND INDEPENDENT (NON-BELL) SYSTEMS—TRAFFIC: 1907 AND 1902.

[Exclusive of mutual systems and independent farmer or rural lines.]

	COMMERCIAL SYSTEMS.			BELL SYSTEM.			INDEPENDENT (NON-BELL) SYSTEMS AND LINES.		
	1907	1902	Per cent of increase.	1907	1902	Per cent of increase.	1907	1902	Per cent of increase.
Number of systems	4,901	3,157	55.2	175	44	297.7	4,726	3,113	51.8
Number of stations or telephones	5,426,973	2,225,981	143.8	3,132,063	1,317,178	137.8	2,294,910	908,803	152.5
Estimated number of messages or talks:									
Total	11,230,581,856	4,971,413,070	125.9	6,401,044,799	3,074,530,060	108.2	4,829,537,057	1,896,883,010	154.6
Per station or telephone	2,069	2,233	.....	2,044	2,334	.....	2,104	2,087	.....
Local exchange:									
Total	10,978,853,618	4,851,416,539	126.3	6,209,430,515	2,998,344,933	107.1	4,769,423,103	1,853,071,606	157.4
Per station or telephone	2,023	2,179	.....	1,983	2,276	.....	2,078	2,039	.....
Long-distance and toll:									
Total	251,728,238	119,996,531	109.8	191,614,284	76,185,127	151.5	60,113,954	43,811,404	37.2
Per station or telephone	46	54	.....	61	58	.....	26	48	.....

CHAPTER V.

FINANCIAL STATISTICS.

Capitalization.—The statistics of capitalization are confined to the par value of the authorized and outstanding common and preferred stock and funded debt of incorporated commercial and mutual companies. Since in many instances the capitalization of one company covers equipment in two or more states, the statistics are not shown by states or any other political subdivision of the United States. No data could be collected concerning the total cost of construction or the amount invested in the independent farmer or rural lines, although the cost of such lines represents a considerable part of the capital invested in the telephone equipment of the United States.

Table 55 shows the details of the capital stock and funded debt of incorporated companies for the censuses of 1907 and 1902. As more fully shown below, the figures include extensive duplications.

TABLE 55.—*Commercial and mutual systems combined, classified as Bell and independent (non-Bell) systems—Capitalization of incorporated companies: 1907 and 1902.*

	Census.	Commercial and mutual systems.	Bell system (A. T. and T. Co.).	Independent (non-Bell) systems and lines.
Number of incorporated companies.	1907	3,616	175	3,441
	1902	2,271	44	2,227
Capital stock and funded debt: Authorized	1907	$1,678,468,955	$1,088,782,251	$589,686,704
	1902	737,969,911	501,233,151	236,736,760
Outstanding	1907	1,072,805,993	749,840,435	322,965,558
	1902	487,060,895	372,300,773	114,760,122
Capital stock, par value— Authorized	1907	1,121,931,023	782,364,000	339,567,023
	1902	534,834,066	414,432,000	120,402,066
Outstanding	1907	765,423,533	547,316,914	218,106,619
	1902	382,378,229	306,627,501	75,750,728
Common stock— Authorized	1907	1,016,961,398	726,494,000	290,467,398
	1902	524,152,341	411,557,000	112,595,341
Outstanding	1907	706,840,774	509,775,359	197,065,415
	1902	377,508,608	306,346,576	71,162,032
Preferred stock— Authorized	1907	104,969,625	55,870,000	49,099,625
	1902	10,681,725	2,875,000	7,806,725
Outstanding	1907	58,582,759	37,541,555	21,041,204
	1902	4,869,621	280,925	4,588,696
Funded debt— Authorized	1907	556,537,932	306,418,251	250,119,681
	1902	203,135,845	86,801,151	116,334,694
Outstanding	1907	307,382,460	202,523,521	104,858,939
	1902	104,682,666	65,673,272	39,009,394

Although there has been an enormous increase in the outstanding capitalization, the ratio of increase for this item does not exceed the ratios of increase for wire, equipment, and number of telephones. Large increases occurred in some states, due primarily to reorganization and consolidation, frequently followed by issues of additional stock. The organization of new stock companies since 1902 and increases of capital made for extending the equipment of existing systems have also contributed to the total increase.

Of the $1,072,805,993 reported as the par value of the outstanding stock and bonds of the incorporated telephone companies in 1907, 71.3 per cent represents common and preferred stock and 28.7 per cent funded debt. In 1902 the corresponding proportions were 78.5 and 21.5 per cent. While at both censuses the par value of the stock outstanding was considerably in excess of the par value of the bonds, the ratio of increase in the issues of bonds in 1907 as compared with 1902 was much greater than that of the stock, the former ratio of increase being 193.6 per cent and the latter 100.2 per cent. There was a very marked increase in the outstanding preferred stock. In 1902 the par value of the preferred stock formed 1.3 per cent of the outstanding stock, while in 1907 it constituted 7.7 per cent. Owing to the reorganization of one of the larger of the Bell companies, with a separation of its capitalization into preferred and common stock, the preferred stock of the Bell system shows a larger increase proportionately than does that of the independent companies.

At both censuses preferred stock constituted a larger percentage of the outstanding capital stock of the independent companies than of the Bell companies, the proportion being 6.1 per cent in 1902 and 9.6 per cent in 1907 for independent companies as compared with one-tenth of 1 per cent in 1902 and 6.9 per cent in 1907 for Bell companies.

The increase in outstanding capital stock was proportionately larger for the independent companies than for the Bell companies, the stock of the former companies constituting 28.5 per cent of the total outstanding in 1907 and 19.8 per cent of the total in 1902. The additions to the outstanding funded debt of the Bell system have largely exceeded those of the independent companies in amount, and the former constituted 65.9 per cent of the outstanding bonds in 1907, compared with 62.7 per cent in 1902.

In addition to the value of stock and bonds, the inquiry of 1907 ascertained the floating debt of telephone companies and the value of real-estate mortgages. Both of these items should be considered in connection with the capitalization. Of the $52,622,277 reported as floating debt, the Bell system was credited with 64.5 per cent and the independent systems with 35.5 per cent; and the corresponding proportions for the distribution of real-estate mortgages valued at $1,387,898 were 24.6 and 75.4 per cent.

Net capitalization.—A considerable number of telephone companies invest funds obtained from the sale of stock and bonds in the capital stock and bonds of other telephone companies. The combination of the capitalization of all telephone companies results in a total that is in excess of the true amount of stocks and bonds in the hands of the public. In some instances the investments are made in order to control the operations of allied companies. While it is impossible in general census work to analyze transactions of this character, the schedule of inquiries called for the amount invested in the stocks and bonds of other telephone companies.

TABLE 56.—*Commercial and mutual systems combined, classified as Bell and independent (non-Bell) systems—Analysis of capitalization: 1907 and 1902.*

1907

	Total.	Bell system (American Telephone and Telegraph Company).	Independent (non-Bell) systems and lines.
Total capital outstanding (stock and bonds)	$1,072,805,993	$749,840,435	$322,965,558
Deduct intercompany holdings of stocks and bonds	274,247,841	258,189,989	16,057,852
Net capitalization of corporations	798,558,152	491,650,446	306,907,706
Deduct value of investments outside of telephone industry of the United States	25,289,808	25,090,795	199,013
Net capitalization based on telephone industry of the United States	773,268,344	466,559,651	306,708,693

1902

Total capital outstanding (stock and bonds)	$487,060,895	$372,300,773	$114,760,122
Deduct intercompany holdings of stocks and bonds	124,780,830	114,842,488	[1] 9,938,342
Net capitalization of corporations	362,280,065	257,458,285	104,821,780
Deduct value of investments outside of telephone industry of the United States	24,187,349	24,187,349	.....
Net capitalization based on telephone industry of the United States	338,092,716	233,270,936	104,821,780

[1] Includes also outside investments other than intercompany holdings, but of insignificant amount.

Table 56 shows the total par value of the capital outstanding and the deductions to be made to arrive at the net capitalization chargeable to the telephone industry of the United States. The total capital outstanding in 1907 amounted to $1,072,805,993. From this gross capitalization there must be deducted $274,247,841, or 25.6 per cent, the amount reported as intercompany holdings, leaving $798,558,152, the par value of the outstanding stock and funded debt of all telephone companies in the hands of the public, or, in other words, the net capitalization of the companies. The ratio of intercompany holdings to the total capital outstanding is much greater in the Bell companies than in the independent companies, being 34.4 per cent in the case of the Bell and but 5 per cent in the case of the independent companies.

In order to ascertain the net capitalization chargeable to the telephone industry, there must also be deducted the amount invested in other industries ($25,289,808, or 2.4 per cent of the gross capitalization), representing investments not a part of the telephone industry proper. This leaves $773,268,344 (72.1 per cent of the gross capitalization) as the net capitalization of the industry.

Similarly, on deducting the amounts of intercompany holdings and the value of investments outside of the telephone industry of the United States from the total capital outstanding for 1902, there remains $338,092,716 as the outstanding net capitalization of all systems and lines.

It will be seen from the table that the net capitalization of the commercial and mutual systems, based on the telephone industry of the United States, increased from $338,092,716 in 1902 to $773,268,344 in 1907, or 128.7 per cent. The increase in the net capitalization of the Bell companies was exactly 100 per cent and in that of the non-Bell companies much greater—192.6 per cent. The net capitalization of the Bell companies represented 60.3 per cent of the total net capitalization of all commercial and mutual systems in 1907 as compared with 69 per cent in 1902.

While it is possible in the above table to calculate precisely the net capitalization based on the telephone business of the United States, it is not possible to distribute that net capitalization precisely as among the different classes of securities. In the case of the Bell system figures are available by which the intercompany holdings of each class of securities may be ascertained and excluded, but in the case of the independent or non-Bell systems the total amount of intercompany holdings is available, but not the amount distributed according to classes of securities. Furthermore, while the investments of telephone companies in stocks or property outside of the telephone business of the United States may properly be deducted from the total capitalization, in order to ascertain the capitalization based on the telephone business of the United States, the amount of this deduction can not, of course, be taken out of any one class of securities. While it would be possible to apportion this deduction among the classes of securities pro rata, the results would have little significance.

Dividends and interest payments.—It is obvious that in considering the relation between dividend and interest payments and capitalization it is necessary to consider the entire amount of capitalization in the hands of the public and the entire amount of dividends or interest paid thereon, regardless of the question whether such capitalization represents the telephone business proper or other investments, or whether the dividends or interest are derived from income from the telephone business or from other sources. In Table 57, therefore, the figures of total capitalization presented are those showing the gross capitalization, exclusive of duplications, but not exclusive of investments in outside business, and the figures of total dividends

and interest similarly represent the gross payments less duplications due to intercompany payments, but without any deductions of income derived from outside sources. The table shows not only the totals but also the different classes of securities and of dividend and interest payments; but for reasons already mentioned it is impossible, in the case of the independent companies, to exclude duplications due to intercompany holdings or payments from the figures for the several classes of securities and payments, so that the sum of the items in the column for independent companies (and consequently also in the column for Bell and independent companies combined) is greater than the net total shown.

TABLE 57.—*Commercial and mutual systems combined, classified as Bell and independent (non-Bell) systems—Outstanding capital stock and funded debt, dividends, and interest, excluding duplications due to intercompany holdings and payments: 1907 and 1902.*[1]

	Census.	Commercial and mutual systems.	Bell system (American Telephone and Telegraph Company).	Independent (non-Bell) systems and lines.
Number of incorporated companies	1907	[2]3,616	175	3,441
	1902	2,271	44	2,227
Capital stock and funded debt	1907	$798,558,152	$491,650,446	$306,907,706
	1902	362,280,065	257,458,285	104,821,780
Total dividends and interest	1907	35,668,827	27,729,346	7,939,481
	1902	18,226,623	15,459,771	2,766,852
Average rate per cent paid on stocks and bonds	1907	4.47	5.64	2.59
	1902	5.03	6.00	2.64
Capital stock	1907	$512,685,265	$294,578,646	$218,106,619
	1902	269,676,741	193,926,013	75,750,728
Total dividends	1907	23,733,670	20,201,937	3,531,733
	1902	14,982,719	13,714,437	1,268,282
Common stock	1907	476,648,616	279,583,201	197,065,415
	1902	265,021,045	193,859,013	71,162,032
Dividends	1907	22,030,188	19,327,479	2,702,709
	1902	14,895,857	13,711,420	1,184,437
Preferred stock	1907	36,036,649	14,995,445	21,041,204
	1902	4,655,696	67,000	4,588,696
Dividends	1907	1,703,482	874,458	829,024
	1902	86,862	3,017	83,845
Funded debt	1907	301,930,739	197,071,800	104,858,939
	1902	102,541,666	63,532,272	39,009,394
Interest	1907	12,316,109	7,527,409	4,788,700
	1902	3,511,948	1,745,334	1,766,614

[1] In the case of the Bell system, duplications are entirely excluded. For the independent systems they are excluded in the total capital stock and bonds combined, and in the total dividends and interest combined, but can not be excluded from the individual classes of stocks and bonds or the payments of dividends and interest thereon. The sum of the figures for the several classes of stocks and bonds of these companies for 1907 is $322,965,558, or $16,057,852 more than the net total given ($306,907,706). For 1902 the sum of the items is $114,760,122, or $9,938,342 in excess of the net total. The sum of the figures for the several classes of dividends and interest payments for 1907 is $8,320,433, or $380,952 in excess of the net total. For 1902 it is $3,034,896, or $268,044 in excess of the net total. For all companies combined the sums of the items are as follows: Capital stock and bonds—1907, $814,616,004; 1902, $372,218,407; dividends and interest—1907, $36,049,779; 1902, $18,494,667.

[2] Of the 4,901 commercial systems, 3,414 were incorporated, and of the 368 mutual systems, 202 were incorporated. The number given includes nine incorporated companies for which no capitalization was reported, since the companies were engaged also in other business and the capitalization was not separable.

This table shows that in 1907 the total dividend and interest payments of commercial and mutual telephone companies (intercompany payments excluded) represented 4.47 per cent on the net capitalization of these companies. The percentage for the Bell system was 5.64, or somewhat more than double the percentage for the independent companies. In the case both of the Bell companies and the independent companies the rate per cent of dividend and interest payments upon net capitalization was slightly less in 1907 than in 1902.

By a comparison of the figures of Table 57 with those of Table 55 it will be seen that in the case of the Bell system, where all the duplications due to intercompany holdings can be eliminated, the intercompany holdings consist for the most part of common and preferred stock and only in small part of bonds. Of the net securities of the Bell system in the hands of the public in 1907, substantially three-fifths consisted of capital stock and two-fifths of bonds. Because of the impossibility of eliminating duplications of individual classes of securities of the independent companies the distribution of the different classes of securities for all commercial and mutual systems combined, as shown in Table 57, is not strictly accurate, but, inasmuch as the duplications referred to are comparatively small in amount, the figures do show roughly the distribution of the net capitalization. For 1907 substantially five-eighths of the net capitalization for all companies together was represented by capital stock and three-eighths by funded debt, while of the capital stock considerably more than nine-tenths was common stock. Comparing 1902 with 1907, it appears that the net capital stock in the hands of the public has approximately doubled, while the funded debt has increased nearly threefold.

A notable feature of the telephone industry is that a large number of the small companies pay no dividends and have no outstanding funded debt upon which interest is paid. In Table 58 companies paying either interest or dividends on the one hand are distinguished from those which pay neither. In this table it is impossible to exclude duplications due to intercompany holdings in the case of independent companies, but such duplications are excluded for the Bell companies. The total of $814,616,004, given as the combined capitalization, represents $491,650,446 for the Bell companies and $322,965,558 for the independent companies (see note to Table 57). It will be understood that the statistics for companies yielding a return on capitalization include the entire capital stock and bonds, even though no dividends were paid on the stock, but only interest paid on the bonds.

TABLE 58.—*Commercial and mutual systems combined, classified as companies yielding a return on capitalization, and companies not yielding a return on capitalization: 1907.*

[Duplications due to intercompany holdings and payments excluded so far as Bell system is concerned, but not for other companies. The duplication in the total capitalization outstanding amounts to $16,057,852.]

	Number of incorporated companies.	Outstanding capitalization.	Dividends and interest.	Average rate, per cent.
All incorporated companies	[1] 3,607	$814,616,004	$36,049,779	4.43
Companies yielding a return on capitalization either as dividends on stock or interest on funded debt	1,438	731,653,513	36,049,779	4.93
Companies not yielding a return on capitalization either as dividends on stock or interest on funded debt	[2] 2,169	82,962,491	.....	.....
Per cent of total:				
Companies yielding a return on capitalization either as dividends on stock or interest on funded debt	39.9	89.8	.....	.....
Companies not yielding a return on capitalization either as dividends on stock or interest on funded debt	60.1	10.2	.....	.....

[1] Only ten companies reported funded debt outstanding with no interest paid.
[2] Exclusive of nine incorporated companies for which no capitalization was reported, since the companies were engaged also in other business and the capitalization was not separable.

It will be seen that the outstanding capitalization of the companies which paid some return on capitalization (either as dividends or interest) constituted nearly nine-tenths of the total outstanding capitalization of all incorporated companies, but the number of such companies formed less than two-fifths of the total number, the large remaining number making no payments as interest or dividends.

The total interest and dividend payments represented 4.93 per cent on the capitalization of those companies which made such payments. But the aggregate amount reported as outstanding capitalization of these companies includes securities to the amount of $88,409,069 on which no dividends or interest was paid, the same representing stocks and bonds of companies reporting dividends or interest paid on one class of securities only.[1] This leaves $643,244,444 as the net aggregate amount of outstanding capitalization on which the $36,049,779 of dividends and interest was paid, the average rate being therefore 5.6 per cent. The net amount of income-yielding securities formed only 79 per cent of all outstanding securities, although the securities of all companies paying either dividends or interest constituted 89.8 per cent of the total.

The 1,438 companies paying dividends or interest show an average capitalization per company of $508,799, while the 2,169 companies paying neither dividends nor interest had an average of but $38,249.

The large number of companies paying no return on capitalization is not due to any great extent to the inclusion of the mutual companies not operated for profit, for the incorporated mutual companies number but 202, or only 5.6 per cent of the total number of incorporated companies; and of these, seven paid dividends or interest. This leaves in the class that made no return on capitalization 195 mutual companies and 1,974 commercial organizations. Of the 175 incorporated companies included in the Bell system, 100 did not pay dividends on stock, these companies being without funded debt. This leaves 1,874 as the number of independent commercial companies not paying dividends, including the few not paying interest in 1907.

Table 59 shows, for the dividend-paying and the non-dividend-paying companies, the outstanding capital stock and the dividends.

TABLE 59.—*Commercial and mutual systems combined, classified according to capital stock of dividend and nondividend paying companies: 1907.*

[Duplications due to intercompany holdings and payments excluded so far as Bell system is concerned, but not for other companies; they do not appreciably affect the average rates.]

CLASS OF COMPANY.	Number of companies.	CAPITAL STOCK.			
		Authorized.	Outstanding.	Dividends.	
				Amount.	Average rate, per cent.
Total	[1] 3,607	$1,121,931,023	$512,685,265	$23,733,670	4.63
Dividend-paying	1,076	860,719,665	354,791,104	23,733,670	6.69
Nondividend-paying	2,531	261,211,358	157,894,161	.....	.....

[1] Exclusive of nine incorporated companies engaged also in other business for which no capitalization was reported, the capitalization not being separable.

It should be remembered that the total capital stock of the dividend-paying companies reported in the above table is the combined common and preferred stock of companies paying dividends on either class, and therefore is in excess of the amount of stock on which dividends were actually paid. Table 60 shows the amounts of common and preferred stock upon which dividends were paid, the amount of the dividends, and the accompanying average rates of dividends; and also the nondividend-paying stock.

[1] Tables 60 and 61 show the actual amount of preferred and common stock and funded debt on which dividends and interest were paid.

TABLE 60.—COMMERCIAL AND MUTUAL SYSTEMS COMBINED—COMMON AND PREFERRED STOCK, CLASSIFIED ACCORDING TO THE PAYMENT OF DIVIDENDS: 1907.

[Duplications due to intercompany holdings and payments excluded so far as Bell system is concerned, but not for other companies; they do not appreciably affect the average rates.]

CLASS OF STOCK.	COMMON STOCK.					PREFERRED STOCK.				
	Number of companies.	Authorized.	Outstanding.	Dividends.		Number of companies.	Authorized.	Outstanding.	Dividends.	
				Amount.	Average rate, per cent.				Amount.	Average rate, per cent.
Total	[1] 3,607	$1,016,961,398	$476,648,616	$22,030,188	4.62	226	$104,969,625	$36,036,649	$1,703,482	4.73
Dividend-paying	999	766,632,175	312,400,815	22,030,188	7.05	146	81,581,725	29,686,640	1,703,482	5.74
Nondividend-paying	2,608	250,329,223	164,247,801	.....	.....	80	23,387,900	6,350,009	.....	.....

[1] Exclusive of nine incorporated companies engaged also in other business for which no capitalization was reported, the capitalization not being separable.

Dividends were paid on 82.4 per cent of the total amount of preferred stock outstanding, the average rate being therefore 5.74 per cent, and on 65.5 per cent of the total amount of common stock outstanding, the average rate being 7.05 per cent.

Table 61 gives the outstanding funded debt on which interest was paid in 1907, that on which no interest was paid, and the amount and average rate per cent of interest.

TABLE 61.—*Commercial and mutual systems combined—Funded debt, classified according to the payment of interest: 1907.*

CLASS OF FUNDED DEBT.	Number of companies.	Authorized.	Outstanding.	INTEREST.	
				Amount.	Average rate, per cent.
Total	[1] 579	[1] $556,537,932	$301,930,739	$12,316,109	4.08
Funded debt on which interest was paid	557	554,498,782	301,156,989	12,316,109	4.09
Funded debt on which no interest was paid	[1] 22	[1] 2,039,150	773,750	.....	.....

[1] Including twelve companies with $1,223,000 authorized funded debt, but none issued.

In 1907, 567 companies, or 15.7 per cent of the total number of incorporated companies, reported outstanding funded indebtedness aggregating $301,930,739. Ten companies of these, with bonds outstanding to the value of $773,750, reported no interest on bonds as paid or due. The bulk of these bonds are used as collateral security for floating obligations.

Capitalization and cost of construction and equipment.—The cost of constructing and equipping the buildings and lines should be the principal factor determining the amount of capitalization.

For incorporated and unincorporated commercial and mutual systems in 1907 and 1902, Table 62 shows the total cost of construction and equipment to date, compared with the outstanding net capitalization and cash investment.

The net capitalization of the incorporated systems, as already explained (p. 58), excludes duplications due to intercompany holdings, and also excludes investments of certain companies outside of the telephone business in the United States. The net figures are therefore comparable with the figures for cost of construction. In considering this comparison, however, it should be borne in mind that the figures of cost of construction given in this table are those carried in the balance sheets of the companies and may not in every case represent the true cost of construction. The Bureau of the Census has made no investigation with a view to ascertaining to what extent in entering cost of construction any of the companies may have included franchise values, good will, or other elements other than cost of construction proper.

For both 1907 and 1902 the reported cost of construction for incorporated systems considerably exceeds the net capitalization based on the telephone business. The disparity, however, is balanced in whole or in part by liabilities other than capital securities. In other words, part of the investment of the companies is represented by floating debt. Undoubtedly a portion of the $44,302,999 of bills and accounts payable reported for 1902 represents floating debt chargeable against construction and equipment. For 1907 the reports of the companies distinguish floating debt chargeable against construction from other current liabilities, the amount so specifically reported being $52,622,277.

For both 1907 and 1902 the amounts reported as cash investment by the unincorporated systems are also less than the reported cost of construction and equipment. In the case of the incorporated companies the capitalization increased much faster than the cost of construction and equipment, but in the case of the unincorporated systems the increase in cost of construction and equipment was at a rate but slightly less than that for the increase in cash investment.

TABLE 62.—*Commercial and mutual systems combined—Cost of construction and equipment, and net capitalization and cash investment: 1907 and 1902.*

	1907	1902	Per cent of increase.
Cost of construction and equipment, including real estate and telephones	$820,417,008	$389,278,232	110.8
Incorporated systems	[1] 808,898,816	381,673,381	111.9
Unincorporated systems	11,518,192	7,604,851	51.5
Net capitalization and cash investment, excluding duplications and outside investments	782,851,516	344,254,015	127.4
Net capitalization of incorporated systems	773,268,344	338,092,716	128.7
Cash investment of unincorporated systems	9,583,172	6,161,299	55.5

[1] Includes $797,612, cost of construction and equipment of telephone lines of nine incorporated companies engaged also in other business for which no capitalization was reported, the capitalization not being separable.

The cost of construction and equipment shown for the unincorporated systems in 1907 represents 1,653 telephone systems and an average per system or company of $6,968. On the other hand, exclusive of the $797,612 for the nine incorporated companies for which no capital was reported, the cost of construction and equipment of the 3,607 incorporated companies aggregated $808,101,204, or an average of $224,037 per system.

Cost of new construction and equipment during the year.—A considerable number of companies, especially the smaller ones, do not keep an accurate record of the expenditures for additions to line and equipment. Amounts charged by some companies to the capital accounts are included by others in the regular expense account. Therefore the statistics concerning cost of construction and equipment in some cases may be less than the actual expenditures for this purpose. The census schedule called for the "Cost of lines, real estate, equipment, etc., added during the year." The amounts reported in answer to this inquiry are of course included in the total cost of construction and equipment item of the balance sheet. As a result of the general financial depression late in 1907, it is probable that the cost of new construction and equipment during the year is smaller than it would otherwise have been. For this reason the total for 1907 is not fairly comparable with the corresponding total for 1902, a year which experienced no such financial distress. The expenditure for new construction and equipment during the year 1907 was 35.7 per cent greater than the amount expended for the same purpose during 1902.

The cost of the new construction and equipment for 1907 and for 1902 is given, by states and geographic divisions, in Table 63.

TABLE 63.—*Commercial and mutual systems combined—Cost of construction and equipment added during the year, by states and territories and geographic divisions: 1907 and 1902.*

STATE OR TERRITORY.	1907	1902	Per cent of increase.
United States	$70,441,175	$51,903,021	35.7
North Atlantic division	25,711,590	18,971,231	35.5
Maine	841,198	116,266	623.5
New Hampshire	435,752	54,742	696.0
Vermont	262,645	63,120	316.1
Massachusetts	2,376,166	2,136,437	11.2
Connecticut and Rhode Island	1,363,201	765,789	78.0
New York	11,736,761	7,566,365	55.1
New Jersey	3,536,393	2,153,816	64.2
Pennsylvania	5,159,474	6,114,696	[1] 15.6
South Atlantic division	4,398,072	4,420,869	[1] 0.5
Maryland, Delaware, and District of Columbia	1,783,853	1,468,404	21.5
Virginia	839,959	780,328	7.6
West Virginia	379,788	298,414	27.3
North Carolina	357,094	373,580	[1] 4.4
South Carolina	135,829	419,546	[1] 67.6
Georgia	691,409	874,836	[1] 21.0
Florida	210,140	205,761	2.1
North Central division	23,634,533	18,703,370	26.4
Ohio	4,259,592	2,929,774	45.4
Indiana	1,791,594	1,780,942	0.6
Illinois	6,137,369	4,472,060	37.2
Michigan	1,618,501	1,399,746	15.6
Wisconsin	916,035	832,618	10.0
Minnesota	1,436,052	1,639,824	[1] 12.4
Iowa	1,182,368	1,841,288	[1] 35.8
Missouri	3,024,035	2,501,924	20.9
North Dakota	620,653	71,441	768.8
South Dakota	243,157	143,891	69.0
Nebraska	959,567	564,456	70.0
Kansas	1,445,610	525,406	175.1
South Central division	5,438,979	5,324,683	2.1
Kentucky	631,195	1,279,203	[1] 50.7
Tennessee	543,000	856,643	[1] 36.6
Alabama	565,484	571,801	[1] 1.1
Mississippi	328,882	328,960	[2]
Louisiana	354,115	450,660	[1] 21.4
Arkansas	363,117	172,636	110.3
Oklahoma	883,382	432,342	104.3
Texas	1,769,804	1,232,438	43.6
Western division	11,258,001	4,482,868	151.1
Montana	462,753	170,706	171.1
Idaho	390,861	108,657	259.7
Colorado	889,818	951,369	[1] 6.5
New Mexico	99,480	18,892	426.6
Arizona	68,868	56,484	21.9
Utah and Wyoming	886,594	356,368	148.8
Nevada	227,396	16,840	1,250.3
Washington	1,881,341	774,230	143.0
Oregon	974,773	249,426	290.8
California	5,376,117	1,779,896	202.0

[1] Decrease. [2] Decrease, less than one-tenth of 1 per cent.

