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CHARLES M. BRACELEN, 1878–1942

Bell Telephone Magazine

February 1943

"The ideal and aim of the American Telephone and Telegraph Company and its Associated Companies is a telephone service for the nation, free, so far as humanly possible, from imperfections, errors, or delays, and enabling anyone anywhere to pick up a telephone and talk to anyone else anywhere else, clearly, quickly and at a reasonable cost."

A Medium of Suggestion & a Record of Progress

Published for the supervisory forces of the Bell System by the Information Department of American Telephone and Telegraph Company, *195 Broadway, New York, N. Y.*

Who's Who & What's What

in This Issue

"BELL SYSTEM POLICY" is one of those broad-gauge phrases which take in a lot of territory. Telephone men and women are familiar with it as compass and guiding star, yet it isn't always easy to recognize policy ac-

Mr. Cooper

tively at work. The long-range look at how the System's financial policy has fostered the development of service to the public, which our first article offers, will be most enlightening if it is read with one eye to the growth of the business since the last war and the other to its growth after this war shall have been won. CHARLES P. COOPER has had plenty of opportunity to experience the application of this policy since he joined the New York Telephone Company as a junior engineer in 1908: division plant superintendent at Albany; General Plant Superintendent of the Chesapeake and Potomac Telephone Company; General Manager of the Cleveland Telephone Company; Vice President and General Manager and then President of the Ohio Bell Telephone Company. Since 1926 Vice President of the A. T. & T. Company in charge of finance, he knows whereof he speaks.

SOMEBODY'S PLAN for a post-war world is a standard feature of each morning's newspaper these days. Narrowing the field to its home grounds, the Bell System too has plans: plans which, with public understanding and support, can provide the nation with new and more and

Mr. Sullivan

better services in the bright days to come. Teamed up with Mr. Cooper's article, MARK R. SULLIVAN'S forecast of the System's opportunities makes a picture to challenge and to inspire those with the vision to look

Mr. Droser

Miss Fawcett

Mr. Florance

ahead. "Straight through traffic" might describe Mr. Sullivan's Bell System career from his start with the Pacific Telephone and Telegraph Company as a traffic clerk in 1912 to his appointment as General Traffic Manager of the company's Northern California-Nevada area in 1928. Six years later he was made Vice President and General Manager of that area; in 1938 his duties became company-wide when he was made chief of staff of the Operating Vice President's organization; and the following year he was elected Vice President in charge of Operations. It was in 1941 that he made the long jump from the Pacific coast to the Atlantic when he was elected a Vice President of the A. T. & T. Company. He is in charge of the Department of Operation and Engineering. His "The Organization of Large-scale Engineering Work" was published in these pages last August.

PEOPLE WHO HAVE relatives or friends in the armed forces—and that includes most of us—should get a lift out of knowing about the special pains which the Bell System is taking throughout the country to put telephones where service men will find them handy. From 1919 to 1927 VINCENT A. DROSER held positions in the traffic department of the New York Telephone Company, and for the next four years in the traffic division of the A. T. & T. Company. Then he moved over to the commercial division, and since the war he has been in charge of a group which devotes itself to planning services for the Army, Navy, Government agencies, war industries, and civilian defense organizations. His first-hand knowledge of service for service men he obtains by frequent visits to many of the places he tells about—and perhaps gets an extra kick out of visiting some Navy base or training station, since he served all through the last war as a signal quartermaster in the Navy.

"WHEN YOU KNOW you're not forgotten by the girl you can't forget" is the title of a popular song of an earlier day. Making sure that men in service are not forgotten, and that they have reason to know it, is just

(*Continued on page 74*)

MILITARY PROTECTION for telephone buildings in Washington was one quick consequence of the attack on Pearl Harbor. While company guards have since replaced soldiers, this picture is symbolic of the great importance of communication there—and throughout the country. See "How Washington's Telephones Went to War," beginning on page 51

Appraisal by Investors of Earnings, Financial Structure, and Reputation Will Influence Their Willingness to Provide the New Capital for Continuous Telephone Development

Financing Telephone Growth

Charles P. Cooper

The following article is based in large part on testimony of Mr. Charles P. Cooper, Financial Vice President of the American Telephone and Telegraph Company, before the Federal Communications Commission on December 17, 1942. THE EDITORS.

THE TELEPHONE BUSINESS is one of the most dynamic in the United States. Almost from its infancy it has been characterized by rapid growth and evolutionary change due to the development of the telephone art through research and invention.

In the application of these developments to the country's needs the Bell System has a record of continuous accomplishment, until interrupted by conditions arising from the present war, in expanding and improving its service, and in making the service more useful and pleasing to the public.

The response of the public to this effort has been a demand for more and more service, and this demand has made necessary a continuous expansion of service facilities.

What this plant expansion has meant in terms of investment is made clear in the accompanying table, which shows a plant of $1,386,000,000 in 1920, and, at the end of 1942, of $5,297,000,000—an increase of $3,911,000,000 in only 22 years.

In order to finance this vast growth in facilities, it has been necessary at frequent intervals to obtain large amounts of additional capital from the investing public. Since the end of 1920, the Bell System companies have issued securities to the extent of over $4,000,000,000. The proceeds have been used in part to retire and refund existing obligations, but more than

$2,580,000,000 has been additional capital for financing the expansion of the telephone plant.

Additional Capital Needed for Further Growth

IN SPITE OF the tremendous additions and extensions to our plant in recent years, the demand for telephone service has increased so greatly that the margins of spare plant that we normally maintain are rapidly being exhausted, and in many places have already been completely exhausted. This is especially true of the interstate toll property of the Long Lines Department of the American Company where the number of intercity circuits would have to be increased by from 25 to 35 per cent in order to give the same quality of service as was given early in 1940.

The war-time shortage of materials has prevented us from building these circuits. For the same reason, construction for new exchange service has been limited by the War Production Board to service for a preferred list, and it is expected that within a few months the unsatisfied demand for exchange service will be quite large. The fact that during 1942 there were 200,000 applications for main telephones that could not be filled, as well as 225,000 applications for other services such as extensions and auxiliary lines, is proof that this expectation is well founded.

We expect to be able to obtain materials to meet the essential requirements of the armed forces, which are still being expanded, and to some extent for the industrial activity associated with the war effort. Consequently, a considerable amount of money will be required for new plant.

Until the shortage of materials becomes considerably less acute, we do not anticipate that our construction program will be such as to require new financing, as we still have substantial funds in hand. But as soon as materials become available, we will be faced with an immediate need for expansion of our plant. This may not be until after the war, but it may be sooner, depending on the course and nature of the war.

We also expect to resume our program of service improvement which has made our service increasingly attractive to the public, and has resulted, except during the depression, in substantial yearly growth.

*More Than One Billion Dollars Needed for Coming Expansion**

I THINK IT IS quite within the bounds of possibility that the Bell System may need from one billion to one billion and a half of new capital within the ten years following the time when materials again become available, and that several hundred million dollars may be needed in each of the first few years of that period.

These estimates are based on present prices. If prices should increase, it is obvious that even greater amounts of new capital will be required, for as plant wears out or becomes obsolete it will have to be replaced at higher cost levels.

The funds for this plant expansion must, of course, be available when needed, unless people are to go without service or get along with poorer service than that to which they have been accustomed.

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* See "The Bell System's Post-war Construction Program," by Vice President Mark R. Sullivan, on page 19.

How the Bell System Must Obtain Its Capital

THE BELL SYSTEM has no royal road to money. When it goes to the money market to obtain additional capital, or money for refunding, it is in competition with everybody else who has need of money, including all other business enterprises and the government. When it issues bonds, it is in competition with all other borrowers, and when it issues additional stock it is in competition with all other seekers of equity capital.

as appraised by the investor, the larger the return required to induce him to place his money in our particular enterprise. The investor appraises the relative risks, and the prospective return in relation to the risk, and it is his appraisal which determines whether we get his money, and at what price.

It goes without saying that in deciding what return would be sufficient to induce him to invest his money, in our company or in any company, the investor looks to the return after taxes. It is what a company has left

	Plant at End of Year	Increase	
1920	$1,386,000,000		
1925	2,561,000,000	$1,175,000,000	5 Years
1930	4,041,000,000	1,480,000,000	"
1935	4,188,000,000	147,000,000	"
1940	4,748,000,000	560,000,000	"
1941	5,048,000,000	300,000,000	1 Year
1942	5,297,000,000	249,000,000	1 Year
Total Increase Dec. 31, 1920–Dec. 31, 1942		$3,911,000,000	

TELEPHONE PLANT, American Telephone and Telegraph Company and its principal telephone subsidiaries

Capital can be obtained only from the people who have funds to invest, and who are willing to invest. The investor is under no compulsion to invest capital in any particular enterprise, or even to invest it at all. If the Bell System is to obtain the capital that it needs for these expansions, the investor must be convinced that it is to his advantage to put his funds into our business, rather than to invest them in some other manner.

It is the investor's judgment which is controlling. The greater the risk

after paying taxes of every kind that becomes available as a return to the investor, and it is the prospective return to him which induces the investor to invest.

The fact that the Bell System has been successful financially, despite the risks of the business, does not mean that risks have not been there. These risks, of which the investor is cognizant, affect and in the last analysis determine the price he is willing to pay for Bell System securities. The prices he has paid and is paying for

such securities are conclusive evidence of his appraisal of all of the risks to which the future earnings of the business are subject. This is what is often referred to as the verdict of the market place.

Bonds vs. Equity Capital

IN ORDER TO OBTAIN the very large amounts of capital required in the Bell System, such as the several billion dollars raised since 1920, it has been necessary to tap the market at all points.

Appealing to the bond market opens up a large source of capital. Furthermore, there are times when it is difficult or impossible to obtain new money by the issuance of stock, and at such times borrowing must be resorted to.

Of course bond money in limited amounts can be obtained on much easier terms than equity capital. However, ability to borrow money by means of bond issues, which should be the minor part of a company's capital, has much less effect in lowering the overall costs of money than is popularly supposed. The stockholder of course assumes most of the risk. Speaking broadly, ill fortune to a company does not reach the bondholder until the stockholder has been completely wiped out.

Because he is given this preferred status, the bondholder is willing to accept compensation at a lower rate, but his preferred status is obtainable only by according an inferior status to the holders of the junior securities (stocks). The holders of such junior securities obviously carry a greater risk than if there were no bonds in existence.

Such income as there is must go to the bond holders first, and in event of a foreclosure, a stockholder may well lose his entire investment. Consequently, stockholders expect to receive compensation at an increased rate commensurate with the increased risk.

When a company has no bonds outstanding, the stockholders are furnishing all of the money used in the business: the well secured capital as well as so-called venture capital. In such case, therefore, the overall return demanded by the stockholder may be expected to be lower than if a large proportion of the investment is represented by debt.

FOR EXAMPLE, if a company is financed 100 per cent by common stock, and a certain rate of earnings holds the market price of the stock at par, it can not be assumed that if a large part of the investment were covered by bonds, the overall cost of money would in the long run be greatly reduced. It can not be assumed that stockholders would be satisfied with the same return on their stock with a large bond issue ahead of it that satisfied them when there were no bonds. If bonds were issued, it would obviously require a higher rate of return on the stock to hold it at market prices sufficient to protect the investment of the stockholders.

Thus the savings which would result from the issuance of low cost bonds would be offset at least in part, and in case of an obviously high debt be more than offset, by the increased rate of earnings on the stock necessary if additional equity capital were to be attracted to the business.

Stockholders will not take the risk of borrowing money, with the pos-

sible chance of losing their property to the bondholders, unless they are to be compensated by an increased return on their less secured capital.

These propositions are not mere theory. They are demonstrated by the verdict of the market place. It is well known that bond yields rise in proportion as the interest requirements consume more of the total income available. It is also well known that the yield demanded by stockholders before they will risk equity capital in the business increases as its proportion of bonds increases.

Over the long pull, therefore, only a relatively minor part of the necessary capital requirements should be obtained by the issuance of bonds and kindred evidences of indebtedness. There must be a solid substratum of junior securities or capital stock in order that sound bonds may be issued. The fundamental type of capital liability of a corporation should be common stock, and the major part of its capital liabilities should be in that form. If there is a sound substratum of common stock, it is then possible to obtain the remainder of the requirements favorably in the form of bonds.

The Bell System's Conservative Capital Structure

THE CAPITAL STRUCTURE of the Bell System has been of this conservative character, as is shown in the table on pages 10–11, which gives the ratio of debt to stock of the consolidated Bell companies, and of the American Company separately, at various periods.

It will be noted by reference to this table that in 1920 nearly 46 per cent of the Bell System's capital structure consisted of long term debt; that in 1930 this debt had dropped to less than 30 per cent; and that by the end of 1942, it had risen again to nearly 37 per cent.

In the case of the American Company alone, the table shows that in 1920 the long term debt constituted nearly 33 per cent of the total capital structure; that in 1930 this debt had fallen to 18 per cent; and that in December, 1942, it had risen to 24 per cent. The remainder is common stock equity. It must be remembered, of course, that most of the American Company's income is in the form of dividends from the Associated Companies, and that the debt of these companies is senior to the stock on which those dividends are paid. The most significant figures, therefore, are those for the consolidated Bell System,—i.e., 37 per cent of long term debt and 63 per cent of common stock equity.

This debt ratio is higher than at any time since 1925. Since our convertible bonds were issued in 1941, the earnings and other conditions have not been such as to induce investors to convert them into stock. Conversion would reduce the percentage of debt and place the company in a position to defer borrowing.

Perils of Over-borrowing to Obtain New Capital

THE BELL SYSTEM COMPANIES have been able to obtain a limited amount of bond money at cheap rates. But it would be a mistake to suppose that they could continue to obtain very much larger amounts at the same cheap rates. The return demanded by both the bondholder and the stockholder would go up as the pro-

portion of debt increased substantially. Not only would a large increase in the amount of debt appear undesirable from the standpoint of overall cost of capital, but it would also be undesirable from the stand-

COMPOSITION OF CAPITAL STRUC

American Telephone and Telegraph Company

	Amount of Capital	
	Dec. 31, 1920	Dec. 31, 1930
Investment of Common Stockholders—		
Common Stock of American Telephone and Telegraph Company:		
Par Value	$ 442,825,400	$1,795,651,200
Premiums on Capital Stock	47,998,097	259,131,603
Applicable Amount of Consolidated Surplus	159,635,689	591,145,218
Total	650,459,186	2,645,928,021
Minority Common Stock of Subsidiaries Consolidated:		
Par Value	43,216,910	92,482,593
Applicable Amount of Consolidated Surplus	2,884,917	7,040,456
Total	46,101,827	99,523,049
Total Investment of Common Stcokholders	696,561,013	2,745,451,070
Preferred Stock	11,949,375	113,064,842
Total Capital Stocks	708,510,388	2,858,515,912
Long Term Debt	595,472,137[1]	1,217,168,595[1,2]
Total	$1,303,982,525	$4,075,684,507

[1] Includes Capital Stock Installments 1920—$19,262; 1930—$111,463,036. [2] Includes Notes Sold to Trustee of

American Telephone and

	Amount of Capital	
	Dec. 31, 1920	Dec. 31, 1930
Investment of Common Stockholders—		
Par Value	$ 442,825,400	$1,795,651,200
Premiums on Capital Stock	47,998,097	259,131,603
Applicable Amount of Consolidated Surplus	159,635,689	591,145,218
Total	650,459,186	2,645,928,021
Long Term Debt	317,429,000	585,623,950[3,4]
Total	$ 967,888,186	$3,231,551,971

[3] Includes Capital Stock Installments of $111,463,036. [4] Includes Notes Sold to Trustee of Pension Funds, 1930

point of continuity of high grade service.

Companies which have borrowed too much are likely to find that they can no longer raise additional capital by issuing stock. When compelled to

TURE—1920, 1930, 1940, 1942

AND ITS PRINCIPAL TELEPHONE SUBSIDIARIES

Amount of Capital		Percentage Distribution			
Dec. 31, 1940	Dec. 31, 1942	Dec. 31, 1920	Dec. 31, 1930	Dec. 31, 1940	Dec. 31, 1942
$1,868,679,400	$1,868,679,400				
269,975,028	269,975,028				
360,451,768	370,533,557				
2,499,106,196	2,509,187,985				
85,797,721	88,588,000				
4,133,846	3,893,070				
89,931,567	92,481,070				
2,589,037,763	2,601,669,055	53.41%	67.36%	67.06%	63.17%
37,907,950	17,904,300	.92	2.78	.98	.43
2,626,945,713	2,619,573,355				
1,234,092,957[2]	1,499,055,838[2]	45.67	29.86	31.96	36.40
$3,861,038,670	$4,118,629,193	100.00%	100.00%	100.00%	100.00%

Pension Funds, 1930—$81,392,432; 1940—$103,830,957; 1942—$81,902,938.

TELEGRAPH COMPANY

Amount of Capital		Percentage Distribution			
Dec. 31, 1940	Dec. 31, 1942	Dec. 31, 1920	Dec. 31, 1930	Dec. 31, 1940	Dec. 31, 1942
$1,868,679,400	$1,868,679,400				
269,975,028	269,975,028				
360,451,768	370,533,557				
2,499,106,196	2,509,187,985	67.20%	81.88%	81.26%	75.86%
576,480,569[4]	798,584,900	32.80	18.12	18.74	24.14
$3,075,586,765	$3,307,772,885	100.00%	100.00%	100.00%	100.00%

—$11,545,214; 1940—$6,786,569.

expand their plant, they can therefore do it only by further borrowing. The time eventually comes when they can borrow no more, and their ability to give service suffers accordingly.

That these are not idle fears is shown by the experience of other industries, particularly the railroads. It is common knowledge that a wave of bankruptcies and threatened bankruptcies due to inability to meet fixed charges was checked only by the tremendous increase in traffic due to the war. That the issuance of too many bonds was a major cause of this situation can not be doubted. The valuation made by the Interstate Commerce Commission demonstrated that their securities were backed by property values. Their trouble has been that too much of their capital has been borrowed.

THIS SITUATION can not be better stated than it was in the report of Chairman Splawn and Commissioners Eastman and Mahaffie of the Interstate Commerce Commission, submitted to the President of the United States at his request in 1938, and transmitted by the President to Congress with his message transmitting his "Recommendations for Means of Immediate Relief for the Railroads." This is what the report says:

> "There is some misunderstanding of the fixed-charge situation and its significance. Many seem to think that these charges represent an unjust burden, and that if it could be removed, all would be well. The fact is that these charges constitute a comparatively modest return on only a part of the legitimate investment in railroad property. There is nothing unjust about this return. The objection to it lies in the contractual obligation to pay regardless of conditions, thus making it difficult for the railroads to weather our periodical business depressions.
>
> "Moreover, as above indicated, even if the investment were more largely represented by stock rather than bonds, the right to obtain, if possible, a return on the fair value of the property would still remain. The advantage of stock is that in times of depression dividends can be passed without danger of bankruptcy. But the fact that they are so passed is in itself a reason why they should, if possible, in times of prosperity be paid in generous measure, at least on stock supported by property value. Indeed companies cannot long maintain good credit unless they are paid. Careful investors will not buy bonds unprotected by a heavy margin of earnings over and above the interest charges. Not only that, but unless earnings are sufficient to make stock attractive to investors, railroads will be forced to do all their financing by borrowings, thus recreating the burden which the bankruptcies are reducing, and eventually putting a stop to financing."

There is no reason to suppose that if the Bell System companies were unable to obtain capital except by borrowing, they would not suffer as the railroads have suffered. The only way to avoid such a situation is to avoid excessive borrowing. This can be done only by raising amounts of equity capital from time to time.

Maintenance of Credit by Adequate Earnings Is Essential

IT IS UNIVERSALLY RECOGNIZED that if a company is to be able to finance itself over a long period, it must maintain its credit. That is basic. Maintenance of credit in this sense does not mean mere ability to pay corporate debts, or even to refund bonds. It means that the company must be highly regarded as a good credit risk not only for large amounts of capital, but for long periods of time. It does not mean merely that the company should be able to borrow money. It means that its standing and rating with the investing public must be such that new equity capital can be obtained from time to time in sufficient amounts to keep the debt ratio at a level which is clearly sound and safe.

The needs of the Bell System companies for new moneys are large and continuing. If we are to be able to obtain this money, our existing securities must at all times be held in high esteem by investors. That esteem is necessary if large numbers of new investors are to be attracted. New investors are necessary both to take over the securities of investors who withdraw, and to provide the companies with entirely new money.

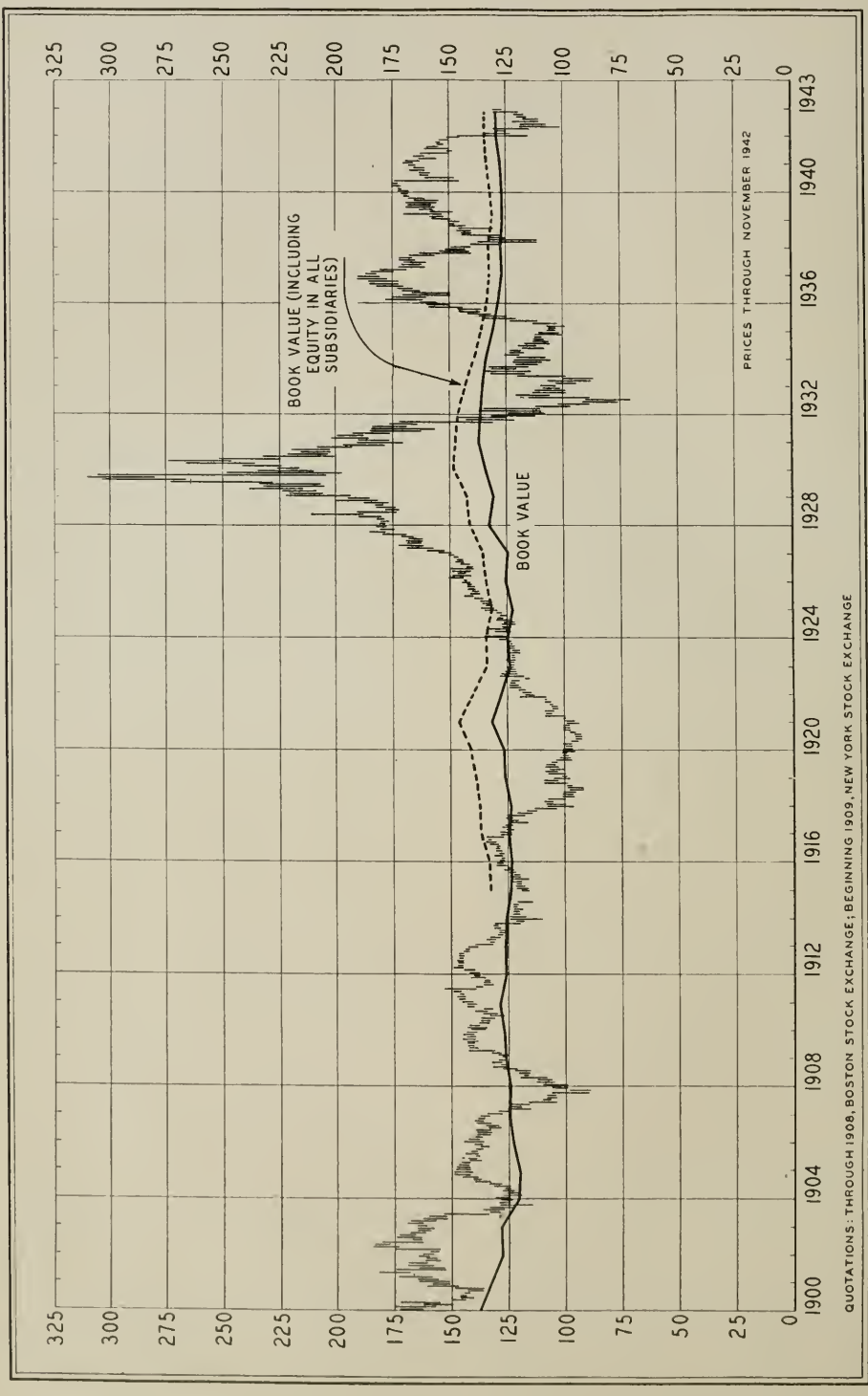
Maintenance of credit in this sense depends on a company's earnings record, and its prospects for earnings. This is particularly true of a telephone company, since its plant and equipment find utility only in giving service. The plant cannot be moved or applied to another use. Its only value is in the continued earning power. Unless the earnings on stock have been satisfactory to investors, and unless the prospects are that they will continue to be satisfactory, investors will not furnish additional equity capital.

The High Credit Rating of the Bell System

THAT THE BELL SYSTEM'S credit is good today has not been accidental. It is the result of sound financial policies, consistently adhered to by the management. These policies include the maintenance of a sound financial structure, and the payment of reasonable returns to investors over a long period of years. If returns which the investors consider reasonable are not earned, this credit would be impaired or destroyed.

I think it is perfectly evident that the ability of the Bell System companies to issue bonds at low rates of interest has been due to the low proportion of funded debt, and the large back-log of equity capital. Of course, it has been possible to maintain this equity back-log only by frequent stock financing in large amounts. The reason, and the only reason, why this continued stock financing was possible is that the earnings, and of course I mean earnings after taxes, were satisfactory to the investors. The Bell System has a fine credit position today, but I repeat that it did not just happen. It is the result of a sound capital structure, and adequate earnings.

The argument that regulatory bodies should reduce Bell System earnings because of its high credit standing starts a vicious circle. The credit is high because the earnings are good, and have been satisfactory to the investors.



MARKET PRICE AND BOOK VALUE of stock of American Telephone and Telegraph Company

Present Bell System Credit Is Based on Past Earnings

IT IS EVIDENT that the past earnings of the Bell System have been sufficient to maintain its credit and, until the depression, to permit equity financing. Credit has been maintained and equity financing has been done. Some critics have contended that these results could have been accomplished with lower earnings. I think it is demonstrable that that is not so, that on the average the earnings and payments to investors have not been more than sufficient to accomplish these necessary purposes.

The sufficiency of the earnings to permit equity financing must, of course, be determined from the standpoint of the common stock investor, since it is from him that the money must be obtained. The investment of the shareholders as a class comprises the amount paid into the company for the outstanding shares and the surplus earnings which have been retained in the business. That is the book value of the stock. Unless the market value of the stock on the average over a period of years is above its book value, it is evident that the company's credit from the standpoint of stock investors will suffer. In other words, the market must value a dollar invested in the telephone business at no less than a dollar, if investors are to continue to supply the industry with the funds which will be required to finance its growth.

The market price depends primarily upon the earnings, and the investors' appraisal of future prospects. Dividends affect the price. Over a long period, dividends necessarily depend upon earnings, and assuming that dividends are paid in reasonable ratio to earnings, it seems clear that the average market price over a long period depends upon the earnings. Unless the earnings are sufficient to keep the market price on the average above the book value of the stock, the stockholders will find themselves losing a part of that investment, and will not be interested in putting more money at risk into the venture.

The stock of the American Telephone and Telegraph Company has been freely traded in on the open markets over a long period of years. We know the prices at which it has been bought and sold. We know the earnings which have induced investors to pay those prices. Obviously, if those earnings had been smaller the market price of the stock would have been lower. We also know the amount of the stockholders' investment—the book value of the stock—for many years past.

FOR A COMPARISON between market price and book value of American Company stock, the reader is referred to the chart on page 14. The series of vertical lines on this chart shows the high and low price of the stock in each month of the period indicated. As will be seen, the price has fluctuated widely.

In contrast to this record of price changes is the black line on the chart representing the stock's book value as reflected by the American Company's accounts. More significant than this graph, however, is the broken line which shows the book value of the stock *including* the equity of the stockholder in all of the American Company's subsidiaries. This broken line

Year	Consolidated Earnings Per Share	Average Consolidated Book Value Per Share	Average Market Price Per Share	Earnings—Book Value Ratio	Earnings—Market Price Ratio
1914.....		$132.57*	$120.98		
1915.....	Not	132.68	122.62	Not	
1916.....		134.82	129.51		
1917.....	Available	136.88	118.71	Available	
1918.....		137.84	100.71		
1919.....		139.74	102.27		
1920.....	$ 9.627	143.79	96.81	6.695%	9.944%
1921.....	12.885	143.54	105.85	8.977	12.173
1922.....	13.538	137.01	121.64	9.881	11.130
1923.....	13.048	134.15	123.21	9.726	10.590
1924.....	12.528	133.13	127.17	9.410	9.851
1925.....	14.821	132.91	138.52	11.151	10.700
1926.....	15.212	134.61	145.47	11.301	10.457
1927.....	15.092	138.45	167.87	10.901	8.990
1928.....	15.724	142.08	182.48	11.067	8.617
1929.....	15.410	145.29	237.01	10.606	6.502
1930.....	11.080	147.74	218.14	7.500	5.079
1931.....	9 551	146.82	166.50	6.505	5.736
1932.....	5.937	144.69	105.15	4.103	5.646
1933.....	5.386	140.88	113.42	3.823	4.749
1934.....	5.964	137.23	113.84	4.346	5.239
1935.....	7.122	134.57	126.29	5.292	5.639
1936.....	9.892	132.73	171.31	7.453	5.774
1937.....	9.758	132.23	165.84	7.380	5.884
1938.....	8.324	131.66	138.76	6.322	5.999
1939.....	10.183	131.42	161.88	7.748	6.290
1940.....	11.265	132.80	165.34	8.483	6.813
1941.....	10.262	134.15	154.39	7.650	6.647
1942.....	8.793	134.42	120.69	6.541	7.286
Average..	$10.931	$137.67†	$146.42†	7.94%	7.47%

* Book Value December 31, 1914. † Average 1920–1942.

American Telephone and Telegraph Company and its principal telephone subsidiaries: computation of percentage ratios of earnings available for dividends per share to average book value of stock per share and to average market price of stock per share

reflects the entire equity behind a share of American Company stock: that is, the full amount of the investment standing to the credit of the common stockholder. This equity includes what stockholders have paid in and also their portion of earnings which have been left in the business. What this equity amounted to before 1914 could not be calculated without a great deal of research, and on that account is not represented on the chart.

Basing this chart are the data appearing on page 16. With some averages not shown but calculated, the average book value per share, consolidated, was $137.27 for the period 1914–1942, while the average market price for that period was $140.08. Thus, during this 29-year period, the market price of the stock was only about 2 per cent more than its book value, including the equity in all subsidiaries. During the 23-year period from 1920 to 1942, the average book value, consolidated, was $137.67 and the average market price was $146.42, or a little over 6 per cent above book value.

The market price at any given date is, of course, the result of many factors, the effect of any of which it is difficult to determine or evaluate. However, while the relationship between the market price and the book value at any particular moment may be subject to unusual or special circumstances, I believe that the period shown on this chart is sufficiently long to support the conclusion that all possible factors which might affect prices have had their effect in this period and have been reflected in the prices. During this long period we have had booms and depressions and all sorts of conditions which have had their effect on values and prices.

The Verdict of the Market Place on American Company Earnings

I THINK THE CONCLUSION is inescapable that the earnings of the American Company and the dividends paid have been sufficient in the minds of investors to put the market value of the stock at figures which on the average have protected, with only a small margin, the amount invested by the stockholders in the business. In other words, while the market at times rates the stock highly, on the average it has rated it as being worth very little more than the amount invested. It seems clear that the earnings and the dividends actually paid over this long period have been no higher than necessary to protect the stockholders' investment. If the earnings had been higher than necessary for this purpose, that fact would unquestionably have been reflected in the price, which would then have been well in excess of the book value.

Now what were these earnings which were sufficient to keep the market price of the stock on the average only slightly above its book value? We do not have them available on a consolidated basis prior to 1920. Referring to the table on page 16, we find that for the twenty-three years beginning with 1920, the average earnings amounted to $10.93 per share. During this period the average book value of the stock—that is, the total investment of the stockholder including premiums and earned surplus—was $137.67. The rate of earnings on the stockholders' invest-

ment for this period was therefore 7.94 per cent. This was sufficient to keep the market price of the stock on the average at $146.42, or about 6.4 per cent above its book value. Thus the earnings inuring to the benefit of the common stockholder at the average annual rate of 7.94 per cent have been no more than sufficient over the past twenty-three years to maintain the Company's credit so as to permit the large-scale equity financing which has been necessary for the expansion of the business.

THE QUESTION ARISES, of course, as to whether the fact that, in the past, this rate of earnings has been necessary to maintain the credit of the Company and permit equity financing, means that the same return will necessarily be required in the future. That question is one that no one can answer with certainty. But the twenty-three year period referred to includes a great boom and a severe depression, as well as many years which may be characterized as normal, and it can hardly be contended that the risks and uncertainties which beset the common stock investor today are less than those which have attended him on the average for the past twenty-three years.

THE SITUATION a year ago placed great responsibility upon the Signal Corps. A large share of this responsibility fell upon the communications industry, which, when called upon, came forward without hesitation to supply the highly skilled individuals to serve where their special abilities would be of maximum value. The men who have volunteered their services to the Signal Corps in an effort to make our country stronger and safer, are to be congratulated for their unselfish and coöperative spirit. These men are setting an enviable record which is both a credit to themselves and to the American Telephone and Telegraph Company and the subsidiaries. The splendid qualifications of your employees who have entered the services of their country indicate the excellent training they have previously received through the years of affiliation with the Bell System. This was the calibre of man the Signal Corps needed in order to place in operation the units now fulfilling their duties in various theaters of operation and in the Continental United States. During the coming year, I know the same spirit of cooperation will exist between your organization and the Armed Services. In this manner, the many vital problems pertaining to communications which concern our Nation's victory will be solved.

From a letter from Major General Dawson Olmstead, Chief Signal Officer, U. S. Army, to A. T. & T. Vice President Keith S. McHugh.

Peace Will Bring Large Responsibilities to the Bell System for the Extension of Existing Services and for New Developments of Great Public Usefulness

The Bell System's Post-war Construction Program

Mark R. Sullivan

CONVERSION TO THE PRODUCTION of machines of war has been vital in the war's progress. For the bond between men and machines is what gives America its strength as the arsenal of democracy. We must produce bombers, not transport planes; warships, not automobiles; bomb sights, not civilian cameras; jeeps, not roadsters; bullets, not typewriters; electronic devices, not civilian telephone improvements. The quicker and the more complete the conversion now, the sooner will come the much-to-be-desired conversion in reverse. Then the problem will be the re-direction of productive capacities to peace-time needs.

Much has been written about post-war planning. Some take the viewpoint that it is not too early now to blueprint in some detail the conversion from war to peace. Others stress the impracticability of such plans until more is known of the future. Why bid the hand, they say in effect, until the cards are dealt? Whether or not post-war plans should be blueprinted in detail, it is clear that a certain amount of future planning is necessary. Indeed, industry has no option but to project its programs, because day-to-day operations now are governed in many instances by the outlook for the future. In such matters as arranging financial plans, in the provision of new and the rearrangement of present plant, and in programming the employment and training of manpower, everything must be done with an eye as to how it fits in with the shape of things to come.