In both 1907 and 1902 the North Atlantic division led in cost of new construction and equipment, with the North Central division a close second. Table 64 shows for commercial and mutual systems, by geographic divisions, the per cent distribution of the cost of new construction and equipment for the years covered, respectively, by the two censuses.

TABLE 64.—*Commercial and mutual systems combined—Per cent distribution of cost of new construction and equipment, by geographic divisions: 1907 and 1902.*

DIVISION.	1907	1902
United States	100.0	100.0
North Atlantic	36.5	36.6
South Atlantic	6.2	8.5
North Central	33.6	36.0
South Central	7.7	10.3
Western	16.0	8.6

New York appears as the leading state in amount of new construction for both censuses, and shows the largest amount of increase, although the highest rate of increase is shown for Nevada. In twelve states the cost of new construction and equipment was less in 1907 than in 1902.

Table 65 shows separately the states having new construction and equipment to the value of more than $1,000,000 in 1907 and 1902, and the percentage the amount for each state is of the total amount for the United States.

TABLE 65.—*Commercial and mutual systems combined—States with new construction and equipment in excess of $1,000,000: 1907 and 1902.*

1907			1902		
State.	Amount.	Per cent distribution.	State.	Amount.	Per cent distribution.
United States	$70,441,175	100.0	United States	$51,903,021	100 0
New York	11,736,761	16.7	New York	7,566,365	14.6
Illinois	6,137,369	8.7	Pennsylvania	6,114,696	11.8
California	5,376,117	7.6	Illinois	4,472,060	8.6
Pennsylvania	5,159,474	7.3	Ohio	2,929,774	5.6
Ohio	4,259,592	6.0	Missouri	2,501,924	4.8
New Jersey	3,536,393	5.0	New Jersey	2,153,816	4.1
Missouri	3,024,035	4.3	Massachusetts	2,136,437	4.1
Massachusetts	2,376,166	3.4	Iowa	1,841,288	3.5
Washington	1,881,341	2.7	Indiana	1,780,942	3.4
Indiana	1,791,594	2.5	California	1,779,896	3.4
Maryland, Delaware, and District of Columbia	1,783,853	2.5	Minnesota	1,639,824	3.2
Texas	1,769,804	2.5	Maryland, Delaware, and District of Columbia	1,468,404	2.8
Michigan	1,618,501	2.3	Michigan	1,399,746	2.7
Kansas	1,445,610	2.1	Kentucky	1,279,203	2.5
Minnesota	1,436,052	2.0	Texas	1,232,438	2.4
Connecticut and Rhode Island	1,363,201	1.9	All other states	11,606,208	22.4
Iowa	1,182,368	1.7			
All other states	14,562,944	20.7			

Balance sheet.—Each telephone company was requested to make a condensed statement showing its financial condition on December 31, 1907, or the last day of the fiscal year covered by its report. This statement was in form of a balance sheet, and Table 66 shows the totals obtained by combining for each census year the amounts reported for commercial and mutual systems that were in operation during any portion of the year.

TABLE 66.—*Commercial and mutual systems combined—Net balance sheet: 1907 and 1902.*

	1907	1902
Total assets	$994,842,990	$466,421,553
Cost of construction and equipment, including real estate and telephones	820,417,008	389,278,232
Permanent investments outside telephone business proper	25,289,808	24,187,349
Treasury stocks and bonds, stock bonus, and discount on stocks and bonds	61,894,257	(1)
Cash and deposits	23,243,481	12,291,840
Bills and accounts receivable	42,828,977	30,629,677
Machinery, tools, and supplies	18,537,584	9,689,691
Sundries	2,631,875	344,764
Total liabilities	994,842,990	466,421,553
Capital stock[2]	*512,685,265*	*269,676,741*
Funded debt[2]	*301,930,739*	*102,541,666*
Gross total[2]	*814,616,004*	*372,218,407*
Net total stock and funded debt, excluding duplications	798,558,152	362,280,065
Cash investment (unincorporated systems)	9,583,172	6,161,299
Real-estate mortgages	1,387,898	(1)
Floating debt (loans and notes)	52,622,277	(1)
Reserves	39,054,501	31,029,628
Bills and accounts payable	23,672,476	44,302,999
Interest due and accrued	6,068,710	(1)
Dividends due	5,901,051	188,067
Sundries	6,731,648	1,124,265
Net surplus	51,263,105	21,335,230

[1] Not reported separately.
[2] Intercompany holdings of independent companies not deducted.

The balance sheet represents the financial condition of all commercial and mutual systems, whether operated by incorporated companies, mutual or cooperative associations, firms, or individuals. It, however, does not include the independent farmer or rural lines, for which no financial statistics were obtained. Duplications due to intercompany holdings of stock and bonds are eliminated, but the balance sheet includes investments of the several companies outside of the telephone business proper.

Each telephone company was requested to include in the total for cost of construction and equipment the expenditures for the entire system up to the end of the year covered by the report, this amount to include the cost of real estate and telephone instruments. The cost of construction and equipment is the largest item of assets and shows the greatest actual increase between 1902 and 1907, the increase amounting to $431,138,776, or 110.8 per cent. This item formed 82.5 per cent of all assets in 1907, compared with 83.5 per cent in 1902.

A considerable amount of franchise value is included in the cost of construction and equipment, but it was impossible to determine the value of such franchises. In 1907, 880 of the 4,901 commercial systems and 56 of the 368 mutual systems reported that the value of their franchises was included in the construction and equipment item; 2,384 systems stated that no value was included for franchises; and 1,949 failed to answer the inquiry as to the inclusion of the value of franchise

in this item. A large portion of the separate item of "Treasury stocks and bonds, stock bonus, and discount on stocks and bonds" should be considered as of the nature of franchise values. The $61,894,257 reported as "Treasury stocks and bonds, stock bonus, and discount on stocks and bonds" is largely traceable to one company in New York which had outstanding capital securities valued at over $40,000,000, with only a small amount of actual construction, and assets consisting essentially of franchise values.

Outside investments other than those in stocks and bonds of other telephone companies were reported in 1907 as amounting to $25,289,808 and in 1902 to $24,187,349.

Rates of increase are shown as follows: Cash and deposits, 89.1 per cent; bills and accounts receivable, 39.8 per cent; machinery, tools, and supplies, 91.3 per cent; and sundries, 663.4 per cent.

On the liability side the rates of increase are 120.4 per cent for capital stock and funded debt combined, exclusive of duplications due to intercompany holdings, and 55.5 per cent for cash investment of unincorporated systems. A direct comparison of bills and accounts payable at the two censuses is misleading, since in 1907 floating debt, real-estate mortgages, and interest due and accrued were reported separately, while in 1902 they probably were included for the most part under "Bills and accounts payable," and to a less extent under "Sundries." Groups of these items—bills and accounts payable, real-estate mortgages, floating debt, interest due and accrued, and sundries for 1907, and bills and accounts payable and sundries for 1902—give totals of $90,483,009 for 1907 and $45,427,264 for 1902, and show an increase of 99.2 per cent. Among the items included under "Sundries" are the additional cash investments of incorporated companies which reported stocks or bonds, and the investments of the 9 companies which were engaged in other business and reported no capitalization, since the capitalization could not be separated. Unpaid dividends, which formed less than one-twentieth of 1 per cent of the total liabilities in 1902, constituted a much larger item in 1907 and formed a little over one-half of 1 per cent of the liabilities in that year.

The net surplus, which is the balance resulting from the consolidation of all reports, exhibits an increase of $29,927,875, or 140.3 per cent, in 1907 as compared with 1902. At the later census, surplus balances, reported by 3,775 systems, aggregated $54,962,033; and deficit balances, reported by 420 systems, aggregated $3,698,928; leaving a net surplus of $51,263,105 for the industry. The net surplus formed 5.2 per cent of total liabilities in 1907 and 4.6 per cent in 1902. Reserves should be considered in connection with surplus, as they are funds set apart from net income for specific purposes. Reserves and net surplus combined amounted to $90,317,606 in 1907 and $52,364,858 in 1902, and these totals form 9.1 per cent and 11.2 per cent, respectively, of all liabilities reported for those years.

The per cent distribution of the several assets and liabilities is shown in Table 67.

TABLE 67.—*Commercial and mutual systems combined—Per cent distribution of assets and liabilities: 1907 and 1902.*

	PER CENT DISTRIBUTION.	
	1907	1902
Total assets	100.0	100.0
Cost of construction and equipment, including real estate and telephones	82.5	83.5
Permanent investments outside telephone business proper	2.5	5.2
Treasury stocks and bonds, stock bonus, and discount on stocks and bonds	6.2	(1)
Cash and deposits	2.3	2.6
Bills and accounts receivable	4.3	6.6
Machinery, tools, and supplies	1.9	2.1
Sundries	0.3	0.1
Total liabilities	100.0	100.0
Capital stock[2]	*51.5*	*57.8*
Funded debt[2]	*30.3*	*22.0*
Gross total[2]	*81.9*	*79.8*
Net total stock and funded debt, excluding duplications	80.3	77.7
Cash investment (unincorporated systems)	1.0	1.3
Real-estate mortgages	0.1	(1)
Floating debt (loans and notes)	5.3	(1)
Reserves	3.9	6.7
Bills and accounts payable	2.4	9.5
Interest due and accrued	0.6	(1)
Dividends due	0.6	(3)
Sundries	0.7	0.2
Net surplus	5.2	4.6

[1] Not reported separately.
[2] Intercompany holdings of independent companies not deducted.
[3] Less than one-twentieth of 1 per cent.

The condensed balance sheet shown as Table 68 assists in giving a broad and comprehensive view of asset and liability accounts.

By assembling all capital assets and franchise values—construction and equipment, stocks and bonds of other companies, other permanent investments, and treasury stocks and bonds, stock bonus, and discount on stocks and bonds—it will be seen that they have increased at substantially the same ratio as the capital liabilities, which consist of capital stock, funded debt, and cash investment. Current liabilities show considerably greater increases than current assets.

TABLE 68.—*Commercial and mutual systems combined—Condensed balance sheet: 1907 and 1902.*

	1907	1902	PER CENT DISTRIBUTION.		Per cent of increase.
			1907	1902	
Total assets	$994,842,990	$466,421,553	100.0	100.0	113.3
Capital assets	907,601,073	413,465,581	91.2	88.6	119.5
Current assets	87,241,917	52,955,972	8.8	11.4	64.7
Total liabilities	994,842,990	466,421,553	100.0	100.0	113.3
Capital liabilities	808,141,324	368,441,364	81.2	79.0	119.3
Current liabilities	96,384,060	45,615,331	9.7	9.8	111.3
Net surplus and reserves	90,317,606	52,364,858	9.1	11.2	72.5

Income account.—Table 69 shows the various items of income and expenditure which each company was requested to state separately and is a comparative summary of the income account for the commercial and mutual systems for 1907 and 1902, with the commercial systems and mutual systems shown separately for 1907. The total income, and operating expenses and fixed charges, by states and geographic divisions, may be found in Table 4 of Chapter II.

This table involves small duplications of income, namely, $380,952 in 1907 and $268,044 in 1902, which represent interest and dividends of certain independent telephone companies received by other independent telephone companies. These amounts enter on the one hand into the gross income, and on the other hand, in part, into the "deductions from income" (interest) and in part into the "deductions from net income" (dividends). As the amounts can not be distributed as between interest and dividends, the duplication can not be eliminated; but the figures are comparatively small and do not affect the general conclusions to be drawn from the table. Duplications due to intercompany dividend and interest payments of the Bell system have been excluded.

TABLE 69.—COMMERCIAL AND MUTUAL SYSTEMS—INCOME ACCOUNT: 1907 AND 1902.

	COMMERCIAL AND MUTUAL SYSTEMS.					COMMERCIAL SYSTEMS.		MUTUAL SYSTEMS.	
	1907	1902	Per cent distribution. 1907	Per cent distribution. 1902	Per cent of increase.	1907	Per cent distribution.	1907	Per cent distribution.
Gross income	$184,461,747	$86,825,536	100.0	100.0	112.5	$183,784,037	100.0	$677,710	100.0
Operating earnings	174,868,918	81,599,769	94.8	94.0	114.3	174,194,500	94.8	674,418	99.5
Telephone business	174,315,061	81,462,233	94.5	93.8	114.0	174,100,624	94.7	214,437	31.6
Assessments	553,857	137,536	0.3	0.2	302.7	93,876	0.1	459,981	67.9
Operating expenses	118,248,576	56,867,062	64.1	65.5	107.9	117,690,964	64.0	557,612	82.3
Net earnings from operation	56,620,342	24,732,707	30.7	28.5	128.9	56,503,536	30.7	116,806	17.2
Income from other sources, total	9,592,829	5,225,767	5.2	6.0	83.6	9,589,537	5.2	3,292	0.5
Interest on bonds and dividends on stock of other telephone companies	380,952	268,044	0.2	0.3	282.4	380,502	0.2	450	0.1
Other permanent investments	644,065		0.3			644,065	0.4		
Leased lines, wires and conduits	2,411,486	1,197,476	1.3	1.4	101.4	2,410,803	1.3	683	0.1
Real-estate rentals	3,671,629	1,348,894	2.0	1.6	172.2	3,671,486	2.0	143	(1)
Interest	1,249,313	1,359,953	0.7	1.6	[2]8.1	1,249,313	0.7		
Miscellaneous	1,235,384	1,051,400	0.7	1.2	17.5	1,233,368	0.7	2,016	0.3
Gross income less operating expenses (i. e., net earnings from operation plus income from other sources)	66,213,171	29,958,474	35.9	34.5	121.0	66,093,073	36.0	120,098	17.7
Deductions from income (fixed charges), total	22,553,729	8,297,709	12.2	9.6	171.8	22,535,432	12.3	18,297	2.7
Taxes	6,368,731	2,944,281	3.5	3.4	116.3	6,358,290	3.5	10,441	1.5
Interest	16,127,817	5,343,325	8.7	6.2	201.8	16,120,130	8.8	7,687	1.1
On funded debt	12,316,109	3,511,948	6.7	4.0	250.7	12,315,579	6.7	530	0.1
On real-estate mortgages	66,343		(1)			66,282	(1)	61	(1)
On floating debt	3,745,365	1,831,377	2.0	2.1	108.1	3,738,269	2.0	7,096	1.0
Rental paid for use of leased lines	57,181	10,103	(1)	(1)	466.0	57,012	(1)	169	(1)
Net income	43,659,442	21,660,765	23.7	24.9	101.6	43,557,641	23.7	101,801	15.0
Deductions from net income, total	23,733,670	14,982,719	12.9	17.3	58.4	23,731,883	12.9	1,787	0.3
Dividends on preferred stock	1,703,482	86,862	0.9	0.1	1,861.1	1,703,447	0.9	35	(1)
Dividends on common stock	22,030,188	14,895,857	11.9	17.2	47.9	22,028,436	12.0	1,752	0.3
Surplus	19,925,772	6,678.046	10.8	7.7	198.4	19,825,758	10.8	100,014	14.8

[1] Less than one-tenth of 1 per cent. [2] Decrease.

In 1907 the commercial companies furnished more than 99 per cent of the combined income of commercial and mutual systems, and the mutual systems less than 1 per cent.

Some mixed systems which did both a commercial and a mutual business are included in the commercial class, the commercial business being in excess of the mutual. Hence a small amount of income from mutual assessments appears for the commercial systems.

The mutual systems for the two censuses are not on the same footing and hence comparisons for the separate systems for 1902 are not given. To assist in the study of the statistics the table shows the per cent distribution of income for the commercial and mutual systems combined in 1907 and 1902 and for the commercial and mutual systems separately in 1907.

Operating expenses for commercial and mutual systems combined show a slight decrease in ratio from 1902 to 1907. Deductions from income show a higher ratio in 1907 than in 1902, the increase being chiefly in interest paid on funded debt. The dividend deductions from net income, though showing an increase of 58.4 per cent in the aggregate amount, have been kept well within net income. Dividends on common stock constitute a much smaller part of income in 1907 than in 1902, but, as a result, the remaining surplus shows an increased ratio.

Operating expenses.—A comparative analysis of the operating expenses for commercial and mutual systems combined in 1907 and 1902 and for the commercial and mutual systems separately in 1907 is given in Table 70.

TABLE 70.—COMMERCIAL AND MUTUAL SYSTEMS—ANALYSIS OF OPERATING EXPENSES: 1907 AND 1902.

	COMMERCIAL AND MUTUAL SYSTEMS.					COMMERCIAL SYSTEMS.		MUTUAL SYSTEMS.	
	1907	1902	Per cent distribution. 1907	Per cent distribution. 1902	Per cent of increase.	1907	Per cent distribution.	1907	Per cent distribution.
Total operating expenses	$118,248,576	$56,867,062	100.0	100.0	107.9	$117,690,964	100.0	$557,612	100.0
General operation and maintenance	101,804,100	49,587,964	86.1	87.2	105.3	101,294,889	86.1	509,211	91.3
Salaries	19,298,423	9,885,886	16.3	17.4	95.2	19,245,349	16.4	53,074	9.5
Wages	48,980,704	26,369,735	41.4	46.4	85.7	48,660,223	41.3	320,481	57.5
Maintenance and legal expenses	33,524,973	13,332,343	28.4	23.4	151.5	33,389,317	28.4	135,656	24.3
Rentals of instruments and apparatus	5,658,207	2,837,013	4.8	5.0	99.4	5,652,879	4.8	5,328	1.0
Rentals of offices and other real estate	6,990,170	2,498,814	5.9	4.4	179.7	6,975,359	5.9	14,811	2.7
Rentals of conduits and underground privileges	1,613,513	681,727	1.4	1.2	136.7	1,613,513	1.4	.....	.....
Telephone traffic paid or due to other companies	1,230,948	442,260	1.0	0.8	178.3	1,204,738	1.0	26,210	4.7
Miscellaneous	951,638	819,284	0.8	1.4	16.2	949,586	0.8	2,052	0.4

Wages and salaries combined constitute the largest part of all operating expenses—57.7 per cent in 1907 and 63.8 per cent in 1902. Of the total for salaries and wages, wages formed the larger part, and formed substantially the same proportion of the total pay roll at both censuses—71.7 per cent in 1907 and 72.7 per cent in 1902.

Maintenance and legal expenses, which form the next largest item of operating expenses, constituted a somewhat larger part of them in 1907 than in 1902. This item groups expenses which it would be highly desirable to differentiate, but, as there is no standard system of accounting in use by all telephone companies, it was impossible to compile reliable itemized figures. "Maintenance" includes all repairs, reconstruction, and expenses incident to the maintenance of the physical properties, while "Legal expenses" cover the cost of all legal services required for the maintenance and operation of the property. It was not possible to report separately these two classes of expense.

The analysis of the two classes of systems is given primarily to illustrate the statistics for the mutual systems, which, though representing but a small part of the volume of telephone business, are of interest on account of the special character of their organization and operation.

In 1907 the pay roll formed 67 per cent of all operating expenses for mutual systems, compared with 57.8 per cent for the commercial systems. The mutual companies did not report any expenditures for rent of conduits and underground privileges.

Deductions from income.—Deductions from income, or fixed charges, comprise three classes of expense—taxes, interest, and rentals paid for leased lines. From Table 69 it is seen that for commercial systems and for the commercial and mutual systems combined, interest, and particularly interest on funded debt, is the most important item. Table 71 gives the per cent distribution of the total fixed charges among the several items.

TABLE 71.—*Commercial and mutual systems—Per cent distribution of deductions from income: 1907 and 1902.*

	PER CENT DISTRIBUTION.			
	Commercial and mutual systems.		Commercial systems.	Mutual systems.
	1907	1902	1907	1907
Deductions from income, total	100.0	100.0	100.0	100.0
Taxes	28.2	35.5	28.2	57.1
Interest, total	71.5	64.4	71.5	42.0
On funded debt	54.6	42.3	54.6	2.9
On real-estate mortgages	0.3	.....	0.3	0.3
On floating debt	16.6	22.1	16.6	38.8
Rental paid for leased lines	0.3	0.1	0.3	0.9

Although taxes increased at the rate of 116.3 per cent for commercial and mutual systems, they formed only 28.2 per cent of the fixed charges in 1907 as compared with 35.5 per cent in 1902. A specific report of the different kinds of taxes was made for the first time at this census, and Table 72 gives the detailed statistics therefor.

TABLE 72.—*Commercial and mutual systems—Taxes: 1907.*

				PER CENT DISTRIBUTION.		
	Commercial and mutual systems.	Commercial systems.	Mutual systems.	Commercial and mutual systems.	Commercial systems.	Mutual systems.
Taxes, total	$6,368,731	$6,358,290	$10,441	100.0	100.0	100.0
On real and personal property	3,380,415	3,370,848	9,567	53.1	53.0	91.6
On capital stock	803,923	803,422	501	12.6	12.6	4.8
On earnings	1,324,829	1,324,529	300	20.8	20.8	2.9
Miscellaneous	859,564	859,491	73	13.5	13.5	0.7

The taxes combined as "Miscellaneous" are chiefly franchise and pole taxes, principally the former.

Interest charges have increased largely and very much faster than taxes. Of the total interest charges for commercial and mutual systems, the interest on funded debt formed 76.4 per cent in 1907, compared with 65.7 per cent in 1902, and the interest on real-

estate mortgages and floating debt combined formed 23.6 per cent in 1907, compared with 34.3 per cent for floating debt in 1902, showing a considerable increase of ratio for funded debt interest charges and a decrease for floating debt.

The payments made for the use of leased lines include a large number of rentals, although the aggregate amount paid is not large. For example, nineteen systems in Illinois reported an aggregate expenditure of $1,287 for rental of lines; sixteen in Indiana, $2,021; twenty-three in New York, $1,472; and eight in Pennsylvania, $13,706—the last total being the largest amount shown for any state. They represent established lines and to a large extent rural lines, or lines perhaps originally erected for private service.

Income of independent farmer or rural lines.—As a rule, the larger companies kept records from which the financial data called for by the census schedule could be obtained, but many of the independent farmer or rural lines, which include some small mutual systems, could furnish no data concerning financial transactions, and in those cases in which such data were furnished only income from operations and assessments was reported. The statistics reported are presented in Table 73 by geographic divisions.

The financial data for the farmer or rural lines are not included in the tables presenting financial statistics for commercial and mutual systems. This omission directs attention to the fact that the totals for gross income are somewhat less than the true aggregate for all of the systems and lines that were in operation in the United States during 1907.

Income from operations and assessments amounting to $1,783,458 was reported by 12,430 independent rural lines which operated 448,685 telephones, or 79.3 per cent of the total number of telephones (565,649) on all such lines. No income, whether from operations or assessments, was reported for lines equipped with 116,964 telephones, or 20.7 per cent of the total number. The expenses, when reported, were practically the same as the income. The average income per line for the lines reporting income was $142.76 and per telephone $3.97, which can be taken as representing approximately the expense per line and per telephone for the farmer or rural lines. When this average per telephone is applied to the total number (565,649) of telephones on all independent farmer or rural lines, $2,245,627 becomes the estimate of the total income and expense for all lines of this class.

TABLE 73.—INDEPENDENT FARMER OR RURAL LINES—INCOME FROM OPERATIONS AND ASSESSMENTS, BY GEOGRAPHIC DIVISIONS: 1907.

DIVISION.	Number of lines.	Number of lines reporting income.	INCOME.					PER CENT DISTRIBUTION.				
			Total.	From operations.	From assessments.	Per cent of total.		Number of lines.	Number of lines reporting income.	Income.		
						Income.	Assessments.			Total.	From operations.	From assessments.
United States	17,702	12,430	$1,783,458	$460,653	$1,322,805	25.8	74.2	100.0	100.0	100.0	100.0	100.0
North Atlantic	1,343	849	140,129	67,604	72,525	48.2	51.8	7.6	6.8	7.9	14.7	5.5
South Atlantic	965	559	105,386	43,505	61,881	41.3	58.7	5.5	4.5	5.9	9.4	4.7
North Central	11,374	8,651	1,225,288	241,351	983,937	19.7	80.3	64.3	69.6	68.7	52.4	74.4
South Central	2,718	1,602	204,005	69,776	134,229	34.2	65.8	15.4	12.9	11.4	15.1	10.1
Western	1,302	769	108,650	38,417	70,233	35.4	64.6	7.4	6.2	6.1	8.3	5.3

Detailed statistics for the independent farmer or rural lines in 1907 are given by states and territories and geographic divisions in Table 84. The North Central division had approximately two-thirds of the total number of lines and of total income reported. The state of Iowa leads in number of lines, with 3,029, followed by Missouri with 2,344, and Illinois with 1,409. The states of Kansas, Nebraska, New York, Texas, Ohio, Minnesota, and Oklahoma follow in the order named with fewer than 1,000 but more than 500 lines each, and the states of Connecticut, Maryland, and Delaware combined, New Jersey, and Utah had less than 10 lines each. More than one-half of the income from operations and nearly three-fourths of the assessments are credited to the North Central division. In each division the greater part of the income was from assessments.

Relation of traffic to income and expense.—The census statistics were not collected with a view to making exact computations concerning the income and expenses per telephone or per message. Such statistics necessarily include data for all systems irrespective of the conditions under which these systems were operated. The methods of bookkeeping are not uniform for all companies. Some companies charge to operating expenses certain items that are charged by others to capital account. A considerable proportion of the companies, especially the smaller ones, have very imperfect systems of accounting, and the data reported by such were necessarily not complete or satisfactory.

In considering the income and expenses per unit, proper weight should be given to the different methods of charging for telephone service; but this is impossi-

ble in census statistics in which the reports for many companies are combined. For this reason the computation of earnings and expenses per telephone or message given in Tables 74 and 75 should be accepted only as indicating, or approximating, the actual conditions.

TABLE 74.—*Commercial and mutual systems—Operating earnings and operating expenses per station and per message: 1907.*

	Commercial and mutual systems.	Commercial systems.	Mutual systems.
Average number of messages per station or telephone per year	2,048	2,069	1,128
Average operating earnings:			
Per station or telephone	$31.49	$32.10	$5.35
Per message	0.01538	0.01551	0.00475
Average operating expense:			
Per station or telephone	21.29	21.69	4.43
Per message	0.01040	0.01048	0.00393
Average net operating earnings:			
Per station or telephone	10.20	10.41	0.93
Per message	0.00498	0.00503	0.00082
Ratio of operating expenses to operating earnings	67.6	67.6	82.7

The revenue and operating expenses of the mutual systems were very much less than those of the commercial companies, as a result of the fact that mutual systems are essentially rural and their revenues are designed to cover expenses only. The inclusion of the mutual systems with the commercial companies does not materially affect the results, as the mutual systems form such a small part of the total number of systems. For commercial and mutual systems combined the average operating earnings were $31.49 per telephone and 1.538 cents per message for 1907, and $35.24 per telephone and 1.609 cents per message for 1902.

In 1907 the ratio of operating expenses to operating earnings for the commercial systems was 67.6 per cent and was much lower than for the mutual systems—82.7 per cent.

Table 75 shows for the commercial systems alone the average gross income per station or telephone and per message and its distribution to the various items of disbursements. It is, in one sense, improper to calculate the average gross income per station or telephone—that is, to divide the total income of companies from all sources by the number of stations or telephones—since the gross income includes income from outside investments having nothing to do with the telephone traffic. Inasmuch, however, as the deductions from the net income (the dividends and the surplus) are derived from the gross income from all sources and not from the earnings from operation alone, it is necessary, if any calculation of the amounts of these various items per station or per message is to be made, to compute similarly per station or per message the total income from which these items are derived. Since the difference between the gross income and the earnings from operation is comparatively slight, this distribution does show, with approximate accuracy, what part of the amount paid by the public for the use of a telephone per year and what part of the amount paid per message goes to the different purposes indicated.