Certain fundamentals of the conditions which are to be expected at the end of a victorious war are not difficult to analyze. The tremendous flow of raw materials into war pro-

duction will largely stop. Materials will once again be available for the production of the things of peace, urgently needed by the people in this country and in other countries. The great reduction in war production will immediately release quantities of productive manpower, to be followed shortly by additional manpower released by the armed forces. Industry will have the plant, machinery, and technical and managerial personnel to carry on a tremendous program of peace-time production.

The Future Need for Things of Peace

THERE CAN BE no doubt that, upon the close of the war, the need for things of peace in large quantities will be immediate and pressing. Many combat areas will have suffered that destruction of practically everything which is the fate of such areas in a modern war. In all countries there will be the accumulated need for civilian goods to replace those worn out or become obsolete through the years of war. The number of new automobiles which will be required is a striking illustration of the accumulating demand for peace-time goods.

Beyond this, a flood of new things will become available as well as a flood of improvements on things previously made. This will be stimulated by increased resources in certain materials such as aluminum and magnesium and by the developments of new materials such as plastics. It will be stimulated also by developments of new ideas in many fields, such as in electronics, and by production techniques which have been given great impetus by the war.

The Bell System has prepared for its guidance a summary estimate of requirements for post-war telephone plant construction. The results indicated are of interest on their own account and also as an illustration of what may be expected broadly, since the Bell System, serving, as it does, all industries, may be considered as a cross-section of total industry.

Obviously, the amount of work needed to be done will depend upon when the war is finished: the longer the war, the greater the accumulation of needed civilian production. But even on the assumption of a short war, the accumulated demand for goods will be gigantic.

In the telephone field, first of all there will be a backed-up demand for telephone service which it has not been possible to provide under war restrictions. Some telephone service now used for war work will be released, come the cessation of hostilities, but many of these services will quickly be converted to civilian uses and, on balance, it seems clear that the accumulated net demand will be large.

A One-and-a-half Billion Dollar Program

THE BELL SYSTEM now has 200,000 requests for main telephones which are held in abeyance because of the lack of facilities, and this number is expected to increase rapidly as the normal margins of plant become depleted in more and more places. In addition, there are now about 225,000 applications for other items of service which are also held in abey-

ance because of shortage of facilities. These include individual-line service in place of party-line service, residence extensions, additional lines, and large private branch exchange switchboards.

ALSO, LARGE AMOUNTS of materials and construction are necessary to relieve the present seriously overloaded condition of the plant. In common with other utilities, the telephone companies are overloading their plants in order to give as much service and to as many customers as possible with a minimum use of critical materials for plant additions. This overloading in the telephone plant is in many cases reflected in service. Delays are encountered, particularly in the completion of long distance calls, because of busy circuit conditions. Requests for new telephone installations which can be met are filled more slowly, due to the time required with a congested plant to make necessary rearrangements. To provide adequate service in the most economical way, the restoration of normal plant margins will be necessary and will involve, in many cases, the replacement of plant put in under war conditions. It will also be necessary to do a considerable amount of maintenance work which has unavoidably been deferred in order to save critical materials, but which must be resumed as soon as materials are available in the interest of plant and service protection.

Another item contemplated in this schedule of work is an increased amount of reconstruction and relocation of telephone lines because of enlarged highway and other construction programs. The amount of such work will, of course, depend upon how large a program of highway construction is undertaken as a part of the post-war activities, but it can well be substantial.

A major factor in the Bell System program of conserving critical materials is the suspension of a large program of plant improvements which is normally carried on and which necessitates the replacement of existing plant by newer types. For example, as a result of a program carried out over a considerable period of years, the Bell System telephones are now about two-thirds dial. The program of conversion to dial has been interrupted by the war but will be resumed when conditions permit. There remain approximately seven million manual telephones. Some will continue manual indefinitely. Others will be cut over to dial and, in total, large-scale construction will be required for this purpose. A similar item is the replacement of older types of telephone sets and other equipment on the subscribers' premises with newer types, a program which has now gone into reverse since older types which normally would be junked are being repaired and re-installed.

A FURTHER ITEM is the resumption of a program of extending systems of toll line dialing; that is, means by which connections over toll lines are completed by dial pulses originated either by the subscriber or by a telephone operator. Further extension of the toll cable network to replace heavily loaded open-wire lines now largely held in abeyance is another item of this nature.

It is to be anticipated that, beyond this, there will be further extensions of certain services now given in a

limited way; as for example, the extension of overseas telephone service to additional points, the more general establishment of time and weather announcement services, the extension of service to motor vehicles and to boats of inland waterways.

All these items, it is estimated, will total up to between one billion and one and a half billion dollars. The work will, of course, be carried out over a period of years, the number of years varying in different cases depending upon the urgency of the work and the ability to arrange for the necessary financing and manpower.

The Shape of Things to Come

THE FOREGOING SUMMARY has been extended only sufficiently to embrace provisions for equipments and facilities which are now developed and for which the need is known within reasonably accurate bounds. Beyond this there are many developments of a more speculative nature. Some of them are based upon research and development work completed in recent years, the application of which has been interrupted by the war, and others upon new developments which will come about through the future application of war-time research and development. Many developments of a speculative nature which have attractive possibilities for the future might be cited. Two, of outstanding interest, are television and transatlantic telephone transmission by submarine cable.

Successful means for television transmission between cities by telephone channels, similar to the transmission of radio programs now between cities, has been a challenge to communication engineers. The solution calls for circuit design capable of providing a band width in the magnitude of millions of cycles. The coaxial cable, which is already in commercial use for telephone transmission, together with repeaters and other apparatus recently perfected or under intensive development, promise to provide the band width necessary for television transmission within the bounds of allowable costs.

Such a network would depend upon the wide extension of coaxial cables, the justification for which would lie initially upon increased telephone long distance circuit requirements, as well as upon the general development of television broadcasting by broadcasting companies. Encouraging development of television was proceeding prior to the outbreak of the war. The war interrupted commercial application but, on the other hand, it has speeded up research and inventions in electronics for war devices so greatly that television, like many other developments, will be found after the war to have advanced in spite of this interruption. While much remains speculative as to the future of television, the fascinating advantages it opens up are tremendous, and a great telephone network for television transmission has definite possibilities.

Transatlantic communication by means of submarine telephone cable, although still containing many elements of speculation, also offers definite possibilities. The present transatlantic telephone communication by radio transmission has certain disadvantages as well as advantages.

Radio has some advantages over cable. It is less exposed to the possibility of physical interruptions by mechanical difficulties, and it possesses flexibility whereby new routes can be established or old routes abandoned by relatively simple changes at the terminals only. On the other hand, radio has some disadvantages. Radio channels are not available in unlimited numbers; radio transmission is subject to interruptions by magnetic storms; and, in addition, with radio the very significant feature of privacy is difficult if not impossible to safeguard under all conditions. Envisioning closer relationships with Europe following the war, particularly with the English-speaking countries, the need for greatly expanded facilities connecting this country and Europe may be expected to follow. These factors have lead to the consideration of a transatlantic cable as an auxiliary to the short wave systems.

Much laboratory and experimental work has been done on long-range submarine cables. While not all the problems have been solved, there has been considerable progress toward perfecting a multi-channel submarine cable for use over extended distances. The cable would use repeaters distributed throughout its length, designed as integral parts of the cable structure and so constructed as to operate over a long period of years without attention. While such a cable must wait on some technical developments and commercial arrangements, as well as upon materials and manpower, it does not present a more difficult problem than many that have been solved in the past, and it can well become a reality in the not too distant future after the war. And, of course, a transatlantic cable is only one of the transoceanic links which may ultimately be required in a world-wide network of telephone communication.

Mention has been made of only two speculative projects. In addition, it is to be anticipated that the application of new things after the war will make possible a large number of other improvements. This will be but bearing out the experience of many years of research in the Bell System. Such applications could readily run into several hundreds of millions of dollars of additional construction work.

The Significance of the Bell System's Program

A Bell System construction program of the type and magnitude discussed is of great significance. An investment of, say, one and a half billion dollars means building plant nearly one-third as large as the total plant of the Bell System which has been constructed to meet the present-day requirements developed after 65 years in business. It would be in addition to the construction required to meet the current growth of the period. Assuming an average rate of growth, the addition to such requirements of the items discussed in the foregoing would call for an extremely large construction program over a considerable number of years.

After the war, the ability of industry to arrange, quickly and smoothly, for manpower "to go to peace" will be of transcendent importance. It will be vital not only to those return-

ing from war and war work but to those who, although entering industry as replacing personnel, desire continuous and permanent employment. The problem should not be insurmountable. The needs of the people of the world for peacetime products will be sufficiently great to permit of the full employment of all available manpower. The skills necessary for the proper direction of a large program will be available in the industrial structure of the country.

In addition to men and material and skills, however, large amounts of money will be required, and the ability of industry to move ahead rapidly with a post-war construction program will depend in large part on the latitude allowed free enterprise in raising the necessary funds. Free enterprise in the past has made possible the organizations and teams which have proved so effective in these critical times in producing unprecedented quantities and qualities of war implements. Free enterprise will meet the challenge of the post-war era with the same effectiveness if only it is permitted to function without unwise restrictions.

How FAST the Bell System will be in a position to raise the vast sums required to meet its post-war construction needs depends almost entirely upon how well it sustains its credit position during the war. For this reason, the Bell System's ability to continue to finance at a reasonable cost is a matter of importance not only to the System but to the nation as a whole. If the Bell System is permitted to earn enough in the war period to maintain its credit, the capital can be raised economically and quickly, the materials can be obtained, and employment can be given to tens of thousands of men in the transition period from war to peace—when it will be so important to speed up the induction of manpower into peacetime activities.

THE PATH OF SAFETY in rendering an essential public service would not be in the direction of less earnings or less financial strength. The emphasis on low earnings rather than on reasonable rates and service is a little as if a farmer bought a mule mainly on the basis of how little the mule could live on rather than how much he could pull if properly fed.

From "The Bell Telephone System," by Arthur W. Page, Vice President, A. T. & T. Co. Harper & Brothers, publishers, 1941.

Providing Telephone Service for Men in Military and Naval Establishments Is a Big Bell System Job Which Contributes to Their Happiness and Well-being

Service for Service Men

Vincent A. Droser

"This is the telephoningest Army I ever saw," said a veteran top sergeant recently. "No matter where the men are, they want to telephone their folks back home."

The situation which called forth the sergeant's comment is one of which telephone people are well aware. To them it presents many problems, yet affords no little gratification. Incidentally, it strongly reflects the extent to which our soldiers and sailors had developed the habit of using the telephone in civilian life.

Many officers feel that the provision of public telephone facilities in our camps and naval stations in this country is invaluable to the morale of the men. There is ample evidence of this in the pleased expressions on the men's faces after they have finished their calls, and in happy remarks such as, "Boy, that call was worth a month's pay," "Gee, the baby can talk, she said hello," "Mom's O.K. now," which may be overheard wherever the men gather at public telephones. Of their calls, those to their home towns are usually the most important to them and to their families and friends. Many of the men have never been away from home before. Their use of the telephone ranges from homesick calls to Mother and Dad to proposals of marriage.

Satisfactorily meeting this requirement for public telephone service for the armed forces, under difficult conditions involving serious material shortages, is one of the Bell System's major war-time responsibilities. It is, moreover, quite separate and apart from the provision of telephone service for the official war business of the Army and Navy.

In tackling this job, there were many problems to be overcome. In a matter of months, hundreds of camps and naval stations were constructed and occupied—and are still being constructed and occupied—many of them as big as cities and in remote locations with little or no existing telephone facilities available. Equipment and circuit scarcities have developed seriously. To complicate matters more, calls in most military

and naval establishments come in bunches, when the men are off duty—usually after evening mess, before week-ends or leaves, and when ships dock. The pace of the job has been set by a fast growing Army and Navy and it has required fast and ingenious System-wide action to keep ahead of it.

FROM THE BEGINNING of the "state of national emergency," public telephones have gone into our new and enlarged military establishments wherever there was definite need for them. As experience accumulated about the problems encountered in providing service at these places throughout the country, it became apparent that, although no two establishments are alike, there are certain common factors involved which could well be studied by the entire Bell System.

During the summer of 1942, therefore, three regional conferences were held of Commercial, Traffic and Information people from all the Associated Companies. During these meetings the experiences of the several companies were reviewed and discussed and sights were set.

It was clear that the companies were doing their best to give the men in the armed forces telephone service which is as good, as pleasing, and as convenient as it can be made—within the limits of available materials. But the conferences also developed many important suggestions for doing certain parts of the job better.

It was apparent, for example, that attended public telephone service provides the most effective means for making the service more pleasing and convenient and for obtaining the most efficient use of facilities. In addition, there was agreement as to the importance of providing one or more full-time camp telephone managers in each of the larger establishments to supervise telephone service, get fast action, and represent the telephone company to the men and to the military authorities on the ground.

The conferees also considered it important, through publicity material, to give the men suggestions about the use of the service and likewise to help them to realize that, despite some real handicaps, the companies are doing their utmost to give the armed forces good telephone service.

Camp Telephone Managers Render an Important Service

CONDITIONS IN military and naval establishments in this country vary so widely and undergo such frequent change that alert and continuous on-the-ground supervision is essential to find the answers to the many telephone problems involved and to find them quickly. For this reason, experienced men have been appointed as full-time camp telephone managers at the larger camps and bases. Sometimes one camp manager may handle the work for two or three smaller establishments if they are reasonably close together.

Broadly speaking, the manager's job consists of keeping currently informed of facts about camp telephone needs, of getting a good picture of what the men and their officers think about the service, and of taking whatever action is needed to avoid or improve any unsatisfactory condition. These managers have to be capable, fast acting men as well as

good-will ambassadors. Much important work often has to be done quickly on the job, sometimes without the benefit of the usual staff assistance. Evening hours and weekends take special attention, since calling is heaviest then.

Accompanying a manager during the course of his day's work, to see the new section: its layout, its buildings, and the kind of troops to be quartered there; estimate the facilities needed, decide whether attended service is warranted, plan telephone locations, and arrange for space. Approvals must then be obtained, and arrangements made to provide the service when the area is activated.

THE DIVISIONAL INSIGNIA which decorate these unattended public telephone booths create an authentic Army atmosphere and harmonize with their surroundings in this service club

the many and varied duties that are involved in representing the telephone company in camp, would be an interesting experience. Here are some typical examples of what one might encounter.

A new section is to be added to the establishment. The manager confers with the Signal Officer. They study

A new division moves into tents without previous notice, for an unknown stay. They have been located at some distance from existing public telephones in camp. Here the manager must act quickly and use his ingenuity. The answer may be to install public telephones temporarily in a tent or on a truck, or to move in

a mobile public telephone unit (a trailer or bus).

During his observations in the evening busy hours he may find that, because of shifts in troops or other causes, the telephones in one part of the post are no longer adequate and men have to wait a long time to place their calls, while at other locations telephones may not be so busy. If the situation appears likely to continue, he will work out a redistribution of facilities with the Signal Officer or take other measures to equalize the load.

One telephone location may need new directories; another, better arrangements for getting change; another, better lighting facilities. There are plenty of things which come up from time to time that need "fixing."

Then there are unusual jobs which sometimes call for quick action; as, for example, the day a large brush fire started near a camp and was spreading dangerously. The Signal Officer asked for an emergency telephone installation to help direct activities near the fire line. The manager knew how to get in touch with the right people, secured the right materials, and the telephone was installed and working in thirty minutes. Such coöperation is greatly appreciated by the Services, and the Commanding Officer quickly commended the efficient work of the telephone company.

A CAMP TELEPHONE BUILDING. Men waiting on the benches outside are summoned by loud-speaker when their calls are ready. The outdoor booths are for use during hours when attended service is not provided

NEW JOBS and new assignments often develop unforeseen aspects. This is true of the work of the camp telephone manager. Since he is among the soldiers or sailors every day, they quickly get to know him. In fact, some managers wear an arm band so they can. Naturally, the manager has many opportunities to be of per-

sonal assistance to the men in ways little related to the telephone.

In making his rounds, one manager saw a baby on a table near some public telephones. Coming out of a booth was the child's mother, crying. She had come a long way to see her husband, but after only a brief visit his unit had been suddenly called out on maneuvers and she had been trying in vain to find rooming accommodations in a nearby town. Furthermore, she was marooned in camp, since the next bus to town did not leave for many hours. "You just couldn't leave the mother and baby stranded there," reported the manager. So he found them a suitable place to live and arranged for someone to drive them to town.

One dejected soldier told the manager that he had arranged to meet his fiancée at the railroad station, but because of an "alert" he was not permitted to leave camp and she would not know how to reach him. He had been trying in vain to get word to her. So the manager went to the rescue. Later, after the "alert," the boy and girl visited the manager to express their appreciation.

One sailor asked the manager to help him select an engagement ring.

Many other cases involving friendly personal service on the part of the manager could be cited. "I feel sort of like a father to these boys," said one manager. "You get to know a lot of them and they often come to you with their problems."

Camp telephone managers have made a real place for themselves. Service problems are being met promptly as they arise; service has been improved; and the soldiers and sailors freely show their appreciation of the telephone companies' efforts to serve them.

WHEN A WARSHIP makes port, or a sudden influx of soldiers overtaxes a camp's established telephone facilities, a specially designed truck or trailer with booths and an attendant can be quickly brought to the spot

Generally, camp telephone managers are assigned to places with more than 5,000 men. Wherever practicable, the manager is appointed while the camp is still under construction so that he can participate in planning, with the Signal Officer, for the necessary telephone facilities. About 160 camp managers are now assigned to this work by the Associated Companies, and others are to be appointed in new or growing establishments.

Providing Public Telephones

ONE OF THE camp manager's most pressing problems is to determine as early as possible how many public telephones are likely to be needed and the best locations for them. These are matters requiring close study and consultation with the military or naval authorities.

There just isn't any simple formula which can be used generally for estimating in advance how many telephones will be required, because so many factors govern the requirements for public telephones.

The need is greatest at reception centers, since men are there only for a few days and are anxious to telephone their families shortly after arrival and when leaving. Requirements are also comparatively high at air fields.

Traffic is also likely to be heavy when the camp is near a city, when a large proportion of the men have friends and relatives nearby, or when the men are mostly from neighboring states. Calling is also generally heavy where there are frequent troop movements—provided, of course, the men are permitted to keep their families informed of their whereabouts.

The kind of training which is being given affects the extent to which the traffic is concentrated during certain hours. For instance, in training camps where all the troops have the same hours, the traffic is likely to peak up during a short evening period. In other camps where the men train in shifts, traffic is more evenly spread, so that fewer telephones are needed. A fairly compact establishment, permitting a few large groupings of public telephones, generally requires fewer telephones than one spread over many square miles, since concentrations are often impracticable where the territory involved is scattered. If conditions warrant the installation of attended public telephone service, this too, will tend to reduce the number of public telephones needed, since more efficient use of the telephones is obtained.

THE MANAGER and the military authorities generally search for locations which provide adequate space, are open when the men most need them—say, up to 10 P.M.—have facilities for making change, and are reasonably quiet.

The most popular and convenient locations are usually the service clubs, the recreation buildings, and the post exchanges. These places are centrally located and attract large numbers of men. Other locations include hospitals, officers' clubs, administration buildings, restaurants, and officers' quarters.

Special buildings and additions to existing buildings have been required in some cases to provide adequate space to house large groups of telephones, particularly for attended

service. In some camps, where weather conditions permit, outdoor booths have been used where sufficient interior space was not available.

Merely putting in public telephones does not mean good service. There are other associated service features which have an important bearing on the convenience and ease with which the service can be used.

buildings, signs are usually needed to show where the telephones are.

Convenient directory facilities are also needed, and for this purpose lighted directory shelves are provided wherever practicable. Directories are heavily used and, therefore, require constant checking and frequent replacement.

The service man naturally wants to

EARLY EVENING HOURS bring great demands on a camp's public telephones

To begin with, a camp has many streets and buildings, and the soldier or sailor, especially if he is a newcomer, will want to know which buildings have public telephones. That means signs must be provided—outside directional signs as well as signs to designate the buildings with public telephones. In large rooms or

know what his call will cost. Cards or posters showing rates to frequently called points are usually posted prominently at station locations.

Facilities for obtaining change are very important at each public telephone location. Wherever possible, unattended public telephones are put in or near service clubs, post ex-

changes, ship's stores, and other places where change is readily obtainable. In some cases it has been found desirable for the telephone company to provide representatives to make change. In other instances, suitable arrangements for making change have been made with the Army or Navy people.

COMFORTABLE FURNISHINGS and a pleasant atmosphere are all a part of giving the men in camp good telephone service

Since public telephones are generally in locations where large numbers of men congregate, booths are almost always necessary to exclude noise and to insure privacy.

Care and attention are given, of course, to such matters as appearance of booths and equipment, and the provision of such accessories as lights, fans, and seats.

Advantages of Attended Service

PROBABLY NO PHASE of the service problem at these military and naval establishments is more difficult to cope with satisfactorily than the rush to place calls which ordinarily occurs in the early evening hours. This is due largely to the fact that from early morning to evening the men are busy learning how to fight a war. Also, it is in the evening that Mother and Dad, wife or girl friend are more likely to be home.

During the evening, then, booths and circuits are most likely to become congested, and the stage is well set for serious crowding and long waiting. The remedy is not as simple as just adding more facilities. In fact, just putting in more plant is practically out of the question because of the critical shortage of facilities, and any additions are proposed only in urgent cases after everything else has been done to assure the most efficient use of the facilities available.

Nothing the telephone companies have done so far to improve this

situation and to make the service generally more convenient and attractive has been so effective and has met with so much favorable response as the provision of attended public telephone service.

Soldiers and sailors like it, and say so without qualification. They like it because there is usually no waiting in line at attended locations. The soldier or sailor can step right up to a counter and give his call to a cheerful and efficient attendant. If he has any question about how much his call will cost, or should he have difficulty finding a telephone number, the attendant is glad to help him. While the attendant is working on his call, he can sit comfortably, browse through a magazine, or perhaps write a letter. If for some reason his call is delayed, the attendant knows what the trouble is and can tell him all about it. There is no need of "hanging around" a booth, and no need to be concerned about losing one's turn. When his call is ready, the attendant tells him over a loud-speaker that it is waiting in a particular booth. When he finishes his call, he can pay for it without having to worry about change; the attendant has it for him.

That the men appreciate the service is illustrated by their many favorable comments and letters.

After telephoning his girl friend in a distant city one sailor wrote—

"Thank you, Bell Telephone Co., I just spoke to Dotty and the service was excellent. I'm walking on air."

A soldier attending an Officers' Candidate School wrote:

AN ARM-BAND identifies the camp telephone manager at the left, so that the men may recognize him anywhere about the post

"The men at Camp ———— certainly appreciate what the Bell Telephone Co. is doing in keeping us in contact with our homes."

Apart from the advantages mentioned, attended service permits a considerably more efficient use of trunk facilities between the reservation and the local central office. It also reduces the number of telephones needed, since they are used more efficiently; i.e., the telephone is in use only when both parties are ready to talk.

THE GIRL in the foreground, at this camp's busy attended location, is getting information from the rate-and-route guide to speed a soldier's call

Attended service is now offered at well over 100 locations in military and naval establishments (generally those over 5,000 men) and it is probable that the number will soon be nearly doubled. Most of the very large establishments will have more than one attended location.

The facilities provided at attended locations often include a two-position switchboard serving eight to twelve telephones—although larger installations with as many as five positions and 25 telephones are being provided. Where the operating attendants cannot handle the full load, one or more non-operating attendants are often added to record calls, look up routes, rates, and telephone numbers, and collect payment for calls.

To meet the soldiers' and sailors' needs, it has been found desirable to operate the attended stations usually from about 5 to 10 or 11 P.M. on weekdays and during busy periods on Saturdays and Sundays. However,

the hours are generally governed by the local situation, and in some cases attended service is offered all day. During periods when the attendants are not on duty, the telephones are frequently connected through to the well ordered. Loud-speakers are used to announce calls to men in other parts of the building and to men outside—where there may be benches to make waiting still more comfortable in warm weather.

THIS SPECIALLY INSTALLED attended location in a railroad station has proved a great convenience, particularly to the men of a large camp near by

local central office and operated as unattended stations.

The little as well as the big things are important in making these locations cheerful, comfortable, and attractive. Booths are modern, lighted, and generally provided with fans, and in some cases with memo paper, pencils, and ash trays. Comfortable chairs and tables with magazines make waiting for calls less irksome. Directories on lighted shelves are easy to use. Directories for frequently called distant points are on hand. The quarters in general are well lighted and ventilated. There are ash trays, matches, and waste baskets, and the place is clean and

Commenting on the attended service, one soldier wrote, "I wish to express a soldier's appreciation for the great improvement that the telephone company has made to our camp. . . . That, sir, under these conditions, is service plus. It is very convenient for the men to have a place to read and smoke while waiting for their calls to be completed. . . ."

The attendants are selected, of course, for their alertness, efficiency, pleasing personality, helpful manner, and resourcefulness. These girls naturally have many opportunities to be of special help to the service men.

There was the soldier who got an unexpected seven-day leave and

INFORMING SERVICE MEN about the telephone facilities provided for them, and explaining how to use them most satisfactorily, are important parts of furnishing good telephone service. Here are a few of many examples. At the left is an advertisement run in a camp newspaper, and below is a booklet giving useful and interesting facts about Fort Meade as well as its telephone facilities. The other three items are typical of the use made of posters

MEET HOWARD GRANT...

New Telephone Manager for Camp Swift

MEN of Camp Swift will be seeing a lot of Howard Grant, pictured above, who recently took over a big, new job as telephone manager for Camp Swift.

Grant's most important assignment is to provide the best telephone service possible for the men at Camp Swift. He also will work with the Signal Officer on the official service at the Camp.

Grant was picked for the job of telephone manager for Camp Swift because he is an experienced telephone man with a real interest in the men here. He will be on duty during the hours the telephones are the busiest ... you will find him to be f... and helpful.

If you have any telephone troubles ... if he can h... any way ... please feel free to call on Howard. He is ... in your telephone problems ... eager to help you ge... possible telephone service.

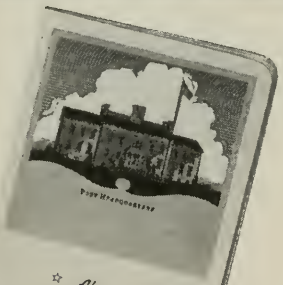
SOUTHWESTERN BELL TELEPHONE CO...

TELEPHONE CENTER in the SERVICE CLUB will help speed your calls

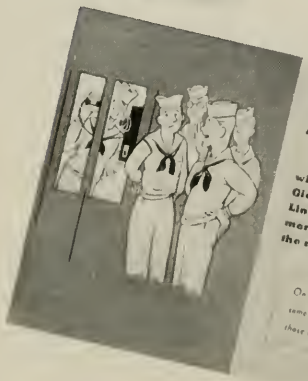
"We'll do our best for you"

FOR YOUR CONVENIENCE we've installed ten telephone booths on the second floor of the Service Club ... A skilled telephone operator is in attendance much of the time to assist you in placing your calls, to provide change and rate information and otherwise furnish a friendly, helpful service. Directories of other cities are available for reference.

You are welcome to visit the Information Center in the Service Club



About FORT GEORGE G. MEADE Maryland



HEY, MAC! NOT TOO LONG

PLEASE don't talk too long when other fellows are waiting. Give them a chance to call too. Lines are busy with war calls and more lines can't be added because the materials are needed for fighting equipment.

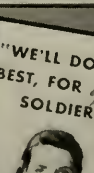
On calls at 35¢ or less the rate is the same 24 hours a day ... so you can make those calls at any time and avoid the rush.

To help SPEED your Long Distance calls

Here are some suggestions about long distance calls which may give you faster service and actually save you money.

1. Call by number, if possible. Your call will go through more quickly.
2. Use the cheaper station-to-station service if you know that the person to whom you wish to speak is near the telephone.
3. Have the change ready both for the initial period and for time, if you think you'll talk long.
4. Speak clearly and distinctly, with your lips within ½ inch of the transmitter. Thus, you'll avoid having to repeat, which may save you money.
5. We can usually give you fast service on calls made on Sunday when lines are less crowded with calls. Rates are reduced all day on Sunday – at the same level as night rates.
6. If your call doesn't go through while you're in the booth, please stay close by so that you can be called to the telephone.
7. If a call for someone else comes through while you're in the booth, please call him to the telephone.

"WE'LL DO OUR BEST, FOR *You*, SOLDIER"



wanted to call his bride of two months in a distant city to say he was about to leave for home. There was no answer at home, and all he could tell the attendant was that his wife worked for one of a number of insurance companies in a large building. With some ingenuity on the part of the attendant and the long distance operator, the right company was found and the soldier talked to his bride. He almost missed his bus in his desire to thank the attendants.

One sailor, impressed with the attendants' courteous and helpful attitude, said he had been a student of public relations and felt it his duty to tell his friends of the fine work being done by the telephone company.

Mobile public telephone units (trailers and telebuses) are being used quite extensively in providing attended public telephone service temporarily to meet special requirements. They are proving particularly helpful at such locations as naval docks or stations when a number of ships are in port, at military and naval establishments pending installation of permanent attended service, and to supplement permanent installations when a large number of men are unexpectedly moved into the establishment. Their mobility and the speed with which they can be put into service have been of real value in meeting unusual demands.

CITIES AND TOWNS near large military and naval establishments also present the problem of serving the men in the armed forces when they are off duty. With the influx of thousands of service men to these cities, the public telephone facilities are not always adequate to handle the additional traffic thus imposed. This requires constant review, frequent rearrangement of facilities, and sometimes additions to plant.

However, before proposing any additions to central office or outside plant to meet these situations, the telephone companies carefully review the facilities already available in the city, to be sure they are being used most efficiently and that other expedients for providing service have been fully employed. These measures may include the removal or relocation of little used public telephones; use of local advertising to reduce peak-hour traffic by encouraging callers to use public and other telephones during the less busy periods; provision of attended service, among other reasons to obviate additional coin control equipment in the central office; and planning public telephone facilities on the basis of average busy periods, recognizing that there will be some waiting in line during occasional or unusual peaks, such as pay days, Saturday nights, etc.

Explaining Service Features

IT QUICKLY became apparent that there was a big job to be done in giving the men in our camps and naval stations the pertinent facts about their telephone service.

Why aren't there more telephones? Why does it take so long to get a call through? Answers to these and similar questions are easy to get when the manager or an attendant happens to be around. But such questions sometimes arise in a service man's mind when there is no one around to give him the facts.

The Associated Companies have

therefore taken various steps to tell the men why sometimes there are unavoidable delays in calling the folks; why at times there do not seem to be enough telephones.

Many service men do not know the differences between person-to-person and station-to-station calls, about the evening and Sunday reduced rates, nor even how to place long distance calls. So the telephone companies try to give them helpful suggestions for using the service.

Such help reaches the men by means of advertising in camp publications, posters at telephone locations, leaflets, blotters, and booklets. The booklets most popular with the men seem to be those which, in addition to information about telephone service, include historical facts about the establishment, points of interest in camp and the nearby city, bus schedules, and other miscellaneous information which would be helpful to a newcomer.

IN JUDGING the value of such a comprehensive effort to give the country's soldiers and sailors the best telephone service which present conditions permit, the final criterion is, of course, the opinions of the men themselves. Evidence has already been given to show that the telephone companies are fulfilling a genuine need of the men in service, and that they are quick to show appreciation. However, the officers who are constantly working with the men are in a particularly good position to appraise this effort. What do these officers think?

After talking with a number of men who had placed calls at a new attended service location, one Brigadier-General said, "This is one of the finest services placed at the camp for the use of the personnel by any organization. I can readily see where it is a definite help to the boys." A Captain in charge of a Navy receiving station stated that the attended service has been a big factor in maintaining morale among the men. A Signal Officer in a large Southern camp wrote that the public telephone service "has been a tremendous morale factor." There have been many other similar expressions.

THIS IS A JOB in which all employees play a vital part—whether they are working directly with the armed forces, or are engaged in keeping the country's telephone communications system running smoothly at the switchboard, in the shops and terminal rooms, in the offices, and along the wire routes. The job is a continuous one—for the duration—not only because of the constant changes necessary under the stress of war but also because of the speed with which our armed forces are still growing. There are probably more than 5,000,000 of our boys under arms today and there may be millions more before the war is over.

In war-time it is not always possible to maintain, in all respects, the customary high standards of Bell System telephone service. When the men in service return to civilian life it may be they will carry with them, never-the-less, some memory of the Bell System's organized and conscientious efforts to live up to its obligation to give them the best service under existing conditions—and perhaps some feeling that it succeeded in worth-while measure.

What Bell System Women Are Doing for the Men in the Armed Forces and for the Nation's Civilian Enterprises Makes a Fine Chapter in Their Record of Service

Telephone Women's War-Time Off-duty Activities

Margaret E. Fawcett

THE PARTY WAS OVER and the service men were thanking their hostess. A tall Texan was speaking. "Ma'am, you telephone girls sure know how to give a party," he said. "You've given us something to remember when we're 'over there.'"

How right he was! Telephone women "know how" to do many things, and they do them wholeheartedly—enjoying both the doing and the giving. Telephone work itself is a war job, and they realize that it has first call on their time and energy. But they find the time to do lots more.

Who are these "telephone women"? Operators, of course; but, no less, those occupied in the functions of billing and accounting, those who greet the public at the desks and counters and over the telephones of commercial offices, those whose working tools are notebook and typewriter: all who contribute, each according to her occupation, to the efficient provision of a nation-wide telephone service.

Where are they? Everywhere: in towns, in cities little and big, throughout the country.

How many are they? In the Bell System, about 222,500.

Among these women, out-of-hour activities are of long standing and of many kinds.

Now, with the nation at war, many of the things in which they are interested are related to the nation's drive for victory. Fortunately, some of the activities which were started while we were at peace have war-time uses. In addition, many new distinctly war-time activities have been undertaken.

These are in two broad groups. First are the out-of-hour courses which have been organized and developed on a System-wide basis at the headquarters of Bell companies for their women employees. Second are those activities which have sprung up spontaneously. The latter cover a wide range. Telephone women are quick to sense the need for "getting

something started," and they act promptly when the need is recognized. A complete list of all of the activities that are currently under way, and the extent of the participation in them, would be amazing to most people.

Good Health in War-time

COURSES IN FIRST AID have a great appeal. Many thousands of telephone women have taken the standard Red Cross course during the past year from women employees qualified as first aid instructors, and thousands more are now receiving this training. First aid training has a recognized value in the proper initial treatment of injuries, and also in promoting safety consciousness among those who receive the training. The knowledge thus acquired will be useful not only in the event of war-caused casualties. Evidence is accumulating that telephone women are already putting their training to use in various important ways to assist themselves, members of their families, and the victims of accidents.*

"A healthy America is a strong America." The truth of this—the tremendous importance of good health to the individual in getting the most out of life, and to the nation in its drive for victory—is known to telephone women in every section of the country. Health activities have been popular among the girls for many years. Back in 1925 the Bell System's "General Health Course for Women" was launched. Revisions have been made from time to time, and now the current course "Health—Appearance—Personality" emphasizes present-day health concepts and the accent on health in con-

THE CAKE which the girls in this group made and are about to enjoy marks the conclusion of a course they have taken together

* See "First Aid Training in the Bell System." MAGAZINE, November, 1942.

junction with appearance and personality. This course, which includes a special text-book, consists of six lessons of one hour each. It is given by carefully trained instructors chosen from among women employees for their teaching and leadership abilities. Over 200,000 women have graduated from these courses.