TABLE 75.—*Commercial systems—Income and expenses per station and per message: 1907 and 1902.*

	1907	1902
Average number of messages per station or telephone per year	2,069	2,233
Average gross income:		
Per station or telephone	$33.86	$38.87
Per message	0.01636	0.01740
Average earnings from operations—		
Per station or telephone	32.10	36.52
Per message	0.01551	0.01635
Average income from other sources—		
Per station or telephone	1.77	2.35
Per message	0.00085	0.00105
Average operating expense:		
Per station or telephone	21.69	25.42
Per message	0.01048	0.01138
Average deductions from income (taxes and fixed charges):		
Per station or telephone	4.15	3.72
Per message	0.00201	0.00167
Average net income:		
Per station or telephone	8.03	9.72
Per message	0.00388	0.00435
Average deductions from net income (dividends)—		
Per station or telephone	4.37	6.73
Per message	0.00211	0.00301
Average surplus—		
Per station or telephone	3.65	2.99
Per message	0.00177	0.00134

For commercial systems the average number of messages per station or telephone per year shows a considerable decrease from 1902 to 1907. The average for earnings from operation, and operating expenses also decreased, while the average for fixed charges increased, whether measured by the telephone unit or the message unit. While for the reasons already stated the averages in the table should not be accepted as exact, the decreases in the income and operating expenses per telephone and per message are in harmony with the generally accepted understanding of actual conditions. The increase in the number of telephones operated under the measured system of payment and the improvements in business methods are the principal factors leading to these results. The increase in fixed charges is due to the increase in interest charges accompanying the large increase in funded debt.

The income and operating expenses per unit vary greatly for different states, being, in general, high for the states containing the large cities and districts of high telephone density. Extension of the equipment of the several companies, however, occurs without regard to the political divisions of the country. In the majority of instances it was necessary to assign the entire income and expense account to the state in which the principal office was located, although a portion of the wire and some of the telephones were credited to another state. Therefore it is impossible to make satisfactory computations of the average income and expense items per telephone or per message for the separate states.

Income account of systems having at least 1,000 stations or telephones.—At the census of 1902 there were 194 commercial and mutual telephone systems with

at least 1,000 stations or telephones each. The financial statistics furnished by these large companies are as a rule more exact than those for the small systems, and consequently comparisons and averages based on them are in some respects more satisfactory than those based on the statistics for all systems. Table 76 gives a comparative income statement for systems having 1,000 or more stations and for those with less than 1,000 stations in 1907 and 1902, respectively.

TABLE 76.—COMMERCIAL AND MUTUAL SYSTEMS COMBINED, CLASSIFIED ACCORDING TO NUMBER OF STATIONS OR TELEPHONES—INCOME ACCOUNT: 1907 AND 1902.

	COMMERCIAL AND MUTUAL SYSTEMS.		SYSTEMS HAVING AT LEAST 1,000 STATIONS OR TELEPHONES.		SYSTEMS HAVING LESS THAN 1,000 STATIONS OR TELEPHONES.	
	1907	1902	1907	1902	1907	1902
Number of systems	5,269	4,151	614	194	4,655	3,957
Number of stations or telephones	5,552,929	2,315,297	4,397,725	1,679,199	1,155,204	636,098
Gross income	$184,461,747	$86,825,536	$166,496,616	$76,567,941	$17,965,131	$10,257,595
Gross earnings from operation	174,868,918	81,599,769	157,167,289	71,374,134	17,701,629	10,225,635
Operating expenses	118,248,576	56,867,062	107,031,030	50,806,748	11,217,546	6,060,314
Net earnings from operation	56,620,342	24,732,707	50,136,259	20,567,386	6,484,083	4,165,321
Income from other sources	9,592,829	5,225,767	9,329,327	5,193,807	263,502	31,960
Gross income less operating expenses	66,213,171	29,958,474	59,465,586	25,761,193	6,747,585	4,197,281
Deductions from income (taxes and fixed charges)	22,553,729	8,297,709	21,143,370	7,562,950	1,410,359	734,759
Net income	43,659,442	21,660,765	38,322,216	18,198,243	5,337,226	3,462,522
Dividends	23,733,670	14,982,719	22,671,939	14,357,918	1,061,731	624,801
Surplus	19,925,772	6,678,046	15,650,277	3,840,325	4,275,495	2,837,721

	PER CENT OF TOTAL.				PER CENT OF INCREASE.		
	1,000 stations and over.		Less than 1,000 stations.		Total.	1,000 stations and over.	Less than 1,000 stations.
	1907	1902	1907	1902			
Number of systems	11.7	4.7	88.3	95.3	26.9	216.5	17.6
Number of stations or telephones	79.2	72.5	20.8	27.5	139.8	161.9	81.6
Gross income	90.3	88.2	9.7	11.8	112.5	117.4	75.1
Gross earnings from operation	89.9	87.5	10.1	12.5	114.3	120.2	73.1
Operating expenses	90.5	89.3	9.5	10.7	107.9	110.7	85.1
Net earnings from operation	88.5	83.2	11.5	16.8	128.9	143.8	55.7
Income from other sources	97.3	99.4	2.7	0.6	83.6	79.6	724.5
Gross income less operating expenses	89.8	86.0	10.2	14.0	121.0	130.8	60.8
Deductions from income (taxes and fixed charges)	93.7	91.1	6.3	8.9	171.8	179.6	91.9
Net income	87.8	84.0	12.2	16.0	101.6	110.6	54.1
Dividends	95.5	95.8	4.5	4.2	58.4	57.9	69.9
Surplus	78.5	57.5	21.5	42.5	198.4	307.5	50.7

Although the average number of telephones per system increased from 558 in 1902 to 1,054 in 1907 for all systems, the average decreased from 8,656 to 7,162 in the case of systems with at least one thousand telephones, and increased from 161 to 248 in the case of systems with less than one thousand telephones. In a number of systems the class having at least one thousand telephones shows a much higher percentage of increase than the class having fewer telephones. This is in part due to the passing of systems from the smaller class to the larger during the interval between 1902 and 1907. As a result the former class had larger proportions of the total in 1907 than in 1902 for most of the items shown in the table, the exceptions being "Income from other sources" and "Dividends." In the case of the companies having less than one thousand telephones the percentages of gain for these two items were larger, but the amounts per system were small, the "Dividends" averaging $228 per system in 1907 and $158 in 1902, and the "Income from other sources" averaging but $57 per system in 1907 and $8 in 1902. Only eleven of the systems comprising the class with at least one thousand telephones in 1907 were mutual companies, all of the others being commercial.

Table 77 shows for commercial and mutual systems, classified according to number of stations or telephones at the two census periods, the per cent distribution of gross income according to the disposition made of it.

TABLE 77.—*Commercial and mutual systems combined, classified according to number of stations or telephones—Per cent distribution of gross income by disposition: 1907 and 1902.*

	COMMERCIAL AND MUTUAL SYSTEMS.		SYSTEMS HAVING AT LEAST 1,000 STATIONS OR TELEPHONES.		SYSTEMS HAVING LESS THAN 1,000 STATIONS OR TELEPHONES.	
	1907	1902	1907	1902	1907	1902
Gross income	100.0	100.0	100.0	100.0	100.0	100.0
Operating expenses	64.1	65.5	64.3	66.4	62.4	59.1
Deductions from income, total	12.2	9.6	12.7	9.9	7.9	7.2
Taxes	3.5	3.4	3.6	(1)	2.2	(1)
Interest, total	8.7	6.2	9.1	(1)	5.6	(1)
On funded debt	6.7	4.0	7.0	(1)	3.4	(1)
On real-estate mortgages	(2)	.....	(2)	(1)	0.1	(1)
On floating debt	2.0	2.1	2.0	(1)	2.0	(1)
Rentals paid for use of leased lines	(2)	(2)	(2)	(1)	0.1	(1)
Dividends on preferred stock	0.9	0.1	0.9	(1)	0.9	(1)
Dividends on common stock	11.9	17.2	12.7	(1)	5.0	(1)
Surplus	10.8	7.7	9.4	5.0	23.8	27.7

[1] Not shown separately. [2] Less than one-tenth of 1 per cent.

The averages per station or telephone and per message of the various items of the income and expense account for systems classified according to number of stations or telephones are of interest and are given in Table 78.

TABLE 78.—COMMERCIAL AND MUTUAL SYSTEMS COMBINED, CLASSIFIED ACCORDING TO NUMBER OF STATIONS OR TELEPHONES—AVERAGES PER STATION AND PER MESSAGE FOR INCOME AND EXPENSE ACCOUNTS: 1907 AND 1902.

	COMMERCIAL AND MUTUAL SYSTEMS.		SYSTEMS HAVING AT LEAST 1,000 STATIONS OR TELEPHONES.		SYSTEMS HAVING LESS THAN 1,000 STATIONS OR TELEPHONES.	
	1907	1902	1907	1902	1907	1902
Average number of messages per station or telephone per year	2,048	2,190	2,166	(1)	1,598	(1)
Average gross income:						
Per station or telephone	$33.22	$37.50	$37.86	$45.60	$15.55	$16.13
Per message	0.01622	0.01712	0.01748	(1)	0.00973	(1)
Average earnings from operation—						
Per station or telephone	31.49	35.24	35.74	42.50	15.32	16.08
Per message	0.01538	0.01609	0.01650	(1)	0.00959	(1)
Average income from other sources—						
Per station or telephone	1.73	2.26	2.12	3.09	0.23	0.05
Per message	0.00084	0.00103	0.00098	(1)	0.00014	(1)
Average operating expense:						
Per station or telephone	21.29	24.56	24.34	30.26	9.71	9.53
Per message	0.01040	0.01122	0.01124	(1)	0.00607	(1)
Average deductions from income (taxes and fixed charges):						
Per station or telephone	4.06	3.58	4.81	4.50	1.22	1.16
Per message	0.00198	0.00164	0.00222	(1)	0.00076	(1)
Average net income:						
Per station or telephone	7.86	9.36	8.71	10.84	4.62	5.44
Per message	0.00384	0.00427	0.00402	(1)	0.00289	(1)
Average deductions from net income (dividends)—						
Per station or telephone	4.27	6.47	5.16	8.55	0.92	0.98
Per message	0.00209	0.00295	0.00238	(1)	0.00057	(1)
Average surplus—						
Per station or telephone	3.59	2.88	3.56	2.29	3.70	4.46
Per message	0.00175	0.00132	0.00164	(1)	0.00232	(1)

[1] Not reported separately.

The above figures, of course, do not show the ratio of the operating expenses to the operating earnings from telephone traffic, since gross income includes revenue from other sources. The percentages which operating expenses bore to operating earnings are shown in Table 79.

TABLE 79.—*Per cent of operating expenses to operating earnings: 1907 and 1902.*

	Per cent.
All commercial and mutual systems:	
1907	67.6
1902	69.7
Systems having at least 1,000 stations or telephones:	
1907	68.1
1902	71.2
Systems having less than 1,000 stations or telephones:	
1907	63.4
1902	59.3

CHAPTER VI.

EMPLOYEES, SALARIES, AND WAGES.

The schedule of inquiry used in the census of telephone systems in 1907 did not call for as much detail in regard to employees as did the schedule used in 1902. At the prior census, foremen, inspectors, linemen, wire men and battery men, and trouble men were reported separately; but at the later census all wage-earners except operators were grouped in one class. The operators were reported separately and by sex. As a result of the fact that the employees of the majority of companies perform various duties, it was regarded as advantageous to secure in this census separate statistics for only the following classes of employees, namely, salaried officers of corporations, other officers, such as superintendents, general managers, etc., clerks and bookkeepers, operators, and all other wage-earners.

Table 4 of Chapter II presents the number and salaries of salaried employees and the average number of wage-earners and the wages for all systems, by states, for 1907 and 1902, and since farmer or rural lines reported no employees or wages, or salaries, the same figures are the figures for commercial and mutual systems.

TABLE 80.—COMMERCIAL AND MUTUAL SYSTEMS—EMPLOYEES, SALARIES, AND WAGES: 1907 AND 1902.

	COMMERCIAL AND MUTUAL SYSTEMS.			COMMERCIAL SYSTEMS.			MUTUAL SYSTEMS.		
	1907	1902	Per cent of increase.	1907	1902	Per cent of increase.	1907	1902	Per cent of increase.
Employees, total:									
Number	144,169	78,752	83.1	142,436	77,588	83.6	1,733	1,164	48.9
Salaries and wages	$68,279,127	$36,255,621	88.3	$67,905,572	$36,077,661	88.2	$373,555	$177,960	109.9
Salaried employees—									
Number	25,298	14,124	79.1	24,959	13,958	78.8	339	166	104.2
Salaries	$19,298,423	$9,885,886	95.2	$19,245,349	$9,871,596	95.0	$53,074	$14,290	271.4
Wage-earners—									
Total average number	118,871	64,628	83.9	117,477	63,630	84.6	1,394	998	39.7
Total wages	$48,980,704	$26,369,735	85.7	$48,660,223	$26,206,065	85.7	$320,481	$163,670	95.8
Operators—									
Average number	80,214	39,858	101.2	79,085	(1)	.....	1,129	(1)	.....
Wages	$24,309,877	$10,765,098	125.8	$24,080,873	(1)	.....	$229,004	(1)	.....
Men—									
Average number	3,576	2,525	41.6	3,432	(1)	.....	144	(1)	.....
Wages	$1,218,387	$729,666	67.0	$1,184,224	(1)	.....	$34,163	(1)	.....
Per cent of total operators	4.5	6.3	.....	4.3	.....	.....	12.8	.....	.....
Women—									
Average number	76,638	37,333	105.3	75,653	(1)	.....	985	(1)	.....
Wages	$23,091,490	$10,035,432	130.1	$22,896,649	(1)	.....	$194,841	(1)	.....
Per cent of total operators	95.5	93.7	.....	95.7	.....	.....	87.2	.....	.....
All other wage-earners—									
Average number	38,657	24,770	56.1	38,392	(1)	.....	265	(1)	.....
Wages	$24,670,827	$15,604,637	58.1	$24,579,350	(1)	.....	$91,477	(1)	.....

[1] Not shown separately in 1902 report.

As before explained, because of the differences in the classification of the mutual systems and the independent farmer or rural lines at the two censuses, the statistics for the commercial systems and for the mutual systems for 1907 are not strictly comparable with the statistics for the same classes in 1902. But the effect of the change in classification in the statistics pertaining to employees, salaries, and wages is comparatively small and hence they have been shown in detail in the foregoing table for the commercial systems and the mutual systems for 1907 and 1902. The independent farmer or rural lines and some of the small mutual systems have no persons regularly employed to operate and maintain the systems. All of the work on the lines is done by the subscribers themselves at odd times, and no statistics could be obtained concerning the number employed or the time given to the work. Reliable statistics for employees could be secured only from the commercial and the more important mutual systems. All persons employed in connection with the management, operation, or maintenance of the lines are reported in the census data. The employees engaged on new construction work are not included, but their salaries and wages are included in the total given for the "cost of lines, real estate, equipment, etc., added during the year." The statistics for employees, therefore, show as nearly as possible the average number of persons required to operate the telephone systems during the year, under normal conditions.

The increases in the number of employees and wages between 1902 and 1907, as shown in Table 80, are quite in keeping with the other increases in the industry. The preponderance of women operators over men has increased since the former census, the proportion of the men having diminished from 6.3 per cent of the total number of operators in 1902 to 4.5 per cent in 1907. A comparison of the number of

employees at the times of the several censuses illustrates the rapid growth of the industry. In 1907 the salaried employees and wage-earners numbered 144,169. In 1880, when the first census of telephone systems was included in the decennial census, they numbered only 3,338; in 1890, 8,645; and in 1902, 78,752.

For each class of employees the percentage of increase in their number is less than that in their salaries or wages, a condition which indicates a considerable increase in the average compensation received by the employees of telephone companies in 1907 over that received in 1902.

The number of persons employed in a telephone exchange indicates the size of the exchange and the volume of business done by it. In 1880 the total number of exchanges in the United States was 437 and the total number of employees 3,338, an average of 7.6 employees of all classes to each exchange. In 1890, when the total number of exchanges was 1,241 and the total number of employees 8,645, the average number of employees per exchange had declined to 7. At the 1890 census the operators, of whom there were 4,769, were for the first time enumerated separately, and there was an average of 3.8 operators to each exchange. A reference to Table 81 shows that this was also the average number of operators per exchange in 1902 but in 1907 the average had increased to 5.2. There are many exchanges which employ scores of operators, but the average is kept down by the much more numerous exchanges that have only one or two.

The average number of stations or telephones per employee has increased very materially since the last census, as shown by the following comparative tabular statement:

Commercial and mutual systems—Average number of stations or telephones per employee: 1907 and 1902.

DIVISION.	Census.	Number of stations or telephones.	Number of employees.	Average number of stations or telephones per employee.
United States	1907	5,552,929	144,169	39
	1902	2,315,297	78,752	29
North Atlantic	1907	1,619,566	46,539	35
	1902	647,670	27,405	24
South Atlantic	1907	339,430	9,802	35
	1902	143,314	5,040	28
North Central	1907	2,568,719	58,534	44
	1902	1,091,168	30,213	36
South Central	1907	514,330	16,427	31
	1902	225,999	8,326	27
Western	1907	510,884	12,867	40
	1902	207,146	7,768	27

Table 81 gives, by geographic divisions, the number of public exchanges and the average number of the several classes of employees per exchange, for commercial and mutual systems combined, at each of the last two censuses, and for the commercial and mutual systems separately in 1907. The statistics disclose the relative magnitude of the exchange force in the several geographic divisions of the United States.

Practically every item of the telephone statistics bears witness to the great advance the industry made from 1902 to 1907. Not only did the number of systems and exchanges greatly increase but the individual companies expanded in their operations. The average number of wage-earners required to operate an exchange increased, for commercial and mutual systems, from 6.2 per exchange in 1902 to 7.7 per exchange in 1907. For commercial systems alone the increase was from 6.8 per exchange to 8 and for mutual systems alone from 1.1 per exchange to 1.6. The number of operators per exchange increased from 3.8 in 1902 to 5.2 in 1907 for the two classes combined. The tables for 1902 did not show the number of operators for commercial and mutual systems separately; but in 1907 each commercial exchange employed an average of 5.4 operators, and each mutual exchange an average of 1.4.

In the combined statistics for commercial and mutual exchanges the North Atlantic division had the largest averages in both 1902 and 1907 for each class of employees, this fact indicating that the systems were generally larger in this division than in any other. In the combined systems the Western division ranked second at both censuses, as shown by the average number of all wage-earners, all operators, and women operators.

Commercial systems owned fourteen-fifteenths of the exchanges reported in Table 81, and it is the predominance of their influence that resulted in the conditions just noticed for commercial and mutual systems combined. Considered separately for 1907, the statistics for commercial systems show that the North Atlantic division had per exchange the largest average number of salaried employees, of wage-earners, and of each class of wage-earners, and that it therefore contained the commercial exchanges of largest average size. The commercial systems of the Western division retained the second place with less certainty than did the commercial and mutual systems combined. For total number of wage-earners in 1907 they still show next to the largest number, an average of 7.2 per exchange; but both the South Atlantic and the North Central divisions follow closely, with 7 and 6.8, respectively. In average number of operators the North Central division exceeded the Western division, and the South Atlantic division was behind the Western division by an average per exchange of only 0.4.

The great difference between the average number of the various classes of employees for commercial systems and those for mutual systems is so obvious as to need no interpretation. It is noticeable, however, that in the North Atlantic division, where all averages were highest for commercial systems, with the exception of men operators all were lowest for mutual systems.

The mutual systems of the four other geographic divisions appear to rival each other very closely as to

average size and amount of business transacted. The average number of operators, which seems to be the most accurate basis of comparison, is 1.5 per exchange for the South Atlantic and the Western divisions and 1.4 for the North Central and the South Central divisions. For all wage-earners the North Central division shows the highest average, 1.8; but the others follow closely, the Western with 1.7, and the South Atlantic and the South Central with 1.6 each.

Tables 82, 83, and 84, for commercial systems, mutual systems, and independent farmer or rural lines, respectively, show in detail the complete statistics, except for capitalization and balance sheet, as called for by the schedules of inquiry in 1907.

TABLE 81.—COMMERCIAL AND MUTUAL SYSTEMS—NUMBER OF PUBLIC EXCHANGES, NUMBER OF EMPLOYEES, AND AVERAGE NUMBER OF EMPLOYEES PER EXCHANGE, BY GEOGRAPHIC DIVISIONS: 1907 AND 1902.

DIVISION.	COMMERCIAL AND MUTUAL SYSTEMS.			COMMERCIAL SYSTEMS.	MUTUAL SYSTEMS	AVERAGE NUMBER OF EMPLOYEES PER EXCHANGE.			
	1907	1902	Per cent of increase.	1907	1907	Commercial and mutual systems.		Commercial systems.	Mutual systems.
						1907	1902	1907	1907
Number of public exchanges: United States	15,527	10,361	49.9	14,702	825				
North Atlantic	3,049	2,330	30.9	2,922	127				
South Atlantic	1,241	791	56.9	1,141	100				
North Central	7,422	5,212	42.4	6,861	561				
South Central	2,304	1,144	101.4	2,279	25				
Western	1,511	884	70.9	1,499	12				
Number of employees: United States	144,169	78,752	83.1	142,436	1,733	9.3	7.6	9.7	2.1
North Atlantic	46,539	27,405	69.8	46,374	165	15.3	11.7	15.9	1.3
South Atlantic	9,802	5,040	94.5	9,615	187	7.9	6.4	8.4	1.9
North Central	58,534	30,213	93.7	57,225	1,309	7.9	5.8	8.3	2.3
South Central	16,427	8,326	97.3	16,377	50	7.1	7.3	7.2	2.0
Western	12,867	7,768	65.6	12,845	22	8.5	8.8	8.6	1.8
Salaried employees: United States	25,298	14,124	79.1	24,959	339	1.6	1.4	1.7	0.4
North Atlantic	8,064	5,703	41.4	8,042	22	2.6	2.4	2.8	0.2
South Atlantic	1,614	1,015	59.0	1,586	28	1.3	1.3	1.4	0 3
North Central	10,625	4,768	122.8	10,348	277	1.4	0.9	1.5	0.5
South Central	2,984	1,266	135.7	2,974	10	1.3	1.1	1.3	0.4
Western	2,011	1,372	46.6	2,009	2	1.3	1.6	1.3	0.2
Wage-earners: United States	118,871	64,628	83.9	117,477	1,394	7.7	6.2	8.0	1.6
North Atlantic	38,475	21,702	77.3	38,332	143	12.6	9.3	13.1	1.1
South Atlantic	8,188	4,025	103.4	8,029	159	6.6	5.1	7.0	1.6
North Central	47,909	25,445	88.3	46,877	1,032	6.5	4.9	6.8	1.8
South Central	13,443	7,060	90.4	13,403	40	5.8	6.2	5.9	1.6
Western	10,856	6,396	69.7	10,836	20	7.2	7 2	7.2	1.7
Operators: United States	80,214	39,858	101.2	79,085	1,129	5.2	3.8	5 4	1.4
North Atlantic	24,864	11,950	108.1	24,728	136	8.2	5 1	8.5	1.1
South Atlantic	5,084	2,458	106.8	4,937	147	4.1	3.1	4.3	1.5
North Central	34,118	17,350	96.6	33,324	794	4.6	3.3	4.9	1.4
South Central	9,086	4,510	101.5	9,052	34	3.9	3.9	4.0	1.4
Western	7,062	3,590	96.7	7,044	18	4.7	4.1	4.7	1.5
Men: United States	3,576	2,525	41.6	3,432	144	0.2	0.2	0.2	0.2
North Atlantic	1,153	946	21.9	1,113	40	0.4	0.4	0.4	0.3
South Atlantic	357	216	65.3	347	10	0.3	0.3	0.3	0.1
North Central	1,322	985	34.2	1,239	83	0.2	0.2	0.2	0 1
South Central	670	315	112.7	661	9	0.3	0.3	0 3	0.4
Western	74	63	17.5	72	2	0.05	0.07	0.05	0.2
Women: United States	76,638	37,333	105.3	75,653	985	4.9	3.6	5.1	1.2
North Atlantic	23,711	11,004	115.5	23,615	96	7.8	4.7	8.1	0.8
South Atlantic	4,727	2,242	110.8	4,590	137	3.8	2.8	4.0	1.4
North Central	32,796	16,365	100.4	32,085	711	4.4	3.1	4.7	1.3
South Central	8,416	4,195	100.6	8,391	25	3.7	3.7	3.7	1.0
Western	6,988	3,527	98.1	6,972	16	4.6	4.0	4.7	1.3
All other wage-earners: United States	38,657	24,770	56.1	38,392	265	2.5	2.4	2.6	0.3
North Atlantic	13,611	9,752	39.6	13,604	7	4.5	4.2	4.7	0.06
South Atlantic	3,104	1,567	98.1	3,092	12	2.5	2.0	2.7	0.1
North Central	13,791	8,095	70.4	13,553	238	1.9	1.6	2.0	0.4
South Central	4,357	2,550	70.9	4,351	6	1.9	2.2	1.9	0.2
Western	3,794	2,806	35.2	3,792	2	2.5	3.2	2.5	0.2

CHAPTER VII.

TELEPHONE DEVELOPMENT—DESCRIPTIVE.

Industrial and technical development.—The rapid industrial progress of the last decade has been the result of a progressive increase in national activity. Agriculture, mining, commerce, manufacturing, transportation, and, in fact, all the various branches of production and distribution of natural and artificial resources, are gradually coming to be more and more conducted by scientific methods which necessitate intimate correspondence between individual acts and the results which are their aim. In developing the individual efficiency which enables the average worker to accomplish a large amount in proportion to the energy expended and to pass smoothly from one task to the next, an exceedingly important factor has been the extension and improvement of methods of instantaneous communication across space.

Existence of telephone traffic is essentially an indication that time is being saved. By bringing into communication two persons separated by greater or less distances a telephone conversation eliminates the time which would be spent by one or both in traveling to a meeting place, without destroying the gainful element of personal contact; or it cuts down the interval between the conception of an idea and its execution which must necessarily accompany the transmission of written communications. The net result of this saving in time and effort in great cities may be made clear to the mind not only by absolute statistics but by an appeal to the imagination based on the assumption that each telephone may be considered to displace a certain number of actual messengers. It is extremely doubtful if at certain times of the day the streets of the congested business districts in any of our larger cities, or the stairs and elevators of their large office buildings, would have sufficient space to accommodate the number of persons who would have to pass back and forth to carry the necessary communications which are now transmitted over telephone wires. In addition to the saving in this respect, the telephone brings about a further improvement in individual working efficiency by diminishing the period of time during which the action of the mind is interrupted—that is, involved in obtaining the ideas of other persons on the matter that may be under consideration.

The recognition of these principles has led to a widespread adoption of telephone service as a fundamental aid to the routine of the average business firm and household in all parts of the country, in ways of which a brief summary is given in the present connection and which will be described later in more detail. In the local distribution of those classes of supplies which are of most general consumption the telephone aids, as a large number of grocery and provision stores include among their customers a considerable proportion whose residences are equipped with telephones, and such stores make a practice of calling regular patrons every morning to ascertain their needs for the day. Department stores in large cities have installed telephones at the counters, and advertise personal service by telephone, thus enabling a patron to communicate directly with the salesman in that section of the store in which the goods desired are for sale, who can give descriptions and advice, and perform most of the services which would have been involved in a transaction conducted across the counter. In some towns of moderate size the utility of telephone service in building up a regular trade, reducing expense of taking orders, etc., as well as in ministering to the convenience of patrons, has been so thoroughly recognized by tradesmen that they have at their own expense installed telephones upon the premises of customers. Even among persons doing business on a small scale, such as cobblers, cleaners of clothing, and even laundresses, telephone service is coming to be considered necessary for keeping in touch with customers and reducing the amount of idle time. Some railroads have superseded the old plan of using messengers to forward orders to employees whose services are desired at the yards by maintaining, at the expense of the corporation, telephone service at the homes of the employees. In clubs and hotels the telephone is used to a very large extent for sending messages from one floor or room to another, or to the general office, reducing messenger service in that it saves at least one trip for every call as compared with older methods of communication. Factories install interior systems which enable the office to keep in close touch with department foremen; and the use of such systems in connection with long-distance lines makes it possible for a general office in a city to know almost instantly the condition of any order in a main or branch factory, even though it be in a small town many miles distant. Steam and electric railroads are using private telephone systems for the control of car and train movements. Newspapers have increased the efficiency of their service by extensive use of both local and long-distance facilities in gathering news.

Corresponding to the great development of telephone service in towns and urban localities, with its resultant benefits, a rapid extension of this utility which is most significant of one of our important progressive national tendencies has been taking place in the rural districts. Perhaps a primary reason for the beginning of the large use of the telephone in farmhouses was the social need, arising from the isolation which is almost a hardship in districts thinly settled, and where each farmer cultivates a large area. To the farmer the telephone serves not only as a means of relieving the loneliness of the members of the family and keeping in touch with social and educational opportunities of the vicinity, but supplies facilities for taking advantage of favorable prices in neighboring markets; obtaining prompt delivery of needed supplies and repair parts for equipment; for employment of emergency or temporary labor; and for summoning aid in case of sickness of persons or valuable animals, in case of fire, and sometimes of crime. The rural telephone has been used systematically in library-extension work; and in regions where the damaging effect upon crops of sudden weather changes can be minimized by human action, the regular distribution of government weather reports by rural telephone has been, in many instances, by itself a feature of the service which is considered by its users to more than justify its cost.

The substitution of telephone service for traveling is, of course, no longer confined to short distances or the beaten paths of maximum commercial traffic; and it supplies the element of personal contact in a manner nearly equivalent to the actual proximity of speakers. The custom of leaving offices in the city each year for a period of one or two months, which is spent in the country or at the seaside, for rest and recuperation, is growing among persons responsible for the conduct of business. The ability to remain away from the center of affairs without loss is created by the use of the long-distance telephone for keeping in touch with the daily progress of events, and for giving instructions to the persons left in immediate charge of affairs.

It has become clearly established that the utility of the telephone is not at all dependent upon density of population, but rather upon its precise economic value to those who use it for particular purposes. For example, in certain sections of the country, lumber camps use telephones attached to roughly erected lines of wire strung from tree to tree, to control the movements of men working upon the trees in the forests, or upon logs as they are floating down rivers to mills. In the national forest reserves, and the state forest reserve of New York, extensive systems of telephone lines have been built, partly for the use of the settlers, but more particularly to enable rangers, on the lookout for fires, to call help to extinguish flames before their destructive action has spread over a wide area. In large construction projects, involving earthwork over extensive areas, such as have been under way at Panama; in reclamation projects for watering the arid regions of the West; in work carried on by private contractors; in the working of mines; and also, to a limited extent, in the construction of very high office buildings, an appropriate local telephone service has been found to facilitate greatly the handling of men and materials.

In districts, such as those surrounding developed water power, where the operation of factories, street-railway lines, and lights is dependent upon electric power transmitted from a distance, the necessity of avoiding interruption is great. The prompt report and remedy of defective conditions is made possible through the installation and use of a telephone line which parallels the power wires, and is equipped with an instrument at each point where an attendant is employed.

So manifold are the services of this public utility, in its present condition of development, that an entire enumeration of its uses would in fact be an almost complete catalogue of the possibilities of communication in the industrial and social life of the country. While new uses for telephone service will be discovered in the future from time to time, the main opportunities for extension seem to lie along paths already traced, rather than in the application of the telephone to new fields of activity.

The telephone in farm life.—No single factor has played so great a part in the amelioration of the conditions of life on the farms of the United States as has the telephone. Although the telephone was invented only thirty-two years ago and the first exchange was opened but thirty years ago, many hundreds of thousands of telephone instruments are to-day installed in the farmers' homes of this country. On April 26, 1879, a circular issued by the National Bell Telephone Company, establishing the rates for the annual rental of telephone instruments, recognized in a dim, anticipatory way the needs of these isolated communities of the rural districts. At that time all the instruments covered by the patents were leased to those who wished to use them, and in addition to the rates named for the use of telephones for "general purposes" the circular gave a schedule of rates providing for leases for special purposes. Among the various forms of leases for which special rates were provided, a lease for "social purposes" was included. This was defined to be "for use between residences when connected on a single line or circuit for social purposes exclusively." Another rate was given for leases for "club purposes," which were defined as covering cases where the residences, offices, etc., of different parties were connected on any single line or circuit. These were not exchange telephones, which were then considered as intended for general purposes, but represented an attempt to serve a purely neighborhood group. Under this form

of lease a group of farmers could establish a line and talk with all the others on the same line, although as they were not connected with an exchange they could not reach any person connected to another line.

About 1881 Mr. Morris F. Tyler, at that time the president of the Southern New England Telephone Company, operating in Connecticut, began to foster this form of development, and carried it to its next logical step, namely, the connection of these lines to the nearest exchange belonging to the company. An annual charge was made for the use of the instruments and lines within the group of neighbors, for in that state the lines were built by the telephone company and not by the farmers, and a small toll charge was made whenever any of these club subscribers desired to reach the exchange with which their circuit was connected.

This was in reality the beginning of the development of telephone service in the United States outside of the strictly urban centers, and the methods there adopted were soon taken up in other parts of the country. During the next few years, however, comparatively little was done to push this form of service, as the extraordinary demand for telephone service in the cities and larger towns not only took all the time and attention of the managers but made such demands upon financial resources as to render it impossible to devote any money to the development of rural service.

After the expiration in 1893 of the fundamental patents on the telephone a number of concerns undertook the manufacture of telephone instruments, and inasmuch as the field in the cities was by that time fairly well served, a great impetus was given by these manufacturers to the development of rural lines. The opportunity was quickly seized upon by the farmers, and the use of the telephone on farms increased. Since 1902 both the Bell companies and the independent manufacturers have done a large amount of work with the object of aiding the farmers throughout the country to obtain telephone service. Various means have been adopted of accomplishing this end. In some parts of the country the telephone companies have themselves built lines extending into farming districts and have furnished the farmers with telephone service, but the method more usually employed has been to aid the farmer to build his own lines and to give him connection with the exchanges already established in the towns with which he trades, and in this way also to connect him to the great toll-line system of the American Telephone and Telegraph Company, now covering nearly the entire United States, and connecting with a system covering practically the whole settled part of the Dominion of Canada.

In those communities where the farmers have built their own telephone lines, the original form of organization has been purely mutual. Construction has been a cooperative work and the association of the farmers the most primitive type of corporation. The establishment and development of such farmers' telephone systems have usually gone on along evolutionary lines, and have followed more or less closely the form herewith outlined. A group of farmers who lived within a reasonable distance of one another, having come to the conclusion that telephone service was an essential comfort of life, and that it had already passed from the region of luxuries into the field of necessities, would meet together and arrange to establish a telephone system which should connect them with one another. The work involved in constructing such system would be so divided that each member of the association would contribute an equivalent part of the material and labor. If the country was wooded, the farmers making up the association agreed to cut and supply the poles and to haul them to the places where they were needed. In many cases it might happen that one member of the group of farmers had a wood lot and could supply all the poles, and he would agree to furnish a sufficient number of poles, while the other members of the association would take charge of the work of setting them and stringing the wires. The farmers' boys and the farm hands did the work of setting the poles and putting on the cross-arms, which would in many cases be hewn out of native timber. The wire and the insulators, the switchboard and the instruments, would have to be bought, and so a cash assessment would be levied on each member to make these purchases. If it became necessary to buy poles because of the lack of suitable timber in the district, the assessment had to be proportionately increased. The work of stringing the wires and installing the instruments was taken up by the mechanically-minded farmers and their boys, and in a very short time a complete telephone system was in operation. The switchboard was placed in the house of one of the members of the association situated at some convenient point, and the operation of the lines was attended to by the wife and daughters of the farmer in whose home the board was located.

A strictly mutual, isolated system of this kind sufficed for a while to give all the telephone service this particular group desired, but it was not long before progressive farmers realized the need of connection with the outer world. Negotiations would therefore be opened with the telephone company operating in the nearest town, the town with which these farmers did their usual trading, for a contract by which the farmers could secure town service and also get access to the toll lines reaching to the county seat and the metropolitan center of the district. These contracts between the groups of farmers and the larger systems operating in the cities and connecting

with the long-distance toll lines made these farmers' groups or mutual companies, as many of them were called, a part of a larger system—sometimes the Bell, sometimes the independent—and marked the first step toward attaining the ultimate end of telephone service, which is to enable every one who has access to a telephone to reach every other person who can reach one.

This connection with the more important systems in a way furnished all the telephone service needed for the second period of development, but a third step had to follow. In many cases, as these little mutual farmers' lines took on more subscribers and extended from farm to farm, they began to overlap one another in the territory served, a fact which in the natural sequence of events led to the consolidation of these lines and the formation of larger systems. As a result of this process of consolidation the purely mutual character of the ownership became weaker. In order to secure a proper maintenance of the lines and those uniform methods of operation and construction which are essential to good service, it was found necessary for their ownership to take the corporate form; and to-day a very large number of incorporated telephone companies exist in the United States controlled by a regularly elected board of directors, which are in reality nothing but a combination of small groups of farmers forced by the circumstances to take the form of a corporation.

The uses to which the farmer puts the telephone are manifold, and illustrations might be given by the dozen of the value of this service, but a few of the more prominent will show the incalculable value of the telephone in the everyday life of the farm. Perhaps the one respect in which it has been of greatest service to the farmer, taken as a whole, has been the access which it has given him to the great markets in which his products are sold. The grain grower in the West, when he is approached by a grain buyer who wishes to purchase his wheat, simply steps to his telephone and asks the next town where the telephone exchange is located to tell him what the closing prices in the Chicago market were the night before, or how the market opened that morning. He is then prepared to trade with the buyer on an equal footing. The farmer knows the freight rates to the terminal markets, and he knows what his grain ought to be worth on the farm when Chicago or Kansas City quotes a certain price for grain in those markets. The man who has suffered has been the grain dealer. Where formerly he had margin enough between the price which he paid for his grain and the price which he could obtain in the terminal markets to make a handsome profit, he is now obliged to figure quarters and eighths of cents.

Another class which has benefited is the truck farmers in the neighborhood of the large cities. These have been enabled by means of the telephone to reach the city markets and to find out whether there is any demand for their fresh vegetables, or whether the market is glutted and prices are low. If the latter condition exists, the farmer can wait a day or two, instead of carrying in his produce and running the risk of having to sell at a very low price, or to carry it back home to the great detriment of the vegetables, to say nothing of the wasted time of his horses and men. With a telephone he merely waits until he is told that a load of corn or of tomatoes will find a ready market at a fair price.

If a horse falls sick or a valuable cow is in danger, a veterinarian is called and is at the farm in half the time needed before the days of the telephone. If a farm machine breaks down, by the aid of the telephone and the trolley express, or, in case of small parts, the rural free delivery, the broken part can be obtained in a few hours and work go on as before. In some parts of the country where horse stealing has been more or less prevalent, the rural telephone has come very near to putting an end to this form of theft, because a man who has lost his horse immediately telephones to the central exchange, which notifies all of the farmers in the district to look out for such a horse.

On the social side of life the telephone on the farm plays an important part. In many parts of the country at a certain prearranged signal, such as two long rings, every one on the farm lines goes to the telephones, and when central is assured that practically everybody is on the line it reads out any important matters of general news which may have come in during the day, and also gives out the weather report. It is, indeed, very common for the weather report, as soon as received, perhaps about 10 in the morning, to be repeated to all the subscribers on farm lines. From a social standpoint this practice, by which the farmers, many of them separated by considerable distances from their neighbors and from the nearest towns, are kept in touch with the everyday happenings of the world, is of incalculable benefit. In this way throughout large stretches of the country the farmer is better informed as to the events of the day than the busy city resident whose reading of the morning paper consists of a glance at the headlines over his coffee.

Socially, too, the telephone has rendered each neighborhood more homogeneous. Although the houses may be separated by stretches of farms from half a mile to 3 miles in extent, yet if they are all on the same telephone line there is a sense of community life impossible without this ready means of communication. This is an immense boon in the life of the women on the farm, who for days at a time during planting and harvesting seasons may be left alone in the house during working hours, while the men are

away on distant parts of the farm. The sense of loneliness and insecurity felt by the farmers' wives under former conditions disappears, and an approach is made toward the solidarity of a small country town.

The establishment of farmers' lines is, of course, inexpensive, so far as cash expenditure is concerned. The farmer contributes what he has the most of, that is, labor and material, and is called upon for the smallest possible amount of what he finds it hardest to secure, that is, cash. For a company to undertake this construction would require enormous sums of money, and this money would represent simply the conversion of one form of wealth into another with no gain in the total wealth. The farmers build these lines in their spare time, that is, in the time which otherwise would not add anything to the wealth of the community, but which by this means is directly converted into permanent wealth.

To maintain the telephone line it is customary for the various members of the association to become responsible either for that portion of the line located on their farms, or for some other definite portion of the system, and inasmuch as the service on the whole line depends upon the proper maintenance of every portion of the line, if any one of the members neglects to keep up his portion he soon finds himself in disfavor with all the other members of the group. On the other hand, the farmer who knows that a friend is responsible for the quality of the service on his telephone line is far more lenient toward small interruptions in the service or faults in transmission than he is under similar circumstances when the service is furnished by a company. When, in course of time, it becomes necessary as a result of the expansion of the system to secure the services of some one who shall give his whole time to seeing that the line and the instruments are kept in proper repair, farmers' boys are found growing up in every country community who take an interest in electrical and mechanical methods, and who gladly devote themselves to this work for a very moderate amount of cash payment, their ambition being to learn the methods of operating.

The operating expense of the telephone service is likewise small. A switchboard placed in a farmer's house and attended by the farmer's wife and daughters makes but little demand upon the time of anyone, and this service is given for a minimum cash payment. The mere fact of having the switchboard, the center of the farmers' group, is often a source of sufficient pride to cause this work to be done for nothing.

Thus it happens that in the earlier days of a farmers' telephone system, when the plant is small and is carefully looked after by the members of the association, the cost of the service is very trifling Later on the plant grows old and deteriorates and requires more repairs. The number of subscribers increases and the operators must spend their entire time at the switchboard. Storms come, and the partially worn-out plant succumbs more readily to the weather. The result is that at the end of the year the members of the association find that the expenses have been greater than in previous years, and much larger than they had ever figured on. This produces dissatisfaction, but still the telephone service has become so indispensable that it must be continued. When this stage has been reached, the association usually feels obliged to become a regular company and very often to consolidate with its neighbors, in order that the consolidated company may secure a technical man the cost of whose services can be apportioned among a sufficiently large number of subscribers so that this charge will but slightly increase the burden on each.

Very few of those who express dissatisfaction with the increased expense of the telephone service which results from the conditions indicated, stop to think of the reasons for this increased cost of service, and of the increased value which their telephones now possess. As the system has grown the investment has naturally become greater, and inasmuch as the newer subscribers are located at points more distant from the center of the group than were the first, the investment in poles and wires for each subscriber has become greater. So, too, the investment in the switchboard becomes greater with the growth of the system. A small switchboard for a hundred subscribers can be installed for about $4 a subscriber, while for a thousand subscribers such a board might easily cost $20 for each subscriber.

Similar conditions exist with regard to the work of operating the switchboard. The farmers at first do not consider the fact that where there were 20 subscribers, and each one could talk to but 19 others, the daily number of calls from each subscriber was small. When the number increased to 300, each subscriber could reach 299 others, so that the demand for telephone calls became greater. The result was that with a small number of subscribers the average farmer would resort to the telephone three times a day. When he could reach 299 of his neighbors he might call up 10 of those a day. This increased number of calls would mean, of course, that an operator could attend to fewer lines than had formerly been the case. With 20 subscribers, each of whom gave but 3 calls a day, there would be but 60 calls, so that the operator would have a great deal of spare time, and would not need to stay at the switchboard, but could go to it when the bell rang. With 300 subscribers, and an average of 10 calls a day for each subscriber, the number of calls daily would be 3,000. If these calls were distributed equally over the entire day, they could still be handled by one girl without difficulty if she gave her entire time, but telephone calls, even in rural districts, are not so distributed.

The morning is apt to be a busy time on the farm lines, when business is being transacted with the adjoining town, plans made with neighbors, and orders given of one kind and another. A practical lull then ensues during the major part of the day, followed by a sudden rush of business about supper time, when the telephone visiting begins and the members of the farm-line telephone associations discuss all the events of the day and happenings past, present, and to come, and make appointments for business and for pleasure. During this time the farmers' telephone board is a very busy place, so that the number of patrons a single operator can attend to is smaller, and consequently more operators must be employed to handle the calls. As the number of subscribers and of calls increases, this demand upon the operator becomes such that each must be given fewer and fewer lines to attend, especially if their lines are frequently used, so that where one girl might in the early stages of telephone development easily attend to 100 or even 150 lines, a point is reached where a girl may have all that she can possibly do to satisfy 60 subscribers.

These facts make it apparent that as a telephone system grows the cost grows likewise, and all through the country the farmers have found themselves obliged, in order to keep up their plant and furnish the kind of service which they feel they want, to increase their assessments in the case of the mutual associations, or to raise their rates in the case of the incorporated companies. The one thing which the farmer has often failed to see is that with this increase in cost has come a great increase in the value of the service. When he was able to reach only a dozen neighbors, and was not connected with any village, the service was of value to him, but still not of great value. After he was connected to the nearest village exchange, and was able to reach 300 subscribers, the service became immensely more valuable, and this service he still obtained for a minimum of cost. As the country filled up and the number of people connected with his telephone system increased up to the thousands, while the cost to him may have increased a few dollars a year, still the increase in the value of the service which resulted from the fact that it reached so many more persons was many times greater than the small additional expenditure required of him. In actual dollars and cents the additional profits which the farmer, in selling his products, may make on a single transaction through having the facilities of quick communication with the trading centers would in many cases suffice to pay the cost of a telephone for his entire lifetime.

The combination of the interurban street-railway lines with their express and freight facilities, the rural free delivery by which letters and papers are delivered at the farmer's door, and the telephone which puts him instantaneously in touch with the whole world, has done much toward making farm life attractive. These facilities have extended the suburbs of the larger cities farther and farther into the country each year, and have tended to reduce the congestion in the cities, and in a measure to check the drift of farm population into urban centers; and there is no doubt that with a larger development of these factors in modern life there will be an even stronger tendency toward distributing the population in suburban and rural districts.

At the present time no reliable figures are available as to the actual number of farm telephones. The definition of a rural district and the distinction between real rural districts and suburban districts which are rural in character, but which make up a part of the municipal area of some large city, are very vague. Inasmuch as in these suburban areas the telephones constitute part of the city system, a large number of city telephones should really be classed as rural in character. For two states figures which are of some value are at hand. In Connecticut, where only the Bell company operates, and where there were at the census of 1900, 26,000 farms with buildings, there were, on January 1, 1909, something over 15,000 rural telephones, without considering the telephones located in the rural areas of the cities. In Iowa, where the farmers have built extensively and where competition between the Bell companies and the independents, and also between groups of farmers and both the Bell and independent companies, has been very active, the rural telephone has reached a higher stage of development than elsewhere in the country. At the census of 1900 about 220,000 farms with buildings were reported for this state, while on July 1, 1907, the latest date for which figures are tabulated, the telephones classified as rural numbered 160,000. This classification covers in some cases small urban centers but also fails to include rural telephones in suburban areas. According to these figures 73 per cent of the farms in Iowa were supplied with telephone service, the statistics including a certain amount of duplication of service, while in Connecticut 58 per cent of the farms were supplied with telephones without competition. Moreover, in Iowa the major part of the development has come from the building of these lines by the farmers themselves, while in Connecticut the entire development has been brought about by the Bell company, which has built all the farmers' lines in operation there. Naturally the greater cost in Connecticut, due to the demands upon the company for money, as contrasted with the lower cost in Iowa, due to the use by the farmer of his spare time for this work, in a measure accounts for the difference in development, but in both states the

farmer appears to be very well provided with telephone service.

Grocery and department-store trade.—The development of the telephone business in the retail establishments of the country has been very marked during the period since the previous census. Practically every store of any size is now provided with a private-branch exchange telephone system connecting all the departments and connected also with the central office by a number of trunk lines. Most of the larger department stores are also provided with sound-proof booths and with nickel-in-the-slot telephones, and even where booths are not provided, in many places these nickel telephones will be found on a large number of counters scattered throughout the building, so that the public may at any time find what is equivalent to a pay station in all parts of this class of stores.

The use made of the telephone by grocers and butchers has steadily increased, and in many places it is customary for tradesmen to call up their customers in the morning and obtain their daily orders by telephone. This early collection of the orders covering the day's business results in a great economy of time and teams in securing systematic and rapid delivery of the goods ordered, and often enables a store to dispense with one or more teams on account of the better systematization of the work, thus saving to the store in a year many times the cost of the telephone service. This plan also results in an increased use of residence telephones, installed on the measured-service plan, thus securing to the different residences the use of a telephone for other purposes at a minimum of cost.

Conduct of business while at summer resorts.—The last few years have seen such an extension of telephone lines through the various summer-resort districts of the country that it has become practicable for business men to leave their offices for several days at a time, and yet keep in close touch with their offices. Every year sees the lengthening of the vacation period on the part of executive heads of large businesses because of the absolute certainty they have that by means of the long-distance telephone, no matter where they may be, they can be in constant communication with the office.

Forest reserves, lumber camps, etc.—One of the uses to which the telephone has been put which is of great value to the country as a whole has been in the establishment of telephone lines through the various forest reserves, by which the fire guards can be in constant communication with one another, and can summon help quickly to stop a small forest fire at its inception and before the tremendous destruction of timber caused by such fires has taken place. In many of the forest reserves the telephone is used constantly by the patrol to keep in touch with one another, and these lines are being extended wherever forests are set aside as reservations. In the spring of the year when the lumber drives are started down the rivers the telephone, as already noted, is often of most vital importance in keeping the gangs who are ahead of the drive in constant touch with the drive itself, so that the exact time at which the logs will appear at any point where they may need special attention in getting them through rapids or over shoals is known sufficiently in advance to enable the concentration of men at the points of trouble.

Hotel telephone service.—Practically every large and medium-sized hotel and many small hotels throughout the country are provided with telephones located in every guest room, by which not only the interior needs of the hotel can be supplied, but which give access to the local telephone system of the town and the long-distance lines. From the standpoint of the hotel keeper the installation of these telephones is of great advantage, inasmuch as it often saves the trouble involved in sending a bell boy to a room to ascertain what is wanted, his return to the office, and later return to the room with the required article. With the telephone all that it is necessary to do is for the guest to give his order to the switchboard and the article is carried up, thus reducing the time needed for the service by one-half or more. This is of course a distinct saving, and inasmuch as the hotels are usually allowed regular pay-station commissions on toll business a revenue is also obtained from these telephones. These two items, the saving in service and the revenue obtained from the toll service, go a long way toward paying for the entire cost of the telephones.

From the standpoint of the guest it is a great convenience to be able to speak directly from his room to any point which he may wish to reach. Thus, while he is dressing in the morning, he can make his appointments for the day or telephone to his family in a distant city, while the privacy of his talk is greatly increased by this form of installation. Men having confidential messages to send who are known to be in a particular town are often watched about the lobby to hear whether they call up a point which may give some clue to the business upon which they are engaged. All this is avoided by telephoning directly from one's room.

The better class of apartment houses, including practically all in the larger cities, are at the present time provided with private-branch exchanges of the same type as those used in hotels. In the less expensive type of houses the telephone is placed at least in the janitor's room, where it can be used by all of the tenants.

Push-button private-branch exchanges.—In a considerable number of small factories, where but a few stations are needed, a push-button type of intercommunicating telephone has been installed, so that the office can communicate with any department without having to have the expense of a private-branch exchange installation provided with an operator. In many large residences this type of telephone has to a great extent supplanted speaking tubes and bells, and all rooms are connected with one another.

This type of telephone can be used either as an independent intercommunicating system not connected with the central office in the town, or as an extension of the main telephone station to every room that may be needed. A large number of extension stations are being installed in all parts of the country. Where the telephone in a residence is installed downstairs an extension instrument in the upper story is a great saving of wear and tear, and of time in answering telephone calls.

Prepayment or coin-box service.—In many places a type of service has been introduced for the benefit of patrons who use the telephone to but a limited extent, under which a guarantee of so many calls a day is made to the company, each of which is to be paid for, additional calls being charged for at a fixed rate. This type of service enables such persons to have a telephone at a minimum cost, while under the guarantee system the company is recompensed for the cost of installing a telephone in a place where the amount of use would not of itself give a proper return. Indeed, it is doubtful whether many of these subscribers could pay the actual cost of installing and operating these stations, but the fact of the existence of large numbers of telephones of this type in residences makes the business telephones of the retail tradesmen of far greater value. As noted above, the ability of a grocer to reach all his customers in the morning makes his telephone of sufficient value to him to enable him to pay to a certain extent a part of the cost of these smaller residence telephones.

In a number of cities there has been a movement on the part of the druggists to do away with the practice of permitting the public to have free use of the telephones in their stores, which has been so common, and they have advocated the substitution of nickel-in-the-slot telephones for the usual free instruments standing on the counter. A few druggists and some telephone companies have opposed the introduction of the nickel-in-the-slot telephone on the ground that those who use the telephones are patrons of the drug store and it is only a courtesy to allow them this privilege. On the other hand, the assertion has been made by the telephone companies, and by the mass of the druggists, that many—indeed, the majority of those who come into a drug store to use a telephone—are not patrons of the store, but are simply undertaking to evade payment for a call at a pay station.

Perhaps the most practical objection made, however, to permitting the use of the telephone by these casual patrons is that such use tied up the lines so that in many cases the drug stores could not be reached by patrons who desired to give orders over the telephone. Moreover, the druggists under the pay-station commission plan receive an income from nickel-in-the-slot telephones, whereas a free telephone placed on a counter for anyone to use is merely a source of expense.

General conditions of exchange work in cities.—An address given during 1909 by Mr. B. E. Sunny, president of the Chicago Telephone Company, before the Electric Club of this city, embodied a considerable amount of data as to the practical conditions involved in the relations between a city telephone exchange and its subscribers.[1] According to the speaker there were, at the time of his address, 30 telephone exchanges in Chicago and 205,000 telephones. The service required a total of 575,000 miles of wire, of which 460,000 were underground. The number of four-party stations was 85,000; two-party stations, 31,000; single-line stations, 43,000. In addition there were 2,075 private-branch exchange switchboards, supplying over 40,000 stations. About 1,300,000 originating calls were handled in an ordinary business day. The trunk lines connecting exchanges numbered 10,500. In the central business district there were about 52,000 telephones, connected principally to the Main, Central, and Harrison exchanges.

The operator's speed in answering calls was stated to be about four seconds, and the total time necessary to secure a complete connection, on an average, from twenty to twenty-five seconds. It was the company's aim to have all the calls answered within a maximum of eight seconds.

It might seem that to some extent accuracy in the service was sacrificed to secure speed, for one of the chief advantages of telephone communication is that it is practically instantaneous; but, in spite of this fact, the work of the operators was computed to be 94.5 per cent accurate. There had also been an improvement in the matter of accuracy. In 1900 the number of written complaints was 229 per 1,000 subscribers' stations; in 1909 the number of such complaints had been reduced to 38 per 1,000 stations. This improvement was attributed to more efficient operating and a closer relation between the company and the telephone public. It had also been brought about to some extent by doing away with 10-party lines, for which 4-party lines have been substituted. An analysis of the disposition of a day's traffic showed that 78.5 per cent of the calls received the desired connection without trouble, 13 per cent were held up on account of the line being busy (although the number of such cases showed a decrease), 3 per cent failed to

[1] Electrical World, Dec. 23, 1909, p. 1504.

obtain the desired connection on account of no responses being received from the person called, 1 per cent were interfered with on account of double connections, cut-offs, etc., 3 per cent went astray owing to wrong connections being given as a result of error on the part of the operator, and 1.5 per cent failed to obtain the connection in the first instance on account of errors in giving the numbers on the part of the subscribers. In the traffic department about 3,500 operators were needed, in addition to 500 supervisors and 274 other operating employees. These figures were for Chicago service alone. About 1,250 operators and 275 supervisors were required at the time of maximum load, in addition to managers and other male employees. The busiest hour of the day was between 10 and 11 a. m., 10 per cent of the day's telephone business being done in this hour. The busiest minute of the day was 10.10 a. m., and the busiest day of the year was the day before Christmas.