Keeping pace with the rising national interest in nutrition, a new course for Bell System women has just been inaugurated. Its title is "Food Makes a Difference." The text material for this six-lesson course, which is also given under the leadership of specially trained instructors, covers the chief war-time problems of nutrition now confronting individuals, and their connection with good health and national fitness. Among the subjects considered are the fundamentals of nutrition; the proper choice, preparation and serving of foods; war-time rationing and food alternates; and special consideration of each individual and her own nutritional needs.

THE SELF-DEVELOPMENT course, first given a couple of years ago, was arranged as the result of the desire expressed by many telephone women in all parts of the country to achieve a broader outlook—to gain new horizons. It covers ten subjects: conversation, better speech, reading, dress and grooming, etiquette, entertaining, home decoration, managing our money, travel, and hobbies. Company women, specially trained, who conduct the informal group discussions, encourage the members to pool their ideas and experiences. A reading list, compiled for use with the course, enables the girls to study each topic as fully as they wish while taking the course and to pursue fur-

HOME NURSING as taught by the Red Cross is popular with telephone women

ther, after they have completed the course, any subjects which especially interest them.

While not designed as a war-time activity, this course is being continued in some places as a pleasant interlude on the lighter side and, as might be expected, many of the subjects are now being discussed with the war in mind. Thus, the meeting on "travel" becomes a lesson in geography that covers the many places all over the world in which our service men are located. The interest in "entertaining," always a popular subject, now centers around social affairs being given for the men of the armed forces, and benefits for the U.S.O. and the Red Cross. As for "managing our money," it will require managing indeed—by all of us—to purchase war bonds, to pay our taxes, and to contribute toward the good morale of one's self and associates by presenting a pleasing appearance always.

BANDAGES AND SURGICAL DRESSINGS for the Red Cross are turned out by the thousands by such groups of Bell System workers

Telephone service is vitally important now to military establishments and industrial plants, whether they be near big cities or remote from large centers. Many telephone women, like good soldiers, have volunteered for work which requires them to live in places far from home. To these

women, the self-development course offers not only many pleasant hours while it is in progress; it suggests also many hobbies and enjoyable interests which may continue to occupy their leisure moments.

Work for the Red Cross and Other Agencies

SOME TELEPHONE WOMEN are taking the standard Red Cross course in home nursing which is given by qualified Red Cross instructors. The primary purpose of the course is to give training in carrying out necessary home routines in the care of infants, children, and the aged, and to instruct in proper methods of practical nursing.

Groups of telephone women can be found in practically any telephone building rest room busily sewing and knitting for the Red Cross. They are making caps, sweaters, mittens, gloves, socks, afghans, layettes, and sewing garments for hospital patients and for children being cared for by the Red Cross. They have produced thousands of articles. In many places, classes have been held for those who wanted to learn to sew or knit, with telephone women as instructors. In some cases, the companies provide sewing machines.

SINCE ALMOST EVERYONE has friends or relatives in the armed forces, writing letters to men in service is an activity in which many can participate

THE GENEROSITY of Bell System employees is exemplified by books contributed for Army camps, by one of two mobile canteens presented to the Salvation Army by traffic women in a large city, and by "talking letters" provided for soldiers and sailors

Knitting is not confined to rest rooms: the girls continue it in their leisure time at home and even on the way to and from the office. Many soldiers, sailors, and marines, as well as civilians, have cause to be grateful for the thoughtfulness and industry of telephone women all over the country.

For those who do not care to knit or sew, the American Red Cross has opportunities in its workrooms for making surgical dressings and bandages. Some of the telephone companies have provided specially equipped rooms on company premises where employees may carry on this useful and necessary work.

The Gift with *the Giver*

In addition to this sewing and knitting to practical ends, telephone women appreciate that the happiness of children is important too, and they have continued their usual practices of helping Santa Claus. The Red Cross war relief organization welcomed dolls made by the telephone girls in a western city for distribution to children in its care. The dolls were entirely handmade, even to the faces and bodies. Scraps of all kinds were used in making the costumes, and the results were so attractive that numerous requests were received from business houses which wanted to display them. At least one such display was arranged by the Red Cross. Elsewhere, another group of employees contributed 3,600 toys to hospitals and charitable agencies. There were many dolls in the collection, dressed by telephone women in a manner attractive enough to make the eyes of lots of little girls dance with pleasure.

Telephone women in every section of the country have made many gifts to the men in the services. They have raised money in numerous ways, including cake sales, dances, bazaars, and "Victory" parties. Since they believe that "the gift without the giver is bare," they have put much time and effort, as well as money, into the gifts, because of their desire to add the personal touch.

Boxes of useful articles have been packed and sent to men in the services at home and abroad. Many letters of thanks have been received. One was from boys in Iceland who were not only appreciative but also a little cold and more than a little lonesome. Another expression of appreciation was contained in this letter:

"To the Operators of the Bell Telephone Company—

"I wish to take this opportunity to thank you for the kindness you have shown me. It isn't often that total strangers take such an interest in a soldier. On second thought, you really aren't strangers. I've spoken to all of you in all probability some time or other over the tremendous maze of telephone wires. Thank you a hundred times over, and when I smoke these cigarettes, I'll be saluting you with every puff."

At one city in the west, a committee "to see the boys off" has received many favorable comments for effective work accomplished. The telephone girls there were the first to get up at all hours to see the soldiers off with gifts of cigarettes, gum, candy, peanuts, and the more practical gifts of shaving cream and lotion, not to mention stamps; and the local draft

board, the local newspaper, and the broadcasting station have all given voice to an expression of appreciation which is felt by the whole community. Each girl on the committee takes her turn at helping the chairman, and each carries a tray decorated in the colors of that particular Bell telephone company.

The girls in a southern central office held a victory party, and from the proceeds sent a draft for $253.00 to General MacArthur in Australia to provide candy, cigarettes, and other articles for the boys in hospitals there. In addition, two wheel chairs were bought for an Army hospital.

THESE GIRLS spent a good many hours helping the local Civilian Defense organization, after their regular tours of duty

Volunteers on the Home Front

THE CHAIRMAN of one city's Red Cross Volunteer Blood Service recently sent a letter to the telephone company to express appreciation to its employees who had volunteered to serve half a day each week at the switchboard at Red Cross headquarters. The letter read in part: "I would like to express the appreciation of the American Red Cross Blood Donor Service to the young ladies employed by your company who volunteered half of their free day each week to service our switchboard . . . You will be interested to know that your employees have rendered between 600 and 650 hours of service for which we are grateful. . . ."

What is more, many hundreds of telephone women all over the country have donated blood to the Red Cross blood bank and in some cases they have given affairs to raise money for the expenses of the bank.

Recently, one of the governmental agencies in a large city had a rush job

requiring a large amount of clerical work in connection with fuel oil rationing. The telephone company was asked if one hundred girls would volunteer from the clerical forces to assist on their own time. They would indeed. Five hundred volunteered! . . . and a pleased government official said, "Isn't that just typical of the telephone girls."

Over and over again, the boys in distant camps and those overseas tell of how much it means to them every time they hear from the folks back home. Mindful of this, many telephone women, individually and in groups, are devoting time to writing letters so that those who are away will know that they are remembered by those at home. Nor is it only a matter of writing letters. Demonstrating their versatility, other groups have prepared news-sheets and bulletins to keep telephone men in the armed services all over the world informed of local news and interesting and unusual happenings on the home front.

Telephone women in many places are maintaining honor rolls of men in the service—and displaying much originality and cleverness in both design and workmanship.

In one telephone rest room, for example, a large wall map was drawn and painted by three of the girls. Red, white, and blue ribbons extend from a soldier, a sailor, and a marine "telephone doll," on a table under the map, to locations on the map where telephone employees, and immediate relatives of employees, in the armed forces are located. A scrapbook, kept on the table, contains pictures, addresses, and birth dates. Letters and packages are being sent

FOOD IS VITAL and help is scarce, so telephone employees in many places helped with the harvest last fall

THIS WAR MAP of the locations of friends and relatives (top) is kept up to date in a traffic rest room. Bell System girls in many parts of the country have given parties and picnics for men in the armed forces

to these men regularly. The dedication of this tribute to the men in the services was the high-light of a recent party in the rest room for company employees and their guests.

There has been much enthusiasm among the employees in these activities. They help develop a spirit of comradeship that is so vital during times like these, and give a feeling of being and sharing together in the war.

Entertaining Service Men

MANY TELEPHONE WOMEN are serving in recreation centers and canteens, acting as hostesses and as dance partners. Parties sponsored by them are numerous. Many are conducted not only in the evenings but at various other times, and offer opportunities to all interested employees to participate.. One such was a party for service men in a west-coast city, given by operators at the Civic Center hospitality house. During the afternoon and evening, almost 2,000 soldiers and sailors were welcomed. Refreshments were made at home by the girls —an ambitious undertaking that provided about 1,600 sandwiches, more than 75 cakes, twenty-four dozen doughnuts, and a great many boxes of home-made cookies. In addition, candy, coffee, and cigarettes were provided.

In another city, young women of the accounting department gave a party and dance for service men at one of the large hotels. The affair was decidedly international in character, for men in all of the services from the United States, Canada, England, Australia, and New Zealand united to have a good time.

Telephone women have participated in shows of various kinds—some of which they staged themselves. Of many examples, here are a few:

In a New England city, the employees entertained at a miniature minstrel show at the new U.S.O. Club. Some of the service men were members of the cast.

At the other side of the continent, a program for service men featuring an employees' concert orchestra was presented.

Six telephone women put on their own vaudeville show for soldiers at one camp and the program proved to be such a smash hit that a four weeks' leave of absence was granted them, during which the group performed again at the same camp and then at others in the vicinity.

OUT-OF-DOOR PICNICS have been conducted on Sunday afternoons or at other times when service men have leisure. One such picnic was arranged in a southern city, for seventy-five telephone women and for seventy-five Signal Corps men from a near-by camp. A park was selected for the picnic, the day and the time were named, and the young women were on hand to meet the boys, each with an attractively packed box lunch for two. Each man drew for a box and with it went, as partner for the day, the girl who had packed it. The telephone woman who acted as chaperone said that she had no difficulty getting the party started, but she certainly had a hard time getting the boys headed back to the post on time—they were having such a good time. A "thank you" note signed by all of the men was received a few days later. It had a postscript: "When do we have another?"

When a group of telephone women sent a committee to an Army hospital to find out what the boys there needed and wanted, they received a prompt answer, "visitors."

That is an understandable and apparently a general feeling among the men in hospitals—as the girls in another city also discovered recently. For some time they had been making and sending cookies to the men in the hospital near them, when a Red Cross representative at the hospital invited them to visit there and meet the men. A group of thirty girls, laden with gifts and refreshments, had the first party. Both hostesses and guests had such a good time that the soldiers asked the girls to return soon. The invitation was accepted promptly and seventy girls went to the second party. The entertainment at these parties is varied: piano solos, songs, community singing, and bingo with prizes. Light refreshments are usually served. More such parties are planned for the future and the girls are continuing to send a batch of cookies each week.

All such visits are, of course, arranged and discussed beforehand with the proper representatives at the hospital so that they can be fitted into the hospital routine.

THIS ACCOUNT has been about the activities of *groups* of telephone women. Nothing has been said here concerning the amount and kinds of work being done by countless individuals as their personal contributions to the nation's war-time enterprises of many sorts. Only passing mention has been made of the part which the telephone companies of the Bell System are taking in these various projects: sponsoring some, coöperating in others, providing leadership, making space and facilities available when they are needed. Like most pictures of System-wide undertakings, so big a canvas must be painted broadly. Examples only, from here and there about the country, have been cited, unidentified as to locale not because they are unusual but because they must stand as typical of what is taking place everywhere.

New employees, now entering the System in large numbers as war raises the quota, and women with backgrounds of experience in telephone work, join in these various activities, share common interests, and find both stimulus and relaxation in out-of-hour occupations which contribute in one way and another to the war effort. Busy as they are with their important regular jobs, they are accomplishing much else besides, and doing it so earnestly and so well as to earn much praise for their industry, generosity, and practical patriotism. Telephone women are doing and will keep on doing their part to speed the victory, in working hours—and out.

As of the beginning of this year, the Bell Telephone Laboratories are at work on about 228 major projects for the Army, 150 for the Navy, and 22 for the National Defense Research Council. About 82 per cent of the Laboratories' current expense is on behalf of these 400 projects for the Government.

Of Utmost Importance in Washington, "Command Post" of Our Country's War on Many Fronts, Are Swift and Unfailing Communication Services

How Washington's Telephones Went To War

Eustace L. Florance

"War Activities of the Bell Telephone System," by Vice President Keith S. McHugh, published in the November, 1942, issue of this MAGAZINE, *recounted in broad outline and for the entire country the challenge to and the achievements of the Bell System in meeting extraordinary demands for war-time service. Geographically, Washington is but a minute segment of the United States; but with its expanded population, and with its multitude of Government departments, bureaus, and commissions engaged in winning the war and in other Federal activities, the challenge which the System is meeting everywhere and every day is both intensified and epitomized for the telephone companies which serve the Capital and its environs—as this article makes clear.* THE EDITORS

THE FURNISHING of telephone service to the Capital of a great nation in peace is a serious and complex undertaking. Reinforcing that service for the G.H.Q. of many nations united in war . . . well, that is something else again.

The ramifications of the task and the turbulence of events make it impossible to record systematically or comprehensively all the elements of the job. While memories are green and records still fresh, however, fragments for the chapters of a remarkable epic can now be assembled.

The trends of the indices that measure growth and action in the telephone business of the Greater Washington area first reveal the impact of defense and war in 1940, and

so, for the most part, this account covers the three-year span, 1940–1942.

THREE ASSOCIATED COMPANIES are concerned: The Chesapeake and Potomac Telephone Company, in the District of Columbia; the C. & P. of Baltimore City, in Maryland; and the C. & P. of Virginia, across the Potomac. For unity of action, however, the supervision of the area has been entrusted to one of them, the C. & P., operating in the District. This long-standing arrangement has been invaluable, particularly in this period when governmental establishments have been crowding outward in what were once only residential suburbs.

Squarely behind these three Companies stands the whole Bell System. The A. T. & T. Company, through its Washington executive office and the commercial office of its Long Lines Department, serves the Government and others in matters outside the scope of the local companies. Long Lines plant forces maintain the test rooms, the circuits and channels that reach from Washington around the globe. Western Electric's distributing house, not far from the Capitol, delivers the goods and Western's installation forces are in most telephone buildings and many of Uncle Sam's. The Bell Telephone Laboratories, although not represented in corporate person, can point to its handiwork on every quarter.

If one could conceive the moving to Washington of every Vermonter—man, woman, and child, three hundred and fifty thousand souls—with those unable to find accommodations in the sixty-two square miles of the District overflowing into the adjacent counties of Maryland and Virginia, one would have some conception of what has happened in thirty months to the population of the region. It has, since April, 1940, increased nearly 40 per cent—from 900,000 to more than a million and a quarter.

The Federal Government in this period has doubled its roster of civilian employees in Washington, and with more than 290,000 has now three times more than were needed to polish off the Central Powers in 1918.

The increase in population, the organization and movement of great government agencies, the intensifying of all activities, have had far-reaching effects on the life of the city.

Like a Tidal Wave

THE IMPACT on the telephone system came from all directions. The volume of local and long distance calls rose sharply in 1940, soared in 1941, and continued to climb in 1942.

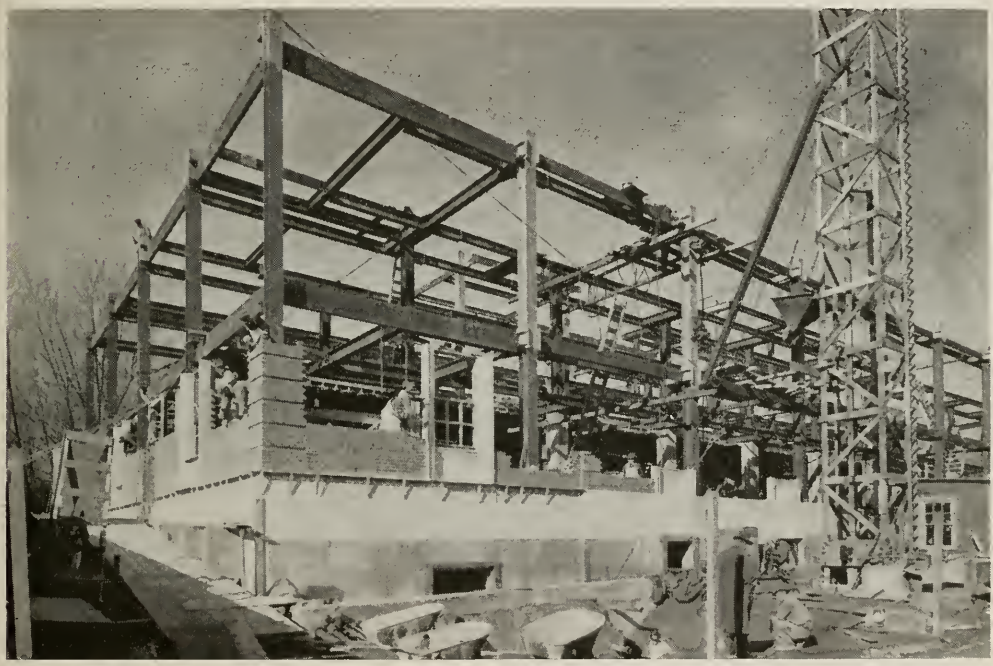
In the three years 1940–42, the District has gained about 104,000 telephones; it took the 11 preceding years to gain as many. Growth in the suburban area has been comparably swift and relatively great—a total of 48,000 telephones. Thus, in the period, Greater Washington has gained 152,000 telephones—49 per cent—and goes into 1943 with more than 460,000 telephones: five times as many as it had on Armistice Day in 1918. The Federal Government subscribes for more than 100,000 of them, about two and a quarter times the number of three years ago.

One indication of what happens when Uncle Sam bestirs himself can be found in the number of telephones installed and disconnected. For the

year just ended, telephones connected and disconnected in the District of Columbia were 38 per cent more than the total in service at the first of the year.

Kaiser Wilhelm's note announcing unrestricted submarine warfare was delivered in Washington on Friday, February 1, 1917. Toll calls that

Toll calls out of Washington averaged 11,000 per business day in 1939; 12,700 in 1940; 24,200 in the last week of November '41. In the fateful week of Pearl Harbor they soared to 32,400, an increase of one-third literally overnight. Since then the curve has continued upward. At this writing, a quiet business day



THIS IS ONE of the eleven telephone buildings which have been constructed or enlarged in Washington and the vicinity since the Japs struck in the Pacific

day jumped 20 per cent, or 300 calls, and continued to climb week by week to an average of 5,200 per business day in October 1918. A chart in the company magazine of that time plots this rising curve of calls and the legend beneath it reads in part: "Could anything be more impressive?" The editor could not foresee the events of a quarter-century.

brings 39,000 calls.

Obviously, neither a peacetime plant nor peacetime methods could satisfy demands for service of this order. It takes time to engineer and expand a telephone system, though of late a good many traditions on this score have crumbled. Storm signals flying through 1939 gave warnings which were heeded, and

plans started that year have served the nation and the business well. The comprehensiveness of these plans is only partially revealed by the sum of 458 major construction projects undertaken in three years, in contrast to 225 in the preceding triennium. Gross additions to the telephone plant of the District of Columbia (including re-used material), has in this period exceeded $43,000,000, and the additions in the nearby Maryland and Virginia areas amounted to nearly $17,000,000 more. Plant that cost $83,000,000 has been added to or removed from a telephone system [1] that stands on the books today at about $98,000,000.

offices, about 111,000 yet remained manual. The need for an enlarged telephone system—one that could take it—if war should come, could be foreseen. The prospects of mobilizing adequate operating forces in such event were not so certain; accordingly, the dial conversion program was hastened, and by the time this article appears the substitution will be substantially complete.

THE ROLL of construction projects completed or launched is too long to call, but some end results give indication of what they achieved. The table below speaks for central office facilities.

Local Central Office Facilities

	Serving the Metropolitan Area		
	Dec. 31, 1939	Dec. 31, 1942	Change
Dial Units	14	36	22
DSA Positions	126	588	462
Manual Positions	592	123	— 469
Manual and Dial Subscriber Lines	187,000	265,000	78,500

Dollars, however, are cold terms in which to measure the accomplishments of this program—accomplishments that would stand more conspicuous than a new bomber plant or shipyard if they were not so dispersed and so varied.

The substitution of dial service for manual progressed throughout the decade of the '30's, unit by unit, as growth made the change advantageous. By the end of 1939, three-quarters of the District's telephones were dial; but, including the suburban

But the table does not speak for the countless hours of engineering, manufacturing, and installing that goes into a program of this magnitude and complexity, nor of the mental and physical toil, nor of the ingenuity and resourcefulness of people determined to meet time objectives set by necessity. Laconic reports in the Washington files of Western Electric's installation department touch on the matter, as:

> "Shepherd & Sligo #2—347 frames, 14,300 lines—started 3/1/41, cutover 6/28/41—Normal interval 31 weeks, actual 12

[1] Gross additions, $60,000,000; removed or abandoned, $23,000,000.

—Double shift job—21 carloads of equipment erected in 10 days—"

There are many such reports.

To house this equipment and all the assortment of apparatus that make up a going central office—cable and switch frames, generators and test desks—eleven buildings were built or enlarged and administrative forces moved to rented quarters, the

THESE 12 REELS of telephone cable, averaging 2,200 feet in length, were laid across the bottom of the Potomac River to supplement those already carrying voices between Washington and points beyond

area of which now equals one-tenth of Company-owned property.

The Anacostia and Potomac Rivers come together at Haines Point and cut a sharp "V" through the heart of the Metropolitan area. Eighteen cables (12,800 pairs) comfortably carried the flow of messages over and under these water barriers through 1940. But war tolerates no barriers, and in two years 22 new crossings (22,000 pairs) were needed and provided. Twelve of these cables were placed at one time under the Potomac to serve the War Department in its new Pentagon Building. But river crossings and submarine cables are not good criteria of the amount of outside plant that has been added for subscribers' telephone lines, for the cables between Government buildings, for inter-office trunks, and we let it all go with the bare statement that in three years 445,000 miles of aerial and underground wire have been added in Washington alone, an increase of 48 per cent—7,100 miles per square land mile.

Toll Service for the Capital

HISTORY REPEATS ITSELF. While Ambassador Bernsdorf was delivering his Kaiser's note to the State Department that February day in 1917, some telephone engineer was perfect-

ing plans to add in the coming weeks four positions of toll board to the thirty-odd then in service—preparing for the traffic that Woodrow Wilson's second Inauguration would bring. In the emergency that followed, it took but sixty hours to put this equipment in service.

On that historic Sunday in December of 1941, thirty new toll positions, partly wired, were being readied for the Christmas rush of calls. In 18 hours they were manned and in use—and two weeks later 65 positions had been cut into service.

These incidents and others like them stand out boldly, but they give no indication of the continuing preparations that had been in the making to reinforce the long distance facilities against any emergency.

By December 1, 1940, a second toll office had been established, partly as protection against any mishap that might befall the No. 1 office, and also to provide for growth. Opened with 12 switchboard positions and 110 circuits to a few key cities, it has now built up to 134 positions and more than 600 circuits that comprehensively cover the nation. The building in which it stands was cleared of local switchboards by transfer of service to other central offices, and the men of the C. & P., the Long Lines, and Western Electric who did this job will explain that installing a toll office and dismantling two local offices at one time in close quarters is no simple task.

That year, too, twin cables were buried between Baltimore and Washington at a cost to three Bell Companies [2] of $1,000,000. In this section of a network that covers the Atlantic Seaboard from Maine to Florida, all telephone cables heretofore followed one highway. For the protection of service, again, the new cables were placed over an alternate route. In the light of later events—among them, for instance, an increase in toll calls out of Washington of 151 per cent in three years—there are echoes of a bygone day in this statement of December, 1939, about the project:

> "The combined projected future requirements . . . are based on an estimated annual average growth in messages of about 5 per cent annually during the period 1939–1955 and are considered reasonable for use in plans for this project."

The anticipated growth of a decade and a half arrived in three years.

Three hundred and thirteen switchboard positions in the two Washington toll offices are 193 more than in service three years ago. More are on the way. But the record must also show that decentralization of much toll traffic to local offices has greatly helped to carry the load and, including these local offices, more than 600 positions are now available to handle the business.

Circuits to Everywhere

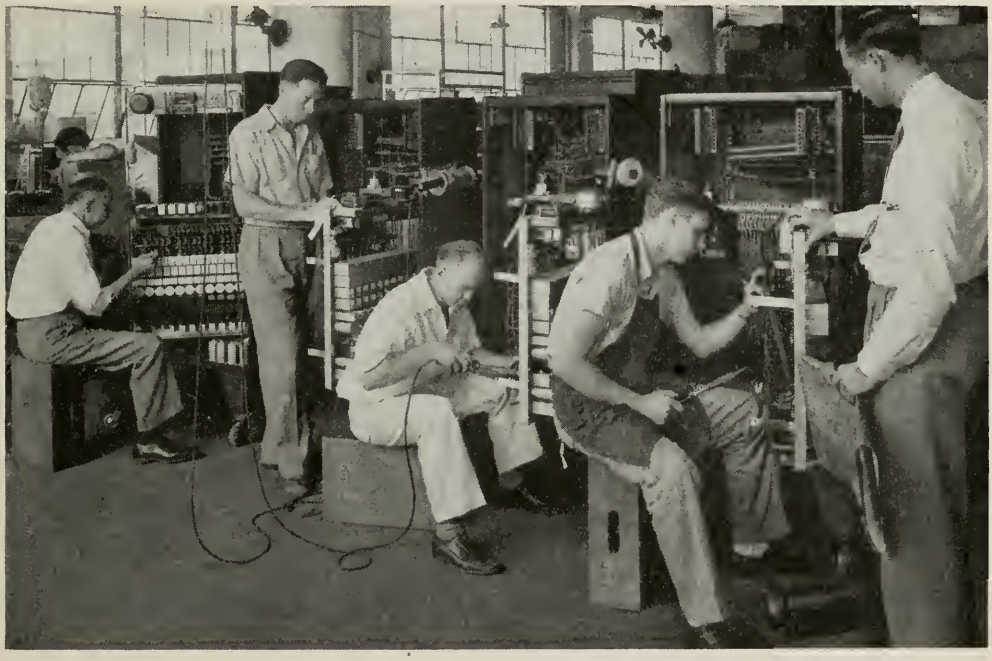
Switchboards alone carry no messages. A quarter-century ago Uncle Sam bravely went to war with a network of less than 150 long line circuits out of Washington at his command. December 1, 1940, he was preparing for defense with 458. In 1941 he went to war with 730. He

[2] C. & P., C. & P. of Baltimore City, and A. T. & T.

wages war today with more than 1,200. But these, divided up as they must be, to find their way to 121 different cities in 28 states and Canada, are not yet enough; and so about one-quarter of them are redistributed each day as the flow of traffic changes.

The story of circuits rightfully belongs to Long Lines, but it is also the story of the Laboratories and of the K-Carrier. It's plain, of course, these new circuits were not strung from day to day on pole lines to distant cities. They are, with small exception, the product of the K-Carrier system; one in a family of carrier current developments, that enables two cable pairs to provide twelve telephone channels.

The bare record shows 54 carrier systems [3] were installed in 1942. These figures, unadorned, will not impress the layman; the fact remains, however, that this mystifying apparatus, in bulk enough to fill a large dwelling, yielded upwards of 600 circuits that in a day can carry 18,000 war calls.



PRIVATE BRANCH SWITCHBOARDS are important in providing service for Government agencies. Here are some being prepared for installation by wiring specialists at Western Electric's Washington distributing house

Nor were these installations "business as usual," for at the beginning of 1942 there were in place only 64 systems [4] and plans are on foot for the installation of 60 more in 1943. Already Washington is the second largest carrier center in the country.

Calls to the nearer towns and cities

[3] 50 "terminal" and 4 "through" systems.
[4] 28 "terminal" and 36 "through" systems.

pass over the circuits of the local companies, and these too have been reinforced. When two years ago, 96 circuits carried the traffic to and from Baltimore, today 148 are in service; and for the load to the half-hundred toll centers and tributaries reached over Associated Company lines, 500 circuits are now humming—an increase of one-third. Behind these Associated Company circuits lies an account of other cables, not long and distinguished ones, but hastily placed sections along obscure country roads, strengthening the network of the region as war brought new importance to names on the map—Belvoir, Cedar Point, Solomons Island, and others.

PVL's and Teletypes

THE VOLUME and character of messages that pass in and out of Washington over private lines will never be known, but the circumstances surrounding the establishment of many of these services give testimony of their belligerent purpose. One after another, often on critical days, under stress of great urgency, private line services have been set up to distant places through the closest kind of cooperative action by Long Lines and the Associated Companies concerned.

If the pen is mightier than the sword, will it not turn out that the teletypewriter is mightier than the tank? While TWP [5] played a small role in World War I, in TWX [6] the country has a wholly new weapon. Among all means of communication, probably none in this area has gone so far and fast to war. All told, 1,100 teletypes are firing words at their targets with higher velocity and at longer range than a machine gun shoots its bullets.

Outward TWX messages, now passing 2,900 per day, have more than trebled in a year, are nearly nine times greater than two years ago. These messages come from almost 500 TWX stations, about twice the number of 12 months ago, and most of them in the Government's service. The switchboard through which these messages pass to their destination has undergone continuous expansion: six additions in two years. It has grown from nine positions to 45. The circuits to carry these messages over the country have been multiplied three and one-half times since 1940. By contrast, there are more TWX switchboard positions, circuits, and operators in service today than were required for message toll service when once before the Nation's Capital went to war. One government message center makes use of 26 TWX machines, the trunks to 17 of them assigned in sequence to insure uninterrupted inward service.

THE private line teletypewriter has also gone all out against the Axis. Associated Company and Long Lines services, together, at the first of 1940, accounted for less than 175 machines in the Metropolitan Area; clattering away now are more than 600. These administrative networks serve many purposes. One, for instance, transmits to a printer 500 listing changes daily for the addenda to the Information records of N.W.A. (National War Agencies), whose telephone directory, in passing, contains alphabetical and classi-

[5] Private line teletypewriter service.
[6] Exchange teletypewriter service.

fied sections and, with 20,000 listings, compares in bulk and pages with the telephone book for a city the size of Wheeling, West Virginia.

Naturally, it has taken organization and ingenuity to keep abreast of this growth in teletypewriter services, nor has it been easy going. Instrumentalities have been scarce. Personnel had to be found and trained. In the commercial department a half-formal procedures for training customers' teletype attendants have matured into a full-fledged school that in 11 months has instructed more than 600 pupils in the art. Nor is the end in sight.

Private Branch Exchanges

HERE IN THE CAPITAL and its suburbs can be found the largest private branch exchange switchboards in the world. Competition of late has been keen. The half-century ending in 1939 saw the Companies' investment [7] in manual multiple and large dial PBX's rise gradually to $3,046,000—and only three years more saw it pass $10,800,000.

INSTALLING THE world's largest private branch switchboard in the War Department. Installers worked around the clock to speed it to completion

dozen men under a full-time manager work round the clock to answer the hundred questions that must be settled for each new service, each addition or rearrangement. In plant, the installation and maintenance crew has grown from seven men to more than 40; and the traffic force at the switchboard, supplied and supervised by the telephone company, has built up from seven to more than 100. In-

The net growth of 49 systems in

[7] Including associated equipment, frames, and power plant, and excluding building and central office cable.

these three years, of 711 positions and 72,400 station lines, is simple to tally, but the hundreds of new installations, additions, and replacements that made up this net and measures the enormous installation and construction job that had to be accomplished have not been recorded. Here for one-quarter of the period,[8] and relating to Government PBX services alone, is a partial record: 58 PBX projects for 35 governmental agencies in which 390 positions were added or replaced and carrying with them equipment for 33,330 station lines. In the fortnight that followed Pearl Harbor, 24 PBX positions were connected for Government bureaus.

Surprisingly, there are on government and subscriber premises more large PBX positions in the Metropolitan area than there are operators' positions in telephone company offices[9]—and nearly one-half as many station lines as central office subscriber lines.

The War Agencies

THE HISTORY of the war agencies created to prosecute the war on the economic, production, and labor fronts will undoubtedly be recorded in due time. It begins on May 29, 1940, when the President approved the regulations governing the functioning of the Advisory Commission to the re-established Council of National Defense, and will be an astounding story of organization, reorganization, of recruiting, training, and housing of great clerical, technical, and administrative forces. The telephone installer and his kit, the PBX installers and others in the crafts, will be found on every page, unruffled in the turmoil.

No brief account can describe the extraordinary conditions under which telephone service was provided for these agencies; but some comment about one installation (for N.D.A.C.) may give an idea. Conceived as a manual PBX of 3 positions and 300 station lines, it turned out a week after birth to have 9 positions and 800 lines, and in a span of six months grew to 31 positions and 2,000 lines, plus 5 positions for toll. Skipping over two years of evolution, filled with growing pains, during which N.D.A.C. became the National War Agencies, this colossus, now dial, stands today with 89 positions working and 11,000 station lines. Still growing, it is a little crestfallen that it held the record—largest PBX in the world—for only ten months, out-ranked by the War Department in September 1942.

THE SUCCESSIVE ADDITIONS and replacements of such large amounts of equipment, each accomplished in extraordinarily short intervals, has been only one part of the project. Another has been the servicing by plant, traffic, and commercial of the station facilities connected to the system. In time the direction of this work became formalized in a section of the commercial department. A staff was assembled, some of the men borrowed from Associated Companies, all selected for their knowledge of subscriber telephone layouts and special equipment.

The weekly reports of this servicing force tell in telegraphic style a vivid story—

[8] First nine months 1942.

[9] 1,161 vs. 1,032 as of 12–1–42.

"3–14. Section organized today with 70 people. Initial installation 16 lines, 43 extensions. Section expected to grow to 600 people by 5–15, according to the Chief.

"3–28. Inter-American Defense Board, new agency organized this week. Ultimate growth 17 units.

that this PBX serves 14 of 23 war agencies, each divided into bureaus, divisions, sections and units. In seven months the Company's representatives studied the telephone arrangements of 2,000 units and restudied more than 400. In addition, they received and acted upon 4,900 demand requests for assistance in planning moves, rearrangements, or additions of station facilities.

LAST DECEMBER these accounting girls billed 607,000 toll tickets—a quarter of a million of them for calls made by Uncle Sam

"4–18. Floor plans reviewed. Recommendations incorporate all plans. 1500 telephones involved in move.

"7–25. O.W.I. expected to require 550 branches on office rearrangements and new layouts being reviewed."