Some branches of the service rendered by telephone companies are not realized by the general public. Thus the number of requests for the time received daily by the Chicago Telephone Company in 1909 amounted to about 60,000, the maximum number of such requests coming between 7 and 8 a. m. The company's pay roll for operators was about $6,000 a day, and if the time taken for the service referred to is charged pro rata, the cost to the Chicago Telephone Company to tell its subscribers the time was $300 a day. Another branch of the service whose magnitude is not generally appreciated is in transmitting fire alarms and police calls. In the month of October, 1909, the Chicago Telephone Company handled 1,488 fire calls and 4,084 police calls, showing that the telephone is an important adjunct to these departments of public safety.

The number of cases of trouble with the lines reported during the year was about 1,250,000, or about 6.7 reports per station, but many of these were of a temporary nature and adjusted themselves. The total number of actual cases of trouble cleared up during the year was 452,000, or 2½ per station. The number of men employed by the inside-plant department was 1,446, of whom 420 were regularly employed on maintenance work. Rain and thunder storms in summer and snow and sleet storms in winter give telephone companies much trouble. A severe storm may easily double the normal number of troubles. In case of a severe storm extraordinary measures are taken to meet the emergency, gangs of men being sent over all routes with directions to put all lines in order, regardless of actual cases reported. In many cases these gangs are given rigs to enable them to cover more ground and to carry more material. The severe sleet storm of January 12, 1908, gave a severe test to the telephonic protective apparatus. Owing to this storm one hundred and eleven cases of trouble with the lines were reported, occasioned by high-tension crosses, besides an undoubtedly large number of other cases where the lines were cleared up before the difficulty was traced to its original source. In no case did the high-tension current get beyond the arresters in the offices, and the only fire noted was in the wiring of one station, which was probably due to current coming in over an unprotected telegraph wire.

Causes of irregularity in service traceable to telephone users.—Irregular and inaccurate service has been shown by frequent scientifically conducted tests, to be due in large proportion to the ignorance or carelessness of subscribers. Where a subscriber secures a wrong connection it may be due either to the error of an operator, or to the fact that the subscriber gave the wrong number, or pronounced the number indistinctly, or with his lips at such a distance from the transmitter that the operator misunderstood. Although the operator may repeat the number as given her, the subscriber does not even then always observe the error and make correction before the connection has been completed.

One of the most useful methods of reducing the amount of irregular and inaccurate service is the plan of instructing subscribers in the correct use of telephone facilities. By notices in directories, newspaper publicity, and other means, telephone users are frequently cautioned to avoid calling for connections without checking their remembrance of the desired number by reference to the directory; to speak always in an ordinary tone of voice with the lips close to and in front of the transmitter mouthpiece; and to speak numbers clearly and distinctly. It is also suggested that numbers easily mistaken for each other should have their consonants emphasized in pronunciation to minimize the possibility of error. By pushing their educational efforts among the public as well as among their own employees, most companies have raised the standard of accuracy of telephone service to a high point.

Information service.—As ordinarily employed, the term "information service" covers only the answering of questions which will assist the subscriber in securing the desired connection in the case of calls at subscribers' and trunk switchboards. Multiple jack mountings are commonly marked with spots of paint of different colors and location, conveying intelligence to the operators of the conditions existing on the lines. Thus a party line having two stations connected is marked to indicate this fact, and the code numbers of the stations. If a station listed in the directory as connected to a certain party line has been removed, or if the subscriber has had his number changed, this is indicated by a marking.

Should a call be received for a station not connected to the line whose number is given, the operator would be made aware of the fact from the marking of the jack. Handling the regular business alone keeps her too busy to allow her to enter into conversation with

the subscriber, or refer to any records, in order to obtain the further information required for completing the desired connection. Accordingly she transfers him to the "information" operator, who investigates and assists him to secure the connection asked for, and informs him when a telephone has been taken out, or of its new number. The information operator also has records which enable her to assist a subscriber to secure connection to a telephone which has been so recently installed that its number is not in the directory, provided he knows the name or address of the subscriber whom it is wished to reach, and in other ways relieves the switchboard operator of the necessity of explanation or discussion with the subscriber for the purpose of facilitating the completion of connections.

In some sections of the country, usually under stress of competition, the information service has been developed to include the giving of times of train departure, location of points of local interest, etc., but such a practice leads to difficulties which have caused most companies to believe that it is not desirable and not a part of their normal function.

A common exception to the rule of referring irregular calls to "information" is found in the practice of giving the time of day upon request, which is followed in many exchanges, the subscriber's operator furnishing this information. This service has been so far developed that in Chicago an investigation made in 1909 showed that, as noted elsewhere, an average of some 60,000 calls for the time of day were made in each twenty-four hours. This, too, is a special service which has grown to such proportions that its extension is no longer encouraged or considered good practice.

Development of private-branch exchanges.—Special methods of handling telephone calls have been largely developed during recent years to meet the requirements of city subscribers to telephone service in cases where several persons in one business establishment or dwelling have occasion to use a telephone so often that it becomes economical for each to have an instrument in a location convenient of access, while the amount of use would not warrant the expense of separate lines to the central office. In many such instances a large amount of the traffic originates and terminates under the same roof, and economy and convenience are both attained by the installation on the premises of a small switchboard, built and operated in much the same way as a central-office switchboard. This switchboard is attended by an operator who may give all her time to it if the installation is sufficiently large to require it, or, in case of small installations, may do some other work and turn to operating whenever a call is received.

Throughout the country, hotels are now among the largest users of this private-branch exchange service. In fact, to so great an extent has it proven its utility that there is to-day hardly a single first-class hotel in any important city which has not a telephone in every room, from which guests may talk with other rooms, the office of the hotel, persons connected to the city system, or over long-distance lines to other subscribers of the systems with which the branch exchange connects. Among other large users of this class of service are the department stores. Several thousand telephones are installed in the huge mercantile establishments of this class in New York, Philadelphia, Chicago, and other great cities, where a telephone is located in each department so that subscribers to the regular service may call clerks and make purchases direct. Smaller business establishments and offices are also heavy users of branch-exchange service, as it provides a means of communicating promptly between departments, as well as reaching outside points.

In nearly all private-branch exchanges a very large proportion of the service is internal. The sizes of branch exchanges range downward from those which are almost exact duplicates of the central-office switchboards, and employ eight or ten operators, installed in large hotels or department stores, to the little stations where four or five instruments and two trunk lines are connected to a small cordless board through which interconnections are established simply by the operation of keys.

In New York the private-branch exchange has to a great extent solved the problem of giving service to the hundreds of apartment houses, each of which may have from six to fifty or more tenants. Each of these tenants, as a rule, requires some telephone service, but their use for a telephone is so limited that many of them do not at present care to have even party-line telephones at the rates which necessarily prevail for this class of service in a city where construction is comparatively expensive. This objection is obviated, however, by providing the apartments with telephones which are connected to a small switchboard operated by employees of the building, and equipped with sufficient trunks to handle the actual traffic between the building and the central office. Charges are made on the measured-rate plan. These switchboards not only serve the tenants in a satisfactory way, but are a material factor in the development of business service, affording business men means of reaching the residents of apartment houses and of being called by them.

Factories, offices, clubs, etc., are frequently equipped with so-called intercommunicating systems; and these are generally better adapted for residences than for business houses. In such systems all the lines are carried through a switch at each telephone. The person calling connects his own telephone to the line carrying the station called by simply depressing a button, which operates springs in a key to effect the electrical connection. He then presses a button which

rings the bell of the station called. The wiring for such a system is carried in a cable which has a number of pairs corresponding to the number of keys in each switch, and hence to the ultimate number of stations which the system can carry. Current for ringing and talking is supplied through a battery located at a central point in the system, from which current is supplied to the lines through retardation coils which prevent cross-talk.

Although such systems have been in use for many years, it is only within the past few years that they have become a material factor in the development of internal communication in business establishments. This growth in importance has been due to the very great improvements which have been made in the construction of the switches, and to the recognition of the desirability of using a high grade of cable.

The earlier and imperfect intercommunicating systems were not considered suitable for connection with central-office equipment, to give exchange service, but several more carefully built modern types have been developed with a view to obtaining such connection, and are now installed in places where the internal use of the system is the principal occasion for its installation, with occasional need of calling the central office from some of the stations.

Service in large buildings.—A notable feature of the technical development of the past five years has been the method by which the large new buildings of the day, particularly such new office buildings as the Metropolitan Life Building on Madison Square or those which are to be seen in the lower part of Manhattan Island, are equipped with telephone service. It is stated that five of these buildings—the Singer, the Broadway Exchange, the City Investing, the Metropolitan Life, and the Hudson Terminal—have a total of 2,360 miles of wire and 9,700 telephones, enough for a central exchange in a city of 100,000 people. For the twin structures in the Hudson Terminal Building—the Fulton and Cortlandt—an equipment was installed during 1907 and put into service early in 1908 which provided the necessary wiring for no fewer than 3,000 telephones direct to the central exchange, about half that number of lines being "cut in" immediately for the use of occupants. In order to accomplish this it was necessary to install in the building a main or cross connecting frame, as the center of the distributing system, to which are connected all the wires of the main-house system. From this main frame run three 606-pair cables extending up through the Cortlandt Building and two 606-pair cables up through the Fulton Building, these wires being used for individual lines and trunks, and ringing current and battery leads to private-branch exchange switchboards for all floors, except the first. From the main frame to the second floor the cables are carried through conduits, while above that floor they are inclosed in a special shaft, provided for the purpose, through which they extend and from which they ramify in diminishing sizes determined largely by the renting area. Above the second floor each of the buildings is divided into four wings, and at the center point of each wing of the respective floors, as well as at the center of the floor, is a telephone junction box, making five for each floor. These boxes are placed on a line with the molding that carries the concealed wires from the boxes to the various rooms, and communicate with the cable shaft by lateral wrought-iron conduits installed during the erection of the building. Instead of making the splices in the riser cables at each floor, the splice is in general made at every third floor. Variations in the plan are required where an entire floor or more is occupied by a single company or firm, with a private-branch exchange. Some of the separate systems controlled by these branch exchanges are very extensive, such as that of the Erie Railroad, which occupies the entire second, seventh, eighth, ninth, and tenth floors, and one-half of the sixth floor. The private-branch exchange, which is located on the sixth floor, is the center of this large private system; and a special cross-connection box is located on that floor for connecting the switchboard with the extension lines and with the main-house cable giving the central-office connections. In this box terminates the branch of the main-house cable which provides for these connections to central, and also two special private-line cables which extend into the wire shaft and thence run to the various floors occupied by the railroad.[1]

Improvement in outside plant.—The open-wire type of local telephone lines, consisting of bare copper or iron wires attached to glass insulators borne by cross-arms on wooden poles, has been rapidly disappearing during the census period from the business and closely settled residence districts of all cities and towns, following a movement inaugurated in the larger cities. Cable has supplanted this open wire to such an extent that the term "all-cable plant" is in general use as expressive of the best type of construction. For some years the employment of underground cable in business districts has to a large extent been obligatory upon telephone companies, as the result of ordinances passed by local governing bodies to gratify a public desire for streets made more sightly by the removal of obstructions, and to minimize possible interference with fire-fighting apparatus, or, in a minor degree, the hazard from the exposure of numerous telephone circuits to contact with electric light and power wires. Within the last few years, however, telephone companies have ascertained, in many cases, that the durability of a conduit system and the freedom from interruption in service resulting from burying lead-incased cables in what amounts to a solid stone vault,

[1] American Telephone Journal, Vol. XVII, May 30, 1908, p. 499.

is a sufficient reason for the voluntary extension of such a system.

In cases where this method of construction is employed for a small system not having highly skilled electrical engineers, and operating in a town served by an electric railway whose current distribution is poorly engineered and maintained, and which operates its cars on rails defectively bonded, danger exists from electrolytic action, which has destroyed sections of cable in many localities where stray current returning to the power house by way of the cable sheaths has left them to pass into the earth. Street-railway systems are, however, improving in this respect, and methods of detecting the early existence of conditions liable to produce electrolysis, and of forestalling its destructive action by controlling the paths of stray currents are becoming better known, thus removing one of the most potent objections to the substitution of underground for aerial lines wherever the density of circuits is so high as to enable the annual reduction in maintenance expense to compensate for increased investment in a comparatively expensive underground containing plant.

It is customary to carry wires from the central office through large cables directly into the business district which they are to serve, each cable containing at the time of installation sufficient wires to provide for the needs of the present and for some time into the future. From these large cables smaller branches are taken off and carried to terminal boxes, made either of metal or wood, metal being increasingly used. From supports mounted close to the cable terminal box, wires are usually carried directly along the walls of buildings or through the air to the points of entrance upon the premises of subscribers. In business or apartment-house districts where many telephones are in service under one roof, a cable box, usually located in the basement, may serve each building, thus doing away with all outside local wiring.

In spreading to less thickly occupied districts, including any residence district in which the telephone-using population is not dense, a point is eventually reached where it is not economically possible to carry the wires in underground cables, no matter how desirable it might be from the point of view of sightliness. Recourse is then had to aerial cable; in other words, the underground cable is joined to a cable running out into the open air and supported upon poles located in alleys or upon the rear of private property. Short poles are used, and the usual absence of auxiliary strengthening devices gives a marked increase in beauty and compactness as compared with the old type of high open-wire poles, with guy lines extended to outlying anchors, while the cost of supporting structures is reduced. In some in tances, as in the interior blocks of New York City and other places, where there are no alleys, cable is supported on the walls of buildings and on fences. The present tendency, which has been developed in the past five years, is to carry the wires as near as possible to subscribers' terminals within the sheath of a cable, tapering off the branches taken from the main cable, by successive subdivisions, into units of smaller and smaller sizes, and extending each ultimate division to a terminal point very close to a minute group of subscribers' stations. In the average urban, suburban, or town residence district, it is easily possible to find a large number of locations for cable terminals from which may be extended spans of insulated wire, without intermediate supports, to points of attachment to the building they serve. In many localities this practice of fanning out the main cables into very small units has been carried so far as to result in the use of terminal boxes arranged for as few as ten pairs of wires, and, in fact, the introduction of this form of distribution has been to a large extent brought about by the development of types of terminal boxes which contribute to its economical installation and maintenance.

In places where a slightly wider separation of telephone users makes it impossible to reach the requisite number of subscribers' stations without a succession of intermediate supports for the wires between the cable boxes and the buildings, it is not unusual to employ trains of metal rings supported upon a rope of twisted wire strands, technically known as "a messenger," hung from low poles. Through these rings are carried twisted pairs of wires. Each wire is encased in a weatherproof compound within a braided cloth covering which is treated with weather-resisting material. Specific reasons why insulated twisted pair wire has come into increasing use to supersede bare wire for subscribers' terminal ends of lines are that it can be installed with smaller and more conveniently adjusted fixtures; reverts to a normal position after carrying extraordinary loads, as of sleet; does not hum and transmit other objectionable noises through walls of buildings when under stress of wind; costs less for maintenance; and is less unsightly.

The general result of this so-called "all-cable" type of construction is not only to keep each individual line comparatively free from accidents which interrupt the service, and to retard deterioration of wire and supports, but to maintain a condition of high insulation which affords voice transmission of almost constant, predetermined efficiency. Hence the effect of all-cable distribution has been not only to reduce the expense of maintaining each mile of wire, but to provide patrons, and particularly those in common-battery exchanges, with circuits not commonly subject to leakage of electricity, or to inductive influence from neighboring light and power conductors, both of which reduce the efficiency of voice transmission; while the risk that lines will make accidental contact with electric light

and power circuits carrying dangerous currents is far less than with open wire.

Some systems show a marked tendency toward a reduction in the number of party-line subscribers as compared with those having individual lines. This has lowered the average number of subscribers' outlets per pair of wires, with the result of somewhat simplifying the distribution system.

In cities where underground cables have been used for a considerable time, telephone development has frequently been so rapid as to outrun the expectations of the engineers who originally determined the dimensions of the conduits. Two methods of getting additional wires in place to serve subscribers have presented themselves for consideration—either (1) to reopen the streets along all lines of conduit having insufficient capacity, install new ducts, and draw into them additional cables of the same size as those previously used; or (2) to pull out the cables then in use and replace them with others of the same diameter but containing a larger number of wires. Of these two plans, a choice had to be made. It was apparent that in order to use cables containing a larger number of wires, the size of each wire must be reduced, and this, in turn, made it necessary in some cities to consider the installation of new offices, because a line of small wire in cable, if too far extended, reduces the efficiency of transmission below the requirements for good service. The working out of some of the complex problems, not only in cable manufacture but in studies of electrical effects influencing transmission, and practical determination of central-office locations, which have made it possible to use cables containing many fine wires within a 2⅝-inch sheath, has been one of the most interesting features of telephone development within the period covered by this report.

At the end of the year 1902 cable manufacturers were ordinarily producing cable of maximum wire contents of 300-pair, with No. 22 B. & S. gauge wires, although 400-pair cables had been built. By the end of the year 1907 it was not uncommon to find operating companies ordering 600-pair cables with No. 22 B. & S. gauge wires, and work looking toward the development of an 800-pair cable, with No. 25 B. & S. gauge wire, is being undertaken. These large units are not only installed to enhance the capacity of the old duct systems, but are employed in all cases where the telephone density in a district not remote from the central office is high.

The occasional use of compound cables, containing wires of two distinct sizes—as No. 19 and No. 20 B. & S. gauge—is an interesting outgrowth of attempts to equalize transmission throughout a plant by providing, for trunks between central offices, wires of larger size than those needed between a central office and near-by subscribers' stations.

In the construction of the conduit, or of other structures containing underground cable, no radical changes have been made within the past five years. But the dimensions of concrete envelopes for protecting the tile or fiber ducts, ironwork for supporting manhole covers, and the covers themselves, racks for holding cables in orderly position about the interior sides of the manholes, and other subsidiary parts of the underground construction, have been changed for the better. The use of iron pipe to protect cable from the point where it leaves a manhole as far as its emergence into the outer air has been superseded by tile construction, reducing risk of damage from freezing in Northern states, and from electrolysis. More attention than formerly is paid to the elimination of moisture from conduits and manholes by grading the ducts on an even slope, providing sewer connections in manhole floors, and plugging the ends of unused ducts.

Careful work in bonding cables and the taking of systematic observations of local conditions have continued, and have been a means of reducing electrolytic damage from vagrant electric-railway currents.

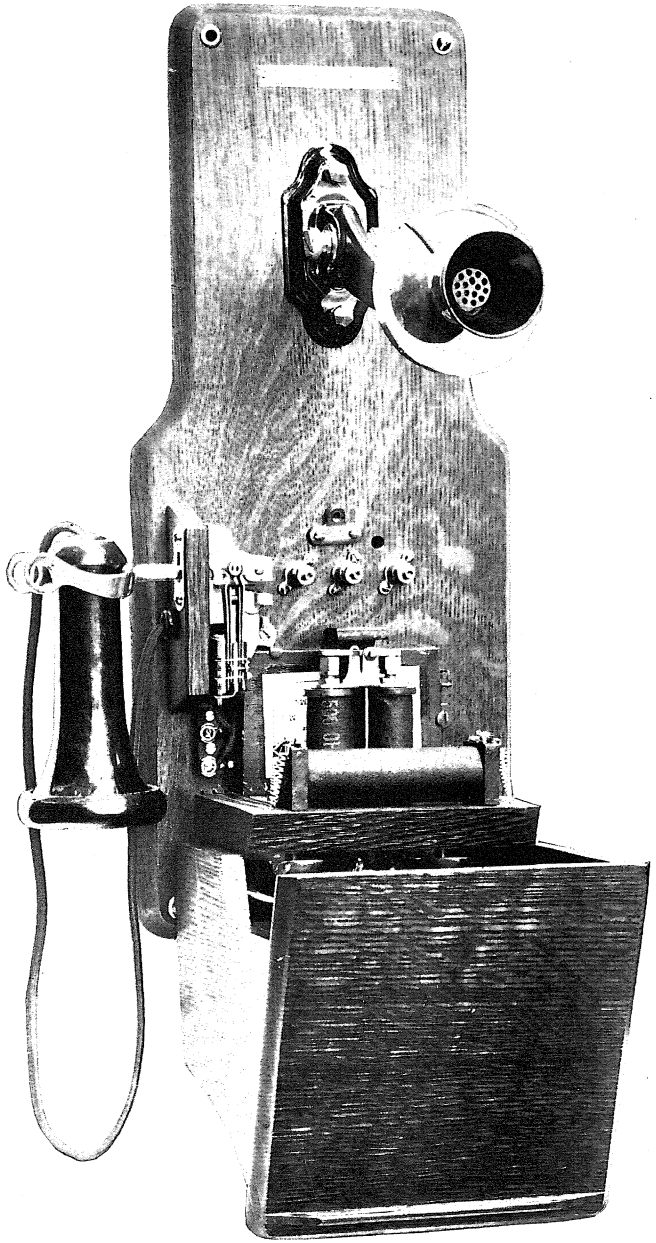
In cities where extensive underground systems are devoted to trunk and toll line cables, the tendency has been toward a wider separation of manholes, with a corresponding diminution in the number of splices. Improvements in cable sheaths, and in methods of handling, have made it possible to extend the interval between manholes for trunk cables to as much as 700 feet.

Reenforced concrete has been tested by telephone companies as a structural material. Manholes have been built entirely of this material, with the exception of the iron framework for covers, and the covers themselves.

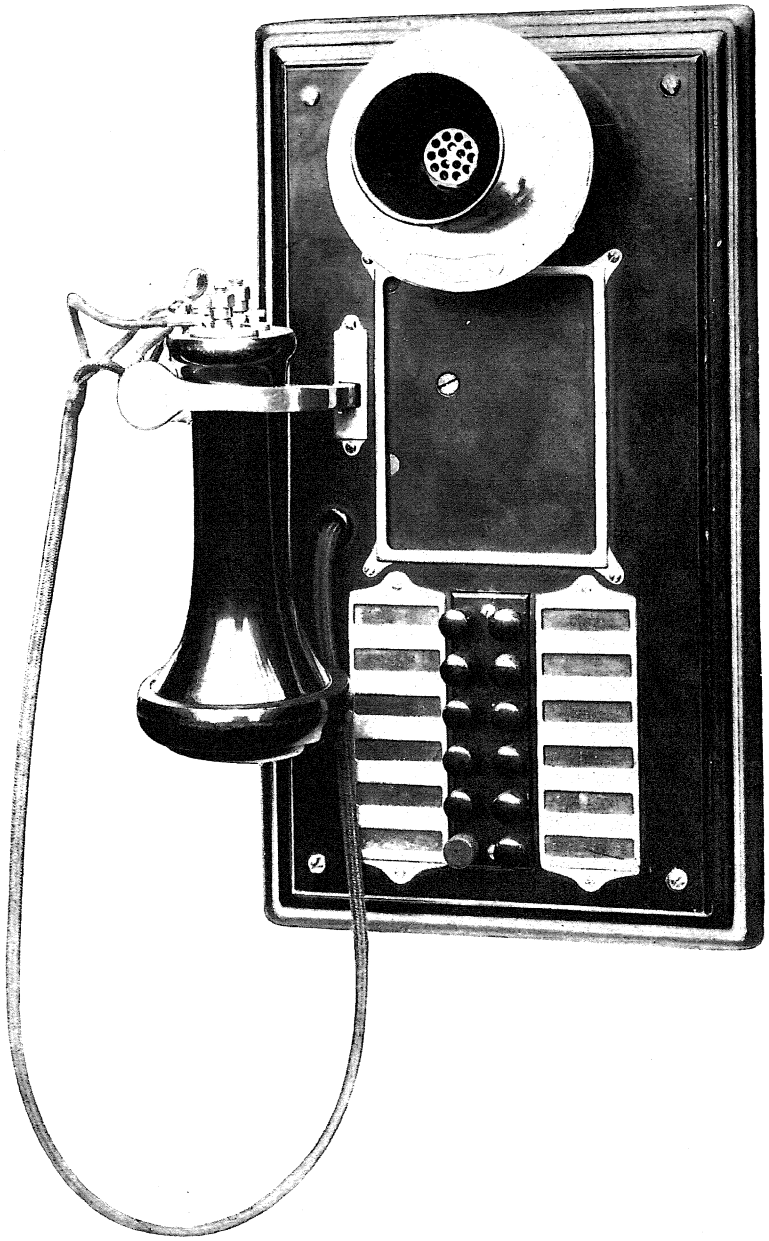
The new type of all-cable construction, by compressing a large number of wires into exceedingly small space, and within lead envelopes, and keeping a heavy proportion of the mileage entirely under ground, makes the modern telephone system in the highest degree inconspicuous and unobtrusive. In addition it shields the vital parts of the plant, which represent much more than half of the investment for local or town operation, and the remoteness of which from direct human supervision makes protection most supremely essential to uninterrupted service.

The substation and subscribers' instruments.—As in earlier periods of the industry, the most commonly used types of telephones are the wall-set, a complete telephone, and the desk stand, which has a portable standard equipped with a receiver, transmitter, and hook switch, associated with a separate box containing a bell, and also a generator, if used on a magneto-system, connection to the line being made through flexible conductors incased in a braided covering.

Although the vigorous competition in the manufacture of these instruments by many producers has led to numerous variations of detail, several important lines of development have been generally followed.



TYPE OF MODERN TELEPHONE, ALL PARTS ACCESSIBLE. WIRING PROTECTED.



FLUSH MOUNTING METAL STAMPED TELEPHONE INTER-COMMUNICATING.

Increases in service efficiency and reduction of manufacturing and maintenance costs have been the objects chiefly sought.

In working toward these ends manufacturers and operating companies have cooperated by the free exchange of information. In addition, the leading factories have endeavored to develop methods of testing which approximate the normal, as well as the exceptionally severe working conditions to which equipment is exposed. The practice of testing raw material has led to the purchase of uniform grades, of higher quality than was formerly obtainable. The making of tools and general shop practice have reached a state of efficiency where operating companies are in a position to carry safely in stock small parts of all classes for replacing such as become defective in service.

Transmitters and receivers have profited to some extent by more careful selection of materials, improved machine work, and better design, although no marked advance involving the discovery of new principles has been made. Yet greater uniformity, slightly increased durability, especially under adverse climatic conditions, and a somewhat higher average of transmission efficiency characterize the instruments generally found in service. The slight advances made in receiver manufacture may be similarly summed up.

The great improvements which have been made in the manufacture of dry batteries have led to their general introduction into magnetotelephones, and this has been followed by the use of transmitters of higher resistance than was practicable with the troublesome acid-solution batteries formerly used.

An extension of selective party-line service has been primarily due to improvements in bells. The harmonic bell now used by many telephone companies depends for its operation on the tuning of the striking mechanism to vibrate with a natural periodicity equivalent to that of an alternating current impressed upon the line. The systems most commonly used provide for four bridging bells on a line, each having its striker adjusted to respond to current of a different frequency. The adjustment is made by fitting the bell intended to respond to a given frequency with a striker mounted at the base upon a spring of appropriate stiffness, and carrying between the gongs a head of suitable weight to effect the tuning in combination with the spring. Four current frequencies, commonly employed for ringing such bells, are 16, 32, 50, and 66 cycles. Only the correspondingly tuned bell on a given line responds to a given frequency.

Bells for nonselective-bridging service have received minor improvements through the use of iron of a better and more uniform grade in the cores, the provision of more accessible adjusting mechanism, and the employment of better designed mountings.

A leading influence in the improvement in detail has been the invention of instruments which enable certain tests of electrical and magnetic properties of materials to be made with accuracy and rapidity in factory laboratories. The knowledge gained through exact measurement has enabled manufacturers to increase very considerably the electrical efficiency of all apparatus. A conspicuous example of improvements due to such scientific methods is a 20 per cent gain in the power output of generators used in magnetotelephone sets. Increasing manufacturing skill has here produced results in the shape of greater uniformity, lasting qualities, and ability to furnish more powerful and effective currents without increasing the bulk of the machine.

Although good practice and modern standards of service limit the number of instruments for a magneto-rural line to ten, some locally owned rural lines frequently carry from twenty to thirty, and the wires are poorly erected and maintained. But even under these adverse conditions moderately good signaling is possible with high-grade generators and bells, and transmission is also very fair. The demands upon signaling equipment for such lines are exceptionally severe, not only by reason of the large number of instruments they carry, but because a heavy additional load results from the removal of a receiver from the hook. This places across the line a low-resistance path, so that if a receiver is removed between an ineffective attempt to call and a repetition of the effort, a major part of the current from the generator passes through the receiver at the listening station. The prevalence of the listening habit has caused the provision of means for installing a condenser in local circuits in connection with the receiver. This raises the resistance of the path to signaling currents of low frequency, without impairing its efficiency as a path for voice currents, which have a much higher frequency of alternation. When this device is used, the fact that some one on the line is listening does not prevent signaling.

Numerous selective signaling systems, providing for temporarily locking out of the circuit all stations, except the one called, have been devised, but, although some operate successfully, no marked demand for them has been apparent. The "lockout" often introduces complications of its own by "kicking back" into the system. More success has attended the simple device of providing each telephone with a push button for grounding the line, and grounding the drop at the central office, while bells are rung on the bridging principle over the metallic circuit, so that the attention of the switchboard operator may be attracted by a subscriber without ringing bells at other stations. A somewhat expensive but efficient means of serving the same purpose is to equip each subscriber's station with a generator, which, by suitable circuit translation devices, may be used to send out either pulsating current or alternating current by which other subscribers on the line or the central office may be signaled separately.

The general arrangement of wall telephones has shown a tendency to become more compact. Considerable ingenuity has been exercised in bringing about this result, and at the same time in making all working parts requiring inspection or adjustment more accessible. This statement applies to the wiring as well as to the various mechanical devices which are included in the set. It is now customary to make a large number of parts easily removable and interchangeable with others in order to facilitate economical repair. There is no doubt that the tendency along this line, which has developed simultaneously with improvement in the durability and working efficiency of the parts, has been, to a large degree—combined with low rates—a result of the rapid expansion of telephone service, and the consequent scarcity of skilled labor, which has been insufficient to do uniformly high-grade repair work at subscribers' stations. Where only moderately skilled help is employed it has been easier to replace a part having only a slight defect, and to bring the old one back to the office for repair by an expert. It is not improbable that within the intercensal period 1908 to 1912 better returns from operation and the better education of the great body of workers will bring about a reversal of this tendency. Likewise, it may well happen that attention will be shifted from the attempt to increase the facility with which parts may be adjusted at the subscriber's station to an effort to secure greater stability in the conditions of the line, which now are often so variable as to necessitate frequent trips to subscribers' stations to remedy conditions due wholly to outside influences. Indeed, in some quarters the tendency to reduce adjustable features has already become very apparent.

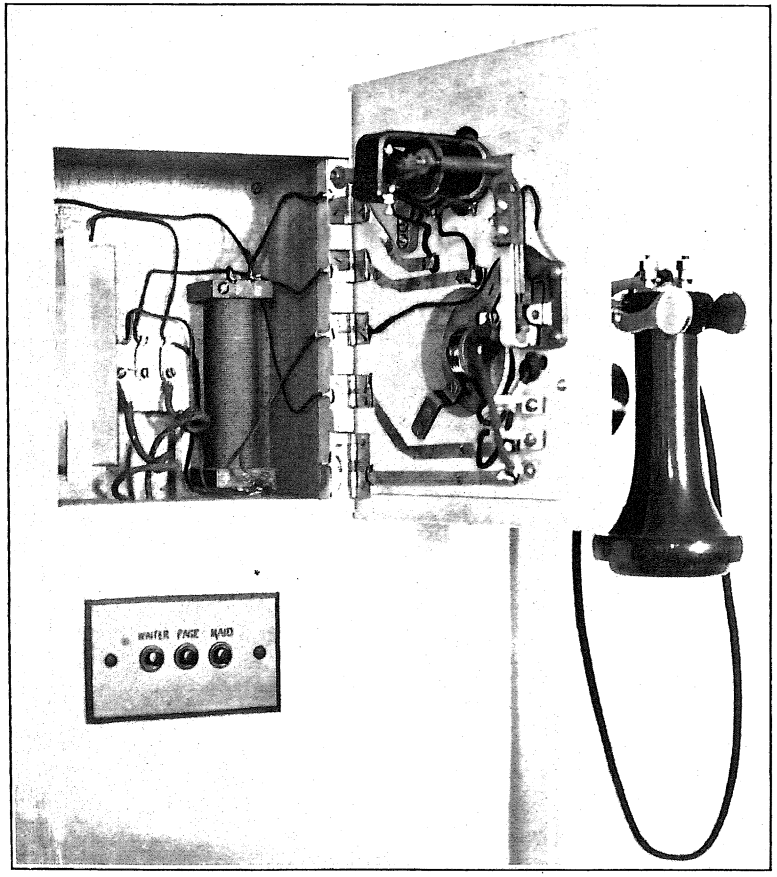
The most radical departure along new lines in the construction of subscribers' instruments has taken place in the introduction of steel-containing boxes. Although some steel telephones are built in the familiar cabinet style, for wall sets, most of them are made in compact form, and, as they are finished in durable enamel, possess merit on the score of appearance as well as on that of durability.

In desk sets skilled mechanical work has made it possible to use designs which are more pleasing to the eye, and far stronger, than the earlier types. The tendency has been toward reducing the number of pieces of metal by performing several operations on the same piece of stock instead of combining a number of smaller parts. A number of ingenious devices have been perfected for making the contacts of the hookswitch, which is a part of the stand requiring most frequent attention, more efficient in operation and more accessible. The hookswitch is now very frequently located in the base of the instrument, connection being made to the pivoted hook in the standard by a system of levers. The result of this combination is to place in a position for inspection at a glance all movable contacts and wire connections in the base of the stand. Some manufacturers have even gone so far as to mount therein a small induction coil, thus doing away with three-wire connection through a flexible cord which has, in the past, been a prolific source of error and trouble in the installation of this type of instrument.

The mounting of transmitters upon hollow arms within which extends wiring entirely independent of any connection with the external shell of the instrument, and the carrying of insulated connecting cords to terminals entirely inside the nonconductive shells of receivers, are improvements which lower maintenance expense and reduce the liability of occasional electrical shocks to subscribers, which, even if not dangerous, are well known to have been of an unpleasant character to those who have experienced them while using instruments whose external metal covering formed part of a line circuit.

Central-office switchboards.—Multiple switchboards for common-battery exchanges in the larger towns and in cities embody the same external characteristics, and operate on exactly the same principles, as in 1902. With increasing development, however, it is but natural to expect the growing use of larger units. Thus the Bell companies now install in offices in all cities and towns of considerable size frameworks with capacity for 9,600 multiple jacks. The tendency among the independent companies operating in a few large cities has been toward the concentration of a great number of lines in a single main switchboard, with a corresponding reduction of outlying or branch exchanges, the reason assigned for this practice being that it assures more rapid service for a heavy proportion of the subscribers, by the elimination of one switching operation. The largest independent boards in service are those at St. Louis, with room for a 17,000 line multiple; Cleveland, 18,000 multiple; Buffalo, 18,000 multiple; and Detroit, where also the multiple has a capacity for 18,000 jacks, although the height to which an operator would have to reach makes it doubtful if the few hundred jacks on the topmost tier will ever be used.

Considerable work has been done in redesigning details of multiple switchboards, not only for the purpose of standardizing the equipment and improving various parts entering into the construction of the boards, but to obtain orderly arrangement. The great degree of success which has been attained in this latter regard is usually as much appreciated by a person unfamiliar with the construction of a telephone exchange, on his first visit, as by the expert to whom use has made all details familiar. As each operator at a subscribers' multiple switchboard of the regular type must be able to reach one terminal of the line of each subscriber entering that central office, in order to



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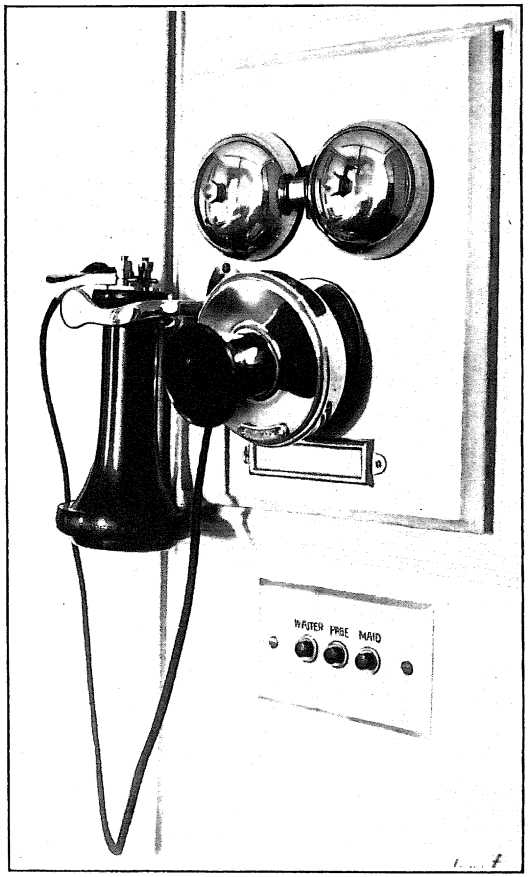


CLOSED.

FLUSH MOUNTING TELEPHONE FOR HOTELS.

connect to it, through a conducting cord, any calling line which terminates at her position, each line is terminated on a multiple jack at intervals, on a standard 9,600-line board, of about 6 feet; that is, once for each three operators' positions. An operator reaches forward, to the right or left, in making connection, according to the position of the particular jack. For convenience in numbering and manipulation, the multiple jacks are mounted in groups of 20, and the cables carrying the lines to them have 20 line units of wire inside a single sheath. Thus, when a group of 20 lines is passed through the multiple, all outside covers are removed from the end of the cable carrying these lines for a sufficient distance to allow the wires to be brought out and tied in position, the completed cable end resembling a long flexible-toothed comb. The insulating covering is removed from the end of each wire, and the bare metal attached to the proper terminal of a division of a multiple jack and united with it by the application of solder and a hot soldering copper. The terminal of the jack is simultaneously connected with the wire of a section of cable extending in each direction, so that the respective line wires in these cables are joined together, forming continuous metal conductors through the medium of the soldered joint at jack terminals in each section, the cotton-thread outer wrapping of the wires being marked with combinations of colors according to a definite code corresponding to the numbers they are to take. The work of making the different joints is very rapidly done by skilled employees, a fact which contributes to the surprise of the uninitiated at the remarkable freedom from circuit interruptions which is experienced in large switchboards, where the number of soldered connections may run up into the millions, and the weight of the wires amounts to many tons.

In addition to the soldered contacts in the multiple, there are a large number of other contacts in each section of the switchboard in connection with the various circuit-controlling devices, and other necessary equipment. In the modern switchboard all apparatus, wires, and soldered joints of each class are carefully grouped together in definite and orderly association, numbers being stamped or painted where they will be clearly visible, and the relation of all working elements being definitely understood. By this method an employee furnished with a diagram of circuits is enabled to run down promptly any defective condition and to repair it. It is this orderly arrangement throughout the exchange which, in connection with modern methods of testing, makes it possible to locate within a very brief interval after it is reported any fault which may be noticed by a subscriber attempting to use a connection. Better still, the systematic observation of conditions by those employed in the office reduces to a minimum the possibility that any defective condition will reach a stage which will cause an interruption to service.

Harmonic signaling.—The development by a number of independent manufacturers of a system employing the so-called harmonic mode of signaling has been responsible for a noticeable divergency of service standards between many of the independent and Bell exchanges. From the start very low rates characterized the independent exchanges. The policy extensively followed of using earnings for the development of plant prevented the accumulation of a surplus, and often interfered with the payment of dividends. In many cases the expansion of these systems was so rapid that the cost of extension absorbed not only the surplus revenue, after operating expenses had been paid, but a large amount of the available resources of the original investors, to the exclusion of other enterprises in which they might have been interested; while the nonpayment of dividends made it difficult to attract the support of new capital. This was particularly true because reliance was placed mainly upon local capital, the available supply of which was limited, while the method of financing did not appeal to outside investors, who would look for returns rather than be interested in the increase of facilities to the temporary exclusion of dividends. Moreover, investment and operating costs per subscriber were usually found to grow larger as the number of telephone users was augmented. Under these conditions, while a material increase in rates was not desired, or even considered practicable, attention was forcibly turned to party-line operation as a means of serving the maximum number of subscribers from a minimum wire and switchboard plant. This policy of extensive party-line development, at a low rate per subscriber, followed by many independent exchanges has been, broadly speaking, the opposite of the policy of the Bell companies, which is, by means of an educational process, to bring subscribers to the point of using individual or two-party line service, at a subscription rate commensurate with these facilities.

The demand for a party-line service which should avoid the nuisance occasioned by the ringing of all the bells on a line whenever a particular instrument thereon is signaled led to the invention of the harmonic system already referred to above. The construction of the bell, based upon the principle of mounting the striker on a spring, or reed, attuned to respond only to current of a predetermined frequency, has been explained in the discussion of telephone instruments. It was there stated that a harmonic party line usually carries four telephones, so that currents of four different frequencies must be available for ringing them. The connection to the line of current of the proper frequency for selecting and ringing a bell is accomplished by a key having four sets of springs, associated with plungers, in each cord circuit at the central-office

switchboard. Connection between the cord and the jack of the called lines is established by inserting the plug, the proper plunger is depressed, and current of the corresponding frequency circulates in the line until the plunger is released. By means of this device the appropriate bell is rung while the others on the line remain quiet. A movable indicating device on the key shows which plunger was last depressed, so that if an operator wishes to complete other connections and then return to the first to ring the bell in case of a delayed response, she is not obliged to remember which party was called, but simply presses the plunger which is shown by the indicator to have been used for the first ring.

When the party line was first invented and brought out, current for each of the four frequencies was commonly conducted to the ringing keys from a special dynamo. This dynamo was operated by a motor, whose armature and that of the dynamo were connected to a common shaft. Energy for driving the motor was derived from the electric-light circuit entering the exchange. It was soon found that the fluctuations in the strength of the current in an electric-light circuit were sufficient to cause variations in the speed of the motor, producing undesirable changes in the current output of the ringing dynamo. The tuning of harmonic bells is too accurate to admit of any variation of frequency in ringing current; if such a variation takes place, the called bell responds too weakly, and the reeds of others are liable to tremble, sounding the gongs lightly. This condition led to a search for a steady source of ringing power.

The utilization of battery current supplied this need. Equipment was developed to reverse alternately connections of positive and negative battery terminals to the leads running to ringing keys. This equipment has for each frequency a constantly vibrating arm, operated by electrical mechanism, at an appropriate speed or rate of vibration. Through this arm positive and negative battery wires are alternately connected to each side of the ringing circuit, thus practically converting the direct, unidirectional current emanating from the batteries into the alternating current required by the bells, for which reason this apparatus is appropriately termed "a converter." The converter has also included transformers for stepping up the voltage on each frequency.

Although the converter developed for harmonic signaling is in many respects a distinctly novel piece of apparatus, it is not the only device for utilizing batteries to provide alternating current for ringing telephone bells. For some years improvements in dry batteries have been in progress and in many exchanges groups of these cells now furnish current for signaling subscribers. An instrument called a "pole changer" is utilized to effect the transformation of direct to alternating current, which it does by means of a vibrating arm swinging between pairs of contacts, like the converter which it antedates.

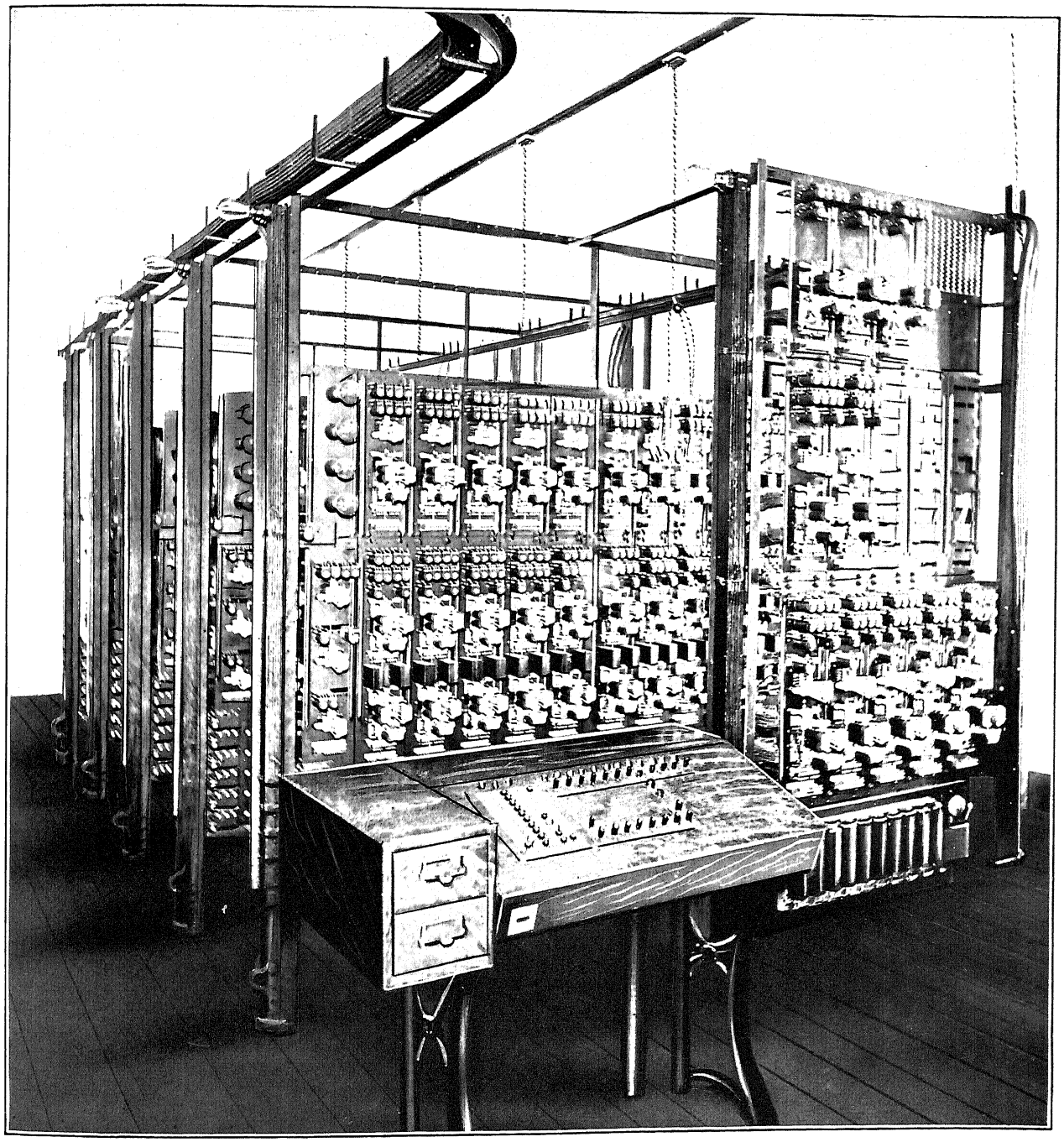
The pole changer requires even less expert attendance than the ordinary small dynamo and motor used for ringing, and is not dependent upon the continuity of operation of an electric-light circuit or the unsteady steam engine of a distant factory, to whose shafting it was not uncommon to find the ringing dynamo of a telephone exchange belted, before pole changers were generally adopted. A proper number and arrangement of batteries gives sufficient current for signaling even on heavily loaded rural lines and long-distance circuits. The pole changer is responsible for an improvement of service in many small exchanges, where local conditions would have prevented the use of a power-driven ringing dynamo and where operators would otherwise still be compelled to turn the crank of a separate hand generator at each switchboard position every time a call was made.

Improvements in the automatic system.—In the automatic exchange, machinery actuated by the manipulation of a numbered rotary dial on the calling subscriber's telephone performs rapidly the desired switching. It has been so developed within the period covered by this report as to satisfy all the requirements of operation in many single or divided central offices of large capacity, and, in connection with manually operated toll boards, practically all the necessities of their long-distance use.

The automatic system was first brought to public notice in 1892, when an exchange of 100 lines capacity was put in operation. Progress was slow and installations were confined to switchboards of 200 lines capacity until about 1897, when the so-called trunking system was developed, opening the way to installations of greater capacity. Two years later the trunking system reached a further state of development when the principle of automatic selection of trunks was first applied in an exchange of 10,000 lines capacity. References to the system in general will be found in the Census Report on Telephones for 1902.[1]

At the beginning of the year 1903 the practicability of large exchanges had been so thoroughly demonstrated as to justify the installation of exchanges of much larger size than heretofore contemplated. Switchboards at Grand Rapids, Mich., and Dayton, Ohio, were installed during this year, with an initial equipment of about 6,000 lines each. In these installations the so-called bridging type of switches was employed, resulting in a marked improvement in transmission as well as greater efficiency of operation as compared with the earlier type. Prior to this the operating relays remained in series in the line during conversation, and their operation when a calling subscriber replaced his receiver at the termina-

[1] Special Reports, U. S. Census, Telephones and Telegraphs, 1902.



MAIN SWITCH RACK AND APPARATUS, AUTOMANUAL TELEPHONE EXCHANGE.

tion of the conversation effected the release of the switches used in establishing the connection. In the bridging system the relays were of high resistance and bridged across the line during conversation.

In these installations a type of telephone was used which was universal for exchanges of any capacity. Each switchboard had a capacity of 10,000 lines, every subscriber's number being represented by four figures. The construction was, however, such that additions could be made indefinitely, and with this improvement the automatic switchboard overcame limitations in capacity. The Grand Rapids board has since grown to more than 10,000 numbers, and this type of switchboard may be increased so as to include a maximum of 100,000 numbers, five figures being employed for the additional numbers. In both the Dayton and the Grand Rapids installations an improved type of switchboard construction was employed, the switches being mounted on steel shelves and provided with efficient protectors, thus almost eliminating the fire risks.

During the year 1903 a further improvement in automatic apparatus was effected by the adoption of the "trunk release," which increased the efficiency of the talking circuit by removing the bridging relays during conversation, the release of the switches being effected over a release trunk controlled from the connector switch, which is the last switch used in establishing a connection. The talking circuit then took its present standard form.

The use of local batteries in the telephone for talking had long been considered an objection, and in 1904 the engineers of the automatic system developed and put into operation, at South Bend, Ind., the first common-battery automatic switchboard. The use of the common or centralized battery resulted in the simplification of the telephone and eliminated the expense and annoyance incident to the maintenance of a set of batteries at each subscriber's telephone or substation. Subsequent installations have all been of the common-battery type.

The year 1903 marked also the beginning of the Los Angeles installation, which is especially interesting because it was the first to employ the multioffice system, and the first to operate the automatic system in connection with the manual system on a large scale. Previous to this installation no attempt had been made to divide the switchboard among different offices, although the economical advantages of such an arrangement from the standpoint of outside construction were recognized. Since the automatic switchboard is composed of a number of units, interconnected by means of trunk lines, there seemed to be no reason why an exchange could not be subdivided, and it is asserted that the success attendant upon the Los Angeles installation proved the correctness of this theory. This exchange now comprises about 33,000 telephones, connected to nine switchboards located in different parts of the city and interconnected by trunk lines. The method of operation is identical with that employed in a single-office exchange, and the subscriber making a call is not aware that to establish his connection he is operating switches in two or three different exchanges.

The demand for a party-line service resulted in the development, during 1904, of a four-party harmonic ringing system applicable to the automatic apparatus. Since then many automatic exchanges have installed party-line equipment, although the tendency at present is to use the district station when it means economy in cable and wire plant. In the party-line system, as developed in 1904 and 1905, the four telephones on a line have different numbers, and any one telephone may be called and rung without the knowledge of the other subscribers on the line.

The Keith line switch, which was developed during 1905 and 1906, was a radical departure from the type of switchboard apparatus previously employed. It marked a great improvement in the system, both from the manufacturers' and from the operators' standpoint, and at the same time fitted in perfectly with all the standard equipment. By substituting for a first-selector switch, with which every subscriber's line was equipped, a comparatively simple and inexpensive line switch, the function of which was to connect automatically the calling line to any one of a number of first-selector switches, the required number of these selectors in an exchange was reduced 90 per cent. The space required for a complete automatic switchboard was reduced one-half, and the total number of working parts more than one-half. The line switch was first employed in additions to the boards at Wilmington, Del., and Grand Rapids, Mich., and subsequent installations have all employed this type of switch. The perfection of the line switch was destined to have a far-reaching effect on exchange construction. The switchboard unit of 100 lines was now so reduced in size and so simplified in construction that it required but little attention and it seemed perfectly feasible to install these units in the center of some congested district at a distance from the main exchange, thereby effecting a saving in the cable required to serve the district. The first installation of this character was at Dayton, Ohio, in 1906–7.

In this and in subsequent installations in a number of automatic plants the practicability of the automatic district station is said to have been demonstrated. At Columbus, Ohio, several of these district stations with a capacity ranging from 100 to 600 lines were installed in 1907. Along with subexchanges a system of testing was developed which enabled complete tests of every line at the subexchange to be made automatically from the main exchange, and which rendered the presence of a switchman at the subexchange throughout the day unnecessary.

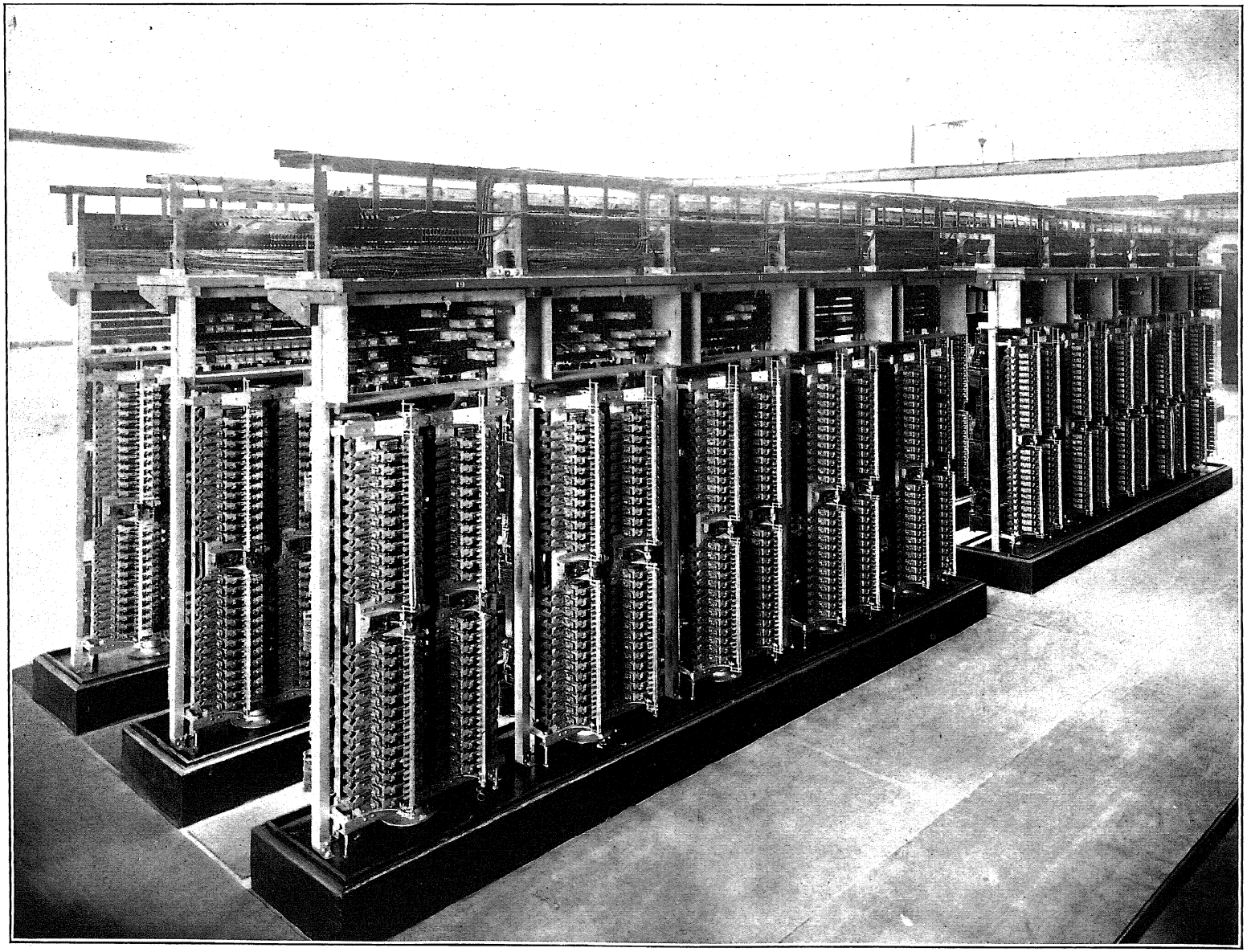
Immediately prior to the year 1907 all the automatic exchanges in operation were of the three-wire type—that is, in addition to the two-line wires, each telephone had a wire connecting it to the ground. The next advance, which, from an operating standpoint, was a decided one, was in doing away with this third wire, resulting in what is known as the "two-wire system." Along with the two-wire system came many improvements tending to facilitate operation. Among these was a new calling device, compact and small enough to be carried in the pocket, which was capable of being substituted in any automatic two-wire telephone, and adapted for changing manual telephones to automatic. The development of complete supervision, extending to the subexchange, the perfection of measured service, recording only the number of completed calls, and a pay station in which the coin must be deposited only after the called party has answered, are among the features of more recent appearance. Among the minor developments during the last five years the fire-alarm service is interesting. The alarm is turned in automatically by a movement of the dial. A gong immediately notifies the attendant, who at once presses a button, thereby sending in the alarm, automatically, to every engine house, and placing himself in direct communication with each of them. This service is part of the equipment of the numerous exchanges.