Some insight into the scope of these activities comes with the knowledge

Rapid expansion brought into the Government service many new people with little experience in office procedures. Early in 1941 it became apparent that the company could, out of its experience, be helpful in teaching telephone habits which, by saving of time, tempers, and telephone facilities would help get on with the war. A training course was mapped out and a faculty of seven women has so far given classroom instruction

to more than 40,000 government workers of 39 bureaus on how to use the telephone more effectively. The training is continuing at the rate of about 75 classes and 1,100 pupils a week. Official appreciation of this effort has been abundant. General Brehon Somervel has written:

> ". . . training given to approximately 772 officers and civilian employees of . . . Office of the Quartermaster General. . . . This training has been of tremendous value and I wish to express appreciation. . . ."

THE PENTAGON BUILDING on the Virginia bank of the Potomac and the switchboard that serves the War Department have taken their proper places as contemporary wonders of the world. The dial system with its 125 operator and 36 information positions equipped for 13,000 station lines—with its more than 1,200 tie lines, trunk lines and long distance loops—is the proud descendant of a humble five-position manual PBX through which the War Department went to battle in April, 1917.

Cold figures do not tell that the Bell System had never before made a PBX installation of this size and complexity, that the Bell Laboratories especially designed the board, that Western manufactured it in record time, installed in only 17 weeks; nor do they bring out the magnitude of the task such a project entails in many directions: engineering, retraining of operators, thousands of cable pair and telephone number assignments, and all the deluge of installation and service order work.

The Navy's telephone system, with N.W.A. and War, completes the triumvirate of new giants. A manual system of 27 positions was sturdy enough to ride the seas of the '30's, but the going got rough in the '40's. By June of 1941, a 701–A dial PBX, equipped for 21 positions and 2,000 station lines, had been launched and commissioned. Four months later, it was enlarged to 43 positions and 4,000 lines and a satellite dial unit had been installed to serve 500 additional lines on the Virginia side of the Potomac, where the department occupied a new Federal building. As the fleet grows to cover two oceans, so does this PBX. At this writing it consists of 61 operator and 8 information positions to serve 7,000 station lines. Here is a system that has grown to three times its capacity of a year and a half ago.

Ever on the Alert

WHEREVER YOU may be in any of 14 telephone buildings, you will hear, at a pre-arranged time each day, the test rings of a far-flung air raid alarm system; and should it fail at any point, you might observe a worker reach for a telephone and report that the signal had not sounded.

In a business that has always jealously guarded the integrity of its service against the elements and its employees against accidents, the war, first in Europe and then in Washington, only brought different hazards to be prepared for. Even in 1939 the presence of guards might have been noted in three telephone buildings, and as the times grew more tense the posting of guards was extended to other buildings. According to plan, military guards took post and quarters in the two principal toll offices on the day following Pearl Harbor

and the Metropolitan police took charge in other central offices. These were relieved in time as additional Company guards were recruited and trained.

The identifying passes that employees must display to gain access to their places of work date back to August, 1940, and about that time protection for vulnerable doors and windows appeared. Four days after Pearl Harbor, operating and equipment rooms, where the business must function around the clock, had been blacked out by makeshift use of building paper and later, as they could be secured, with permanent shades and light traps. To know that 1,300 windows were thus attended to gives point to the statement.

The author has his assignment in the Fire Warden Service and his sector post on the windy corner of a roof. He is but one of 1,600 men and women in an organized Wardens Service that has been equipped and trained to extinguish incendiary bombs, render first aid, direct the force to shelter areas and protect the property if a day should come when that be needed.

Some day we may be permitted to tell exciting tales of how the telephone business in the Capital responded to calls upon it from the Army, the Navy, and from others charged with the protection of the District and the nation, for remarkable communication services.

It must suffice now to say that much also has been done to make the service throughout the city secure as possible and to meet contingencies of many sorts at many places. Even in a business that has long been geared to function night and day, Sundays and holidays, new dispositions were needed at many tactical posts—from executive offices to test desks, to guarantee instantaneous action in any exigency and at any hour.

The Garrison

As OUTFITS GO, the Bell System's garrison for Greater Washington is not so large. About 7,600 strong, it is no more than two regiments with a full complement of specialists. With action on the telephone front intensifying, recruits were mustered into the service and reinforcements brought from other sectors. Since the first of 1940, the garrison has grown by 2,900 effectives; a gain that does not disclose the extent of recruiting and training that has been required to build it up to war strength and fill the files left vacant as men were called to fight on other fronts.[10] It is safe to say that no less than 10,000 men and women have been placed in the ranks.[11]

The Infantry of this force is the 7,000 employees of the Associated Companies that furnish telephone service in the area. The Engineer Corps is Western Electric's installation men, now only a company of about 200. But these are mobile troops and early in 1942, at the peak of their campaign of switchboard and PBX installation, Western had two battalions—900 men on the firing line. The SOS, Western's Washington distributing house, accounts for another company of about 175 which, at the height of the battle of wartime expansion, now past its

[10] 571 employees of the C. & P. Telephone Companies in the Washington area were in military service at the beginning of 1943.

[11] 9,133 employees engaged in 3 years by the C. & P. Telephone Company alone.

turning point and in our favor, shipped telephone materials from stock in lots as high as 700 tons a week—much of it for the Capital

INGENIOUS TIME-SAVER: tin can and string convey toll tickets from a toll office to temporary toll positions two floors above via holes drilled through the floors. Three days before this picture was taken, the author's desk stood on this spot

area. A. T. & T. and Long Lines, the Signal Company of the garrison, musters at present about 200 people, where a detachment of 85, at the first of 1940, was quite adequate.

The bombs that fell on Oahu sent troops quite unexpectedly and hurriedly to many places. They likewise brought to Washington a band of volunteers, summoned from states as far away as Minnesota, to take their temporary places at switchboards and with installation crews hard-pressed to carry the load. One hundred and seventy-five of them were on the job a fortnight after December 7 and, in all, 600 experienced long distance operators, craftsmen, engineers, commercial representatives and others from 15 Bell Companies have seen or are now seeing service on the Capital Front. It may be that 600 workers competent to deal with a dozen different operations in the business could be assembled from half the nation without prearrangement. The plans that were made in August of 1941 to do just this if need arose are none-the-less good evidence of foresight.

It is not sufficient, however, to treat in numbers only of the men and women who faithfully have held the line. They have accepted and discharged many responsibilities over and above those that arise in their profession. They put, in 1942, more than three-quarters of a million dollars of their wages in War Bonds,[12] many have taken first aid instruction, and they have been active in Civilian Defense, Red Cross, and in other ways open these days to the citizen.

Any forecast of what the future holds for the business would be foolhardy. There are signs, however, that the storm of activity, at least in regard to construction and installa-

[12] 92 per cent of the employees of the C. & P. Co. are subscribing 8.7 per cent of the payroll.

tion, is abating, partly because the first requirements of the war machine in Washington have now been met and partly because the requirements of civilian use must wait the day when priorities can be relaxed. Traffic still grows, however; each day the capacity of the plant is stretched a little more, the leisurely social use of telephone lines is giving way to war calls.

One thing remains certain: if the spirit of an organization, its ability to fight as one team, are enough, no demands of our Government or of the armed forces for any communication facilities the Bell System can supply or devise will remain unsatisfied.

So, except as herein recounted, All's Quiet along the Potomac.

I AM PARTICULARLY GLAD to hear [your voice] at this moment, Mr. Powley, because it is coming to me over a line which we decided to built three years ago against the possibility of war with Japan. Because of that decision, you and I at this moment have the privilege of opening to regular service the new underground Transcontinental Cable of the Bell System. Now, for the first time in history, a telephone conversation can be carried all the way from coast to coast over a telephone cable, instead of going part of the way over open wires strung on cross-arms on poles. . . . The laying of this telephone cable *underground* across the Great Plains and across the Sierras—clear from Omaha to Sacramento—at a cost of $25,000,000, is a great feat of engineering and construction. We have had transcontinental telephone service for many years, of course—ever since January, 1915—and four transcontinental telephone lines already cross the western half of the United States by four different routes. But on all of these lines, as you know, the wire is strung overhead. The new cable, lying deep in the soil, safely below the cutting edge of the farmer's plow, is safe also from the attacks of wind and sleet and destructive ice. It will ultimately more than double the number of talk channels available for transcontinental calls, but it also greatly increases the dependability of transcontinental service. I consider this Transcontinental Cable, as we have named it, one of the great milestones of telephone history.

A. T. & T. President Walter S. Gifford, in New York, to Ned R. Powley, President of the Pacific Tel. & Tel. Co., in San Francisco, December 21, 1942.

"More Than Service"

Harold M. Prescott

The philosophy of service which is meeting the challenge of war conditions is made plain by the Traffic Engineer of the Bell System's headquarters company

THE SOLDIER moved about restlessly. He glanced at the clock, snuffed out his cigarette and again walked over to the girl seated at the little table and engaged her in earnest conversation. A few moments and he resumed his aimless pacing. The hands of the clock slowly crept past ten—ten-fifteen—ten-twenty.

The silence was broken by a muffled ringing. The girl at the table was suddenly occupied. And then—

"Ready with San Antonio. Booth three, please."

The soldier turned quickly, flashed a momentary smile in the direction of the table, and hurried to the booth. Several minutes later he reappeared and approached the table.

"I sure appreciate everything you've done in putting that call through," he remarked. "It was mighty important to me. How much do I owe you?"

The girl spoke briefly into a telephone.

"A dollar and a half, please." She smiled cheerfully. Then—

"I didn't do much," she said. " 'Long Distance' did all the work."

"Well, when you see her, tell her 'Thanks' for me, will you?"

The young man grinned, and from the door he added, "—and thanks again to you."

The girl busied herself at the table for a few minutes, inspected the room briefly, snapped off the lights and went out.

To thousands of Bell System employees the incident itself is commonplace: completing a long distance call for one of Uncle Sam's fighting men anxious, for a few fleeting moments, to hear again the voices of the folks "back home." It happens every night, many times over, in every section of a great nation girded for war. But the events leading up to the completion of the call eloquently attest to the accomplishment of a real service objective.

The call had been placed shortly before nine in the evening. In ordinary times, it would have gone through with little or no delay. But these are no ordinary times. The wires are loaded and hum with calls important to the successful prosecution of the war. In common with many things we have long had in abundance, the materials required to meet the unprecedented demands for long distance service have been diverted to war production: more planes, guns, tanks, and ships! And so some calls are bound to be delayed. The soldier's was one of these, and, though he well understood the reasons, it was small comfort to him in a matter of such personal importance.

The girl at the table—the public

telephone attendant—understood the situation too. Perhaps better; for inwardly she counted the minutes with the soldier, and her interest in and sense of personal responsibility for the call were clearly evident. It was with a surge of pleasure and satisfaction, then, that she announced with a smile, "Ready with San Antonio." Her interest was obvious to him. His appreciation was both spontaneous and sincere.

To some of us, the opportunity to manifest so clearly the Bell System's desire to serve in a courteous and businesslike manner, yet with a warm and friendly interest, occurs infrequently. To many thousands of employees, however—operators, repairmen, service representatives and others—it is an everyday occurrence, and by this very fact the earnestness and sincerity of our desire to give a completely satisfactory service is constantly being challenged. The extent to which they recognize and utilize these opportunities as they perform their daily tasks will largely determine the lasting impressions of the service and personnel created in the minds of our customers.

Striving for technical perfection—a prompt, courteous, error-free service—is, of course, an ever-present objective. But today, more than ever, we are looking beyond technical performance to the human and personal side of the business. Not in the sense that unnecessary or improper emphasis will be given to the personal element, because even in these difficult times the vast majority of all calls and all transactions with our customers are handled promptly, efficiently, and to their complete satisfaction—and this, after all, is the fundamental objective. But in the sense that when calls are unavoidably delayed, when service difficulty is encountered, or when the unusual or unpredictable arises, we will signify by word and deed our personal concern and interest in furthering the customer's wishes. Call it what you will—and it has been referred to in various terms over the years—"personal interest," "personalized service," "overtones of services," etc., it all boils down to a sincere desire to conduct the business as efficiently as we know how in the best interests of our customers and in a *considerate, thoughtful,* and *cheerful* manner.

This is the challenge.

It confronts us not only as an organization but, equally important, as individuals; for ours is a business which, requiring on-the-spot compliance with and satisfaction of the customer's wishes, depends fundamentally upon the individual. We do not have the benefits of careful and painstaking prior inspection of our product, as in the case of manufactured articles or goods. We furnish a service. Moreover, it must be ready at all times and under all conditions—when the customer wishes to use it. The elements that make for a better service—the long-range planning, the careful training, the efforts to anticipate and be ready to meet unexpected demands upon the service—are not seen nor appreciated by the user. The things he feels and senses, the impressions he carries away of our competence and ability, and the regard in which he holds us, largely come from the personal side of the business—the voice, manner, and un-

seen personality of the operator who handles his call.

These things have always been important, but never more so than today. The thoughts of millions the nation over are preoccupied and seriously concerned with the trials and tribulations of war. The material things we have taken so much for granted are in increasing degree becoming less plentiful and, in some cases, are being denied to us. Under these conditions, we are all more sensitive to the little things that touch upon our daily lives. There are mounting evidences of this in telephone service since the materials to meet the ever-increasing demands are being put to more pressing needs. It becomes an obligation, then, to insure that the sources of potential irritation in the business—carelessness, inattentiveness, lack of interest—are completely eradicated as a cause for dissatisfaction with the service.

In the ordinary case, nothing more is required than that we be alert and attentive to the customer's wishes and that we handle the call or transaction promptly, courteously, and accurately. But when delay is encountered or something goes wrong in the completion of a call or when temporary restrictions in the amount of service that can be given become necessary—and in these days we must expect that some of this will be unavoidable—then the desire to give a pleasing and satisfactory service must be translated into positive action in terms the customer can readily understand. It must be clearly shown that every resource and every means at our disposal will be cheerfully used to comply with his wishes, and that if these do not prove sufficient for the immediate purpose our regret is genuine and sincere. This conception of the job must be fundamental with all employees and can only be applied successfully if the individual feels it and lives it.

We, both as patriotic citizens and as workers on the production firing line, face a heavy responsibility in furnishing the vital communications needed in integrating a vast and diversified war effort. "War calls" come first and will often justify special and preferential handling with the closest sort of attention by all concerned to insure prompt and accurate completion. However, the attention required for the expeditious handling of those vital war calls in no way relieves us of the responsibility of giving the best possible service on every call—*and giving it cheerfully*.

We meet these responsibilities with a heritage of service that has become traditional. The years are punctuated with acts of loyalty and devotion to the service, and epics of heroism in the line of duty. The list is long and reaches into every section of the country, encompassing fires, floods, earthquakes, hurricanes, explosions—. The only compulsion has been the individual's sense of personal obligation to the community or to a fellow being.

This spirit pervades the entire organization; and today, with the nation fighting for its very existence, the desire, willingness, and determination to maintain the service, come what may, is given fresh impetus and assumes added importance. It comes from the knowledge that the job we

are doing is vitally important. To be sure, it does not have the spectacular element of the ship sliding down the ways or the rumble of tanks off the assembly line. Rather, it is a steady, unswerving, and unobtrusive contribution, the importance of which has time and again been attested to by military leaders and production men.

As we go along, thousands of new employees will join the ranks. They will work side by side with those who have already experienced under fire that sense of service obligation and who clearly see the part they play and the contribution they make. Both have a responsibility—the one to point the way by precept and example, the other to take up and carry on a worthy tradition.

IN THIS TRADITION we must be doubly sure that under the stress of difficulties which will confront us in maintaining high levels of technical performance, the overtones of service—the friendly and personal touch—are not neglected, that cheerfulness is not found wanting. That on the contrary, we will be more sensitive than ever to this responsibility, keeping constantly in mind the thought that every transaction is a separate and personal matter, apart from all others; that each one should engage our complete and undivided attention; and that each one should be entirely free of any impression of perfunctory interest. The aim is to have the customer sense that, regardless of circumstance, *his* particular request is receiving the utmost consideration, and that we are honestly and sincerely concerned when difficulties of any nature temporarily obstruct the attainment of a service objective.

FREQUENT RECOGNITION, in the press and on the radio, has been made of the fine services rendered by the telephone companies. Governor Darden of Virginia, in a radio talk to the telephone people of that state, paid the following tribute:

"We must be prepared for an unexpected assault on the Atlantic Coast and I think that Virginia in particular must be very watchful in that area which we commonly call Tidewater. If the blow should come, we will depend to a great extent upon you; your willingness to stick by your post. Your ability to transmit vital information which we must have in order to attempt to deal with the difficulties which will confront us is of vital consequence and I know that we will be able to count on it because I have seen you and had the privilege of working with you through months which have been especially trying.

"It is a marvel to me that you could be as cheerful and as efficient as you have been in handling long distance calls that I have had occasion to make many and many times in the last six or eight months. The telephone service and the cheerfulness of those who help you is an astounding thing to me. The fact that you can pick up a phone here in Richmond and talk to almost any place in the United States quickly and that if you are in difficulty you can get help and get it given cheerfully is the thing that I marvel at . . . that's *more than service;* that's more than efficiency—it's a great spirit and a great heart. It is the thing that has made

this country great and it is the spirit that is going to save it."

This tribute to the spirit of service that exists throughout the Bell System today has not been easily or unjustifiably won. May we continue to justify it through the trying times ahead!

Charles M. Bracelen 1878-1942

Harvey Hoshour

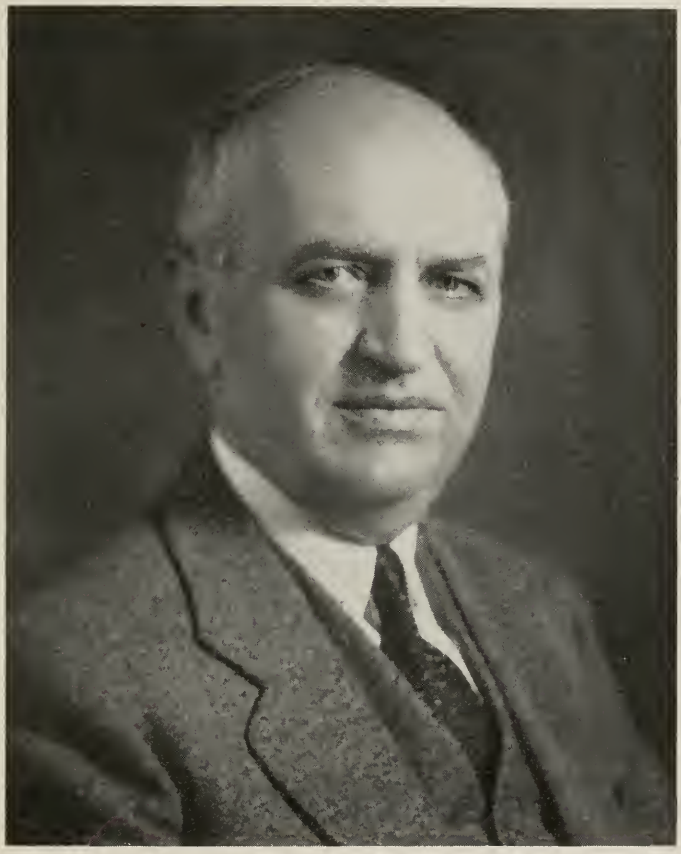
Mr. Bracelen joined the legal staff of the American Telephone and Telegraph Company in 1918 as an attorney. He became General Solicitor in 1921, and was elected a Vice President in 1924. From 1926 until his death on October 8, 1942, he was the Company's Vice President and General Counsel.

Of Maitland, the great English legal historian, Mr. Justice Holmes wrote:

"One is almost ashamed to praise a dead master for what he did in a field where he was acknowledged to be supreme. When his work is finished it is too late for praise to give the encouragement which all need, and of which the successful get too little. Still, there is a pleasure in bearing one's testimony even at that late time, and thus in justifying the imagination of posthumous power on which all idealists and men not seeking the immediate rewards of success must live."

These words of Mr. Justice Holmes might have been written about Mr. Bracelen, so well do they apply to him. And so well (and so much better put than I could express it) do they express the feeling that has impelled the "bearing" of this "testimony."

Several years ago a Justice of the Supreme Court of the United States, who had known him for many years, said to one of Mr. Bracelen's associates: "Bracelen is as fine a lawyer as I have ever known." When Mr. Bracelen was given an honorary Doctor of Laws degree last May by the University of Nebraska, from which he had been graduated 40 years earlier, Mr. Gifford wired: "His brilliant legal mind is unique—unequalled by any I have known." Fine tributes these, to which many another could be added, but my thought is that this "testimony" rather should be limited to some slight statement of those qualities in him that most impressed me in the



The late Mr. Bracelen

ten years it was my good fortune to know and to work intimately with Mr. Bracelen.

Mr. Bracelen had a mind of rare acuteness and clarity, and a fine knowledge of the law, its principles and its techniques. He could reason very closely and logically in the traditional manner of first-class lawyers. One would expect this in a man in his position, and in this respect he did not fail. But, in addition, he could and did think intuitively, and brilliantly so. Often he seemed to check one method against the other, at times reasoning backward from a conclusion which he seemed to *feel* rather than to arrive at by purely analytical processes. Otherwise put, he had both a first-class logical mind and a full measure of imagination—and he used both in the consideration of the problems that came to him. In a word, he had wisdom, that something so well characterized by Chief Justice Stone as the "indefinable distillate of mind and spirit upon which mankind must place its ultimate reliance as the solvent for the problems of human experience."

Mr. Bracelen was a sensitive man, sensitive to beauty, sensitive to fun, and, above all, sensitive to ideas—whether his own or those of others.

Always he kept his mind open and his conclusions tentative until the moment of decision. As a result, some of his conferences were long in duration, but they were always satisfying, always convincing. He prevailed, when he chose to prevail, by force of persuasion rather than by that of his position, and it was a far from uncommon thing for him to yield his first judgment to that of his associates. Just to be exposed to Mr. Bracelen's reactions to the views of his conferees, to his continuous self-searching, and to his luminous expositions—things which characterized his every conference—was an experience which one could not forget if he would and would not if he could.

Mr. Bracelen was an understanding and sympathetic man. To an associate away from the office for a time because of sickness he wrote:

"Just a few lines to let you know I am thinking of you. It's a shame you have to be away from your family at Christmas and I need not tell you that I am most sympathetic. But, of course, you are doing the sensible thing. I suppose the progress of recuperation seems slow to you, especially just at this time, no matter how satisfactory it really is. . . .

"Above all, don't worry about being away from the office. That's an *order* from your boss! You must not think of returning until your doctor and Mrs. ————, as well as you, agree that it is all right to do so. When that time comes we will be most happy to see you, because we do miss you very much."

Only a man of great sympathy and large understanding could have written such a letter as this. Mr. Bracelen was this kind of man.

Mr. Bracelen had a most unusual facility of expression. The files of the Bell System companies' Legal Departments are full of letters and opinions written by him, all of them crystal clear in meaning and expressed with a skill rarely found in documents written by lawyers or anyone else. So also of his briefs and of the suggestions he made concerning the briefs of his associates. As an example there comes to mind the first brief of any consequence that fell to my lot to write for Mr. Bracelen. He made several suggestions, the most important of which was that at the very beginning of the brief there could well be added two or three sentences which, as he put it, might "point up" the brief a bit. Later, when the brief was printed, I asked one of my associates in the office to read it. His comment was: "Fine, particularly the first few sentences, which immediately get the attention of the reader." The sentences which he referred to were entirely Mr. Bracelen's.

Mr. Bracelen was a man of intense loyalty: loyalty to his family, to his friends, to his associates, and to the Bell System. And invariably he inspired loyalty in others. This latter was exemplified some years ago when he was arguing before a Congressional Committee in opposition to a bill then pending before it. He made a characteristically forceful and persuasive argument. It was apparent that he had the Committee with him, and indeed the Committee later

reported the bill adversely. An opponent, apparently nonplussed by the Committee's attitude, countered by attacking Mr. Bracelen's motives and those of the Company he worked for. A later speaker, who represented interests which had no connection whatever with the Bell System, and who had not seen Mr. Bracelen for many years, took up the cudgels on his behalf, saying to the Committee that he had known him as a boy in Nebraska 40 years before, and that he could state of his own knowledge that Mr. Bracelen was wholly incapable of base motives or false pretense, and that therefore the statements made about him just could not be true.

Mr. Bracelen was indomitably courageous. Some years ago I heard him argue a most important case for the Bell System in the Supreme Court of the United States. At the time I knew that he was unwell, but it was not until a few months before his death that he told me that on the day of this argument he was so sick that he was hardly able to keep on his feet and that only by driving himself to the very limit was he able to present the case at all. At the time of the argument I thought his presentation was adequate, not in his best form, but certainly in quality far beyond that ordinarily heard in Supreme Court arguments. As I see him now, presenting this case, answering the Court's questions, moving from one point to another with apparent ease, the argument, or rather the man, seems great, as great he was, and truly courageous, as also he was.

As many of his friends know, Mr. Bracelen regarded his doctor's degree from his University as the culmination of his career. To some it might seem strange that this should be so of one who was the chief legal adviser of the largest corporation in the country. But to Mr. Bracelen the intangibles were always looming up larger and more important than the tangibles, and I venture that to those who knew him well his emphasis of the significance of the University honor that came to him almost too late will not seem paradoxical at all. Nor will those who knew him well think it strange that he believed, as he did, that Mr. Justice Cardozo was the greatest among modern American judges. Not many men (and perhaps even fewer lawyers) can think finely both logically and intuitively. Mr. Bracelen could and did. Mr. Justice Cardozo could and did.

It was Mr. Bracelen's thought that, upon his retirement, he would write a book or series of articles on modern administrative law under some such title as "The Fourth Department of the Government." To him the development of modern administrative law was not a thing to be deplored or met with unreasoning opposition. Administrative tribunals were institutions to be studied and understood, and, in so far as they expressed the public interest, to be supported and coöperated with. Mr. Bracelen believed that public utilities should be regulated, and it was his thought and desire that the companies he represented should so conduct themselves as to merit the confidence of those who had the duty of regulating them. With these views, and with his adroitness in expression and flexibility of mind, as well as be-

cause of his experience over the years, it is hard to think of anyone, in the Government or out, who could have done the thing he had in mind so well as he. That he wanted and purposed to do it is but another index of Mr. Bracelen's character. That he did not live to accomplish this purpose is the loss of all those who believe in sound regulation of public utilities and who are interested in the effective functioning of our form of government under modern conditions.

ONE THING MORE: In those who knew him well, Mr. Bracelen's going has left a sense of personal loss that will not cease. Even so, ours is a lasting pride that he was our counselor and friend, and ours is the hope that by so often being with him we may somehow have caught a little of his clarity of mind, his imagination and his understanding. Then, too, there is the fact, as some of us so strongly believe, that the qualities he had do not really die at all. As a New England poet recently wrote:

Men die, but not those qualities they give—
As truth and beauty, love and loyalty—
To make of life true Immortality.

Who's Who & What's What

(Continued from page 3)

one of the many fine things that Bell System women are doing—in addition to their full-time war jobs—which MARGARET E. FAWCETT describes in this issue. Starting in traffic work in New Jersey in 1916, where her progress soon carried her into personnel activities in that department, she was transferred to the A. T. & T.'s traffic division in 1928 to work on training plans. For the past three years she has been in the employment section of the division, where, as one phase of her personnel work, she has helped to train group leaders for the self-development course. Her war-time assignment has taken her into military establishments all over the country where Bell System women are operating the Army's private branch switchboards, and into many central offices where the impact of the war has been equally great.

TO EVERY COMPANY in the Bell System the war has brought tremendous problems—and accomplishments. Nowhere in the System have both been more concentrated than in and around the focal point of Washington, and EUSTACE L. FLORANCE'S fluent pen brings us a vivid picture of what the last three years have meant to the companies which serve that region. A Captain of Infantry in the last war, he has been with the Chesapeake and Potomac companies since 1921. Appointed division commercial supervisor in Washington in 1926 and General Commercial Manager of the Baltimore company in 1929, he returned in 1936 to Washington as General Information Manager for the C. & P. group.

WHILE IT IS primarily to traffic people that HAROLD M. PRESCOTT addresses himself, his philosophy of service is universal in the over-all. Modestly, he claims for his contribution only the "re-use" of the thoughts

Mr. Prescott

Mr. Hoshour

of others, and credits Mr. J. W. Cook of his staff with an assist. In traffic work since he joined the Pacific Telephone and Telegraph Company in 1911, Mr. Prescott headed east to the A. T. & T. Company in 1928, became Traffic Results Engineer a year later, and was made Traffic Engineer in 1940. He contributed "Toward a More Pleasing Service" to this MAGAZINE for April, 1940, and "More and More—with Less and Less" to the November, 1942, issue.

SYSTEM-WISE, there's not much occasion for contact with the head of A. T. & T.'s Legal Department except by members of the legal staffs of the Associated Companies. The tribute which HARVEY HOSHOUR pays to the late Mr. Bracelen will no doubt make many others wish that they had had opportunity to know him. Mr. Hoshour's paper was inspired by close association with Mr. Bracelen from 1933 to 1939 as A. T. & T. General Solicitor and since the latter year as Vice President and General Counsel of the New England Telephone and Telegraph Company.

THE EDITORS

GRANTING THAT a long-distance telephone will be forthcoming, it will require an absolutely perfect condition of the elements along the route over which the wire runs; there must be no rain, no fog, no sleet, nor mist; no moisture in the atmosphere, no electrical storms. . . . After all these difficulties have been overcome there still remain many reasons why it will not be a success . . . No sir . . . The coming long-distance telephone will be a plaything, nothing more. Put a mark on the assertion.

Cincinnati correspondence in the Syracuse, N. Y., Sunday Times, February 22, 1885.

A Vital War Resource

From the A. T. & T. Annual Report for 1942

EMERGENCIES ARE NOT NEW to the Bell System. They have been met many times in past years through the accidents of fires, floods, earthquakes and hurricanes. The System was prepared to meet this present trial of war, which is making greater demands than ever before, because it is financially sound and strong; because it has a magnificent communications plant in superb condition; because of the competence and spirit of service of its army of well-trained employees who have the "know how," who are experienced in the art of communications and in the team-work necessary to give good telephone service; because, as a private institution, it has been allowed under the American system of private enterprise to develop, unfettered by the chains of unreasonable laws or men; and because the institution has a deep sense of its responsibility to the public it serves. This freedom to develop has made it possible to have laboratories constantly improving the art of communications, and a manufacturing department constantly improving the quality of telephone equipment. Adequate earnings have made possible good wages and salaries, with provision for sickness, accident and death benefits and pensions, so that a high quality of personnel could be maintained, and have permitted paying a reasonable return to those investing their savings in the business, thereby insuring the financial credit of the System so that it could obtain, for the most part from stockholders, the large amounts of new capital continuously required to meet the growing demands of the nation for telephone service.

The trust thus given by the American people has returned to them the best telephone service in the world; a service that in extent and speed far surpasses that of any of the Axis nations, in fact that of any nation; a service that is one of the nation's great and vital war resources.

With the sympathetic understanding of the public when they encounter difficulties with telephone service due to war-time restrictions and overloads, the great army of telephone men and women may be counted upon to do their full part so essential on the home front with the same effective effort, devotion to duty and high morale as our fighting men have shown on the fighting fronts.

Bell Telephone MAGAZINE

THE IMPACT OF WAR ON LONG DISTANCE SERVICE

TELEPHONE SERVICE FOR WAR INDUSTRIES

AMERICAN SCIENCE MOBILIZES FOR VICTORY

OPERATING ARMY SWITCHBOARDS

THE TELEPHONE PIONEERS OF AMERICA

American Telephone & Telegraph Company · New York

Bell Telephone Magazine

June 1943

"*The ideal and aim of the American Telephone and Telegraph Company and its Associated Companies is a telephone service for the nation, free, so far as humanly possible, from imperfections, errors, or delays, and enabling anyone anywhere to pick up a telephone and talk to anyone else anywhere else, clearly, quickly and at a reasonable cost.*"

A Medium of Suggestion & a Record of Progress

Published for the supervisory forces of the Bell System by the Information Department of American Telephone and Telegraph Company, *195 Broadway, New York, N. Y.*

Who's Who & What's What

in This Issue

THAT LONG DISTANCE LINES are crowded with the calls of the military services and war industries is not news to telephone people. Few realize, however, how heavy has been the actual increase in traffic since Pearl Harbor and what problems it has imposed on the Bell System. Both illuminating and authoritative is MARK R. SULLIVAN'S discussion of these problems and of how they are being met; for not only is he head of the Department of Operation and Engineering but he was for 29 years engaged in traffic and administrative duties with the Pacific Telephone and Telegraph Company before he was elected a Vice President of the A. T. & T. Company in 1941. His Bell System career was more fully described in this MAGAZINE for February, 1943, to which he contributed "The Bell System's Post-war Construction Program."

RAMIFICATIONS OF THE Bell System's contribution to the war effort are nearly as wide as the war itself, and many of them little known. The scope and importance of one of them is described by S. WILLIAM LIDMAN, whose familiarity with his topic comes from visits to many war plants and discussions with plant executives and Associated Company servicing groups. His interest in these matters was evidenced when, upon graduation from Harvard in 1920, he did graduate work in industrial management at the University of Pennsylvania. After six years with the Bell Telephone Company of Pennsylvania, he was transferred in 1927 to the O. & E. Department of the A. T. & T. Company, where he has since been engaged in various phases of sales and servicing work.

THIS HAS BEEN CALLED—among other things—a scientists' war, and it

Mark R. Sullivan

S. William Lidman

Robert W. King

Glen L. Whiteman

Samuel T. Cushing

is encouraging indeed to read in ROBERT W. KING'S paper how coördination is being achieved among the many branches of science to direct all their resources of research against the enemy. After receiving his B.A. (1912) and Ph.D. (1915) degrees from Cornell, he taught there until 1917, when he joined the Western Electric Company as a physicist. He has since served in various scientific capacities with the A. T. & T. Company and the Bell Telephone Laboratories, and from 1929 to 1935 was assistant technical director in Europe for the former. He is one of the editors of the *Bell System Technical Journal,* and since 1940 has been Assistant Vice President of A. T. & T's Department of Development and Research.

ANOTHER LITTLE-KNOWN Bell System war activity, and one of importance out of all proportion to the number of System people directly concerned, is the operation of private branch switchboards for the Army, about which GLEN L. WHITEMAN writes. He has visited many of the switchboards—Navy as well as Army —to study the service problems which arise there. Starting with the Southwestern Bell Telephone Company in 1910, he held traffic assignments there, with the Long Lines Department, and with the New York Telephone Company before joining the traffic results section of the A. T. & T. Company's O. & E. Department in 1922. For the past 13 years he has had to do chiefly with activities which help PBX customers in the operation of their switchboards.

SECRETARY of the Telephone Pioneers of America since 1939, when he was appointed a staff assistant in the Personnel Relations Department of the A. T. & T. Co., SAMUEL T. CUSHING traces the development of the Association during a third of a century from small beginnings to its present position of importance. In plant work with the New England Telephone and Telegraph Company from 1906 to 1927, he was on the staff of the plant operation results engineer of the A. T. & T. Company for the next dozen years until his present appointment.