The time required to make a call in the automatic system is from three to six seconds, depending upon the size of the number and the personal skill of the calling subscriber. This does not include "answering." When the connection is completed, the bell of the called telephone begins to ring automatically, and continues to do so, intermittently, until the receiver is removed or the calling receiver is restored. No time is required for the disconnection, as the switches are instantly restored to their original condition when the calling subscriber hangs up his receiver. If the line called is busy, the calling subscriber is apprised of the fact by hearing a buzzing tone in his receiver. The service is secret, and a connection set up can not be disturbed in any way by another subscriber. The telephone is simple in operation, and the service is available and equally efficient at all hours of the day or night.

The automatic switchboard.—At the central office the subscriber's line terminates in a machine called a "switch," and also in a contact which is one of a group of 100 contacts set closely in a so-called bank. The switches in the exchange are of two kinds—selectors and connectors. The connector is the switch which makes the final connection with the line contact of the called subscriber. In this connector a part of the mechanism consists of a movable shaft, which carries contact arms, or "wipers." Arrangements are made whereby the calling subscriber can cause this shaft to be first raised and then rotated by step-by-step movements, so that the wipers are brought into contact, automatically, with the contacts of the desired subscriber's line, placing the circuits in condition for the proper transmission of ringing and talking currents. Hanging up a telephone at a subscriber's station operates a release magnet, which causes the switching mechanism at the central office to be restored to its initial condition, ready for the reception of another call.

Special arrangements whereby systems of various sizes may be operated provide for trunking between different groups of switches. In the original system of 100 lines, which is extremely simple, each line terminates in a connector switch and also in a contact, which appears in the bank in front of the contact arms of every other connector, each line contact being multipled throughout the entire 100 switches. By this means connections are made directly by the connector of the calling subscriber, who rings by pressing a button upon his telephone which sets in motion further automatic mechanism for placing alternating current on the called subscriber's line. When the called party removes his receiver from the hook to answer, a battery circuit supplying the current necessary for talking is connected across the line. Provision is also made, automatically, for the protection of both lines from interruptions due to another call, and for transmitting a buzzing tone back to the telephone of any subscriber who calls a line when it is in use.

To adapt the system to serve 1,000 lines, it is necessary to provide means for switching between ten groups of 100 units. In the 1,000-line system it is possible to effect the switching operation without installing a connector for every line. This is done by employing a sufficient number of connectors to establish the maximum number of talking circuits which are likely to be required at any time, all subscribers using these connectors in common. Each line terminates in a selector, which is a switch similar in construction to the connector, and the function of which is to switch the calling subscriber's line to a connector in any one of the ten groups. Thus two switches are always used instead of one, in making a call, the selector operating to select contacts from the bank which are wired to a connector in the group desired, and this connector, in turn, completing the connection with the desired subscriber in its group. It is a common practice to use 100 connectors for 1,000 lines. The selector, in rotating through the contacts to take up a connector, will pass by any trunks to busy connectors, and not stop until it is in connection with one which is idle. This arrangement for selecting an idle trunk is one of the particularly ingenious features of the automatic system, and is the more creditable as an invention because it is worked out in an extremely simple manner. After the selector has completed the circuit as



VIEW OF SWITCHBOARD ROOM OF MAIN AUTOMATIC EXCHANGE, SAN FRANCISCO.

far as the connector, this in turn takes up the work and completes the connection to the called subscriber through the operation of a vertical shaft, carrying wipers, as for the 100-line system. The ringing of the called subscriber's bell, the connection of the battery for talking, secrecy of communication, and the busy response when the line with which connection is desired is engaged are brought about in the 1,000-line system in the same way as in the 100-line exchange.

To fit the automatic exchange to care for 10,000 lines it is necessary to introduce another selector into the circuit. A completed connection through the exchange in the 10,000-line system will pass through a first selector, a second selector, and a connector. The number of first selectors provided is 10,000, one for each line. There will also be 1,000 second selectors, and 1,000 connectors, used in common. The method of operation in this case is for the first selector to pick out one of the second selectors in a particular 1,000-unit group, while the second selector picks out one of the connectors in a particular group of 100 units, and the connector switch makes the final vertical and horizontal movements to the desired line, as in the 100-line system.

In order to extend the capacity of the system to care for 100,000 lines, it is only necessary to add a fourth switch, which, in this case, will be a third selector. Then the first selector will pick out the 10,000-unit group containing the desired connection, the second selector the corresponding 1,000-unit group, and the third selector the particular 100-unit group in which the connection is included, the connector completing the call.

Tendencies in semiautomatic development.—In telephone exchanges of the type exclusively used up to the invention of the automatic exchange, and now most generally in service, the completion of connections between the lines of subscribers is performed directly by operators. Many of the shortcomings of this system are due to the limitations imposed by the physical capacities of the operators, as, for example, the distance they can reach to insert plugs and the number of separate motions they are capable of performing with their hands in the fixed sequence of obtaining connection with the calling subscriber by inserting a plug in his line terminal and throwing a key on the horizontal table, testing to determine whether or not the desired line is idle, plugging into the terminal of the called line, and, finally, ringing by another movement of the horizontal key. In all automatic systems now in use the work and responsibility for obtaining the correct connection are left with the calling subscriber, who exercises primary control over the switching mechanism in the central office by moving a mechanical numerical device on his telephone.

It is but natural that inventors should have seen a fertile field for exercising their talent in the development of a system which should occupy a middle ground between the manual and the automatic systems, by substituting a trained operator, governed by verbal directions from the subscriber to control the switching, while relieving her of the necessity of making an extended series of motions for each call by having automatic mechanism complete each connection. Thus at trunk switchboards of the standard manual type in large cities having more than one exchange, operators receive their instructions, not directly from subscribers but from other operators. Circuits have been devised which relieve trunk operators from the manipulation of keys, their functions being restricted to inserting plugs, while the ringing of the called subscriber's bell takes place automatically. The result is that such an operator can handle a larger number of calls per hour than her associates at subscribers' switchboards, who have the more complex duties.

In certain exchanges abroad calls come to receiving operators, who ascertain from each subscriber the number of the line with which he desires connection, and transfer the work of completing the call to an operator at a second board. As it is very easy to arrange for transferring the call to an operator idle at the moment she receives the connection, and the functions of the call-receiving operator are of limited range, both classes can work with a high degree of personal efficiency. The tendency in semiautomatic development is to provide an operator with means for receiving calls and to arrange for their completion, including the ringing up of the called subscriber, by automatic electro-mechanism. The control of this mechanism can be readily centered in a numbered keyboard like that of a typewriter or adding machine, so that the necessity of reaching out at arm's length by the operator is eliminated. Once a number is received and is "set up" by depressing the keys corresponding to its digits, the operator can pass to the next call and handle that also with like simplicity. Under such a system each operator will be able to "pass" a far greater number of calls per hour than in a system where switching is performed manually until the connection is completed. In addition, the apparatus can be arranged more compactly on the floor of an exchange than is possible with the multiple switchboard, which must be extended in a continuous line.

At the end of 1907 three prominent groups of inventors were working on this problem in the United States, one of which had already announced and introduced a complete system ready for commercial service.

Protection.—Elaborate safeguards are adopted in all telephone systems to prevent the passage of electrical currents of abnormal strength along the wires to points where they might produce personal injury or destroy apparatus which is costly or incapable of being immediately replaced. In all cases the prin-

ciple of protection involves the control of such dangerous currents by inserting in the wire what might be called an artificial weak link, which breaks down and causes the dangerous current to take a path provided for the purpose and free from risk.

The parts of a telephone system which must be protected in this way are broadly divided into three classes: (1) The subscriber's station, (2) the wires of underground and aerial cables, and (3) central-office equipment. The telephone at the subscriber's station is commonly protected by a combination of a spark gap and fuse. The spark gap consists of two carbon plates, one connected to the ground and the other to the line. These plates are separated by a strip of mica or other insulating material covering their interior faces partially in such a way that a slight air space exists between them. Whenever lightning or a current of heavy potential from an electric-light or street-railway circuit reaches the telephone line, accidentally, the resistance of the air gap between the carbons breaks down, and the current usually passes harmlessly into the earth. A continuous heavy current, such as is caused by a cross with a trolley wire, will produce an arc in the arrester, and melt the fuse between the carbon and the entering wire, thus interrupting the circuit so that the current can not pass into the building beyond the protector.

Proceeding toward the central office, a certain amount of open-wire construction will frequently be found exposed to the risk of crosses with wires of other companies carrying heavy currents, and also to lightning risk. Where lightning is dangerously prevalent at certain seasons of the year, wires connected to ground plates buried in the earth are run to the tops of poles and allowed to project upward like ordinary lightning rods, such as are familiar sights upon buildings in the same localities. A common practice in some sections is to equip rural-line wires with metallic air gap, grounded arresters, to take the discharge directly off the line, rather than to rely upon the protectors inside of buildings.

While a lightning stroke on an open-wire line is commonly able at most to damage a single pair of wires, and the instruments connected to it if they are unprotected, its entry into a cable is a far more serious matter. Here it might fuse together several hundred circuits, or break out through the sheath, leaving a hole through which moisture could enter; thus interrupting the working of the wires and causing inconvenience to subscribers and heavy repair expense to the company. Accordingly protective devices are located at the outer ends of all cable pairs, where open wire is joined to the cable conductors, while the sheaths of the cables and the messengers which support the cable are usually connected to the ground at frequent intervals.

The protection of the subscriber's station and the cable is a comparatively simple matter. At the central office a more interesting condition is found. The equipment connected to the line is protected against lightning and high potential currents by a pair of carbon plates for each side of the line, located on the frame where the entering cable joins the interior wiring. These plates are separated by mica, and one member of each pair is connected to the ground for carrying away the current, as at the subscriber's station. A special protection for the relays or drops connected to the line for receiving signals, and wound with wire so fine that it may easily be fused, is provided in the "heat-coil" or "sneak-current" arrester. This arrester operates to disconnect the outside line from the central-office apparatus, and to connect it to the ground upon the passage for a few seconds of a current strong enough to heat the wire in the central-office equipment to a dangerous temperature if passed through it steadily. These two devices guard the central-office equipment against dangerous currents from outside.

Equipment must also be guarded against a possible excess of current through any particular piece of apparatus from the central-office current supply itself. The battery in a large telephone exchange is simultaneously sending current of limited strength through thousands of separate paths. Should a large proportion of these paths suddenly become interrupted by an accident, the whole current would go through the remainder of them, if there were no protective devices, and would be destructive in its action. Accordingly fuses are inserted in battery-supply leads which furnish current to relays, transmitters, and other operative apparatus of the exchange. Thus should too much current flow momentarily through one of these paths, the wire is interrupted by the operation of the fuse before the apparatus can be heated to a dangerous temperature. Similar protection is provided in the ringing circuits.

The opening of the fuse means that at that instant certain apparatus is rendered inoperative, and one or more subscribers are prevented from receiving the service they are likely to require at any moment. Accordingly the fuses are ingeniously designed to operate a signal upon opening. This signal frequently consists of a bell to attract attention, and a lamp to indicate the particular group in which the open fuse is located. Hence the operation of the fuse not only indicates a dangerous condition of the wire, but attracts the attention of an attendant specifically to that wire, insuring a prompt remedy of the defect, and a minimum of interruption to the service.

Cheaper common-battery switchboards, reducing the central-office cost per line.—The common-battery system of operation is regarded with especial favor by the public as compared with the older magnetosystem because it eliminates the physical necessity of ringing for connection and disconnection, and furnishes more rapid and agreeable service. Its general introduction

OPERATOR'S POSITION IN AUTOMANUAL TELEPHONE EXCHANGE.

in the smaller towns and cities has been prevented by the cost of the equipment, necessitating a rate which at the present time the utility of the service does not justify, and which would prohibit its extension to a large number of subscribers. This method of operation has, however, been extended to a large number of places of smaller size than would have been considered capable of supporting this type of switchboard a few years ago. This has been to a considerable degree the result of the introduction of simplified types of apparatus, which, by the elimination of working parts, reduce the cost of each line and cord circuit. The service rendered by such boards is in some respects inferior to that made possible by the more expensive equipment used in large cities, but in filling an intermediary position between the magnetotype of board and the most elaborate types of the common-battery system, they play a very useful part and represent a distinct advance.

Tone and flash signals for busy and trouble tests.—Special apparatus is used to indicate to the operator originating a trunked call the condition of a called line in a distant exchange. If the line is busy or out of order, the trunk operator, having no listening key, can not get into communication with the subscriber or the subscriber's operator, and inform them of the condition of the line, nor is it desirable that she should take time to do this. Accordingly she inserts the plug connected to the trunk in a special jack connected to the "busy-back" circuit. This jack is wired to an interrupter connected to a battery, which alternately operates and releases a relay in the trunk-circuit signaling back to the calling subscriber's switchboard, where it indicates that the line is busy by flashing out a code of predetermined intervals on the supervisory lamp.

In some cities flash signals are supplemented by tone signals for use both in the exchange and to notify the subscribers of the condition of the line. For example, in the automatic system, and in most manually operated systems in large cities, a rapidly fluctuating current is employed to produce a hum in the calling subscriber's telephone which serves as a signal that the line is busy. So-called tone tests are also employed for a few purposes in the interior of the exchange, as, for example, to indicate to the operator that a line is in trouble and under the supervision of the wire chief, or is being held for a long-distance connection.

Pneumatic-tube equipment.—Accounting for toll or long-distance messages requires under present practice the recording of the details of each connection on a slip of paper known as a "ticket." The data recorded for each message include the names and telephone numbers of both parties to the conversation, the names of the exchanges in which the message originated and terminated, the time when it began and ended, and its duration. The latter items are usually recorded by an automatic stamp governed by clockwork.

To facilitate operating in large exchanges a "recording" operator ascertains from the subscriber the desired connection, records the necessary details on a ticket, and sends it to a "line" operator, who is responsible for completing the connection. In a busy toll exchange hundreds of tickets are made out every hour, and prompt service requires the elimination of all chance for delay or confusion in transmitting tickets from the recording to the line operators. The messenger service formerly employed has been replaced by elaborate installations of pneumatic-tube systems. The tubes extend from the ticket-distributing tables near the recording operators to the different switchboard positions. The ticket-distributing operator never sends a ticket to a busy toll position, as she is informed whether or not a given operator is engaged by a lamp signal, which burns constantly, except when a ticket is in the pneumatic receiver at the operator's position. Whenever a ticket is removed the lamp lights, signifying that the operator is ready to take another ticket. Tickets are transmitted without the use of carriers, often through several hundred feet of tubes. The rate of travel, some 30 feet per second, and the elimination of delays incident to placing tickets in carriers, as in store-service systems, makes the pneumatic tube an effective adjunct to speedy toll operating.

Introduction of "ancillary" answering-jacks in switchboards.—The elaborate investigations into methods of handling traffic which have been carried forward have led not only to the improved organization and supervision of operating staffs, but have induced modifications in the arrangement of switchboard equipment. Economy in operating so far as this is reflected in the average cost of handling calls requires obviously that operators shall be kept busy. It is an interesting and useful coincidence that experiments have conclusively shown that operators handle calls with higher efficiency when the calls occur in reasonably rapid succession. Idleness tends to laxity.

The requisite load for the busy hour, at each position, is obtained by connecting to the answering-jacks which terminate there, by means of the intermediate frame, a number of lines which will originate as many calls as an operator can comfortably complete. But in the less busy parts of the day, when the traffic falls off, some positions are left unoccupied, and the remaining operators reach over to answer calls on the lines terminating at each side of them on the switchboard.

As an operator's reach is limited, this concentration of load during the comparatively idle hours is extended by the use of duplicate or "ancillary" answering-jacks. These are installed in strips of twenty, each strip being

connected to the correspondingly numbered lines terminating in two strips of ten regular answering-jacks. By grouping these ancillary jacks a greatly reduced operating force handles the load, and maintains a normally efficient service during the hours of low traffic.

No multiple and partial multiple in subscribers' switchboards.—Busy cities of large area and widely diversified interests, such as New York, have certain districts in which a large percentage of the originating calls are for lines extending from other central offices; in other words, a major portion of the calls require trunked connections. Inasmuch as the subscribers' line multiple equipment in a switchboard is provided for the sole purpose of facilitating the completion of calls for other lines in the same exchange, the utility of the multiple decreases as the ratio of calls requiring trunking becomes larger. Accordingly it has become a rule of practice to omit the subscribers' multiple from switchboards at which 70 per cent or more of the originating calls require trunking. The strictly local calls are completed through a trunk board under the same roof, which also terminates incoming trunked connections from other central offices. An exception to this rule is sometimes made in the case of very busy lines, frequently called by others terminating in the same switchboard, even though the proportion of calls at the switchboard which require trunking is greater than 70 per cent. Such lines frequently include the trunks of busy private-branch exchanges, and are accommodated in a multiple of small dimensions, in the subscriber's switchboard. Calls for lines not having terminals in this multiple are completed through the trunk or "B" board.

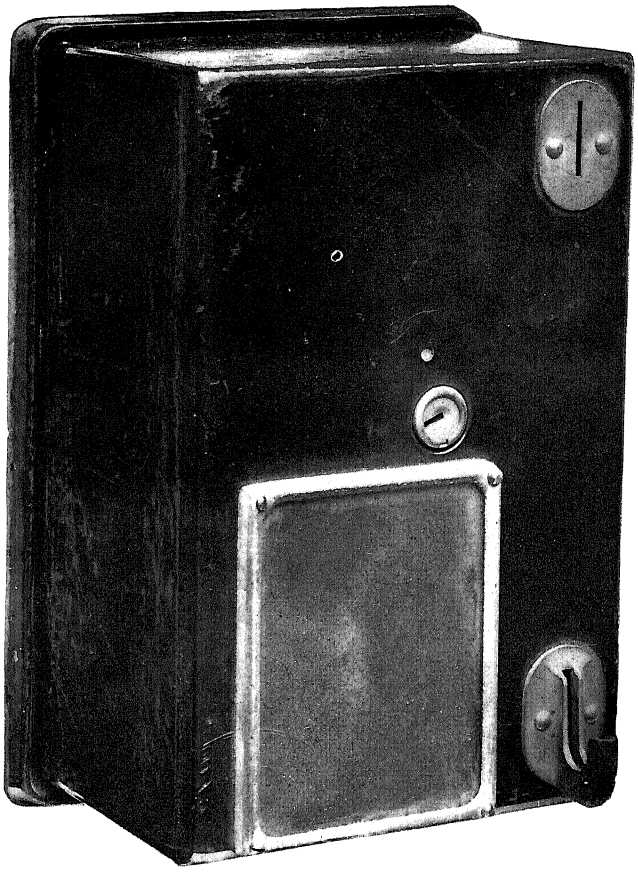
Party-line special signaling.—One of the devices by which selective party-line ringing is accomplished is the connection between each side of the line and the ground of two bells, one designed to respond to pulsating current of positive, and the other to current of negative, polarity. This gives a four-party line, on which any bell can be rung without disturbing the others. Under this plan, in many cases, one jack is provided for each station on the party line; thus a line carrying four stations would terminate in four separate multiple jacks. The wiring interconnecting these jacks is arranged to insure the proper transmission of signaling current. Under this system a subscriber can move anywhere within his exchange district and still receive party-line service without a change of his number, while calling and accuracy of connection are facilitated by the elimination of any prefix or code designation for party-line telephones. This system, known as the "jack per station," is used exclusively by the Bell companies.

An ingenious development of party-line signaling is the automatic ringing of the desired station, which is done in the automatic telephone system, and also in the manual switchboards of the "jack-per-station" type. In the latter boards no ringing or other keys are provided at the trunk operator's position. Her duty is confined to inserting plugs in jacks of called lines, in response to instructions received from other operators over "order wires." The insertion of the plug into the jack corresponding to the desired station introduces to the current of the switchboard cord, from which it passes to the jack, and thence to the line and the subscriber's bell. Under this system an operator can handle a larger number of calls, and, therefore, of trunks, than when she is obliged to manipulate keys.

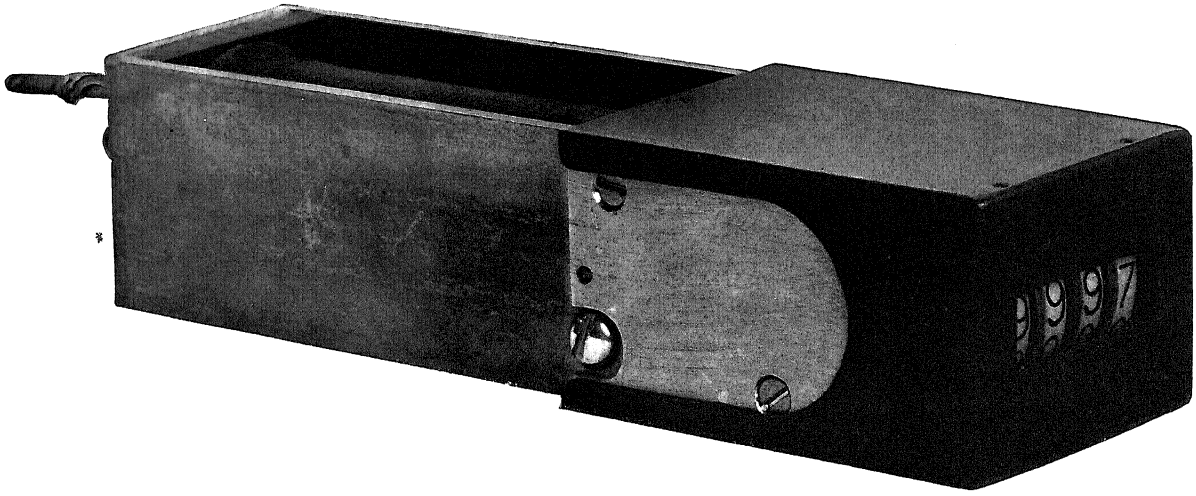
The telephone repeater.—For extending the range of long-distance communication, it has long been conceived that some instrument might be devised capable of responding to electrical waves corresponding to speech, and of reproducing and retransmitting these waves along the line with unaltered form but increased amplitude. Such a device renews from a battery associated with the repeater the energy from the transmitting station which is gradually diminished as current traverses a line. Great difficulties in the way of a practical invention for this purpose have been surmounted, and such an instrument has recently been in commercial operation on some of the lines of the American Telephone and Telegraph Company.

Methods of prepayment service.—Under the measured-service method of charging, as originally carried on, each call was recorded on a "ticket" by the operator receiving it. These tickets were the basis upon which the accounts were made out and bills rendered to subscribers. This plan causes a certain increase in the expense of accounting, and increases the cost of operating, as it reduces the number of calls which each operator can handle in a day, and so involves a higher cost for handling a given number of calls per day than under the flat-rate system. The higher rates which for this reason it was necessary to charge in order to render the service profitable were found to interfere with its extension among those whose use of the system is possibly as low as twenty to forty calls per month, who constitute a very large class of the population in some cities.

This condition has been met in some places by the development of the prepayment or coin-box service. Each telephone furnished to a subscriber using this class of service is provided with a coin box. A subscriber deposits the coin, sometimes as an essential means of calling the central office through the completion by the coin of the electric circuit in the line, and sometimes after being answered by the operator, upon her request. In either case the coin is under the control of the operator, who can send a current over the line to operate mechanism for dropping the coin into the till of the coin box, if the desired connection is completed, or for releasing it from the intermediate receptacle into which it first falls, and restor-



TYPE OF COIN COLLECTOR WITH AUTOMATIC RETURN IN CASE OF UNSUCCESSFUL CALL.



SERVICE METER FOR COUNTING TELEPHONE CALLS.

ing it to the subscriber, if the called party does not answer. When the depositing of the coin has been completed, this fact is indicated to the operator by the lighting of a lamp on her switchboard, which furnishes a check on each collection. Collections from the boxes are made once a month.

This class of service is employed largely in some cities in very small business houses and stores where the public uses the telephone to a certain extent, and, particularly in Chicago, in residence districts where people desire an inexpensive party-line service with a rate proportionate to the amount of use, the rate most frequently adopted being one of 5 cents per call, with a guaranteed minimum of $1.50 per month. Among the merits of this service are its low cost to subscribers, the absence of uncertainty as to collection, the payment for service daily, as obtained, and its tendency to discourage the free or "deadhead" use of the telephones of subscribers by their neighbors, which is an objectionable feature of low-grade flat-rate service. The use of the coin box is, however, regarded by telephone managers as incompatible with high-grade service, and best suited to smaller places.

Police and fire-alarm telephone service.—The telephone is a medium generally employed to supply the necessary means of communication between police and fire headquarters and outposts in various parts of the city. For example, the headquarters of the fire department generally have a special call number in a telephone exchange, and every fire station is connected with headquarters. The use of the telephone for reporting fires is gradually increasing, so that in some places a larger number of reports are received through the telephone exchange than through regular fire-alarm signal boxes set up on the streets. It is easier to get to the telephone than to one of the boxes, and when the citizen has reached it he knows how to use it instantaneously and can give particulars which will be helpful to the force sent to handle the blaze.

The police telephone box set up on an iron post in the street for the use of patrolmen in reporting to headquarters is a familiar sight upon city streets. Police headquarters generally have an elaborate and well-developed electrical system in which the telephone is combined with signaling apparatus for recording the calls of the officers which are sent in simply for the purpose of notifying their superior officers that they are covering their beats on time. A recent development of the police signaling telephone service has been the modification of these boxes to provide them with a powerful lamp signal and gong, which may be operated to call an officer to the telephone if he is within sight or hearing, or if he is not, to notify citizens to pass the word along, and send him to the signal box. In case of a report coming to headquarters by telephone that an officer is needed at a certain place, the person in charge is thus able to call to a street telephone the officer nearest the point where the services of the police are needed and instruct him to proceed to that point at once.