IN THIS SHIPYARD, portable telephones which can be clamped to a ship's rail, and which connect by means of marine jacks installed on outfitting docks, expedite the work after a vessel has been launched by bringing needed tools, parts, and men to the spot much more quickly than the messenger service formerly used. Said one yard official, "Your installation of telephones on board ships . . . has speeded up the outfitting activity . . ." While this picture relates particularly to "Telephone Service for War Industries," beginning on page 91, it is also illustrative of war-time use of the telephone which is the topic of other articles in this issue

With Additions to Plant Severely Curtailed, Increasing Numbers of Calls Make It Progressively More Difficult to Maintain Service Performance at Its Usual Level

The Impact of War on Long Distance Service

Mark R. Sullivan

The following article gives in narrative form the substance of much of Vice President Sullivan's testimony concerning toll board service before the Federal Communications Commission on December 16, 1942. Statistics for 1942, available at the time of the hearing only for the first ten months, have in most cases been revised to include the full year. THE EDITORS.

WITH THE FIRST RUMBLINGS of war, the nation reached for the telephone to get things done. Time: that became the scarcest and most desperately needed of war necessities. Greater and greater reliance was placed upon the telephone, because it makes time by saving time. It gets things done—fast.

All forms of communication service were called upon, and particularly the long distance message toll service. From early in 1939 to the end of 1942, the Long Lines toll volume increased 150 percent. In the short period of the last two years, the traffic has nearly doubled. The increase for this period alone is almost equivalent to the total level of business reached after steady and almost uninterrupted growth over a period of some 65 years.

Double the amount of business would seem to call simply for double the amount of plant and of operating force. Under the most favorable conditions, it would be far from a simple matter to double the far-flung and extensive Long Lines plant; under the circumstances which actually prevailed, it was an impracticable task. For the very materials —copper, aluminum, steel, lead, rubber, and many others—which are re-

quired for telephone construction were among the first to go to war on a large scale. And, quite properly, the amount of these materials available for telephone construction was sharply curtailed.

Copper, for example, had been used in building telephone plant at the annual rate of more than 90,000 tons; now only about 8,000 tons are used. Nor is it quite accurate to say "used," because today, for every ton placed in plant, more than a ton is salvaged and returned to the national copper pool. Thus, there is no drain on the country's copper resources because of telephone construction.

Despite the cross fire of rapidly increasing long distance traffic and rapidly diminishing materials for new construction, the service continues to be rendered efficiently. Over all, the results still average well—as is shown by the following comparison of results two years ago and now:

Then, 1.4 percent of the calls were delayed because of "no circuit" conditions; now 5.6 percent.

Then, the average speed of service on toll calls was 1.4 minutes; now it is 2.7 minutes.

Then, speed of service on 99.4 percent of the calls was within 10 minutes; now, on 96.4 percent.

Then, 93 percent of the calls were handled while the calling party remained at the telephone; now, 86 percent.

Most of the calls go through all right, as these figures indicate. That is an important fact, for telephone service is vital to every phase of the war effort. Just as it requires 75 trains to move an Army division and its equipment, it takes also thousands of telephone calls to get those trains loaded and to send the men and the supplies on their way. Thousands of calls are involved in building a ship, a bomber, or the yard or plant in which it is produced. So it is with every other important war activity. The telephone speeds the war activities—and the fact that most calls are completed promptly tells of an epic performance in which every telephone employee may rightfully take pride.

A system of priorities has been established to insure that vital long distance calls go through promptly. This does not deny to anyone the use of the service; but it does give priority calls precedence so that long distance calls essential to the national safety can be put through at once, even though the circuits may be overcrowded by such surges of traffic as inevitably occur during emergencies or catastrophes.

What the Averages Mean

WHILE THE average call speeds along normally to completion, not all calls fall on or near the average. Telephone lines are like highways: when too many people want to travel the same road at the same time, a traffic jam results. It is the same with telephone circuits: some voice highways, main lines and branch routes, which were engineered in size to carry a pre-war traffic, are now overburdened with war calls.

If the growth in calling were spread evenly over these voiceways, the effect of the increase would also average out evenly. But the increase in use of the service is anything but uniform: following generally the path of war activity, it varies tremendously in different localities.

Long Lines calls in Washington, D. C., for example, are 275 percent of the figure for January, 1941; in Dayton, 355 percent; in Norfolk, 493 percent; and in San Diego, 896 percent. These are a few scattered unusual and unpredictable occurrences. In Norfolk, for instance, on one recent day such an occurrence swept Long Lines traffic up to more than 600 percent over January, 1941.

The speed-of-service figures given

How MANY LONG DISTANCE CALLS go into the raising, training, and equipping of an army of 10,800,000 men? And how many calls pass between them and their relatives and friends at home? Answer those questions and you have in part the answer to why long distance telephone lines are carrying a greater load today than ever before

illustrations of the unprecedented bulge in toll calling in war-active cities.

Over and above these average increases, on individual days and in individual cities traffic is affected by surges which are brought about by

on page 82 are averages for many places—the good, the not so good, and those in between—all averaged out. But just as growth in calling has not been uniform throughout the System, so has circuit congestion been most pronounced in the cities most

affected by war activities. For example, while the Bell System figure for the percentage of customers released due to "no circuit" conditions was 5.6, the corresponding figure for Seattle—excluding calls to nearby points—was 23 percent; for Norfolk, Portland, and Atlanta, about 20 percent.

But the analysis must be carried still further, for even the city results are averages of the speed of service on all the circuit groups in the offices; and here too we have the good, the not so good, and the in between. This is amply demonstrated by the percentage of calls with speed of service over ten minutes on individual circuit groups between important cities. The System figure was 3.6 percent; but on the New York-Dallas circuit group, it averaged out to 44 percent in October, 1942, for example, and exceeded 25 percent on such groups as the Kansas City-New York, Cleveland-San Francisco, and San Antonio-Chicago.

The Complexities of War-time Traffic

FROM THE viewpoint of traffic volume alone, the problems of maintaining prompt toll service have been tremendous. But this increased volume has been accompanied by increased complexities in the handling of calls. It is impossible to evaluate precisely, or to set apart as wholly separate entities, the individual elements contributing to greater difficulties in handling these calls, since each bears upon the others in a marked degree. However, three fundamental factors are: more attempts required per call; a greater proportion of person-to-person calls; and greater length of haul requiring more switching.

The increase in these complexities can be measured by comparing the "units" per toll call. The term "units" is used in the sense of the relative work time required. In determining equipment and force requirements, calls are translated into units by the application of coefficients representing the different operating time requirements for each type of call. For instance, a person-to-person call which is put through on the first attempt is evaluated, at the originating office, at about double the requirements of a corresponding station-to-station call.

The net effect of the increase in these complexities in terms of work units is roughly the same as a corresponding increase in volume of traffic: almost exactly the same as to force and switchboard requirements and to a large degree as to circuit requirements. Since January, 1941, work units per toll call have increased more than 10 percent.

The average length of conversation is another factor which has increased facilities requirements. For Long Lines traffic, conversation time in the past year has increased 7.0 percent, and this longer conversation time is directly reflected in circuit requirements over and above the effect of the increased volume of calls and of the operating complexities already discussed. The combination of all these factors has a pyramiding effect on the requirements for operators, switchboards, and circuits.

Analyzing the Averages

THUS, GOING BEYOND the quarterly or monthly average and breaking it

down into results for individual days and for individual hours, it can be seen that an entirely different perspective of the service emerges.

Even an average for an individual item for a specific period needs to be analyzed to determine how it is made up. An average comprised of individual calls ranging from a few points on the low to a few points on the high side of the mean reveals one kind of service. But an average made up of individual calls or intervals well below and others well above the average represents something entirely different. The customer whose individual call is delayed well beyond the average may appraise the service by that call, even though he may realize that the average speed of all calls is much faster.

BOTH ENDS A-BUILDING toward the middle: background as well as foreground in this picture show one factory. How many long distance calls does it take to construct a war plant of this size—and to tool up for and produce the airplane engines it will turn out? Long distance service is the right hand of the war industries

Why Calls Must Move with Dispatch

TOLL TELEPHONE SERVICE must move with dispatch. Unlike other forms of communication, calls cannot be permitted to pile up for later disposition without adding complications. Delays are cumulative; and as calls are backed up, it takes more and more operator time, switchboard time, and circuit time per individual call. The result is that more plant and personnel are required to handle backed-up traffic than to handle traffic moving without delay.

This principle can be visualized by following through the train of events when a surge of recording signals occurs at a toll board.

Toll operators normally answer

recording trunk signals within 10 seconds. Perhaps 5 to 6 percent of the answers may exceed this. If this percentage inches up to 8, 9, or even 10, some drag on the service occurs, but it is not serious. If it gets much above that, however, trouble starts to accumulate.

The signals become too numerous for operators to answer in order of their appearance on the switchboard, and thus some are answered very promptly while others may go unanswered for long intervals.

As this occurs, the calling parties have a tendency to hang up and call again—starting a new train of signals.

PBX operators are likely to call on two or more trunks simultaneously, causing more signals, further congestion, and unnecessary work by the long distance operators in answering more than once on the same call.

At about this point it becomes necessary for operators to stop completing calls in order to concentrate on recording the calls. This in turn necessitates releasing the calling party after he has given his call, even though a circuit may be available at the time. When this happens, some of the circuits are left idle, thus wasting circuit time.

THIS IS BUT ONE—and by no means the largest—of the Bell System's long distance switchboards through which the nation's war calls are pulsing in ever increasing volume

When the recording signals are under control, the operators then undertake to complete the calls which have accumulated. First, the calling party's line is obtained over a switching trunk. The plant is designed for only a limited amount of calling back for the originating line, and thus switching trunks are not ordinarily adequate for a large accumulation of

backed up calls. The recording or recording-completing trunks on which the calls came in originally are not interchangeable with switching trunks and cannot be used for the call-back. Thus, with many operators becoming free at about the same time to complete the delayed calls, busy switching trunk conditions are encountered which cause delay and added work time.

In the meantime, as the delay increases, the calling party in many cases calls into the toll board to inquire about progress on his call. These inquiries are referred to in telephone parlance as "AG's," meaning "try again." This brings into play more recording signals, more operator time to record the "AG," to send the ticket to the delayed position, to match tickets, and to reach

TWO YEARS AGO this long distance switchboard, with its 20 operator positions, did not exist. It was placed in operation to handle the messages for an Army training area

Having finally obtained the switching trunk and the calling line, the operator then reaches the called station or party and rings the calling station. Some delay having ensued, the calling party in a certain number of cases may be temporarily unavailable and arrangements must be made to complete the call later. This means more attempts, more circuit time, more board and operator time. the calling party to report on the status of his call.

In addition to the "AG's," the calling party in some cases, being particularly anxious to get the call through, places a second call. In these cases the operating time and use of circuits and facilities is frequently duplicated.

This detailed illustration of what happens when traffic does not move

promptly illustrates clearly the cumulative difficulties that result from the backing up of calls. It is, of course, apparent that these difficulties are a matter of first importance to telephone traffic people because of their effect on force, switchboard, trunk, and circuit requirements.

When Calls Are Delayed

WHEN IT BECOMES APPARENT that, because of such a situation, long delays—of half an hour or longer—are in prospect over any route, the delay is "posted" so that operators may tell customers the approximate time their calls will be completed. Throughout 1941—until December 7—the posted delays on Long Lines circuit groups were few in number—two or three a day; occurred at widely scattered points; and in the main were caused largely by circuits put out of order by storms. Since Pearl Harbor, however, there has been a sharp upward trend in posted delays. Today, the number of calls affected by posted delays is running more than 150,000 a month.

As in the case of speed of service, the trend in percentage of toll board tickets representing calls not completed to conversation is upward. For the System as a whole the figure was 8.3 in the first quarter of 1941 and 13.7 in the fourth quarter of 1942. The full significance of a change in percentage cannot be grasped from the percentage figures themselves but must be viewed with relation to the base to which they apply. For instance, this difference of slightly over 5 percent means that on an annual basis, upwards of thirty million more calls are not being completed on the original ticket than would be the case with the completion rate previously prevailing. Many of the calls not completed on the original ticket are of course subsequently made, which adds to the volume of work and complexities.

The important conclusion to be drawn from our war experience to date—and it is borne out by our experience over the years—is that the greatest plant capacity can be obtained during the busy hours of the day only when the traffic is moving with reasonable dispatch. Overloads in the plant add to the complexities of operating and the net result is to reduce the business-day message-carrying capacity of circuits, switchboards, and operators.

In addition to the increased work resulting from higher volumes and changes in traffic characteristics, any special work the operator is called upon to do materially complicates the operating problem. This is particularly true in times like these when thousands of new operators are being added to the force. For example, it is possible to give emergency or war-urgent calls special handling; but should we undertake to give preferred handling to a large proportion of the calls, the complications might be such as to cripple the service generally.

DESPITE THE INCREASED TRAFFIC VOLUME and complexities and the shortage of facilities, there is a bright side to the picture none the less: some truly notable achievements in the face of those major difficulties.

Accuracy, and speed of answer to recording trunk signals, have suffered relatively little. Operators are courteous, as always, anxious to do everything they can to put the calls through.

By these yardsticks, the service holds up well.

Criticisms are fewer than ever before—a gratifying reflection of the public's sympathetic understanding that everything within the Bell System's power is being done to give the best possible service under today's conditions.

Long distance operators, and their sister operators at switchboards of all types, are imbued with a spirit which reflects a full realization of the important part they play in winning the war. "Voices of victory" are theirs as their working phrases go out over the wires to points nearby and to places across the country.

TRAFFIC CONTROL BUREAUS such as this insure the full and efficient use of long distance circuits. Pictured is one of several which have been installed since Pearl Harbor, supplementing those then operating

There have been large additions to the operating force: 150,000 in the past two years, to handle the increased traffic load and to replace losses. But the seasoned operators have stood by and coöperated with the newcomers, and together they have faced the challenge to the service—and have risen to it.

True to the finest traditions of the service, they are giving their best to a difficult job—and giving it willingly and cheerfully. "Soldiers of the switchboard" they have long been called. Never has that phrase had more nearly literal application than today.

This has been a discussion of traffic

problems. But the Bell System is a team—a team of more than 400,000 men and women. Whatever the positions they play in this grim game of winning the war, they play them together, and together they will contribute to the victory. Of incalculable importance to the country now is it that this nationwide telephone service shall be at all times dependable. These men and women are doing and will keep on doing their utmost to maintain it so, and thus to keep faith with their fellow workers —now nearly 50,000—in the armed forces.

In normal times, with a substantial volume of material always in process of manufacture and installation, it is possible to obtain quickly from existing stocks most of the materials and equipment needed to restore telephone service, even when large amounts of plant are destroyed by disasters such as fires, floods and hurricanes. The situation in this respect has been greatly changed by the war. Not only have the chances of service interruption been increased by the possibility of sabotage and enemy action, but the quantity of finished products available which could be diverted to restore service has been greatly reduced by the sharp drop in telephone construction and manufacturing activity. It seemed prudent in the national interest to set aside a reasonable amount of the necessary materials and equipment for emergency restoration of service in the event of an emergency and to hold these materials and equipment at strategic locations where they would be readily available to any operating telephone company.

Approval of this plan was obtained from the War Production Board and the materials and equipment are now being acquired and warehoused at strategic locations. To as large an extent as possible, used materials and equipment already on hand are being employed, thus reducing to a minimum the requirements for new strategic materials and manufacturing effort. The investment in this war emergency stock, which may amount to four million dollars, will be carried by the Company.

From the A. T. & T. Annual Report for 1942.

Bell System Service Engineers Speed the War Effort by Adding to the Efficiency of Production Lines, Conserving Equipment, and Aiding in Plant Protection

Telephone Service for War Industries

S. William Lidman

THIS IS A STORY about the battle of production—about the industries which produce our bombers and tanks and ships and munitions. It tells of a three-fold contribution to winning that battle made by telephone people in the commercial department servicing groups.

There is, first, a contribution to the production efficiency of the war plants, and hence to the volume of war production, which comes from the more effective use of communication in manufacturing. There is, next, a contribution to the conservation of critical war materials. Finally, there is a contribution to the protection of the people and plants of the war industries in the event of enemy action, through improvement in the communications needed in their own air raid and sabotage protection plans.

To understand how these contributions come about, it is necessary to look into some of the war industries and see something of what has been involved in beating our plowshares into swords—in converting our industrial economy to war purposes.

The broad outlines are familiar. Automobile plants now make airplane parts; home appliance plants, machine guns; adding machine factories, bomb sights. Where was one day a corn field is, figuratively speaking, the next day a vast war plant turning out quantities of tanks or aircraft or artillery or shells. Overnight, it seems, a great machine tool plant doubles its output. Small manufacturers by the thousands—the subcontractors—furnish parts which the larger industries assemble into the engines and implements of war. The war demands mass production; mass production methods heed and feed its clamor.

What is required in the way of planning and engineering, when you start with a marsh and end up with a shipyard, or with a farm and end up with a powder plant, when you transform a furniture factory into one making gliders, taxes the imagination. Production objectives must be set, manufacturing processes envisioned, buildings designed. Machinery and other facilities for production and assembly must be engineered. Provision must be made for railroad tracks, loading platforms, cranes and conveyors. There must be facilities for power, steam, gas and telephone service—hundreds of telephones, perhaps, and the quantities of trunks and switching equipments needed to serve them.

A plant grows; the war effort cries for more and still more. New buildings are erected, thousands of people hired. Use of the trunks and instruments and switchboard grows likewise. Telephone service has to be engineered and re-engineered, addition after addition made in the capacity of the customer's telephone system, to keep up with the demand. Or a plant's production experts figure out a way to get greater output through some rearrangement of manufacturing facilities. Space must be re-engineered, cranes perhaps extended, changes made in lighting and power—and, nearly always, telephone service.

Servicing Work is Communications Engineering

THE WORK of assisting customers in the design of an establishment's telephone communications—increasing, decreasing, and changing them so that they will stay attuned to the organization's layout and production methods—is called servicing work, and in the Bell System is primarily the responsibility of a group of Associated Company commercial people usually called servicing representatives or service engineers. An outsider might call them communications efficiency experts. When a department is to be relocated or enlarged, or a new shop is to be erected, these are the men on whom customers depend for communications advice. Likewise, when a customer's switchboard appears overloaded, when trunk lines to the central office appear inadequate for the traffic handled over them, or when a hundred and one varieties of service problems arise, these are the men called on for assistance. In some firms, growth is so rapid or changes so frequent that servicing representatives have to be assigned to them on a full-time basis.

THIS IS NOT to say that customers get this type of assistance only when they ask for it. On the contrary, a large and equally important part of this work consists of making periodic reviews of customers' telephone communications on the telephone company's initiative. For the duration, these reviews are devoted mainly to those operations most directly concerned with war production, but within these broad limits they are thoroughgoing in scope. The representative deals not only with technical telephone matters, to eliminate traffic bottlenecks which might impede production, but also with the establishment's production processes, in order to coördinate telephone service

with them. He talks with executives, department heads, foremen, and sometimes with the workmen themselves—about their work, the part played by communication in it, and their communication problems.

The representative does not, however, do all of this work alone. In his study of production methods, he works jointly with the customer's own staff people. In many technical telephone matters he must, in turn, seek the collaboration of other parts of the telephone company organization. In matters pertaining to PBX operation, for example, he would seek the advice of traffic department operating people; in acoustical matters regarding signals and loudspeakers, the counsel of the engineers; in determining requirements for trunks and switching equipment, the assistance of the specialists on these subjects. Thus, the servicing representative coordinates for the benefit of the customer the service experience of the telephone company as a whole.

ON THIS PRODUCTION CONTROL BOARD, in a factory making parts for other war plants, is posted the status of each order in process. Telephone communication between foremen and the supervisor shown here, as suggested by a telephone company servicing representative, keeps the status report of each job up to the minute, enables the factory to notify customers of expected delivery dates, and supplants a lot of foot-work by factory expediters

The Need for Servicing Work

TO UNDERSTAND THE NEED for this work, it is necessary to put oneself for a moment in the customer's place. True, he subscribes for the trunks, telephones, and switching devices

which his people use or operate. But he has to decide how much service is needed, what it is to be used for, and how it is to be used so that it may contribute fully to the establishment's work. Users have to be trained, equipment properly engineered to the traffic, the system administered economically.

Obviously, many of these matters are technical and their handling requires training and experience which customers themselves rarely possess. They need the advice of telephone specialists which, generally speaking, only the telephone company is equipped to give. The company has therefore long assumed the function, through its servicing forces, of furnishing this advice as a regular part of its service to business customers.

GREAT AS WAS the value of this work for other businesses in other times, the need for it now by the war industries is many times greater. So many of them, and so much pertaining to them, are new.

Industry itself is, in general, new to war production. Many production processes are new. Vast numbers of people in the war industries are so employed for the first time. Finally, certain functions in industry are new; and several of these, including air raid and sabotage protection, depend a great deal for their effectiveness on good communication.

These "newnesses" have had a dual effect on the need for telephone servicing work. For one thing, little has been known about the most effective uses of communication in connection with these new industries and industrial processes. For another, production executives have generally not had the time to devote to studying how telephone service can be most effectively used in the new operations of their plants. At the same time, the situation places a high premium on the nucleus of people equipped to train and direct the inexperienced, and their need for time-saving communication is therefore great. As a consequence, to a large extent the telephone service of the nation's war plants—the task of making it right and keeping it right—has devolved upon the telephone companies' servicing forces.

The Contribution to War Production

THIS BRINGS US directly to the first of the contributions being made by the servicing forces to the war effort: the contribution to the volume of war production. It is a particularly fascinating field in communication engineering. It deals not so much with technical telephone matters as with production processes and the application of telephone service to them—with telephone service as a production tool.

This phase of servicing work is based on a very simple principle: that telephone service, being practically instantaneous, is essentially a device for saving time. It is this time-saving, multiplied by all the opportunities for it in the customer's operations, which represents the efficiency gained and reflects itself in production volume. Take any plant, find some way of saving the time of its men and machines, and obviously you enable them to produce faster and, therefore, more.

There is some danger in making it look as simple as this because it

prompts the questions: Can't war production people see this for themselves? Is servicing assistance really necessary? The principle seems so self-evident.

The answer is that of course industrial people recognize that more variations in the completed car—body style, wheels, color, upholstery, accessories—were accurately handled on the same high-volume assembly line. But the engineering of a procedure such as this takes study (and consequently time) which production

HERE is one of several centralized files in an airplane plant, made feasible by telephone communication, which facilitate access to manufacturing records while also permitting a more efficient use of telephone lines. The arrangement resulted from a study by servicing representatives and the plant's production staff

effective communication in their operations will improve production efficiency. Some of them, in fact, have an extraordinary understanding of this, as witness the use of our services in former days for coördinating assembly in automobile plants, whereby more than a thousand possible people are now in no position to undertake. Nor are they, by and large, sufficiently experienced in telephony to conduct such study without technical assistance. Could even the technically trained production man be expected to know, for instance, that badly needed telephone service in the

explosive atmosphere of a paint-spraying room can be provided by means of an instrument designed for just such locations?

So it is not surprising that when a servicing representative approaches the management of a war industry and offers to make a review of its telephone communications, he is welcomed with open arms. Before going any further into the theory and technique of this work, let us illustrate some of it.

Some Examples of Improved Production Efficiency

THERE WAS THE CASE, for example, of the maintenance superintendent of a large machine tool plant. Now maintenance—the repair service—in a factory is a tremendously important function, for the break-down of a machine not only stops production on that piece of apparatus but may also disrupt other work which depends upon that production.

In this plant, when a break-down occurred, the procedure was to call this superintendent by telephone. However, since he was practically always busy supervising some repair job and might be any place within the vast area of the plant, he had to be located by means of the code signaling system. It made no difference whether the matter was imperative, such as the repair of a production machine, or relatively inconsequential; regardless of what he was already doing and where he was, he had to interrupt his work to answer his code.

To improve this situation, the servicing representative worked out a simple scheme with the customer. A central point was specified at which all maintenance calls would be taken, and at frequent intervals the superintendent called this point to get the messages left for him. Thereafter, interruptions to his work occurred only in emergencies. Not only were many minutes of his own time saved daily; the production of the entire plant benefited from his more efficient handling of the maintenance function.

OR TAKE THE MATTER of conferences. In war plants, because of their newness and the inexperience of so many of their supervisory people, the need for conferences is particularly great. True, many of them require that the conferees be present in person. Others, however, could just as well be conducted by telephone, and there is equipment available—frequently it is already installed in the customer's PBX—for this purpose. Many a supervisory man-hour formerly wasted in walking to and from an executive's office has been saved by the suggestion of a servicing representative that telephone conferences be employed when they will suffice.

Not only do these time-savings apply to supervisory and management people; the rank and file of workmen can be benefited also. This may be illustrated by the case of the highly skilled machine operators who, when they received each new job, had to walk several hundred feet to a stairway and up to a mezzanine storeroom to obtain the cutting tools and fittings needed, and back to their machines before they could begin the new work. While on this journey they were unproductive and their machines stood idle. It was a servicing representative who suggested the

more efficient procedure—which was adopted—of requisitioning the needed apparatus by telephone and having it delivered by messenger.

Communication Is Vital in Mass Production

THE BASIC PRINCIPLE of mass production is, of course, that work is so subdivided that particular individuals and machines perform comparatively few operations and, as a result, are able to perform them well and at high speed. One example of this would be in the machining of a part. One man (or group) performs a cutting operation, another a drilling operation, still another a bending operation; or there might be many such operations, each handled by a different group on different machines, each machine being set to perform one or a very few operations. Another example would be in assembling the product. Certain groups of people put together a few parts into so-called sub-assemblies. These, in turn, are joined together by other groups to form still larger sub-assemblies or "sections," and there are often many such stages before the various sections reach the final assembly line.

Thus, the operations of such a plant are closely interdependent. Sub-assemblies cannot be put together unless all of the parts are available, sections cannot be constructed unless all of the sub-assemblies are available, final assembly cannot take place unless all of the sections are available. The supervision of this flow of items so that they will be on hand when and where and in the quantities needed requires a great deal of communication—in which the telephone plays a large part.

The people whose job it is to supervise this flow in a plant of this type are called expediters, and our next example of a servicing contribution deals with them. The case in point occurred in a tractor plant, where the long assembly line was "fed" by parts and sub-assemblies such as castings from the foundry, gears from the machine shop, controls from the electrical shop, and bolts, bearings, etc. (which were bought) from the receiving room.

There were twenty expediters. When shortages in the various parts bins appeared imminent, they would go in person to the location which made or stocked the item needed. Considerable distances were involved; the receiving room, for example, was a mile from the assembly line. At the distant point, their task was to talk with the foreman and investigate the delay, but it was the latter who arranged to have the necessary supplies trucked to the proper location.

There was no telephone service either on the assembly line or in several of the parts-making shops. The representative's suggestion that little-used telephones elsewhere be moved to these points, and that they be used whenever practical in this "stock-chasing" instead of the foot-work communication method, was acted upon. As a result, so much of the expediters' time was saved that their number was considerably reduced. The men thus eliminated were given more productive supervisory work.

But the receipt of materials *into* the plant is of even greater importance, if anything, than their flow within it. Without them—without the raw stock and operating supplies,

the parts and sub-assemblies made by subcontractors—production could not go on. "The lack of a ten-cent gadget . . . can hold up our whole production schedule" is the way the head of a great bomber plant dramatized it. In expediting this flow, communication is indispensable and, naturally, the functions of following up suppliers and transportation companies to expedite incoming shipments constitute an important part of the servicing review.

Servicing Aids Many Operations

MANY OPERATIONS or functions in the war industries are so important to production and involve communication to such an extent as to warrant servicing attention. To those already mentioned should be added the dispatching of internal transportation, such as the plant's own trucks, railroad, etc. (dispatching is communication); learning the status of orders (getting information involves communication); locating plant supervisory people (which may involve the plant's loudspeaker or code call system); the plant's personnel department (the hiring and placement of new people requires much communication); and, not least, the work of the plant's foremen.

The last deserves a word of explanation. Because of the "newnesses" outlined earlier, skilled supervisors and staff people—foremen in particular—are spoken of by production executives as "the plant's most precious commodity." It is therefore imperative, they say, that a maximum of the time of such people be devoted to the supervisory, training, or planning aspects of their work. They say, moreover, that anything, such as the telephone, which conserves their time will contribute to the smoother flow of materials through the plant, the elimination of bottlenecks and spoilage (important in conserving materials), and thus to the speed of production.

Intentional emphasis was given to the communications involved in certain factory operations because many of these communications are so commonplace that they are scarcely recognized as being communications at all —that, for instance, a foreman *communicates* when he reports the need for maintenance, a workman *communicates* when he requisitions a tool. However, much of the servicing contribution to production efficiency hinges on the representative's recognition of this fact. Its significance is that since communication of one type or another—personal visit, telephone, mail or messenger service, pneumatic tube, etc.—plays such an important part in these operations, the communication media used for them must likewise be important. The greatest efficiency naturally comes from using each medium for doing those things for which it is best fitted.

THE servicing representative's approach to an industry's operations must therefore be functional rather than technical. The questions before him, with respect to any operation, are: How is it carried on? What communication is needed in connection with it? What communication methods are used at the present time? Is the telephone carrying that part of the total, and only that part, for which it is better qualified than other methods? He rea-

sons, "This firm repairs ships; is the telephone contributing all that it should to this work? or, "This department machines the castings; how can better communication help with that operation?" Likewise, for an individual employee his starting-point is, "This production-control clerk records the status of the factory's job-orders; how can more effective telephone usage help his work?"

In other words, the representative has to view telephone service, not as a telephone man ordinarily views it, but as a production man does. These viewpoints are not necessarily the same. We in the telephone business usually think of good service in terms of speed, accuracy of switching and good "overtones," of adequate stations, signals and switchboards; furnishing good service in this sense is an end in itself.

The production man, however, regards telephone service from the same viewpoint that he appraises the value of a piece of machinery or a manufacturing method; namely, in terms of what it contributes to production output. To him, good service as we telephone people view it, while important, is only a means to an end, that end being the efficiency of his own operations. To him, telephone service is a production tool—and a vital one.

THE INTERVIEWERS' TELEPHONES in the employment office of this aircraft factory are invaluable in fitting applicants into the right jobs. Often several calls throughout the plant may be required to place a person with unusual qualifications

Conservation—It Pervades All Servicing Work

BY NO MEANS SECONDARY in importance among the servicing contributions is the conservation of materials. It is, in fact, the most universal of them, pervading everything that the representative does.

To place this contribution in its proper perspective, it should be pointed out that there are really two sides to this conservation matter: what might be called a "supply" side and a "demand" side. When, by means of many ingenious devices—substitution of the less critical materials for the more critical, re-use, postponement of equipment replacements, and others—the Bell System's engineers find ways of getting along with a small fraction of the rubber, aluminum, and other materials formerly required, these would exemplify contributions to the "supply" side. When, on the other hand, a customer asks for an additional switchboard position because he believes his traffic requires it, and he is shown how, through a more efficient use of his existing service, his business can be as well served without it, this would be a contribution to the "demand" side.

This latter is the type of conservation contribution which the telephone servicing forces are making in many thousands of contacts yearly with military, government, industrial and other establishments. The field for it runs practically the entire gamut of the services—exchange, message toll, and intercity private line service.

So far as customers' use of exchange facilities is concerned, it is almost a truism with the servicing forces that service problems often result from conditions which either do not involve telephone equipment or that, when they do, the situation can be cared for by some minor addition or rearrangement. A customer's request for an additional switchboard position has been mentioned. What, to continue with this illustration, are some of the circumstances which might make this extra position unnecessary?

One of them, it is being found, is the extraneous or unnecessary work being done by some PBX attendants. A common example is the attendant who not only operates the switchboard but also acts as receptionist or file clerk or stenographer or perhaps all combined. When her work becomes too burdensome, her management is as likely as not, experience shows, to interpret it as a requirement for another switchboard position. But actually, the overload is on the attendant rather than the switchboard. The servicing remedy, obviously, is to relieve her of these extra duties and have her devote herself to switchboard operation.

FREQUENTLY, IT IS the PBX station users—even the rank and file of the firm's employees—who create unnecessary work at the switchboard. Consider, for example, the way so many of them place calls with the PBX attendant—saying some such thing as "Get me so-and-so" and then hanging up. Instead, therefore, of the simple operation of plugging into a trunk so that the caller himself can make the call, the attendant may have to look up the number, dial or pass the call to the central office, wait until

the called party is reached, and then ring back the caller. It is easy to visualize how much more operating time this requires. Multiply it by dozens and perhaps hundreds of calls a day, and you begin to get some idea of how easily a customer can believe that he needs more switchboard when in reality he does not.

of the day when there are relatively few incoming calls. This is far from a universal solution, however; the servicing representative would obviously not advise this when the postponement of making calls would in any way interfere with the organization's efficiency and thereby impede the war effort.

To THIS CONTROL CENTER of a war plant's air raid protection set-up, wardens and fire watchers would telephone reports of damage, and from it rescue and repair activities would be administered—also largely by telephone. A telephone company servicing representative assisted in planning the communication arrangements

While on the subject of switchboards, it seems desirable to add another illustration: that of the board which is really overloaded but during relatively short so-called peak periods. Here the remedy is sometimes simply to get the organization to spread the calling load, such as by making outgoing calls during times

Conservation Principles Applied to Trunks

CONSIDERABLE SPACE has been devoted to private branch switchboards because, after all, a position of switchboard is a relatively large piece of telephone apparatus and may require the use of some hundreds of pounds

of critical materials. But the same principles apply to trunks and instruments and signaling and other equipments. Let us take just one of these —trunks—as an additional illustration of servicing advice.

Now what are some of the things which create an artificial requirement for trunks? One of them is delays during the conversations caused, say, by having to consult records or files located at a distance; and the servicing recommendation here might be the Mohammed-and-the-mountain device of moving the files to the employees or vice versa. Still another is slow answers. Among other things this is often the result of inadequate telephone signals such as in noisy locations where the telephone bell cannot be heard. Here the solution is to improve the signal rather than provide more trunks. Delays in answering because the people called are away from their desks are also fairly frequent, and here again the correct solution does not lie with the trunks but rather in facilitating the pick-up of calls for the absentees; the servicing man's remedy might be supervision and educational work.

In all these conservation cases, the representative's technique is simply this: In connection with each service problem encountered, whether it comes to notice from a customer's equipment request or he uncovers it himself during his review, he explores the underlying cause and recommends the solution indicated by that cause. He is never satisfied with surface indications.

Toll Conservation Efforts

OPPORTUNITIES TO CONSERVE message toll facilities, jointly in many places with PBX traffic forces, are many.

A striking conservation achievement has been the substantial reduction in the number of customers' requests for what is called "time and charges." This term refers to the practice of asking the telephone company operator to inform the caller of the length of the conversation and cost at the end of each call made. It developed during this work that while some firms apparently needed this information to enable them to allocate telephone expense among different departments or different government contracts, other methods of furnishing it would suffice.

Also, much effort has been devoted to reducing the amount of so-called "directory work" in the toll offices—that is, looking up numbers in distant cities—by encouraging people to place intercity calls by number rather than by name and address. For example, PBX attendants have been assisted in maintaining lists of the telephone numbers frequently called in distant cities, and individual toll users have also been encouraged to keep such lists for their own use.

Effort has likewise been directed toward another toll conservation measure: converting calls unnecessarily placed on a person-to-person basis to station-to-station. This is not an easy matter—it is really a long-term educational process—primarily because there is no general rule for determining the choice between these classes of calls. The decision must be made by the caller. The issue is, simply, that if the particular individual wanted is likely to be on hand anyhow, or if someone else can handle the matter, the extra cost of a per-

son-to-person call, and the extra operating and circuit time which these calls require, have both been unnecessary.*

Conserving Private Line Facilities

MANY FIRMS subscribe for private lines to their branches or to other firms with which they do business in other cities. One of their advantages is that they enable the subscriber to communicate with the distant establishment without going through the usual message channels.

However, increasing loads on the regular intercity message toll lines make it highly desirable to conserve these private lines. The point is that securing the release of an existing private line for use in a message circuit group, or withholding one from a customer who asks for it, may in some cases provide greater call-carrying capacity than when set aside exclusively for the use of an individual customer.

The servicing forces are finding that while the war has increased the private line requirements of some establishments, notably military and government, it has diminished or changed them in others. The servicing task is, of course, to recommend the type of service best suited to current requirements and conditions.

Protecting Life and Property

THE CONTRIBUTION to the protection of life and property arises, as was indicated at the outset, from the servicing of customers' own air raid and sabotage protection plans. To the extent that the representative's effort implements these plans, and helps to defend a plant's precious human skill and machinery from injury, he at the same time makes a potential contribution to war production.

Many war industries—and other establishments as well—are making special provisions for handling such emergencies, paralleling those made by the municipalities for public protection. As in the case of the municipalities, the firms' regular protective forces, such as their own police, fire, and medical departments, have been augmented by employee volunteer groups, including warden organizations and rescue, first aid, fire fighting and repair crews. Control Centers or Report Centers have been provided for administering their protective and rescue measures. Furthermore, telephone communication plays much the same role in the protective arrangements of a business establishment as it does in the civilian defense arrangements of a community.*

THE PUBLIC air raid warning itself is generally an adequate communication. However, many manufacturing plants are so noisy that they cannot rely exclusively on it for "alerting" all of their employees. Some special arrangements must often be made for this purpose, using either a special alarm system or preferably, when available, the firm's existing signaling system for summoning people to the telephone. In addition, some firms which require extra time

* See "The Impact of War on Long Distance Service," p. 81.

* See "The Rôle of the Telephone in the Civilian Defense Organization," MAGAZINE, June, 1942.

for their precautionary measures receive preliminary and confidential warnings by telephone. Checking the adequacy of the plant's warning arrangements is one of the representative's more important functions during the review of this subject.

Some establishments, so as not to interrupt production until the raid is actually imminent, muster wardens and other key employees in the protective organization by telephone in advance of the general alarm for the entire employee body. The facilities and arrangements whereby this is done are likewise reviewed by the servicing representative.

Handling "Incidents"

ASSUMING THAT there has been a raid and that fires, casualties, and other "incidents" have occurred, two things are necessary. First, as in the case of the municipalities, these incidents must be telephoned to the Control Center by the wardens or by fire watchers stationed on the roofs of the plant's buildings. While it is sometimes necessary to provide telephones for reporting purposes, this is avoided wherever possible for conservation reasons. The representative suggests that existing telephone locations be selected for wardens' posts, and in some plants, roof watchers work in pairs—one going to the nearest telephone to report the incident, the other remaining behind to handle it. Second, the Control Center must dispatch the rescue forces to the points where they are needed, and this is also generally done by telephone. Here again the use of existing service wherever possible is urged.

Many of the arrangements made for handling reports of damage from air raids are also applicable in the event of damage from sabotage. Sabotage protection, however, sometimes requires special arrangements. Among these may be provisions for fast and uninterrupted communication with the plant's police force, and physical measures to protect the PBX against saboteurs as well as against bombing. While, for obvious reasons, it is not for the telephone company representative to recommend the precise physical measures which a customer should employ—reinforcing walls and roof, for example—he nevertheless discusses the general desirability of such measures.

IT IS OBVIOUS that a war industry's central office service may be of prime importance in an emergency. As is generally known to telephone people, the telephone companies have taken many steps to assure the ability of certain establishments and people in the community to make and receive central office calls under such conditions. Among them are procedures for dealing with traffic congestion which might delay or block incoming and outgoing calls, and for emergency restorations in case of service interruption. It is beyond the scope of this article to detail these measures. It may be said, however, that servicing work is required in some instances to make them effective, and that the servicing forces, because of their familiarity with customers' operations, are in an exceptional position to advise telephone company management as to the action along these lines which might be desirable for certain establishments.

Finally—One of the representative's more important services to the

customer consists of urging him to test his protection plan and its communications by means of fairly frequent rehearsals, as a device for detecting and remedying flaws.

THIS BUSINESS of servicing the telephone communications of business customers is not a new activity. It is, indeed, an old one—but now with a new and greater importance. What *could,* in our times, be more vital than helping shipyards produce more warships and cargo vessels, aircraft factories more fighters and bombers, tank plants more tanks? More essential than conserving scarce materials by making certain that their use for telephone service is made to the best advantage? More necessary than helping to protect the nation's production lines against enemy action?

The full scope of servicing work is not widely known, it is true. But its accomplishments are already such as to rank it among the more important of the System's many and constant contributions to the winning of the war.

CONTRASTS IN HORSEPOWER of half a century. New York's Broadway "street railroad" was changed from horse cars to cable cars 50 years ago this spring. The cable was pulled into the slotted tube in the street by the "thirty-six splendid horses" pictured at the left, according to the *Scientific American* of April 22, 1893. Contrasting with this scene is one of the cable-laying trains, with a combined 400 horsepower, which plowed the transcontinental telephone cable into the ground.

Industrial and College Research Organizations Contribute to Winning the War in an Unprecedented Coördination of the Nation's Scientific Resources

American Science Mobilizes for Victory

Robert W. King

Foreword

THERE ARE no accomplishments of the Bell System in which its men and women take greater pride than those marking the continuous activities of the Bell Telephone Laboratories in developing and applying the art of communication.

These accomplishments, reflected for decades in improved instrumentalities and systems for the transmission of electrical signals and speech, have been possible because vast resources of scientific knowledge have been devoted, as part of the System's general responsibility to the public, to a broad and fundamental program of exploration, experiment, and design.

To-day the more than 6,000 members of these laboratories, working long hours, are engaged on hundreds of development projects, requiring research, invention, and design, for the Army, the Navy, and the National Defense Research Committee.

That this should be both logical and inevitable will not surprise anyone who considers the vital part played by communications in modern warfare. Rapid movement of troops and supplies over far flung lines of action on land and sea and in the air are possible only when directed through effective communication systems. More and more the electrical transmission of intelligence is becoming the unifying influence pervading all branches of war organizations. It coördinates the movement of naval and aerial fleets; it enables infantry, tank columns and formations of aircraft to operate as a single unit. It shrinks a thousand-mile battle line to the compass of a single sector.

Because communication research is a fundamental interest to all engaged in rendering telephone service, we reprint below a description of the

nation-wide mobilization of science, including this research, that distinguishes and stimulates the war effort of America.

This description consists of excerpts from an address on February 1, 1943, before the New York Electrical Society, by Dr. Robert W. King, Assistant Vice President of the American Telephone and Telegraph Company. Dr. King's references to the National Academy of Sciences and the National Defense Research Committee will be of especial significance to readers of this MAGAZINE who remember that Dr. Frank B. Jewett, Chairman of the Bell Telephone Laboratories, is both President of the Academy and a member of the Committee since its establishment. THE EDITORS

IN THE UNITED STATES there are two main channels by which important military problems can be carried to civilian science.

On the one hand, Army and Navy agencies have properly gone directly to research and development groups and have chartered their services. The major portion of the war work which is in progress at many of the large industrial laboratories has come by way of this direct route.

On the other hand, to relieve the Services of part of the load of directing war research, to instil a fresh and untrammeled point of view, and also to assist in the distribution of projects to groups most competent to handle them, there now exist two principal civilian agencies to cope with the special problems which arise at a time like the present.

Of these authorities constituted to give scientific aid to government in the United States, the earliest to appear upon the scene was the National Academy of Sciences. Incorporated in 1863 by an Act of Congress, it was designated in the wording of the Act that the Academy shall, whenever called upon by any department of the government, investigate, examine, experiment and report upon any subject of science or art.

A continuing partnership was thus set up to be called upon alike in times of war and of peace. The responsibility of initiating intercourse lies, however, with the federal government; it was not contemplated that the Academy would offer unsolicited advice. Hence, it is an arrangement which, from time to time, must present significant limitations, more particularly as the body of scientific knowledge becomes larger and more involved, and the sensing of possible important applications, military or otherwise, not alone the making of these applications, becomes a matter for the expert in science.

Over twenty-five years ago, at the advent of the first World War, the National Research Council was created by President Wilson as a subsidiary organization to the Academy and, by virtue of its divisional organization and its more informal mode of procedure, possesses a flexibility and adaptability which could not readily be imparted to the latter.

An Early Origin

IN PASSING, it is perhaps of interest to note that the relationship between the federal government and the National Academy appears to have been patterned after that which, since the 1600s, has existed between the

British Government and the Royal Society of Great Britain.

In this connection, it may not take us too far afield to recall a famous, though long since past, instance of the tendency of political groups to regard the laws of nature as of no greater authority than those which they, themselves, write. I quote this instance from a brief history of the Royal Society by Professor L. J. Henderson, published in *Science* for January 10, 1941:

"One early question gave rise to a famous controversy concerning lightning rods, and in the year 1777 the affair degenerated into a political quarrel. Pointed lightning rods were the invention of Franklin, who had become a rebel. Benjamin Wilson, an Englishman, advocated blunted conductors, and the partisans of pointed conductors were regarded as friends and supporters of the Americans. The affair seems to have resulted finally in the resignation of the President of the Royal Society, Sir John Pringle, who had said to the King in supporting pointed rods: 'I cannot reverse the laws and operations of nature.' There is a story, not well founded, but widely believed, that the King replied: 'Then, Sir John, perhaps you had better resign.' At all events, Pringle did resign."

THIS BIT of history serves to remind us, not only that there was a time when the so-called "exact" sciences were sufficiently untried in their application to everyday life to make it politically expedient to ignore their conclusions, but, what is even more important in our present discussion, that there is such a thing as intrenched opinion which either willfully ignores new facts or, because of excessive familiarity with old facts, has become blind to the implications of the new. Moreover, we all recognize that one of the frailties of human beings is their tendency to guard a position once they have taken it.

Particularly can this be true in such a field as that of military tactics, where of necessity the more important ideas, plans, and developments must be held in close secrecy, so that effective criticism, both friendly and hostile, is largely ruled out. In such a situation only a group of superbeings established in the seats of the Chiefs of Staff could either be sure in their own minds, or could hope to preserve the confidence of the public, in respect to the freshness of their approach to the solution of matters of such huge national moment as those which a major war places upon the shoulders of a nation's military leaders.

Science and Engineering Are This Country's Best Protection

IN REGARD to the present war, the public recognizes that, above all its predecessors, it is a scientific contest. They know that science and engineering in the hands of the enemy constitute the greatest weapon being used against us. In this sense, it is not a secret weapon which Hitler hopes to wield. The public also knows that science and engineering in our own hands, and rightly and fully used, constitute the best protection to our democratic way of life. Nothing short, therefore, of such organizational machinery as will result in commingling the best of American science and engineering with the best American military brains and skill can be

expected to have any chance of holding the confidence of the public.

So far have we journeyed since the days of the lightning rod episode that now, once science has spoken unequivocally, the politician and the man in the street, equally with the scientist, are alert to the significance of its voice and anxious that it be interpreted for him by those who are most competent. And of the military expert it may be said that now, more than ever before, is he eager to catch every word. He, too, is anxious that at a critical time like the present the best of civilian science be made readily available to him.

THIS BRINGS US to the second of the civilian agencies and to the special organizational creations of World War II. I have already pointed out the limitation under which the National Academy of Sciences and its subsidiary, the National Research Council, function: namely, that they can only undertake government (or public) work when asked to; they cannot initiate projects, nor have they available a reserve of public funds upon which to draw.

By the spring of 1940, and therefore preceding Pearl Harbor by nearly two years, the need of strengthening the national set-up in this respect emerged to view. By that time events had progressed far enough to show that the chances of the United States getting into the war were alarmingly large. The Army and Navy were beginning to call for aid from individual scientists and from certain scientific institutions. This resulted in a scientific tide toward Washington and certain other centers, which, had it not been checked, would have crowded countless thousands of scientists into strange environments and up-rooted them from their equipment and their colleagues, with the result that they would have become quite impotent to shoulder the load about to be placed upon them.

So it was that, by the early spring of 1940, a certain small group of well-known scientists determined to try to rectify this unplanned approach to the mobilization of science, threatening as it seemed such dire consequences to the country.* The solution seemed to be some new organization which could play an independent part in focusing the scientific personnel and resources of the nation upon its rapidly augmenting military problems.

The NACA Prototype

A PROTOTYPE for the new organization already existed, a prototype which had been created as far back as 1915 for the express purpose of establishing coöperative relations between military and civilian groups. This agency is the National Advisory Committee for Aeronautics, commonly known as the NACA. The law which created the Aeronautical Committee provides that it shall "supervise and direct scientific study of the problems of flight, with a view to their practical solution," and also "direct and conduct research and experi-

* Among the members of this group were Dr. F. B. Jewett, Chairman, Bell Telephone Laboratories, Inc., and President of the National Academy of Sciences; Dr. Vannevar Bush, now Director of the Office of Scientific Research and Development; President J. B. Conant of Harvard University, now Chairman of National Defense Research Committee; and President K. T. Compton of Massachusetts Institute of Technology, now one of the members of NDRC.

ment in aeronautics." It is regularly granted public funds by Congress to create and operate research facilities. The Committee is composed of fifteen members, including two representatives each of the War and Navy Departments. Throughout its more than twenty-five years of existence, the NACA has given ample testimony of how fruitful coöperation between civilian and military personnel can be as a means of meeting the requirements of the latter.

Birth of the NDRC

When, some three years ago, the small initiating group of scientists to whom I have referred became convinced that broad participation by civilian science in the whole military program was likely to be essential, and they envisaged the NACA as typifying the sort of organization they thought ought to be created, a somewhat duplicative plan was submitted to President Roosevelt for such action as he saw fit to take. The proposal appealed to him and he decided to carry it into effect by executive order. This order conferred power upon the Committee to take the initiative in many scientific matters which it believes to have military significance. It directed the Committee to develop coördinated plans for the conduct of scientific research in the war program in collaboration with the War and Navy Departments. Moreover, and this is especially important, the order directed the committee to initiate and support scientific research on the mechanisms and devices of warfare with the object of improving present ones and creating new ones.

Thus, in June, 1940, the National Defense Research Committee, more familiarly known as the NDRC, was born. It was composed of eight members, two of these high-ranking men from the Army and the Navy, five civilians well known for their experience in organizing and directing both fundamental and applied scientific research, and an eighth member, the Commissioner of Patents.*

The executive order creating the NDRC omitted any reference to the biological sciences, and, in particular, to medical science. This omission later called for attention and committees representing these latter groups of sciences now report on equal footing with the NDRC (which deals with the physical sciences) to a supervisory body, the Office of Scientific Research and Development, commonly abbreviated OSRD.

Few individuals indeed will question that the present organization marks a big advance over this country's previous attempts to focus science upon the problems of a military campaign. American science is now able to study the technique and problems of offense and defense at first hand, being no longer constrained to a largely advisory status. This, in itself, is beneficial since fresh eyes—and particularly the trained eyes of the scientist—frequently result in fresh diagnoses.

There is perhaps no briefer way of illustrating the expanding role of the OSRD as a mobilizing and imple-

* At present the representatives of the Services on the NDRC are Maj. Gen. C. C. Williams and Captain Lybrand P. Smith; the civilian members are J. B. Conant, Chairman; Roger Adams, K. T. Compton, F. B. Jewett and R. C. Tolman. Conway P. Coe is Commissioner of Patents.

menting organization than to state its successive budgets. During 1940–41, its first year of existence, the NDRC authorized research projects which totaled about $10,000,000. At the time, that seemed a large budget to all concerned. The OSRD, during its first year of existence (second year of NDRC) guided the expenditure of about $20,000,000 throughout the whole scientific field, biological as well as physical. But actual entry into the war brought a gigantic increment. The fiscal year 1942–43 (ending in June, 1943) will probably see the spending of about $100,000,000, while the budget for 1943–44, although still in an embryonic stage, promises to be even more impressive.

Modus Operandi

THE MANNER in which the expenditure of these funds is initiated and supervised can be sufficiently illustrated by reference to a single branch of the full organization, namely, the NDRC.

For supervisory purposes the scope of NDRC is divided into eighteen divisions, each under the direction of a "Chief." To expedite discussions, surveys, and the general handling of work, a further breakdown has been found desirable, the result being that each Division comprises a few so-called Sections. The work of a Section is entrusted to a Section Chief, who in turn calls to his aid certain individuals who become permanent members of his Sectional Committee and who are known technically as Members. Then there are others who may be asked to render advice and assistance from time to time and hence are called Consultants. Members and Consultants are officially appointed by the Director of the OSRD and are designated only after official clearance by the Federal Bureau of Investigation and the Army and Navy Intelligence Offices. Full consideration, therefore, is given to the basic requirements of the military services as regards the confidential handling of their problems.

None of the five civilian members of the NDRC is paid from public funds. A few of the Division Chiefs and Section Chiefs are; but none of the other Members nor the Consultants are. And, all in all, the fraction of the total budget which goes to salaries is less than three percent. The large remainder of personnel who are not paid are, without exception, loaned to the government by their employers. Frequently the loan is complete, the work being of such scope and urgency as to require a man's full time.

Thus, with about 1,000 of our leading scientists encompassed in the present NDRC organization and loaned to the country, it will be seen that the federal government—even the forgotten taxpayer—is receiving a donation from civilian agencies which it would be difficult to express adequately either in words or in figures behind a dollar sign.

AS JUST MENTIONED, only three percent or so of the budget represents payment to personnel. The large balance therefore goes to defray the cost of the scientific projects undertaken. For the most part Members and Consultants do not carry on the research and development projects which the NDRC decides to promote—their duties are advisory and administra-

tive. They formulate the problems which they believe it important to undertake, and then arrange with various scientific institutions to carry on the work.

The scheme naturally places the chief burden for performance of each contemplated task upon the contractor, and the success or failure of the OSRD plan as a whole will in large part depend upon the ability of its contractors to deliver. By serving in the rôle of such contractors, the well-organized and well-integrated laboratories of industrial science, and also of fundamental science, are rendering services to the nation which it would be impossible to assess merely in monetary terms.

For when an emergency impends, one cannot just bring physicists, chemists, mathematicians, and engineers, to say nothing of the other specialties, together within the compass of a single organization and expect them, at a word of command, to begin functioning as a sort of super-intellect. The full power of any such composite group can only be built up gradually through the accumulation of experience and with the knowledge, born of practice, as to how the units can best merge their individual efforts and the products of their individual brains. But, fortunately, so intimate are the relationships between the problems of peace-time science and those of war-time science that the knowledge, techniques, and skills of the former are almost immediately applicable to the latter. Hence, rather than create war-time agencies to handle war-time sciences, it is far more effective to carry the war problems to peace-time agencies.

In another respect also the availability of industrial laboratories as contractors to undertake military problems is proving to be a most valuable circumstance. This comes about as a natural result of the motive behind industrial research; these laboratories, and these alone of all the scientific institutions, have been schooled in certain methods which, in a crisis like the present, are invaluable. Their special skill may be described as the ability to find such expression for their scientific results that the ensuing problems of engineering development and design can be solved in a minimum of time. And like industrial research, the usual objective of inquiry in military research is some weapon or instrument or product which is wanted by the Services as soon as it can be proven workable or effective—and then is usually desired in large quantities.

From Laboratory to Production

THIS SUGGESTS that there is usually a considerable gap to be bridged between the completion of laboratory research and the initiation of factory production. In reality, the bridging of this gap, contrary to what is perhaps general supposition, proves to be a major undertaking in the launching of a new device or product into service.

It can be stated almost as a general rule that more time and effort have to be spent in preparing research laboratory models for production than are consumed in giving birth to these same models from the results of fundamental science. In fact, the latter interval is usually two to three times as long as the former, albeit every effort is made to mini-

mize it. Those who have had actual association with these problems of engineering design, in which the aim is to perfect an article capable of giving satisfactory performance in service, and yet being susceptible of rapid and large scale production, will need no reminder of what the availability of large industrial laboratories means at the present time to the nation's war program.

RETURNING AGAIN to the OSRD, the number of active projects which it has approved and contracted out to universities and industrial research laboratories now stands around 1,400, while the number of contracting institutions is over 400—about 100 colleges and 340 industrial establishments.* Another 600 contracts have already been completed. The contracts vary all the way from those involving a few thousand dollars to those calling for outlays of two or three hundred thousand dollars per month.

You will recall that only those military research projects which channel through the OSRD add up in this year's budget to about $100,000,000. As to the many other scientific projects being handled directly between the armed services and the research institutions of the country, it is impossible to estimate what they total. It seems a safe guess, however, that the war science budget of the nation is considerably larger than was any peace science budget. This conclusion is borne out by the quite general fact that among the large industrial laboratories, budgets are the biggest in history, and the major portion represents work which has been authorized through some war channel *other* than the OSRD. There can be no doubt, therefore, that American science is all-out to win the war.

*The Bell Telephone Laboratories exemplifies the industrial research organizations that were prepared, through size and experience, to accept large projects immediately. EDITORS.

The Country's Scientific Personnel

THE QUESTION is frequently asked as to how many research workers may still be considered as available for induction into the nation's war effort. According to a recent survey the answer is, *very few* indeed.

In round numbers, the scientific personnel of the country who are engaged in research amounts to about 100,000, perhaps one-quarter of whom are scattered among the universities and other institutions of advanced study, while three-quarters are to be found in the technical branches of modern industry. The survey reveals that of university research workers only some five percent are still available, which is the equivalent of about 700 full-time investigators. Among industrial laboratories in the fields of physics, chemistry, electrical and mechanical engineering, about seven percent of the personnel are still available. The survey also shows that 13 percent of the mathematicians and 17 percent of the biologists in the research field were at the date of the inquiry free for war assignments.

An earlier paragraph set forth the rôle of OSRD and its coöperating agencies as a sort of national insurance policy. Its fundamental obligation to the public and to the military services alike is to make certain, to the best of its ability, that in the field of science everything humanly possible is being done to expedite the na-

tion's war effort. In view of the responsibility which rests upon the shoulders of these agencies and the importance attaching to the work they are initiating and supervising, it is natural to raise the question as to how and where the various problems which comprise their program originate.

The record of some two years' operations shows that many are proposed directly by the fighting forces. Others come out of joint deliberations involving OSRD departments, and Army and Navy representatives. Still others are proposed by individuals, and some of these latter come by way of the Inventors' Council. A good many ideas have naturally bobbed up repeatedly, but in general it is not the most valuable suggestions which are oftenest proposed.

But there is always the question of priorities. In the nature of the case it is not possible to push all the many projects along with equal energy and speed. Some deserve the right of way over others. But in this regard the whole situation is fluid and not static. It may happen, for instance, that a project which initially carried an "A" priority drops to the "B" or "C" category, and is replaced by one from below. Such exchanges sometimes result from the shifting demands of the war but may equally well result from the manner in which certain projects, originally conceived of as unrelated, can reach a stage that promises particularly valuable results if they are brought together and coordinated.

ANOTHER QUESTION often asked concerns the steps by which the OSRD certifies a problem or project. What sort of gauntlet does it have to run before a decision is reached to spend public money on it? The answer is somewhat as follows.

Considering NDRC, just by way of illustration, the eight men who comprise it meet together at regular weekly intervals and have before them for review proposals which have come to the attention of the various Sectional Committees during the preceding week. At the Sectional Committee and Division discussions, representatives of the Army or Navy have a chance to consider each proposal and express their judgment as to its importance. It is a résumé of these preliminary surveys which reaches the weekly meetings of the NDRC, and here again, as you will recall, there are Army and Navy representatives.

Thus, the manner in which the proposed developments, in case they prove successful, will fit into and affect present routines of the fighting forces is given consideration. At the NDRC meetings there is also opportunity to weigh the relative advantages of various proposals in case they coincide as to objective or conflict in their demands upon personnel or laboratory facilities.

While the whole civilian group looks to the military personnel for expert counsel, it should be borne in mind that the latter has no veto power. If a civilian group becomes convinced of the merit of an idea and can carry its point with their nonprofessional colleagues of the top committee, it is possible to undertake almost as complete and thorough an investigation of the proposal as though there were military compliance. This means that the mecha-

nism now in operation has moved a long way beyond that which functioned in the last war! Then the civilian group, in effect, waited politely on the doorstep of the military to be asked to participate; now they are an autonomous body of experts possessing funds sufficient to test out their own ideas. Not only the presumption, but the evidence thus far available, speaks in favor of the latter arrangement.

It results in both the civilian and the military groups being put more on the alert. Not only has it resulted in the introduction of valuable military innovations, but it has also in certain instances resulted in the Services abandoning schemes which from the broader scientific view failed to stand analysis. It thus provides a degree of national protection and reassurance which probably could be obtained in no other way.

This is not said to imply that dissension has arisen between the two groups. So far as I know, no major instance has occurred in which any one of the civilian agencies has decided to take the bit in its teeth. But the full and true appraisal of ideas is one of the most difficult duties ever placed upon any organization, whether civilian or military, and it is well attested that the present interplay of discussion between the groups has been of inestimable benefit in clarifying the thinking of all. Coupled with this there is now incontrovertible evidence that scientists, both academic and industrial, on the one hand, and the professional military, on the other, working intensively together, have been spurred by competition, each gaining as the months have passed increased confidence in the value and essential soundness of the other's knowledge and judgment.

MORE THAN ninety per cent of American scientists are engaged in beating the Germans and Japanese.

More than ninety per cent of American scientific laboratory facilities are devoted to the same task.

American scientists are working at this job six or seven days a week, long hours, with few interruptions.

They are getting somewhere, too.

Every now and then the Germans and the Japanese have an unpleasant surprise.

They find that American science has caught up with them and passed them.

It is reassuring to us and discouraging to our enemies, for American scientific facilities are the greatest in the world. And they are functioning.

Little by little, some of the things that have been developed become public, but most of them you won't hear about until after the war.

But now, without the details, you can have faith that American research—industrial and academic combined—is rapidly giving our fighting forces an advantage.

Along with other American industry, the Bell Telephone System has its own Bell Laboratories—the largest in the world—working overtime for victory.

From an A. T. & T. advertisement entitled "Reason for Confidence."

More than 2,000 Bell System Women Are Handling Calls at Many of the Army's Private Branch Exchanges, Thereby Releasing Military Personnel for More Active Duty

Operating Army Switchboards

Glen L. Whiteman

NO ONE REALIZES BETTER than do telephone men and women the force of the impact on communication services of the Japanese attack on Pearl Harbor on December 7, 1941.

With the first flash of the news came a deluge of telephone calls at the nation's switchboards, particularly those of Army establishments everywhere in the United States. The need for trained and skillful operators at these establishments was so intensified that it was only a matter of hours before certain Bell System companies were requested to take over the operation of several private branch exchanges located at important military posts in this country.

A year and a half has now passed since that emergency was met by assigning to this new task trained Bell operators who took their positions at those switchboards—thereby releasing military personnel for duties elsewhere. It is interesting to summarize, in a backward look, the extent of this System contribution to the war effort, of which so little is known.

In the first year of war, the operation and supervision of approximately 200 Army private branch exchanges, with 600 positions and 2,000 operators and supervisory people, became the direct responsibility of Bell telephone companies. Many more have since been added as the Army continues to expand.

These private branch exchanges are located at air fields, arsenals, supply depots, army headquarters, hospitals, and at various forts and training camps. Some are in large cities, others in small communities or even in isolated places miles from the nearest town. One of the camps, where ski troops are trained, is situated over 10,000 feet up in the Rocky Mountains.

The switchboards are either manual or dial, and vary in size from

one-position installations requiring only a few operators to those requiring as many as 45 operators.

In normal times, these Army switchboards are manned by either Signal Corps men or by women civil service employees. As the threat of war grew, in 1941, practically all soldier operators were replaced by civil service women. Now it is Bell System operators who are handling the calls—although included among them are some of the women who, as civil service operators, had been working at the same switchboards when the telephone companies were called on to take over the operation, supervision, and maintenance of the private branch exchanges.

Army officers and men agree that the change from the broad-shouldered soldier operator to the slender girl is a welcome improvement. For his part, the soldier is well pleased to be transferred to other duties.

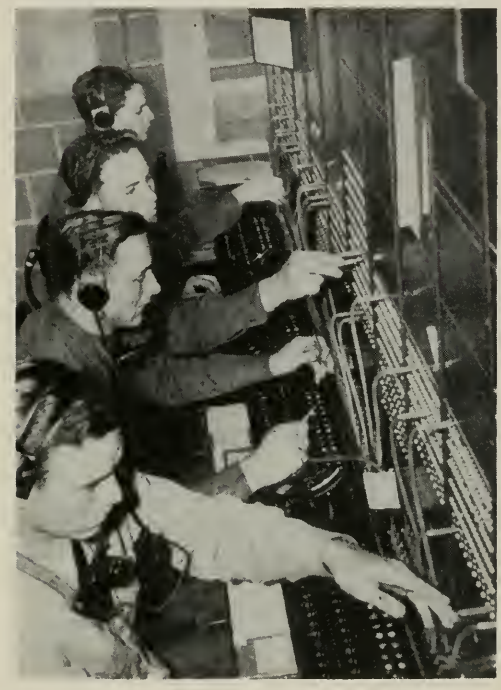
During World War I, at the request of the United States Army Signal Corps, the Bell System operated many private branch exchanges located in Army mobilization centers and cantonments—as they were known in those days. Some time before the start of World War II, the Signal Corps again made preliminary arrangements for this form of service in those military establishments where such operation might be desired if and when a major emergency should be declared. This gave the telephone companies opportunity to make general plans for the operation of such switchboards when the Signal Corps requested.

More detailed preparations were made early in 1941, when representatives of the telephone companies which had military establishments in their areas attended a traffic department meeting to discuss the providing and training of operators, their

THE COMMANDING OFFICER and the Camp Signal Officer inspect the post's switchboard as its operation is taken over by a Bell System force

housing and transportation, and other problems related to the operation of these switchboards.

Some time later, at the request of the Signal Corps, surveys were made at every army establishment then in existence, not only to determine the requirements for telephone company operation of the switchboards but also to view the adequacy of equipment and the need for expansion and changes in plant.



SOLDIERS such as these are released for more active duty when Bell System operators take over the handling of Army switchboards

Thus it came about that because of advance planning and coöperation with the Army, the telephone companies were ready and able, before the smoke had ceased above Pearl Harbor, to assume the responsibility for operating the switchboards at those places where they were asked to step in and take over.

That process is still going on—although as the Army continues to grow it is nowadays not so much a matter of "taking over" as it is of operating the switchboard from the day of its installation.

The Signal Corps works closely with the companies in planning tele-

GAS MASKS were proved by test to be no insuperable obstacle to the operation of this switchboard at an Army post

phone requirements for a fully garrisoned camp. When a new military location is planned, meetings are held in the Associated Company area in which the establishment will be lo-

cated, with staff officers and telephone company engineers participating. There all the many important factors for service are considered. The size and type of switchboard, outside plant arrangements, the housing of people, and the equipment required are decided. This includes rest-room facilities for operators, and dormitory arrangements if employees are to live at the camp.

A TYPICAL DORMITORY for Bell System operators on an Army post. On the steps are the chief operator, the housekeeper, and the hostess

The same sort of check-up takes place at an existing establishment when more facilities are needed or when arrangements are being made for the telephone company to take over the operation of the camp switchboard.

Actual operation of the Army's switchboards—in addition to the Bell System's many other war-time responsibilities—is a good deal of an undertaking. Fortunately, there exists in each of the Associated Companies an organization which has been of great value in meeting the telephone service needs of the rapidly expanding military forces.

FOR MANY YEARS the traffic departments of Bell System companies have made it a practice to give practical help to business customers in the operation of their private branch switchboards. More than 125,000 switchboard attendants (operators) are employed—not by the telephone companies but by the firms having the private branch exchanges on their premises—to operate these switchboards. To assist these business customers, the traffic departments main-

tain placement bureaus which will supply trained attendants on request. In large cities, they give training courses where women without experience may receive instruction in PBX operation and operators may take "refresher" courses. To help these attendants to give and their employers to receive satisfactory telephone service through their switchboards, telephone company instructors make periodic visits to these business customers and their operators.

Thus, while taking over and operating the Army switchboards has presented a good many problems to the telephone companies' traffic departments, neither experience nor technique has been among them. But providing enough operators, with the necessary special qualifications, assuredly has. Furnishing telephone service to large Army establishments has raised the problem of operating personnel since the first big camp was activated. Operating the Army's switchboards has simply—and greatly—intensified it.

A PLEASANT ATMOSPHERE and comfortable furnishings are features of the living rooms of Army dormitories for operators

OBVIOUSLY, a big new military establishment largely increases the traffic through the telephone company's central office which serves it. Often the nearest center of civilian population is a small town which cannot provide the additional operators needed to handle the greatly multiplied numbers of calls. Then it becomes necessary to transfer operators from other localities where the employment problem is not so acute. These operators, brought in some times from a considerable distance, must be housed—

in a community perhaps already overcrowded. In some places the telephone companies have rented or bought large houses and converted them into dormitories.

When the telephone company is requested to operate the same military establishment's own private branch exchange, which handles the Army's local and long distance calls through the central office and all the calls on the post as well, that just increases again the number of operators needed. If, as in the preceding paragraph, the near-by town cannot provide them, then they too must be brought in from some other place. If the camp is far from town, or transportation is too difficult, then a dormitory must be furnished for them on the camp grounds.

THE TELEPHONE COMPANIES provide dining service, in cheery dining rooms such as this, in a few of the operators' dormitories at camps where it would be difficult for them to obtain meals elsewhere

NOW TO GET BACK to some of the interesting points about actual telephone company operation of Army switchboards.

These switchboards, operating 24 hours a day, are the nerve centers of the Army. They handle a large volume of calls. By way of example, more than 50,000 local and 600 long distance calls *originate* daily at one large Army camp switchboard. Most of the calls are concerned with Army business, of course; but an occasional incoming personal call to a soldier from mother, dad, or the "best girl," which is handled through the private

branch exchange instead of a public telephone, is also important.

Another typical Army camp has more than 1700 buildings encompassed in a 6-square-mile area, which from the air looks like a good sized town. This camp is served by a 1000-line dial private branch exchange with four switchboard positions and a force of 20 operators.