In some parts of the country the municipalities allow telephone companies to operate their fire and police telephone and signaling systems, and supply the equipment for them at an annual rental, in order to obtain the skilled services of the telephone men and the testing equipment, which is a part of every telephone exchange, as well as the system of supervision and maintenance, which is necessarily developed to keep the telephone wires in efficient working condition.

Loaded cables.—Detrimental electrical effects, which are unavoidable in the use of insulated wires, twisted together in pairs, in which the wires are in close proximity to each other and to other pairs of wires in the cable, have for a long time limited the range of speech transmission which could be obtained in such circuits. For example, the loss in speech transmission in one mile of No. 19 B. & S. gauge wire, diameter 0.0359 inch, in cable of the ordinary type, is equivalent to that in a little over 8 miles of No. 12 B. & S. gauge copper wire, diameter 0.808 inch metallic circuit, strung on poles with the standard spacing of 12 inches between the two members of the circuit. The fundamental problem of applying a counteractive influence which would increase the ability of wires in cables to transmit speech was most ingeniously solved in a mathematical computation recently worked out by Dr. M. I. Pupin, of Columbia University, and embodied in patents.

The reduction to a practical working basis of the theories thus developed has been steadily in progress under the direction of engineers of the American Telephone and Telegraph Company, and at the present time cables, in which the wires are "loaded" at intervals with inductance coils that nullify some of the detrimental electrical effects inherent in unloaded cable pairs, are in service between Worcester and Boston, Boston and Lynn, New York and New Haven, New York and Philadelphia, Chicago and Milwaukee, and on other less important circuits. The transmission over a loaded No. 14 B. & S. gauge cable pair, such as is used in the circuit between Chicago and Milwaukee, 88½ miles in length, is as good as would be obtained over an unloaded cable circuit which employs wire of the same size but is only 18 miles long. The practical effect of installing this type of cable for circuits of this class is to protect the wires from the influence of the weather, which on open-wire lines might at any time absolutely interrupt the important service given, or reduce the efficiency of transmission. The conditions of the cable circuits are practically constant, so that their installation represents an exceedingly valuable improvement in the facilities for handling a traffic consisting of important messages, heavily concentrated between two points.

In large cities where the circuits between remote central offices are necessarily carried through cable for a considerable distance, detrimental effects of the long cable hauls are reduced by loading the wires used for carrying long-distance messages. Loading a mile of No. 19 cable wire is equivalent to reducing the length of No. 12 B. & S. open wire at the outer end of a 100-mile connection by about six miles. This means that good transmission can be obtained over just that additional mileage of open wire at the end of a 100-mile line for each mile of cable circuit which is loaded as compared with what would be possible if the cable were unloaded. For lines longer than 100 miles there is a progressive improvement in the ratio of gain with the increase in circuit length.

Difficulties attend the application of the loading principle to open-wire circuits, in which the same effects experienced in cables are found to exist to a certain but far lesser degree. These difficulties, however, are being gradually surmounted, and it is probable that the next five-year period will, as a result of the work done and data secured in the present period, witness a very considerable improvement in the development of loading aerial copper circuits.

Development and standardization of testing service.—The quality of service is judged on the basis of speed and accuracy. In all well-managed exchanges frequent test calls are originated by employees of the telephone companies and the results are recorded. Any lapse from standard phraseology or methods of procedure, as well as any inaccuracy or undue delay, is noted and brought to the attention of the operating staff with a view to preventing recurrence of errors.

Such test calls are made in various ways. Sometimes they are originated at subscribers' stations, sometimes within the exchange by means of special test sets which may be temporarily connected to any line. In some central offices the chief operator or a special operator is provided with equipment for the express purpose of making tests, and a certain number are made each day as a part of the operating routine. Where such regular equipment is provided, it is customary to have arrangements for connecting the testing circuits to lines of subscribers, and particularly to those about which complaints have been made, or where possibility of irregularity is suspected, for the purpose of observing their actual service conditions. In such cases, when a call originates or terminates on the line, the supervising operator is notified by the illumination of a lamp, and can connect her telephone to the line and observe the progress of the connection. Important intervals, such as that from the time of originating the call to the operator's answer, from the answer of the operator to the ringing of the called party's telephone, and the total time from the origination of the call to the answer of the called party, are recorded.

Definite standards based upon the average of a large number of satisfactory tests have been established to furnish a basis of comparison by which the efficiency of handling test calls may be measured. In single-office districts the common standard allows four seconds from the time the subscriber lifts his telephone from the hook to the answer of the operator. Three seconds are given for the operator to obtain and repeat the number, while the time from the origination of the call to the answer of the called subscriber should not exceed twenty-four seconds. These conditions vary, however. Where a call is trunked from another office, in a district having several exchanges, the total time allowed is four seconds longer, the extra interval being taken up by the assignment of a trunk for passing the connection to the second exchange. For measured-rate service, the interval between the origination of the call and the completion of the connection is necessarily longer than that given above.

While the figures just given represent the average intervals required for the observations which determine the standard, the results obtained from a series of test calls are compared with a standard of another type, a so-called traffic curve, which is based upon the percentage of calls answered within a given period. To accord with a standard curve of this type for a common-battery, single-office district, a determined percentage of the calls should receive a response from the operators within four seconds, a somewhat smaller percentage requires five seconds for a response, a still smaller percentage six seconds, and so on, while no answer should require an interval of more than ten seconds, under normal load conditions. There appears to be a tendency to abandon these traffic curves, for various reasons.

In some large cities the testing of subscribers' lines under observation has been concentrated in one exchange, where the testing desk is located. Trunks connect this desk to the different central offices, and a certain number of subscribers' lines at each exchange are connected each day to the testing equipment. Operators observe all calls passing over these lines in the course of a normal day's business, and also originate calls upon these lines themselves for observation purposes, if they consider it desirable. An ingenious application of circuit principles consists in the employment of testing trunks of an automatic selecting device at the testing operator's desk, associated with a connector at the remote end of each service-testing trunk. Connector contacts are wired to fifty or more separate working subscribers' lines, with any one of which the testing operator may obtain connection by operating her selector. She is thus enabled to check the service on a large number of operators' positions, in several exchanges, by the use of a very small number of trunks, which are the expensive part of the circuit. It is

objected, however, that this method manufactures calls for tests rather than tests regular calls.

As a part of the routine of obtaining traffic data, so-called "peg counts" are taken to ascertain the number of calls handled by each operator during each hour of the day, once a month. These "peg counts" are utilized in a variety of traffic studies, the object of which is to provide a proper distribution of the load among different operators, and a general regulation of the service.

Rapid handling of concentrated toll business.—"Short-haul" telephone business between cities where traffic is heavily concentrated and a considerable number of circuits are in service is now commonly handled under a simplified system which eliminates, to a large extent, the use of each circuit for transmitting detailed information about calls, in alternation with the conversation of patrons. For moderate distances, under such circumstances, the practice of obtaining full details, including the name of the particular party desired at the telephone, has been eliminated, and a record of the call is made by the originating operator only. The request for connection of a telephone to a remote terminal is transmitted over a circuit called an "order wire," used exclusively for this purpose by various operators in common, and the other circuits are set aside for the exclusive use of subscribers. In this way the company's business is concentrated upon one or two pairs of wires, and the circuits for the use of the subscribers are kept free from interruptions by the conversation of operators.

This system has also been inaugurated on longer circuits, such as those through loaded cables where business between two terminal points is heavily concentrated. This method of handling calls has been responsible for a very material reduction in the interval which elapses between the time of originating a call and obtaining connection with the called subscriber. Circuits are commonly put at the disposal of users, while the calling party waits at the telephone, almost as quickly as if the person with whom connection was desired was in the same city. The use of toll-line circuits at such high efficiency has been a factor in rate reductions which are thus traceable to the scientific study of traffic problems.

Railway telephony.—Transportation of passengers and of freight upon steam railways is a service which imposes highly exacting demands upon men and equipment. The maintenance of schedule time is a factor of primary importance in the handling of the business and the attainment of economical operation. In the case of unavoidable departure from schedule the readjustment of assigned positions of trains admits of scarcely any delay. It is well known that control of train movements is vested in employees whose duty has brought them the title of "dispatcher," and that among the wires which are everywhere seen paralleling the railways the most important circuits are those terminating in the dispatcher's office. The telephone has recently found a new field for expansion in this service which demands such high efficiency in a medium for communication, which must be noted briefly in this report. A more detailed account will be found in the Census Report on Telegraphs, 1907.[1]

Railways have long employed the telephone extensively in transacting their ordinary business, the instrument being a familiar sight to visitors in passenger stations, freight offices, and of course in all general offices, while booths for the use of the public are frequently installed in important stations as an adjunct to the pay-station business of the local telephone company.

The Pennsylvania lines east of Pittsburg in 1907 used over 10,000 telephones, while the New York Central lines between New York City and Chicago carried on a heavy exchange of communications over the substantial copper circuit owned by the railroad company and supported on poles located on its right of way. For years there was talk of the introduction of telephones to replace the telegraph on train-dispatching circuits, but the apparent difficulties and uncertainties involved in such an innovation made the railroads slow to consider the change with approval. This conservatism was due in part to the natural prejudices entertained by telegraphers in favor of the instruments of their trade. In addition, strong sentiment in favor of telegraphy, which had formed a part of the training of many of even the highest officials, existed to a certain extent in executive offices. There was a hesitancy to believe in the reliability of the telephone, due in part to errors and interruptions noticed in service given by central-exchange telephone companies. In train dispatching reliability is the first essential. In addition to these considerations, the wire systems and business methods of the railway companies were closely dovetailed with those of the regular telegraph companies, so that a change was conceived to involve laborious and expensive readjustment of plant and business relations. In 1907, however, there was more extensive discussion of the use of the telephone for train dispatching than had yet occurred, and experiments on a practical scale were made by the Chicago, Burlington and Quincy Railroad, under the direction of Mr. W. W. Ryder, superintendent of telegraph, which convinced railway officials of the adaptability of the telephone to all types of railway service requiring verbal communications.

Special apparatus has been evolved as an adjunct to the telephone in railway work. A dispatcher's circuit leads from the dispatcher's office, commonly located at division headquarters, along the right of way,

[1] Bulletin 102, Telegraph Systems: 1907.

with a telephone and signaling equipment at each station on the line. The dispatcher has at his station an equipment which enables him to select and call at will any one or more of the local operators or agents. Instead of a clicking telegraph instrument, the calling device is a loud-sounding bell, which can be heard by the operator even if he is out on the platform and a reasonable distance from the station. This bell rings continuously when a station is called until the operator goes to his telephone set and stops it by answering. Automatic devices are at present sometimes used at the dispatcher's station to record the answering of an operator. Operators and dispatchers are provided with telephones equipped with a head band, so that they may be automatically held to the ear, leaving both hands free for writing.

Messages relating to train movements are distinctly repeated to the operator word by word, and copied at both ends, then repeated back as a check. During the repetition each word is understood as a check by the dispatcher. Code words are used to abbreviate messages. Words and numbers of critical importance are first spelled out, then repeated as words.

Under these methods it is found that the dispatcher works more rapidly, keeps his work in better shape, and has a better idea of what is going on along the line, than when the telegraph is used, while there is the further advantage that when necessary, he can communicate directly with the conductor or engineer of a train. It has also been found that the use of the telephone throws open employment with the railroads to a better class of employees than it was commonly possible to secure as telegraphers. This results from the fact that the duties of an operator are learned in a month, while fair proficiency as a telegrapher usually requires a twelve-month apprenticeship. One of the most conspicuous advantages of the telephone system is its superior reliability to the telegraph in foggy, wet weather, while it also gives better results where electrical disturbances are communicated to the lines from near-by trolley and high-tension alternating-current power lines. In addition to this greater reliability, the use of the telephone makes transmission more rapid, as words are sent as units instead of letter by letter, so that an ordinary way station can handle from 50 to 75 per cent more dispatches a day than was the rule when the telegraph was the means of communication. This saving in time is to a considerable extent due to the elimination of the tedious method of calling by clicking out a code with the telegraph key, which was formerly the fashion.

Where arrangements with telegraph companies provide for the transmission of their business to the same operator who handles the railway business, the telephone can be used in relaying messages from a telegraph instrument to the terminal.

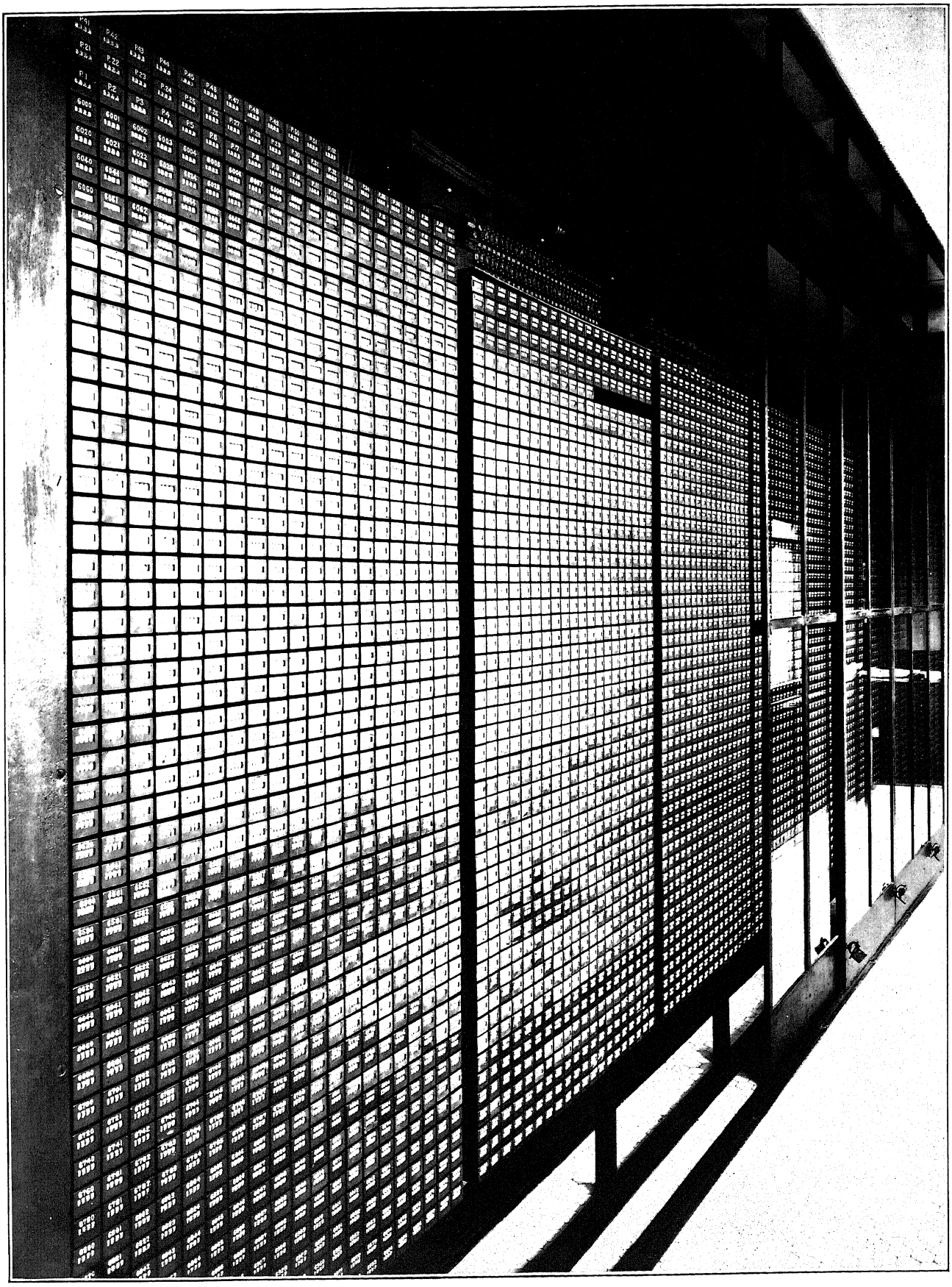
Railway telephony began with the equipment of telegraph lines with special telephone instruments commonly known as "railway composite sets." These worked with a moderate degree of efficiency over the single-wire grounded telegraph circuits which were uniformly in service, but their reliability was not as high as that of the equipment which was developed later at about the time that some railroads began to be converted in opinion and action to the exclusive use of telephones on dispatching circuits. At the present time the tendency on the part of the railways is to employ well-built metallic circuits, equipped with standard telephones and selecting, signaling, and call-recording electro-mechanism of a type built especially for this class of service.

Portable telephones may be carried upon trains, and their provision, particularly upon wrecking trains, affords a means of communicating with headquarters, in case of emergency, from any point along the right of way. The use of the telephone in freight yards, roundhouses, and terminals has grown to be a common factor in the movement of cars and engines. Many passengers now talk with friends directly from trains connected up with local or remote exchanges.

Street-railway telephony.—Interurban electric railways have undoubtedly been pioneers in the field of car operation by telephone. Hundreds of miles of electric-railway track are to-day paralleled by telephone wires, which are erected by the railway companies solely to facilitate the transaction of their business, provide for the safety of their passengers, and enhance the efficiency of service.[1] Commonly a telephone is located at every turn-out or siding, either in a weatherproof box mounted on a pole or in a booth set beside the line. Each telephone is equipped with protective devices, and many companies using booths place an insulated platform on the floor so that employees using the telephone are amply protected from accident on account of a cross between the telephone circuit and the trolley or feed wire, as well as from lightning and currents from other foreign circuits.

At central points, such as division or general headquarters, the lines paralleling the different tracks of an electric system are terminated in a switchboard, and the movements of cars are controlled and recorded by dispatchers. On many lines, at the present time, not only is the conductor obliged by the regulations of his road to obtain permission of the dispatcher before passing a turn-out, but the dispatcher can call a conductor to the telephone by operating a signal, so that a large degree of control over the movements of cars is economically effected. Sometimes cars are furnished with portable instruments which can be connected with the line at any point along the right of way by the use of hook wires carried on a pole, which enables the trainmen to make contact with the overhead wires. In cities a large and complete central telephone system is often a part of

[1] Census Report on Street Railways, 1907, p. 275.



RACK OF METERS, WITH PROTECTING GLASS DOORS.

the equipment of a railway, and this is true not only of surface lines but of elevated railways and subways in New York, Boston, and Chicago. This adaptation of the telephone to the needs of the electric railways has not only been instrumental in increasing the safety of travel over such lines but has had much to do with maintenance of time schedules and increasing the speed with which cars can be safely operated.

Phantom circuits.—In the early days of telephony a circuit consisted of a single wire extending from a grounded terminal at the central office to a ground connection at the distant terminal of the telephone at the subscriber's station. Electrical energy traversed the wire and completed its circuit through the earth. Such grounded circuits were for a time used to a large extent between central offices for the transmission of messages from one exchange district to another, but were replaced with metallic, two-wire lines, to secure improved transmission.

In a long-distance system a large proportion of the fixed investment is bound up in the copper wire which carries the messages. The revenue of such systems was in early times limited by inability to use the two wires of a line for more than one message at a time. Inventions which have received their general commercial development within the past five years have, however, made it possible to utilize two pairs of wires to carry simultaneously three telephone messages, the lines being adapted for this service by the connection of special coils of wire wound upon iron cores at each end of the respective circuits. It is also possible not only to use a pair of wires for carrying a telephone message, but at the same time to use one of the wires for carrying a telegraph message, or even to use each wire for carrying a separate telegraph message, without interfering with the speech which is at the same time passing over the circuit. The assertion is even made that the latest developments indicate the commercial possibility, through duplex and quadruplex telegraphy, to effect the transmission of four or eight telegraph messages over each pair of wires without interfering with their use as a talking circuit.

A study of electrical action will reveal the possibilities of creating, so to speak, a third circuit without stringing any additional wire. Because this third circuit has no physical existence apart from the two original pairs of wires, it was named by early inventors a "phantom" circuit, and the name so appropriately assigned is regularly used. In addition to the coils and a slight amount of special wiring at the terminals of circuits, the only other investment required to produce a phantom circuit is that necessary for a rearrangement of wires on poles at intervals throughout their length to prevent confusion of speech on the lines. It is not possible, however, to create a phantom of two circuits which are not absolutely similar. For example, a copper circuit and a pair of iron wires might be of the same length and size, but the differences in material or molecular character would prevent their owners from combining them to produce a good phantom circuit. It is not natural to expect increased efficiency without extra labor, and in this case the law of common experience holds good, as it is necessary to keep wires which are "phantomed" especially clear of trees and other influences which would lower insulation; in fact, the circuits must be kept in first-class condition. Yet this device has rendered, in the aggregate, thousands of miles of lines more profitable than before its adoption, by adding a potential advance in returns of 50 per cent at the cost of a comparatively insignificant investment, with no harmful effect upon the service.

The result of the adaptation of telephone circuits to the simultaneous transmission of telegraph messages has been the same from the standpoint of investment and returns. Telephone companies now carry on a large part of the communication relating to their own business by telegraph, over circuits which at the same moment are earning revenue by carrying messages for subscribers. For a long time one of the elements entering into the cost of long-distance service has been the use of the wire by operators in making appointments necessary for completing connection previous to the establishment of communication between subscribers. Where the necessary information is transmitted by telegraph over a simplexed telephone circuit, one paying message can follow another as quickly as the wire can be released. Moreover, by leasing the use of a telegraph line formed in this way to outside persons, a telephone company may at any assigned instant be deriving from a particular pair of wires income from three separate persons—one telephoning, a second leasing one wire of the pair, and a third leasing the other wire, the two latter being users of telegraph service.

Information is now transmitted over very long circuits, such, for example, as those between Chicago and New York, by telegraph, using repeaters at suitable relay stations, without in the slightest degree interfering with the telephone service, the rendering of which is the normal function of the lines.

Wireless telephony.—Although it has not been regularly applied to commercial service, the wireless telephone represents, from a scientific standpoint, a most interesting contribution to the art of speech transmission. It involves the modulation of continuous trains of electro-magnetic waves, in correspondence with the intricate variations of sound waves which impinge against the diaphragm of a transmitter. These electro-magnetic waves, at the receiving end, pass through a detector which gathers out the variations, and retransforms their special type of

energy into variations of electric current capable of causing vibrations in the diaphragm of a telephone receiver and thus reproducing speech.

Up to the present time the range of this method of communication is apparently limited to a few miles, and as no method of eliminating interference beyond a certain small degree is known, its practical application has been confined to lines, such as the transmission of messages across narrow bodies of water or along a strip of coast, in contrast to wireless telegraphy, whose range runs into thousands of miles.

Concrete poles.—A desire to find a substitute for wooden poles which would be more durable and capable of bearing greater stresses, has led to experiments with concrete poles. The Pennsylvania Railroad has constructed stationary forms, in which it has made a considerable number of concrete poles reenforced with steel rods, which are distributed along its roadbed and then put in service. Several inventors have built and erected concrete poles with different types of reenforced steel structures. The weight of such poles is a factor which has prevented their economical distribution along any considerable length of ordinary line, and arrangements for molding each pole at the place where it is to be used have not seemed to be capable of being utilized with such economy as to warrant the general use of the concrete structures in competition with wooden poles at prices now prevailing. The use of concrete poles in the telephone field is still very limited.

Operators' schools.—Beginners in operating in practically all of the large exchanges are now taught the best methods of performing their duties before actually being set to the work of serving subscribers. Methods of giving this instruction vary widely in detail among different companies and in different parts of the country. The simplest plan employed is to place the beginner at an unused position of a switchboard, where she learns the nature of the equipment and method of manipulating it, and practices "putting up" connections under the guidance of an instructor until she becomes well acquainted with the exchange routine. Then, for a time, she is a "listener," sitting beside a regular operator, a duplicate of whose receiver she wears, hearing all that is said to the operator and the replies, and observing what takes place under the varying conditions which arise. From this she passes to a regular switchboard position, where the traffic is purposely made light by connecting to the answering jacks terminating there a small number of comparatively idle lines. On each side of such a position are seated operators competent to aid and instruct the newcomer, and under their supervision, and by noting the example they supply, the beginner rounds out quickly the training which she has received under the instructor.

In the somewhat elaborately equipped schools maintained in the largest cities, the student is supplied with instruction books setting forth the organization and rules of the company, the nature of the equipment and its use, and the methods of coping with the various situations which she must deal with in the course of her daily work as an operator. She listens to lectures, studies and recites, learning how the equipment looks, is named, laid out, and operated, by reference to drawings of a sample switchboard, and actual pieces of individual apparatus, such as lamps, jacks, and keys, which are provided in the study room.

Having acquired the ability to tell what to do in any case which may arise, either in regular routine or emergency, the student is given a certain amount of practice each day in putting up sample connections. She sits at a switchboard and handles calls, all of which originate and terminate with an instructor, who makes these calls cover not only regular business but all the many irregularities which must be dealt with properly by an operator. Here the students learn accuracy, and, to a limited extent, speed, the highest development in the latter respect being attained when later she is placed at a switchboard position between two especially competent, experienced operators.

Candidates for positions as operators are accepted, as a rule, only after passing a careful examination as to their qualifications in respect to general health, disposition, mental alertness, education, voice, sight, and hearing. The average candidates who possess these essential qualifications to a sufficient degree to warrant their acceptance as students are normally fitted to take positions at a switchboard as beginners after about one month in the school.

Exchange welfare provisions.—Discipline in the telephone exchange operating room is necessarily strict, and an operator's attention to duty while at work must be incessant; yet such employment is free from any implication of severity and is made pleasant and attractive to the intelligent young women whose services are sought. This is accomplished largely through the efforts which operating companies in practically every city of importance throughout the country have put forth to provide cheerful, comfortably equipped quarters in the exchange buildings for their operators to occupy during the intervals when they are off duty for short periods during the day and during the time before and after going to work.

It is customary to divide an operator's working time into sections by relief periods of moderate length. For the accommodation of those off duty during such periods it is usual for the company to provide a room attractively and comfortably furnished. Books and magazines are placed in such rooms, and some companies arrange with the public library to have their

city exchanges supplied with books through a special service.

In some places operators are interested in cooperating to develop the social value of such quarters by efforts for their decoration, including the provision of pictures, window gardens, etc. This kind of work has been carried even further, in some cities, so as to embrace improvement in the appearance of the exchange grounds by out-of-door gardens in summer.

Arrangements for operators' luncheons are of most varying character, but most companies have, in their exchanges, made provision for them. Some companies merely provide kitchens in which operators may prepare tea, coffee, cocoa, and toast, or light meals. Others supply these foods gratis, and allow the operators to use the furnishings of the kitchen and dining room provided they bring their luncheons, with the exception of what is furnished by the company. A few furnish complete luncheons, gratis, to operators, while some maintain kitchens and dining rooms and supply luncheons at cost, making special efforts to furnish food in sufficient variety and of the best quality at a minimum price.

It is now generally recognized that the operator is not only a responsible factor in the production of service of the requisite quality, but is the personal representative of the company who comes most frequently in contact with the user of its product; that is, telephone service. A cooperative spirit in the recognition of the true relations of the company to the public is being impressed upon operators.

Among the employees of the operating staff who occupy responsible positions, such as the supervisors, monitors, chief operators, etc., meetings are frequently held for the purpose of discussing methods of improving the work. Toll operators who handle long-distance calls have benefited themselves and their employers greatly, in some parts of the country, as a result of the opportunity to meet not only their associates in the same exchange, but operators from neighboring exchanges, in gatherings held at intervals at central points to discuss methods of improving service and utilizing the circuits and other facilities for transacting the telephone business to the best advantage. In Michigan the long-distance operators and managers of the independent exchanges meet regularly once in six months, and all participate on an equal footing in the discussion of practical operating problems, with a noticeable result in improving the service. This principle of cooperation and improvement by getting together and finding out the existing causes of friction and lack of coherence, and methods of remedying them, is carried still further, in many companies, and several associations of companies, by the frequent interchange of ideas between men in charge of different branches of the work, such as managers, construction officers, traffic men, maintenance men, etc. The annual meetings of independent telephone associations in some states, and more frequent district meetings, are largely occupied with such discussions. Similar methods prevail among the Bell companies. In a business as complicated as the telephone industry this frequent interchange of ideas, and the creation of a spirit of cooperation between companies, departments, and men of the same department located at different points along the route which messages must follow, has been one of the greatest aids to the development of efficient service, and this work is now so well advanced that its continuation is assured.