The service given at these private branch exchanges compares favorably with that given in central offices. All operators are experienced—part of them, as already mentioned, being former civil service employees who had operated the same switchboards under Signal Corps supervision. The additional people are selected from near-by central offices whenever possible, and are given the necessary training in the operation of the private branch exchange.

Public transportation facilities are used by the operators so far as possible in getting to and from this work, but these are often inadequate, particularly in the early and late hours. In some cases, it has been necessary to fit the hours of work to meet bus or other transportation schedules. Taxicabs and telephone company cars are sometimes used when other means are nonexistent.

ONE MORNING in the spring of 1941 the private branch exchange located at Camp ———— was turned over to 20 Bell System operators, who replaced soldiers of the Signal Corps. This was the first Army switchboard to be taken over for telephone company operation. Since the camp is about 20 miles from the nearest town, the Army assigned a building near the Signal Corps office as a dormitory. The girls were welcomed by the General in charge of the camp, who gave a reception for them which was attended by a number of officers.

Since the spring of 1941, the Army has provided about 20 dormitories in camps located in isolated places beyond reasonable traveling time to the employees' homes. The Army consults with the telephone company regarding the design and size of each dormitory before starting construction, to make sure that it will house the telephone girls in comfort. Equipment and furnishings are, in general, similar to those provided for Army nurses. The bedrooms, designed to accommodate two girls to the room, and the recreation quarters are attractively furnished. Kitchenette facilities are provided for snack meals in the evenings and for preparing food for those who may be indisposed.

The girls generally obtain meals in a near-by officers' mess or club, at a table assigned for their use. If an officers' mess-hall is not within reasonable walking distance, the girls usually eat in a service club or post exchange restaurant. In a few cases the telephone companies provide restaurants for the operators.

The camp's commanding officer usually takes considerable interest in the operating force, and encourages their participation in the social activities at the camp. The Signal Officer in charge of the private branch exchange usually makes it a point to keep acquainted with the operators and to see that they meet other officers. The operators have access to many of the amusements that are available to the camp personnel, and they are encouraged to participate in

as much outdoor activity as seems desirable. Usually there are unrestricted areas for walking, and at one of the older forts riding horses are available for a small fee.

At a camp for training ski troops, the operators participate in many of the winter sports, such as skiing and bobsledding. To add to the spirit of Christmas at this camp, a tree-cutting jaunt was made to the near-by hills to bring back a Christmas tree. At another camp, located in the South, the operators have made an attractive flower garden around their quarters. This is the only garden within miles.

The operators also attend the movies and dances at the service clubs, and have occasional small parties in their quarters, where some of the soldiers may be invited to play cards, listen to the radio, and take part in such other entertainment as they would enjoy in their own homes.

Although the restrictions are few, the operators are required to be in at the same hours as the men, and must be escorted when going out in the evening. The telephone company hostess meets the girls' escorts, and since she is responsible for their general well-being, she is kept informed of their whereabouts when they are not in the office or dormitory.

SOCIAL EVENINGS in the dormitories' home-like living rooms, and participation in a camp's recreational activities, help the operators' off-duty hours to pass pleasantly

THE OPERATORS ARE—and must be—alert at all times for an emergency. There can be no interruptions—no halt—to the constant flow of communication. They are "on the job" and willingly and cheerfully put up with many inconveniences, such as

waiting in all kinds of weather to travel on overcrowded buses and taking a long time to get to or from work. Others have left their homes and taken quarters in boarding houses and dormitories which are not as comfortable or desirable as their own homes. These girls are getting much satisfaction out of their work, however, because they know that their skill and ability are being applied at their highest usefulness.

THE ARMY appreciates the service they are giving and their desire to help in winning the war. A letter from the commanding officer at one of the camps to an official of one of the Associated companies reads as follows:

"Today is the first anniversary of the installation of my telephone, No. 1, in Camp ———— and the beginning of operation of the switchboard. During this year of service many calls have been placed, both local and long distance. It is with pleasure that I commend you and your fellow workers for the splendid service you have given us. It is my desire that each and every one of your employees who served us so well during this past year be commended for their part in this project.

"During recent weeks, since war has been declared, it has been our lot, here in ————, to be on duty twenty-four hours a day. Troops are moved on less than two days' notice. Sometimes it is necessary for troops to move from one part of the Camp to another within a twenty-four-hour period. All this required extra service on the part of your men in moving the telephones as required.

"Your lady operators, located here in Camp with us, have proven their merit by constant attention to duty. Please convey to them my personal thanks for their part in this program of national defense.

"Again permit me to congratulate you and your company for the excellent service you have given us here at Camp ———— and the voluntary coöperation exhibited by all."

Such an expression of satisfaction with the service they are giving is naturally very gratifying to the operators at Camp ————. But to them and to their sister operators at Army establishments throughout the United States, the highest satisfaction must lie in their realization that through them the Bell System is contributing in still another important and effective way to the success of military preparations and thus to the nation's victory in this war.

THE IMPORTANCE of communications to the Navy under the present conditions cannot be overestimated. Telephone people are all part of an "invisible navy" and, as such, are vital to the armed services in their prosecution of the war just as are the sailors on a battleship or the Marines on Guadalcanal.

From a letter from Vice Admiral F. J. Horne, Vice Chief of Naval Operations, to Vice President and General Manager C. A. Robinson of the C. & P. Telephone Co.

Now Numbering 69,000, This Group of Telephone Men and Women Forms a Strong Link between Achievements of the Past and Greater Accomplishments Still to Come

The Telephone Pioneers of America

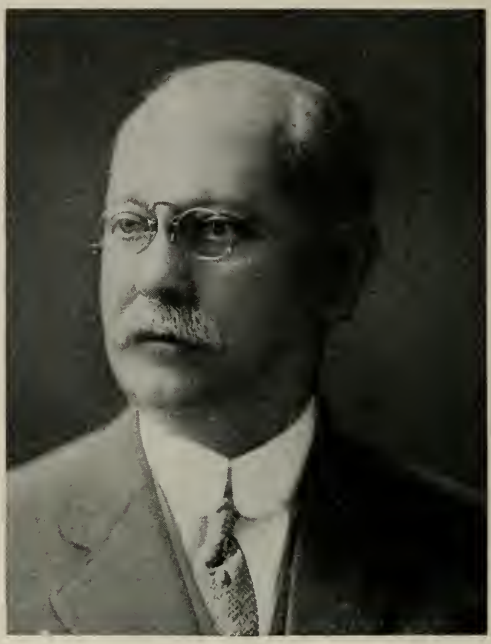
Samuel T. Cushing

IN THE FALL of 1910 three telephone men, Henry W. Pope, Charles R. Truex, and Thomas B. Doolittle, began to discuss an idea which was destined to point the way to the development of an unusual organization, membership in which is one of the most satisfying of all the experiences that come to those who find their careers in telephone work.

At the time of this initial discussion the American Telephone and Telegraph Company had been in existence 25 years. In a few months, long distance conversations would be possible between New York and Denver, a milestone in the increasing range of the spoken word in America. Some months later, it would be possible to talk by underground cable all the way from Boston to Washington. And, as a result of the steadily growing public acceptance of the telephone as an aid to living and working, there were in the United States nearly 6,000,000 telephones owned by or connecting with the Bell System. Such were the evidences of telephone growth in the 34 years since Bell had demonstrated his telephone at Philadelphia's Centennial Exposition in 1876.

The three men, Pope, Truex and Doolittle, had not only watched this growth from the beginning; they had themselves played important parts in bringing it about. The first two, who in 1910 were at the headquarters of the American Company, had begun their telephone careers in 1878 and 1879 respectively. Both had had long and eventful experience as participants in the telephone's establishment and development in the important area of metropolitan New York. Thomas B. Doolittle's invention of hard drawn copper wire, adopted by the American Bell Telephone Com-

Charles R. Truex



Henry W. Pope

pany in 1883, had revolutionized both telephone construction and telephone transmission technique; and in addition to his long service as a telephone engineer, he was one of the incorporators of the American Telephone and Telegraph Company.

Thus these three men had truly pioneered in the development of a great and growing public service. They had felt the pride of noting its ever-broadening scope, its ever-increasing usefulness. And having the personal satisfaction of all whose pioneering work has contributed to such development, it was not strange that they should, with enthusiasm, discuss the idea—originally proposed by Pope—of forming an association of other telephone men and women with the same memories and the same satisfactions.

Nor was it strange that Theodore N. Vail, President of the American Telephone and Telegraph Company, whose advice they sought, should greet the proposal with equal enthusiasm. No one realized better than Mr. Vail what it meant to pioneer, for, as general manager of the early companies formed to organize and promote telephone growth, and as the first president of the American Company (1885–1887) to which responsibility he had returned in 1907, he had a complete knowledge and a full appreciation of the struggles and accomplishments that had brought about telephone service in America on a scale equaled nowhere else in the world.

With Mr. Vail's full approval of the idea, the three men constituted themselves an organizing committee to develop the movement for an association of long-service telephone

Thomas B. Doolittle

Theodore N. Vail

people. They first secured, by personal visits, the signatures of 169 near-by prominent telephone men of the early days on a "membership paper," dated October 1, 1910, and reading as follows:

"It has seemed advisable to a number of the pioneers of the Telephone industry to form an Association, to embrace, to such extent as may be found practicable, the early workers in the telephone fields, under the proposed caption of

THE TELEPHONE PIONEERS
OF AMERICA

for the purpose of renewing and perpetuating friendships, and fostering and encouraging such other worthy and appropriate purposes as may from time to time be suggested and approved.

"You are cordially invited and requested to indicate, by the affixing of your signature hereto, your willingness to join in the formation of such proposed Association.

(*Signed*) HENRY W. POPE."

Having thus secured the support of men who were easily reached, the organizing committee sent a letter on March 1, 1911, to the more distant early telephone men asking them whether they wished to apply for membership in the proposed organization. In this letter the tentative membership requirements were stated as being: "That any person of good standing engaged or employed in the service twenty-five years prior to date of application and at any time thereafter continuously in the Bell service for five years is acceptable." The membership requirement was changed later to twenty-one or more

years of service in the telephone industry.

The First Meeting

NAMES OF APPLICANTS were received in considerable number in response to the committee's letter, and on August 21, 1911, a call was sent out for the first meeting of Telephone Pioneers, to be held on November 2 and 3, 1911, at the Hotel Somerset in Boston, Massachusetts. Pioneers to

THE PIONEER EMBLEM has a definite symbolism. The three sides represent fellowship, loyalty, service. The numerals on the bell are those of the Patent Office number assigned to Bell's patent on the fundamental principle of the telephone. It was in 1875 that Bell verified his theory of the electrical transmission of speech; in 1911 that the Association was organized

the number of 250 were present out of an initial membership of approximately 500. President Vail of the American Telephone and Telegraph Company was elected the first Pioneer President, and Henry W. Pope the first Secretary. Among the notable addresses presented was that by Alexander Graham Bell, the telephone's inventor.

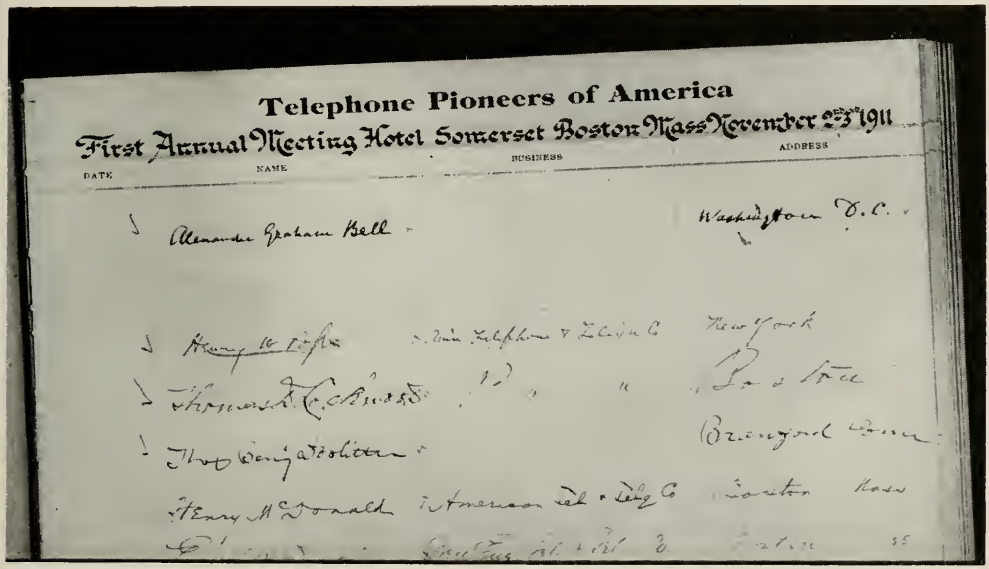
The constitution which was adopted contained the following statement as to purpose:

"The Association is formed for the purpose of recalling and perpetuating the facts, traditions and memories attaching to the early history of the telephone and the telephone system; preserving the names and records of the participants in the establishment and extension of this great system of electrical intercommunication; the promotion, renewal and continuance of the friendships and fellowships made during the progress of the telephone industry between those interested therein; and the encouragement of such other meritorious objects consistent with the foregoing as may be desirable."

THUS WAS BORN the organization whose members today, 69,000 strong, are in every state of the Union and every province of Canada. They range in age from a few who are but 35 years old to a nonagenarian of 95. It is an organization of unique character since, though organized and administered separately from the telephone operating organizations, it constitutes an important agency in the life of the entire telephone industry. It welcomes to its membership craftsman, clerk, operator, supervisor, executive, laboratory scientist, with no distinction as to level or position, but only with the requirement that each member shall have served the telephone industry for 21 years. It is in effect an honor society of men and women united by the common bond of having given on the average a generation of service to the building of telephone tradition and the maintenance of telephone ideals.

In its first decade the principal activity of the Pioneers' Association

consisted of holding annual conventions attended by large numbers of Pioneers and their guests, who welcomed these opportunities to renew the friendships formed in early telephone days. The second meeting was held in New York City in November, 1912. No meetings were held in the years of 1917, 1918, and 1919 because of war conditions. Mr. Vail continued as President of the Pioneers' Association until his death in 1920.*



ALEXANDER GRAHAM BELL's signature stands alone at the top of the register for the first meeting. Second and fourth are those of Messrs. Pope and Doolittle. Mr. Truex, late in registering, signed on the last page

At the annual Pioneer convention at St. Louis in 1921 a most significant step was taken: provision was made for the formation of Pioneer chapters; and for the creation of a General Assembly, composed of the Association officers and representatives of the chapters, as the legislative body of the Association. By that time the membership of the Association had risen to about 2,200 and was thinly spread over most of the United States and Canada, with concentrations of considerable numbers in the principal cities. It was felt that the purpose of the Association would be better served if, by separating the membership into chapters, opportunity were provided for meetings and other activities by various groups locally, with a yearly gathering of representatives of the local units for the transaction of Association business.

* At the end of this article will be found a complete list of his successors in office, with their company titles at the time of election.

Chapters Are Formed

FOLLOWING THIS constitutional authorization, the work of organizing chapters started. In July, 1922, the first five chapters were chartered: Theodore N. Vail at Chicago, N. C. Kingsbury at Cleveland, Kilgour at Cincinnati, Wisconsin at Milwaukee, and Empire at New York City. By the time of the General Assembly Meeting at Cleveland in September, 1922, there was a total of 19 chapters. At first, delegate representation was on the basis of membership, and 65 delegates were present at Cleveland. Later it was stabilized at a figure of two delegates per chapter. Annual General Assembly Meetings continued until 1941, the meeting that year being at Chicago. Then came the war and, as a matter of patriotic necessity, the meeting planned for Detroit in 1942 was cancelled. It is probable that no more General Assembly Meetings will be held until after the war.

With the formation of chapters, membership increased rapidly. By the end of 1930 there were 18,500 members in 41 chapters. Ten years later the membership had risen to 48,000 in 56 chapters. Now there are 69,000, of which 4,500 are in the six chapters in Canada. It is expected that by the end of 1947 the total membership will be approximately 100,000.

While speaking of membership, it may be well to deal with a misconception held by some who believe that the Pioneers' Association is composed largely of oldsters. This, of course, is not so. Proud as the Association is of its life members, these retired employees constitute only about one-seventh of the total membership. Of the 59,000 employed members, approximately 75 per cent are under 50 years of age and 50 per cent under 45 years.

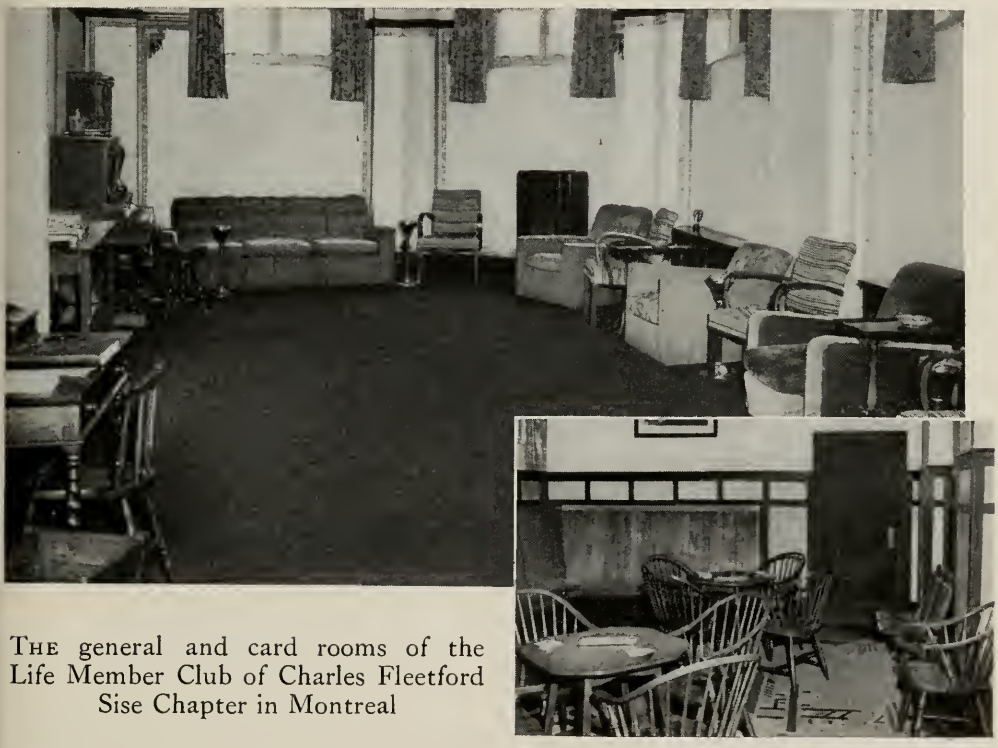
Chapter Meetings and Other Activities

THE INITIAL DEVELOPMENT of the chapters centered chiefly around the holding of meetings which reproduced on a small scale the larger General Assembly Meetings. The emphasis, of course, was entirely social. These meetings, large or small to meet each particular situation, have from the beginning achieved the fraternal purpose intended and it is expected that they will continue to perform this function.

Soon after the chapters were formed, it became evident that a program of Pioneer meetings alone was not sufficiently broad to fulfill the Pioneer objective completely, and in various ways the Pioneer program has been expanded through the years. First among these additional activities is the visiting of members who are ill, bereaved, or in other difficulty. Added to this is the sending of cards and flowers in cases of illness and bereavement. Practically all of the chapters carry on this type of activity to a greater or less degree. A year's work throughout the Association includes a total of approximately the following:

Visits to sick members	2400
Visits to bereaved members or families	500
Cards or letters to sick members	2000
Cards or letters to bereaved members or families	500
Flowers or other gifts to sick members	1600
Funeral floral pieces sent	900

As the number of members in the Pioneers' Association increased and the number of those who were retired began to assume considerable proportions, it became apparent that some special membership treatment should be accorded these retired people. Accordingly, in 1930, the General Assembly provided that the various chapter activities. Many of the chapters pay especial attention to their life members, visiting them on various occasions during the year, particularly if they are ill, sending them Christmas and other greetings, and maintaining contact in other ways. In a number of chapters the life members have formed life mem-



THE general and card rooms of the Life Member Club of Charles Fleetford Sise Chapter in Montreal

Executive Committee might confer life membership (with dues remitted) upon members retiring from active telephone service. The life membership roll has now risen to over 10,000, a highly honored group of Pioneer veterans. As they are able, these life members attend the meetings of the chapters and engage in ber clubs, with their own clubrooms and regular programs of meetings.

Historical Work

NOT ONLY because required by constitutional provision, but naturally because of the character of its membership, the Pioneers' Association has applied itself to things historical.

This interest has been expressed in various ways. One of the most common has been the gathering of telephone equipment and material of the early days, old manuscripts, and photographs. In some cases, these collections have been given very appropriate display treatment through the coöperation of the telephone companies. Many of the chapters have chronicled their own histories. Many record, by photograph and the printed word, the biographies of their life members.

AT THE Chicago General Assembly Meeting in 1941 a project was launched which it is expected will eventually provide a history of the development of the telephone business in each telephone company. It was patterned after the undertaking of this type which has been so successfully carried into its final stages by the Southwestern Bell Telephone Company. The plan is for each chapter of the Telephone Pioneers to gather, particularly through its older members and through the search of newspaper files and other records, information regarding the beginnings and development of the telephone business in its territory, and to compile this information for further treatment. During these stages of the work, clerical and other assistance will be provided by the company personnel relations department; then the compiled material will be taken by the information and public relations department and written into final form.

The coming of war has forced the chapters which had begun work on such histories to confine their efforts largely to the preliminary phase of gathering the basic information from their older members. It is expected that all of the chapters will join in this portion of the work and that the more advanced stages of the historical project will be undertaken after the war.

A number of the chapters have made good progress in developing interest in hobbies, particularly on the part of their older members. It is recognized that a person who has a hobby reaches the retirement age with a much greater certainty of having a happy leisure than one who has not such a sustaining interest. Effort is made, therefore, through hobby shows, talks on hobbies, group gatherings of hobbyists, etc., to create and maintain such an interest on the part of members.

About a dozen of the chapters publish chapter periodicals. These publications vary in frequency of issue, but all have the common purpose of creating another bond among members and carrying the Pioneer message to all, particularly to those who, because of remote location, find it difficult to attend Pioneer meetings.

Chapter Goals

ALL OF THE ACTIVITIES already mentioned, and several routine interests, such as membership committee work and dues collection, for example, are covered by a stated series of objectives termed "Chapter Goals." This statement of the aims of Pioneer accomplishment has been established as an indication of what is considered good Pioneer work. Several of the chapters are already meeting most of these objectives. In addition to

these stated activities, various Pioneer chapters carry on work of their own development, such as sending greeting cards on anniversaries, the selling of war savings bonds and stamps by life members, and contributing to welfare activities.

about the formation of Pioneer chapters so, beginning in 1930, further growth resulted in the organization of councils for local groups of members within various chapters. This made it possible to hold meetings in locations convenient for more mem-

PIONEERS in the territory of the Southwestern Bell Telephone Company compiled the data on which is based this history of the company—shown here in the form in which it has been submitted to the Chapters and others for final checking and revision

Councils and Smaller Groups

ONE OF THE most significant developments in Pioneer work has been the establishment, within chapters, of subdivisions known as councils. Just as growth in membership brought

bers and to organize committee work on a local basis within easier reach of the membership.

Further growth of membership in the larger chapters with widespread territories brought about the subdivision of some of the councils into

groups variously known as subcouncils, districts, clubs, and regions. With the coming of war and the resulting restrictions on transportation facilities, it soon became evident that it would be necessary to reduce considerably the distances which members would have to travel to attend meetings. Consequently, there has been a large increase during the last year in the number of chapter subdivisions, until now 29 chapters are subdivided into a total of 115 councils and, in addition, there are 45 subcouncils, clubs and other Pioneer groups within these councils. Each of the councils and smaller groups carries on a Pioneer program of its own, modified according to its size and location and integrated as a component part of the chapter program.

The Association

THE ACTIVITIES of the various chapters are coördinated and given general direction by a central organization which outlines the basic policies for the Pioneers' Association. The General Assembly, either at its annual meeting or by mail—as was the case for the first time in 1942—elects twelve officers as a governing body for the Association. These officers—President, Past President, Senior Vice President and nine other Vice Presidents—constitute the Association Executive Committee and in turn elect a Secretary and a Treasurer. The Secretary is the executive officer of the Association and, with a headquarters staff of six, carries on the routine business of the Association and maintains general supervision over its activities in line with policies established by the Executive Committee.

A recent change in the plan of administration has divided the Association territory into twelve Association Sections, with one of the Executive Committee members elected from and representing the chapters in each section. This plan of representation has a two-way application: each Executive Committee member is responsible to each of his constituent chapters for carrying its thoughts and ideas to the Executive Committee and, conversely, he is responsible for carrying to his chapters the thoughts and decisions of the Executive Committee. Furthermore, as a representative of that committee, he maintains contact with the chapters by personal visit and other means of communication, and stimulates and helps them in their work in every way possible. From the results already accomplished, it is evident that this plan will prove most effective in the work of the Association and the chapters.

The Association Secretaries

AS HAS BEEN SAID, the Secretary is the executive officer of the Association. Four persons have occupied this position during the life of the organization to date. Henry W. Pope, the "father" of the Telephone Pioneers and the first Secretary, served for three years. In that time he set the Association well on the road which it was to follow through the years to come. At the time of the fourth Annual Convention at Richmond, Virginia, in 1914, Mr. Pope was seriously ill and could not attend. His duties were performed by Roswell H. Starrett of the American Telephone and Telegraph Company and, because of the prospect of

Mr. Pope's continuing illness, Mr. Starrett was elected to succeed him as of January 1, 1915.

Mr. Starrett served as Secretary for more than seventeen years. While he was in office the Association grew through the years of larger and larger Annual Conventions and then embarked on its program of chapter formation and later development. When he assumed the secretarial position in 1915 the Association had a membership of 1,252; when he ended his term of service upon retirement in 1932, there were 21,221 members in 41 chapters.

Mr. Starrett was succeeded on June 1, 1932, by John Groener of the American Telephone and Telegraph Company. During his seven years of executive service the Association grew rapidly, adding 10 chapters and more than doubling its membership. In this period the movement toward the formation of councils and smaller groups within chapters, begun in 1930, saw extensive development. On May 31, 1939, Mr. Groener laid down the reins of office, and was succeeded by the present incumbent of the secretaryship, Samuel T. Cushing.

MEMBERS of the Hoosier State Chapter collected these old instruments and memorabilia, which are on display in the headquarters building of the Indiana Bell Telephone Company in Indianapolis

Association Publications

THE ASSOCIATION issues two publications. Each year, after the General Assembly Meeting, it has been cus-

tomary to send to each member a booklet describing the proceedings of the General Assembly and containing statistical reports and other information. As there was no General Assembly Meeting in 1942, the Executive Committee voted to issue and send to each member, instead of the usual "Proceedings," an "Annual Report for 1942" containing various items of general Pioneer interest, some statistics, and some news. These booklets were distributed in January, 1943.

The other Association publication is "Chats with Chapters," issued quarterly to all officers, committee chairmen, and principal workers in the chapters, councils, and other subgroups. The Association Secretary, as editor, is assisted by six associate editors located in different parts of the country. "Chats with Chapters" is essentially a "trade journal" for Pioneer workers and its material is written especially for these people.

In addition to these Association publications, the various company employee magazines report frequently upon Pioneer activities in their territories and, as previously mentioned, several chapters publish periodicals of their own development.

Statement of War-Time Policy

WITH THE ENTRY of the United States into the war, the question was immediately raised as to what effect the situation would have on Pioneer work. At its meeting in January, 1942, a month after Pearl Harbor, the Association Executive Committee issued "A Statement of Pioneer Policy in War Time," which began with the following preamble:

"With the United States and the British Empire joined in war against the Axis Powers, there is placed upon every individual and every organization the responsibility for reëxamining all interests and activities to determine whether or not they contribute to the war effort and, by this standard, whether or not they should be continued and with what emphasis.

"Review of the interests and activities of the Telephone Pioneers of America by the Association Executive Committee has resulted in the conclusion that the work of the Pioneers' Association should be carried on vigorously during war time, because of its value in building and sustaining morale, but that, at the same time, care should be taken to conserve energy and eliminate waste.

"The Executive Committee recommends that all of the chapters give immediate and serious attention to this matter, being governed in this connection by the following specific recommendations:"

Then followed recommendations regarding the holding of meetings and the carrying on of the various other Pioneer activities, all of the suggested action being keyed to war-time conditions. In the period since this "Statement of Policy" was written, the chapters have continued actively in the manner recommended, taking care to plan their work in conformity with the war-time situation.

The Pioneers' Association in the Years to Come

IT IS EVIDENT that there will be no lack of potential members of the Pioneers' Association in the years to come. For many years there will be

an increasing number of eligibles because of the force additions preceding the last depression. And the fact that the nation is at war does not seem to act as a deterrent to joining the Pioneers. During 1942, 7,190 new members were added, a larger number than in any previous year except 1941, when there was an especial emphasis on increase in membership.

whole extent of the country today? It is to you that this great development is due."

When the telephone's inventor spoke these modest words, transcontinental telephony was but a hope in the minds of the telephone's scientists and engineers, and today's system of 24,000,000 interconnected telephones was not even a dream. Radio telephony was an unborn art.

OLD TELEPHONE EQUIPMENT lends interest to this lounge and ante-room of the office of Theodore N. Vail Chapter in Chicago

And all who may join the Association in 1943 and in the years to come need have no doubts as to the continuing appropriateness of the term "Pioneer." Let them recall Dr. Bell's address at the first meeting of the Association in 1911: "You have all gone so far beyond me! Why, the little system that I look back upon—what is it compared to the mighty system that goes through the

Magnificent accomplishments in research, in apparatus design, in systems of transmission, in manufacturing technique, in operating methods were to mark the coming years and give to the telephone men and women of today an instrumentality of service almost beyond the conception of the early pioneer.

Yet, as Walt Whitman has written: "It is provided in the essence of

things that from any fruition of success, no matter what, shall come forth something to make a greater struggle necessary." The search for better instrumentalities and better methods goes on. The impulse toward improvement cannot be checked; for it is, by the very nature of their work, the controlling spirit of scientists, engineers, technicians—indeed, of all men and women who carry on and carry forward the service—and is an expression of the telephone management's conception of its trusteeship of a national service. All who may play a part in adapting the accomplishments of the future to the needs of men will know, from their own experience, that there always will be telephone pioneers.

Presidents of the Pioneers' Association

Succeeding Theodore N. Vail, President of the Telephone Pioneers of America from 1911 to 1920, have been the following:

1921—*Harry B. Thayer, President, American Telephone and Telegraph Company
1922—*John J. Carty, Vice President, American Telephone and Telegraph Company
1923—Leonard H. Kinnard, President, Bell Telephone Company of Pennsylvania
1924—Albert L. Salt, Vice President, Western Electric Company
1925—*Ben S. Read, President, Southern Bell Telephone and Telegraph Company
1926—*Harry B. Thayer, Chairman, American Telephone and Telegraph Company
1927—*James T. Moran, President, Southern New England Telephone Company
1928—W. Rufus Abbott, President, Illinois Bell Telephone Company
1929—Eugene D. Nims, President, Southwestern Bell Telephone Company
1930—James S. McCulloh, President, New York Telephone Company
1931—*Burch Foraker, President, Michigan Bell Telephone Company
1932—Frederick H. Reid, President, Mountain States Telephone and Telegraph Company
1933—Albert B. Elias, President, Southwestern Bell Telephone Company
1934—*W. B. T. Belt, President, Northwestern Bell Telephone Company
1935—†B. L. Kilgour, President, Cincinnati and Suburban Bell Telephone Company
1935–36—‡Chester I. Barnard, President, New Jersey Bell Telephone Company
1937—James L. Kilpatrick, President, New York Telephone Company
1938—Philip C. Staples, President, Bell Telephone Company of Pennsylvania
1939—Walter S. Gifford, President, American Telephone and Telegraph Company
1940—John J. Robinson, President, New England Telephone and Telegraph Company
1941—N. R. Powley, President, Pacific Telephone and Telegraph Company
1942—George M. Welch, President, Michigan Bell Telephone Company
1943—A. H. Mellinger, President, Illinois Bell Telephone Company

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* Deceased. † Died Jan. 28, 1935. ‡ Succeeded B. L. Kilgour Feb. 14, 1935.

Weather: Clear and Cold

A severe blizzard last January isolated the Jackson central office of the Mountain States Telephone and Telegraph Company, in the wild "Jackson's Hole" valley in the northwest corner of Wyoming. Combinationmen John C. Thompson, Jr., and Arthur D. Cottrell, of Lander, Wyo., were dispatched westward to find and clear the trouble east of Jackson. Mr. Thompson wrote for the company's employee magazine, The Monitor, *an account of their trip which is here reprinted as giving a vivid picture of trouble-shooting under conditions which fortunately are unusual in most Bell System territory.*

Lander, Wyo., Sunday, Jan. 24, 1943, 2:30 P.M. *Weather: Clear and Windy.*

TELEPHONE CALL from Jim Fegley, Lander, Wyoming manager: "How would you like to take a trip—over the Pass?" In other words, the Lander-Jackson toll line was in trouble somewhere beyond Dubois. Art Cottrell and I checked out of Lander with all the usual equipment, snowshoes included, at 3 P.M.

Reached Dubois at 6 P.M. Snow 14 inches deep, weather clear and cold.

Checked in at the Stringer Hotel, Dubois' only haven for travelers. We were entertained by the Stringer brothers, Albert and Oscar, 69 and 67 years. Due to war conditions, no cook was available and the brothers are alternating weeks in the kitchen.

Dubois, Wyo., Jan. 25, 1943, 8 A.M. *Weather: Clear and Cold.*

CHECKED WITH Casper Toll Test and found that the Jackson circuits from Idaho were out and that all highways were blocked.

We reported out at 8:30 A.M. and were accompanied by A. G. Boland, owner and manager of the Dubois Telephone Company, who had agreed to return the truck to Dubois, after we had gone as far as possible in it.

As we left town, a herd of about seventeen elk were grazing on a hill at the city limits. Moose and elk tracks were in evidence from the start of the trip, and the animals were in view at nearly every point on the road. Unusual snow conditions had driven them out of the high country.

Twenty miles out we followed two moose for a mile until they finally left the highway.

We reached the end of the road (literally) at 9:30 A.M. and were on our way. The snow was seven feet deep at this point.

We had covered about two miles, when a moose was sighted, feeding on willows, directly in our course. As we approached, he moved away and at one time only the tip of his ears and hump were visible, moving across the snow field, much as a mole burrows in soft ground. We were able to get within twenty feet of him

and snapped a picture as he rested, and as he moved away. We were fortunate that he was old and "wanted to be alone." Moose dispositions are notoriously bad and they will attack anything and everything in sight if they are annoyed.

Continuing on, we found the snow getting deeper and softer until, as we entered the timber, we were sinking eight or 10 inches in spite of the webs. Travel was very tiring be-

He "wanted to be alone." A moose enountered on the second day out

cause each foot had to be raised at least 12 inches to clear the snow.

At 2:30 P.M. we had reached the foot of the hill and at 4:30 had progressed only a mile farther. We were in the right of way adjacent to Tanner Park. We stood on the snow and connected the test set to the line, notified Lander and Casper of our location, and headed for Tanner Park Cabin.

As we webbed through the pines, many of them more than a hundred feet high, a jay joined us. He was one of the two livings things seen between Tanner Park and Togwotee Lodge, and he escorted us to the cabin.

In traveling through the timber we missed the Park and had to backtrack a mile, so we reached the shelter cabin at 6:10 P.M., having covered only 5.5 miles in the course of nine hours of constant snowshoeing. We were pretty weary, and while Cottrell cut wood for the night I started a fire and got a meal of fried canned meat, noodle soup, and coffee. We rolled out the bedding and "died" for the night. The cabin was so warm that a mouse came out of hibernation and spent the night building a nest in one of the pack sacks.

Tanner Park Cabin, Jan. 26. Weather: Clear and Cold.

We were up and eating breakfast at 8:00 A.M., and as we left the cabin we gauged the snow depth with a pole and took a snapshot of Cottrell in front of the only visible part of our first night's shelter. The snow depth was nine feet on the level.

At 9:30 we had reached the line and checked out with Lander and Casper. The seven miles to Togwotee Pass was just as slow going as the first day and was uneventful. We made the second leg of the trip in nine hours and at 6:00 P.M. were struggling with the old fashioned coal stove in the Togwotee (Highway camp) cabin.

Togwotee Cabin, Jan. 27. Weather: Cloudy and Warm.

During the night it laid down an additional three inches of fresh snow and was cloudy and warm the morning of the 27th. We called Casper

and decided to wait an hour for the weather to change.

At 10:00 A.M. the clouds were breaking, and after gauging the snow depth at eight feet, and calling Casper, we were on our way. The nine miles ahead were the worst of the entire trip. The first five miles were covered without any trouble, but when we pulled out into the open park we found the snow soft and wet, a ground blizzard in progress, and more snow falling. Visibility was ten feet.

Two miles from Togwotee Lodge we heard the motor of the snowmobile coming toward us, but in the time it took us to travel a hundred yards the sound receded. Cottrell's feet had begun to bother him and exhaustion was showing up, every step was an effort, and after what seemed hours we broke into the Togwotee Lodge Park. I went to the line and heard Don Williams, Jackson, Wyo., manager, calling Casper from Turpin Meadows. Cottrell was unable to travel any further, so we had the snowmobile come to Togwotee Lodge and pick us up. [Mr. Williams had obtained the snowmobile and started east. He restored service by removing 21 trees from the line on the west side of Togwotee Pass before meeting the two Lander men.—*Ed.*]

It was necessary to abandon our packs and lighten the snowmobile load as much as possible because of the fall of fresh wet snow.

We reached Turpin Meadows Lodge at 8:00 P.M., and were treated to a well prepared meal of steak and baked potatoes.

After supper we were assigned sleeping quarters, and examined and dressed Cottrell's feet.

Jan. 28, 1943. Weather: Clear and Cold. Snow depth 5 feet.

WE WERE UP at 7:30 A.M. and got under way. Cottrell and the snowmobile pilot were to go on ahead, Don and I were to follow on snowshoes. The snowmobile traveled a couple of hundred yards, only to stop with a broken ski support. Don and I made sure that Fred Abercrombie, owner and operator of the "sled," would be able to fix it and then went on ahead.

THE SNOWMOBILE: a small, light body mounted on ski runners and driven by an airplane propeller

We had been traveling for about an hour when it and its two passengers passed us.

We were traveling in moderately deep, wet snow, but were making good

time (about 2 miles per hour). It was necessary to watch for moose constantly, and when one was sighted its movements had to be observed so that any indication of "off color" action would be noted in time to give us warning to start for the closest tree in sight.

MR. THOMPSON on eight feet of snow. Note the snow-covered roof of Togwotee cabin behind him

Don and I overtook the snowmobile in about ten miles and we all decided to try to reach the Elk Ranch, five miles further on.

At 8:00 P.M. we had all reached the ranch but were unable to call Casper because of line trouble on the rural circuit from the ranch. We were too tired and hungry to web a mile back to the toll line to call. We reasoned that four men in a group would fall into no difficulty and therefore the Toll Test must figure the same way.

We had supper and were assigned quarters for the night. While three of us were resting, Fred Abercrombie borrowed a welding outfit from the ranch mechanic and repaired the broken support on the snowmobile.

Jan. 29. Weather: Clear and Cold.

COTTRELL AND ABERCROMBIE started for the last leg of the trip at 8:00 A.M. and Don and I hitched a ride on the covered wagon sleigh which two little boys from the ranch drove to school at Moosehead Ranch, four miles down the Buffalo River. En route, moose were seen at every stackyard in the area.

Leaving Moosehead Ranch, we continued on toward Jackson. Travel was not difficult and we made good time. At 3:30 P.M. we heard and sighted the snowmobile returning for us.

Boarding the snowmobile, we traversed the last twelve or thirteen miles to Jackson in an hour and a half. All that remained now was to arrange transportation for Cottrell and myself to Rock Springs. Cottrell's feet were examined and dressed by the doctor in Jackson, finding no infection in evidence. We registered at the hotel and had supper and a night's rest.

What Radar Is and Does

The following statement, made by President Oliver E. Buckley of the Bell Telephone Laboratories during the "Telephone Hour" radio program on May 17, is particularly significant when read in connection with "American Science Mobilizes for Victory" on page 106.

THIS WAR is being fought on many fronts, and the scientific front is one of the most important of them all. To insure that we shall win, our scientists must always keep one jump ahead of those of the enemy in the invention and development of new military instruments.

It is significant, therefore, that the scientists of the United States are effectively mobilized to do their part. Most of the work they do must be kept secret, but recently some information has been released on one of the products of their scientific effort—a new tool of war which has brought much disaster to our enemies.

This new tool is "radar," a device for detecting and locating enemy ships and airplanes. Radar works by sending out a beam of radio waves which, when it hits an object, is reflected and caught on the rebound. Thus the reflected radio wave gives warning of the enemy's approach. But it does more: it tells his exact distance and direction. The direction is that of the incoming reflected wave, and the distance is determined from the time it takes for the radio wave to make the round trip out to the enemy object and back. Knowing both direction and distance, guns can be trained on an enemy ship or airplane, even though hidden from sight by darkness or fog.

Radar takes many forms and sizes for different conditions of use, but all work on the same fundamental principle. Like all complicated devices, it is not a single invention but the product of many inventors and designers.

Three years before Pearl Harbor, Bell Telephone Laboratories was already working with our Army and Navy in the development of military radar. Other industrial laboratories joined in this effort. Through the National Defense Research Committee, an organized attack on radar problems was made by a group of leading scientists recruited from universities. All told, some two thousand scientists and engineers in Army, Navy, university, and industrial laboratories joined hands in the development of radar.

Bell Telephone Laboratories, a pioneer in the study of radio transmission and reflection, was in an outstanding position to contribute to the new art of radio detecting and ranging. All we had of technical knowledge and skill was thrown into the common pool. Wholeheartedly, we joined our efforts with those of other groups in this country and England. The radars which our forces are using

today are the result of this joint effort, coupled with the skill and workmanship of the several manufacturers who are enlisted in production. Prominent among the makers of radar is the Western Electric Company, manufacturing unit of the Bell System.

We of Bell Telephone Laboratories are proud of our contributions to this new instrument of war—one of many on which we have worked. We are proud, too, to have played a leading part in this greatest demonstration of teamwork that scientists have ever made.

ALTHOUGH PRACTICALLY ALL research and development effort has been diverted to the purposes of the war, the flow of developments affecting telephone service is not immediately curtailed, for they are the continuing result of ideas and techniques developed in the previous period of research. At present, telephone service is helped by the researches that have been carried out in the past. In fact, if it were not for the products of past research, the Bell System could not cope with the present emergency. Wires which formerly carried single conversations now carry many. Failures of equipment are avoided through greater reliability which has been achieved by research. Machines have been devised to do much of the work formerly done by hands. So the present shortages of materials and men, serious as they are, are nothing like as serious as they might have been.

From the A. T. & T. Annual Report for 1942.

I SHALL NOT ATTEMPT to predict what the coming year will bring for the Bell System, as it necessarily depends, under war conditions, on so many things that are beyond the control of the management. I assure you, however, that the System will continue to perform effectively and fully its important part in the war, and I promise you that we shall do everything in our power to see to it that the System comes through this trial of war fundamentally unimpaired and able to continue to furnish the American people with the best telephone service in the world.

The contribution to the war of the Bell System and of the men and women in it has been and continues to be outstanding; and when the war is over and the facts can all be told, I am sure that you as stockholders in this great private enterprise of a free country will be proud of the part it has played.

From President Walter S. Gifford's statement to A. T. & T. stockholders at the annual meeting on April 21.

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Bell Telephone MAGAZINE

erican Telephone & Telegraph Company • New York

Bell Telephone Magazine

September 1943

"*The ideal and aim of the American Telephone and Telegraph Company and its Associated Companies is a telephone service for the nation, free, so far as humanly possible, from imperfections, errors, or delays, and enabling anyone anywhere to pick up a telephone and talk to anyone else anywhere else, clearly, quickly and at a reasonable cost.*"

A Medium of Suggestion & a Record of Progress

Published for the supervisory forces of the Bell System by the Information Department of American Telephone and Telegraph Company, *195 Broadway, New York, N. Y.*

Who's Who & What's What

in This Issue

THAT THE Western Electric Company is doing a magnificent job of war production is known in general to Bell System people. But "Allo Maroc!" is the first comprehensive account—although necessarily incomplete in many details—of how big and how varied that job is. All who read it will be proud that this integral part of the System, its source of manufacture and supply, can make so effective a contribution to victory. Its author, C. L. STONG, joined the Engineer of Manufacture Department of Western Electric in 1926—after having been, among other things, a "cub" newspaper reporter and an aviator—and subsequently was for a time a field representative of Electrical Research Products Inc. during the conversion of silent motion pictures to sound. A member of Western's Public Relations Department since 1938, he was appointed Information Manager in 1941. Sandwiched in between his other duties have been visits to more than a hundred Army and Navy establishments for first-hand study of how electronics is helping to speed communications in World War II.

TO MATCH and surpass the swift and effective communications of the Nazi blitzkrieg, to maintain contact with forces fighting in the island jungles of the southwest Pacific, to make possible the coördination of far-flung action on many parts of the globe, have been among the tasks of the Signal Corps, U. S. Army, requiring all the expert knowledge and skill it could command. Much of this knowledge and skill has been supplied by the nearly 5,000 Bell System men who have volunteered for specific positions in its organization through the "affiliated plan." The story of this

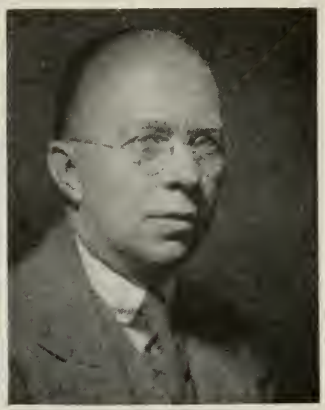
C. L. Stong

Donald S. Bridgman

John W. Campbell

Linus E. Kittredge

Bayard A. Freed



Karl K. Darrow

plan's development and of a few accomplishments by the men enrolled under it is told by DONALD S. BRIDGMAN, who since Pearl Harbor has been the contact point at A. T. & T. headquarters with the Signal Corps and with the System companies in connection with the plan's day to day operation. An Ensign in the Naval Reserve Flying Corps in World War I, he entered the Ohio Bell in 1920 and a year later joined A. T. & T.'s Personnel Relations Department. Since that time he has been concerned with technical and staff employment and related personnel matters.

IN MODERN WAR, problems of matériel are not confined to the fighting forces. Just as military preparedness requires that arms and ammunition be provided to resist a possible enemy attack on our shores, so does it require that telephone supplies be available against such a contingency in order to insure against serious interruption to the country's communication facilities. How the Bell System has met this potential need for central office equipment and outside plant materials is described by JOHN W. CAMPBELL and LINUS E. KITTREDGE, both of whom are members of the Assistant Chief Engineer's division of the A. T. & T. Company's Department of Operation and Engineering. After ten years with what is now the New Jersey Bell Telephone Company, Mr. Campbell transferred to A. T. & T. in 1916, where since 1939 he has been Outside Plant Engineer of the O. & E. Department. Mr. Kittredge joined A. T. & T.'s Department of Development and Research in 1920. When this was consolidated with the Bell Telephone Laboratories in 1934, he worked there on problems of dial

(*Continued on page 204*)

Saving Paper

THE lighter stock and narrower margins which are evident in this issue accomplish, without loss of readability, a saving of paper of more than 20 percent.

U. S. ARMY SIGNAL CORPS PHOTO

ACROSS ICELAND marches this telephone cable as men of the Army Signal Corps establish another line of military communication in the course of their operations on many fronts. See "Skilled Manpower for the Signal Corps," page 164

Of All the Electronic and Communication Equipment Made in This Country for War, More Than One Third Has Come Off the Western Electric Company's Assembly Lines

"Allo Maroc!"

C. L. Stong

On November 8, 1942, a strange voice cut in on the frequency of the radio station, Radio Morocco, at Rabat:

"Allo Maroc! Allo Maroc! This is the transmitter of the American Armed Forces."

In a matter of minutes Arabs, Berbers, Sengalese, and Frenchmen were excitedly exchanging scraps of a message directed to them from that transmitter by the President of the United States: *"Mes Amis . . .* we come among you to repulse the invaders . . . have faith in our words . . . help us where you can . . . Vive la France èternelle!"—and all of the inhabitants but a scattered few were heeding specific admonitions from General Dwight D. Eisenhower and General Henri Honoré Giraud to lay down their arms and coöperate.

That message was the prelude to the arrival on African beaches of scores of snub-nosed invasion barges from which swarmed khaki-clad British and American boys. How many of them are alive today because of that "mystery" transmitter, no one can say. But their numbers must run into thousands.

The action, swift, sure, perfectly coördinated, is now history. Most Frenchmen, of course, felt more like cheering than battling. From Algiers to Casablanca, local inhabitants of the key cities generally stood idly on the sidewalks, enraptured; even milkmen kept delivering supplies as if nothing were happening. Words, far more than bullets, won the cause. Within 16 hours, General Alfonse Pierre Juin surrendered Algiers. And in less than a week the blue Atlas mountains and the Pillars of Hercules looked down on cities, where Odysseus sailed in the fabled dawn of Greece, to see American doughboys from the plains of Iowa and the green hills of Vermont quietly patrolling the crooked streets—and trying hard to look unconcerned.

When the "voice of the Ameri-

can Armed Forces" first called upon loyal Frenchmen for support, many thought the words actually came from the broadcasting station at Rabat and that French Morocco already was in American and British hands. Vichyites and Nazis, who knew better, searched madly for the mysterious station and, not finding it, forced Radio Morocco to resort to jamming. But even the jamming didn't quite work. The mystery station shifted its frequency just a little and, for four days on and off, news from the battle fronts, warnings to civilians to take cover, appeals to loyal Frenchmen, continued to come through.

Nazis and Vichy French leaders in North Africa would have given a great deal to know where the mystery transmitter was located—although it wouldn't have done them much good. Off shore, over the horizon, lay the sinister shape of a great American battleship. Aboard her, under the

U. S. NAVY PHOTO

PERFECT TEAMWORK, even more than individual skill and daring, is responsible for our fighters' superiority in the air, say American airmen. Efficient radio communication between planes and with their base enables each squadron to fight as a coordinated team

protection of her deadly batteries and enclosed by a screen of destroyers, was a Western Electric 5 kilowatt radio broadcasting transmitter.

The story of how this transmitter, designed to bring to New Jersey listeners the usual entertainment fare and the "commercials" of the ether, happened to be aboard a battleship in action off the coast of Africa is one of the intriguing stories of the war.

It began September 29, 1942. Into Western Electric's Radio Division came the first "triple A" priority and directive ever seen by the men who work there on Government contracts.

The Amphibian Command needed a 5 kilowatt transmitter—in a rush! Every hour—every tick of the clock—counted. Its purpose and ultimate destination were not disclosed. No importance could be attached to the fact that manufacture of such apparatus had been suspended for the

U. S. ARMY SIGNAL CORPS PHOTO

GUN POSITIONS on an American troop transport look like this when seen from above. Telephones bring to the gun crews the orders which set all guns to bear on the target of enemy plane or ship

duration—that even replacement parts were becoming increasingly scarce. Only two facts mattered: the Company *had* manufactured such equipment, it *must* find such equipment and make delivery to Norfolk, Virginia—and would do so, somehow.

Division records disclosed that a 5 kilowatt transmitter had been delivered to radio station WHOM in Jersey City—that its installation had not been completed. With a lot of coöperation from all concerned, the equipment was turned over to the Government and rushed to Norfolk, Va., under Army guard. Simultaneously, the Company's Kearny Works dispatched replacements for the few missing parts, and a full complement of spares, to meet the transmitter at the Naval base.

OF ALL the Bell System men who participated in the work, only two Bell Telephone Laboratories' engineers knew why the Amphibian Command so desperately needed a transmitter. They disappeared in the feverish activity of Norfolk and were not heard from again until late in October. Their job, installing the transmitter aboard the warship, took precedence over everything.

During the last hurried days, the side of the deckhouse on the battleship was ripped open so the transmitter could be installed within—the most confined space, incidentally, in which such equipment had ever been set up. A generator, the only one the Army could locate in the time allotted, was rushed from a South Carolina cotton mill, and practically rebuilt on the job.

Then came the final, crucial test. The battlewagon steamed out of the roadstead and opened up her guns to see if the delicate parts of the transmitter could withstand the shock. They could and did—even the concussion of a five-inch gun not twenty feet away. Another Western Electric product was ready for battle action.

Western's Grave Responsibility

THAT IS but one incident in the war story of the Western Electric Company. It is an important incident because it illustrates the premium this war places on the qualities of initiative, coöperation, and dispatch. The full story of how Western Electric converted from its 73-year-old rôle as maker of Bell telephones and source of supply for the Bell System to that of a war-time arsenal of communications equipment for the fighting forces of the United States and the United Nations is rich in such incident. For today, Western Electric products in great variety help to coördinate Allied battle action throughout the world.

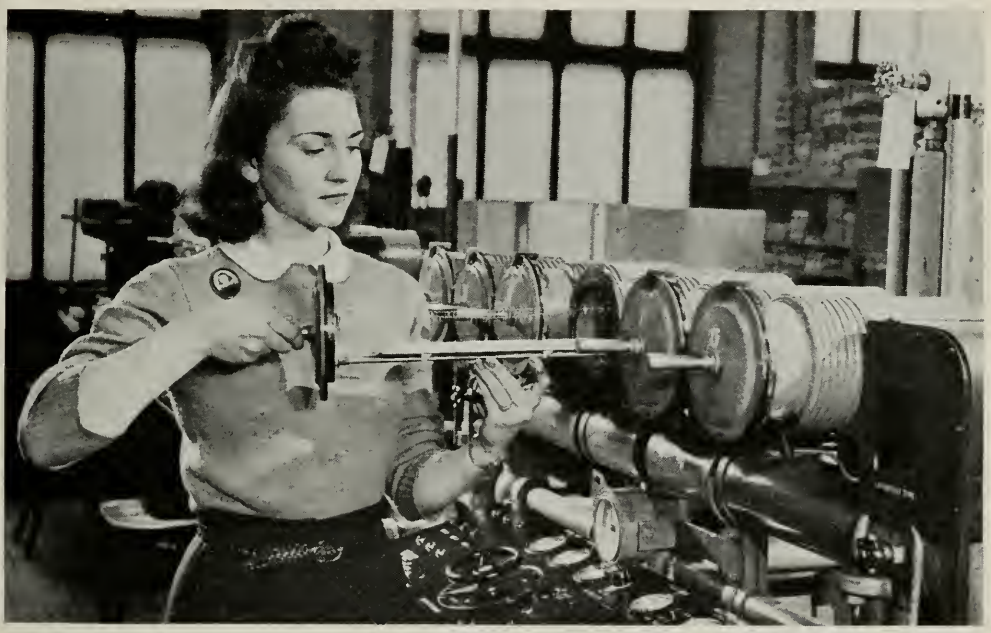
By any yardstick, its wartime job is the gravest responsibility of the Company's industrial career. In a recent telegram addressed to the employees, Major General H. C. Ingles, newly appointed Chief Signal Officer of the Army of the United States, said:

"Communications equipment you make is needed to bring victory on every fighting front. Radio made possible the landing on Attu when dense fog hid even the water from the decks of ships. In the Southwest Pacific, soldiers call the telephone a life or death necessity. In

the jungle, Army Air Forces warning-net teams, using radio, are making India virtually proof against surprise Jap attacks, and in Tunisia a portable radio station guided damaged American planes safely to the nearest airfield. Performance of all communication equipment in combat depends largely on the workmanship of the men and women who produce it. The army relies on you for the best."

To the full extent of its resources, the Company is trying to meet that responsibility.

Thus far, more than one third of all the electronic and communications equipment produced in the United States for war has come off its assembly lines.



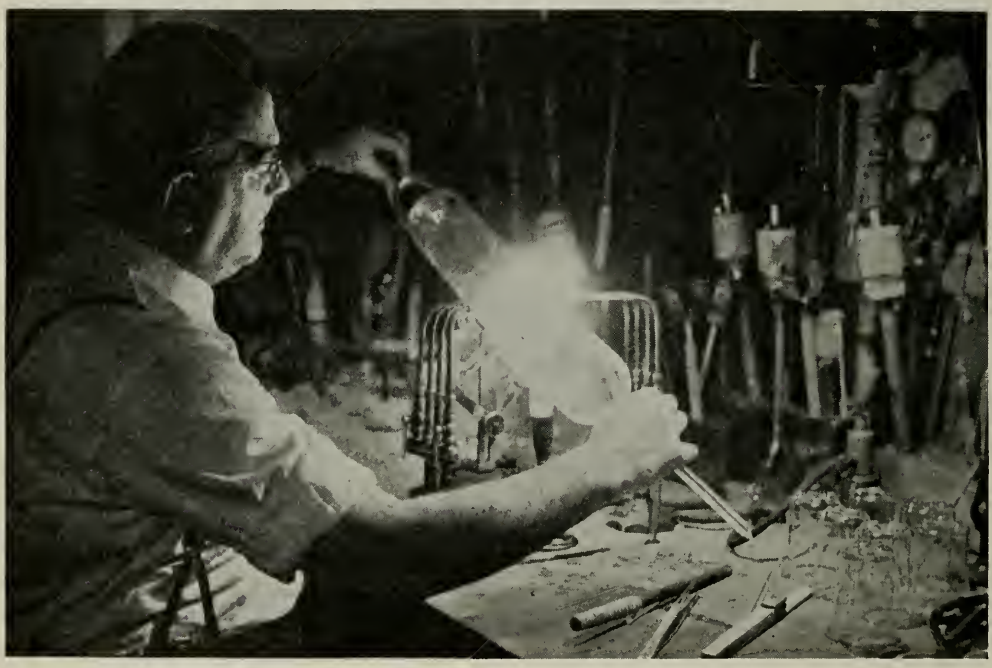
CRYSTALS used to stabilize frequencies in military radios are silver plated during the fine process of manufacture. Here a woman war worker in Western Electric's Hawthorne Works inserts a tray of crystal blanks in a silver-plating machine developed by Bell Laboratories engineers

Preparations in 1938

THIS WAR STORY may well begin with the blustery December day, back in 1938, when the manager of the Company's Specialty Products Division strode into a drab office of the old Munitions Building of the War Department in Washington and expectantly opened an empty, battered suitcase.

"Are they ready, Colonel?" he inquired.

Less than twenty-four hours earlier, the Colonel had asked Western Electric to undertake the manufacture of Command Sets in great number. This instrument is a specialized radio telephone which enables pilots while in flight to communicate with each other and with stations on the ground.



UNDER THE DEFT TOUCH of a craftsman in the Kearny Works of Western Electric, molten glass becomes an element of a water-cooled tube which may see service in a military radio communication unit

It was a tough assignment. Not just because of the problems of volume production or the pinch of a tight delivery schedule, but because of these plus specifications calling for almost impossibly close tolerances in manufacture.

To supply the listener needs of its peacetime broadcasting, America employs about 800 transmitters. To accommodate them, the available space on the air is divided into a number of broadcasting channels, and these are shared by the 800 stations. As long as each fellow sticks in his own groove, the system works pretty well and there is little "jamming." Even so, as every listener knows, the dials are fairly crowded and sets must be tuned carefully for good reception.

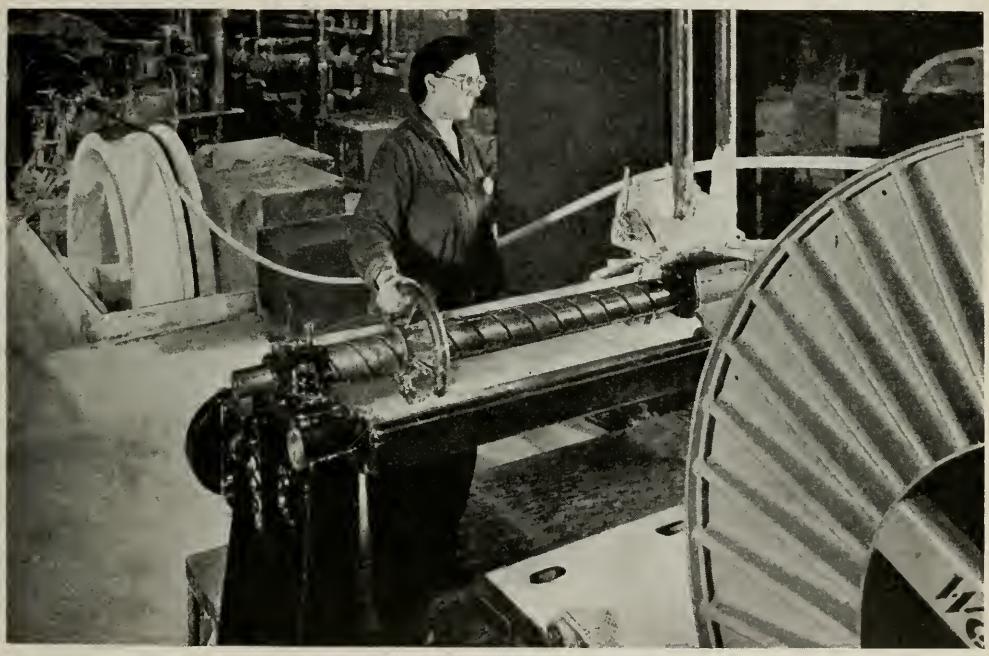
How different is the situation faced by military radio! Each army uses as many as 4,000 transmitters—and three, four, five or more armies may fight jointly on a single front. That means slicing the radio spectrum into

thousands of bits—thin bits. It also means that radio receivers, as well as transmitters, must squeeze in between the closely-packed channels and, once there, stay there. They must hold their frequency. Moreover, like soldiers, they must be capable of withstanding the hardships of battle.

Civilian radios, by comparison, lead placid lives. Usually, they occupy a comfortable corner of the living room with nothing more damaging to endure than the impact of a soft dusting cloth. They operate a few hours a day in carefully-controlled temperatures, and, with the family, share protection from the hazards of weather. The radio telephones of the armed services, on the other hand, work right around the clock.

It's not easy to build that kind of equipment.

But—getting back to that December day in 1938, and the Specialty Products manager's suitcase—the Colonel said "they" were ready. "They" consisted of a single set of blueprints for the now famed Command Set. The previous day, the Army had made its needs known, the Company's representative had done some figuring on his cuff, had telephoned his manufacturing associates for consultation, and had accepted the project for immediate production



THE JOB of distributing armored telephone cable onto a shipping reel in Western Electric's Point Breeze Works, here performed by a woman, was once work for a man who is now in the nation's armed forces

—on condition that the Army would supply finished drawings. The Army got busy. Within twenty-four hours from the time he was approached on the project, the Western Electric representative delivered the coming war's first set of working plans to Western Electric—2,300 of them stuffed in one bag!

Although the Command Set still figures prominently in the manufacturing program, it did not monopolize the "strategic" category for long. In a matter of a few months, the same sort of incident ushered in the military Radar program. This long secret and vital equipment, which through fog, rain, or the blackness of night gives our fighting men the precise location of the enemy's aircraft, ships, or similar targets by timing the echo of a radio beam, has been credited with turning the decision for the United Nations on many fronts, including the Battle for Britain.

From "Defense" to War

THE PERIOD before December 7, 1941, found Western Electric carrying its full share of the preparedness program. Army camps and naval stations were springing up everywhere and non-essential industries were being converted into defense plants, almost overnight. From Western Electric came much of the telephone and radio apparatus necessary to these centers of defense activity. But America was still at peace. It was still a "defense program."

The smoke and dust had not yet cleared above Hawaii when urgent war orders began pouring in. Needed at once were replacements for communications facilities destroyed by the Japs' attack. Switchboards, wire, cable, loading coils: all of the long familiar telephone elements of peace now became critical implements of war.

The company adopted appropriate measures to bring every resource at its command to bear directly on war production. To supplement the rapidly increasing production of its principal Works, a number of smaller factories were set up in rented quarters near these locations. New employees by the thousands, young people fresh from trade schools and high schools, farmers, department store clerks and former office workers, housewives, joined the constantly growing industrial army. These recruits replaced the nearly 20,000 men and women called to the colors and swelled the payroll to its current *75,000 plus*. These people take deep pride in the blows they are striking for victory and, in recognition of their accomplishments, the War and Navy Departments awarded them the coveted production award in 1942. They were among the first industrial groups to be so honored and six months later a star, denoting continuing excellence, was added to the Army-Navy "E" flags.

Production Multiplied

THROUGH specialized conversion, expansion, and sub-contracting, one division has increased production as much as forty times in three war-time years—and, today, hundreds of millions of dollars in Government contracts await fulfillment. In referring to the vast scale on which American industry has joined the fight, Lieutenant General Brehon Somervell.

commanding the Army Service Forces, said, on March 10, 1943: "Your achievements are of such magnitude that no single pair of eyes can see them all at once, no single mind encompasses all of them." Only a personal visit to *places* of production can give such production figures credibility.

To those who think of war work in terms of rattling rivet guns and pounding drop hammers, however, Western Electric plants may seem peaceful, almost placid. They are places where precision work counts for more than bulk and where employees know that the failure of even the smallest part can mean the difference between victory and defeat in a military operation.

The manufacturing facilities are divided into three establishments: the Hawthorne Works near Chicago, one in Kearny, N. J., and the Point Breeze Works at Baltimore, Md., together with a number of associated or "satellite" plants, whose locations for military reasons cannot be disclosed. Together, they embrace 236 acres of floor space.

WESTERN ELECTRIC's distributing houses, stocking some 10,000 different items of telephone supplies, use conveyors to speed the filling of telephone company orders, which in these days are often marked with a war-urgent "rush"

Kearny's War Story

THE KEARNY WORKS concentrates on war apparatus comprised of many small parts—sometimes as many as 60,000 in a single unit of equipment. The parts are formed by stamping, welding, soldering, molding. Then men and women war workers, like experts solving complex jig-saw puz-

zles, fit the parts together to make jacks, keys, resistances, relays, loading coils, filters, networks, lamp sockets, condensers, thermistors, and varistors. Further assembly in turn converts these into switchboards, carrier telephone systems, repeaters, and scores of other communications essentials for the Army, Navy, Lend-Lease and for war industries, defense information centers, Government offices—for the myriad agencies through which total war is waged.

Kearny is speeding production on new apparatus, developed by Bell Telephone Laboratories in coöperation with the Army and Navy. Many of these designs have emerged since the beginning of the war, while others are adaptations of peacetime equipment.

Kearny-made manual switchboards and associated equipment are in use at the fighting fronts, in outpost stations, fire control locations, and artillery observation posts. Portable central offices, much like those used in small towns all over the United States, are regularly floated ashore with landing parties of American troops during invasions. Switchboards, test sets, power panels, together with all the complex accessories needed for an efficient telephone plant, serve the posts, camps, stations, and bases of the Army and Navy. When enemy areas are occupied by the troops of the United Nations, carrier telephone equipment of the most modern design, manufactured at Kearny, moves in to furnish long distance service.

In its Vacuum Tube Shop, Kearny makes tubes for a wide variety of purposes. They range from the giants, which carry the voices of military leaders and statesmen to whole populations, to midget tubes which enable a Naval fighter at sea to make contact with his carrier base.

Hawthorne's War Story

HAWTHORNE'S WAR STORY is a twofold record of production achievement. First, it is the story of how Hawthorne's output of telephone apparatus helped prepare the nation for total war. It is the story, also, of how Hawthorne mobilized to produce highly specialized war equipment.

Today, telephone handsets no longer move along the conveyors in the station apparatus shops. Instead, the people who used to assemble such mechanisms as the receiver, transmitter, and dial for your telephone now make intricate machines which provide data for aiming anti-aircraft guns, enable ground crews to blast Axis fighters and bombers out of the sky with deadly accuracy. If the full story of how these weapons are being used against the Axis could be told, it would read like a fiction thriller.

It is no secret that from its shops come aviation radio units specifically designed for naval aircraft; radios that help American tanks smash the enemy; throat microphones for tank crews; tiny high-altitude microphones for men who, wearing oxygen masks, fight above the clouds; and field telephone sets for front-line soldiers—these are only a few of Hawthorne's many battle products.

On Hawthorne's Radar project alone, blueprints come out of the drafting department at the rate of 35,000 drawings per week to supply

the manufacturing personnel with working information on each of the more than 7,000 piece parts from which some of these complex mechanisms are assembled.

The Point Breeze Works

ESSENTIAL LINK of the telephone systems in theaters of combat, and in every war production area in the United States, is telephone cable, one of the principal products of the Point Breeze Works in Baltimore. Some months ago, in response to a rush order from the Government, Point Breeze turned out 16 miles of tape-armored cable in one fourth of the normal time. Special equipment, and zeal born of the war emergency, made *that* record.

Each week from Point Breeze have come hundreds of miles of rubber insulated field telephone wire, each reel stamped with the insignia of the Signal Corps. This wire has proved itself from Bielvmechetskoia to Guadalcanal, from Point Barrow to the Cape of Good Hope. It is the same product which was dropped recently from a bomber to speed telephone communication across a nearly impassable Alaskan glacier, and its snaky course dogged Rommel and his hordes to their defeat across the sand-swept reaches of North Africa.

WITH MANUFACTURE of telephones for civilians suspended, reconditioning of used sets is an important function of Western Electric's distributing houses. Telephones are cleaned, repaired, re-corded, and tested before being sent back to service

The men and women of Point

Breeze are turning out, on a three-shift schedule, telephone and microphone cords for the Army and Navy and terminal bases, which conserve the time of Signal Corps men in the installation of telephone cables. As in the case of both Kearny and Hawthorne, Point Breeze is also manufacturing a full quota of special electronic equipment.

The Distributing Houses

AT TWENTY-NINE POINTS throughout the United States, the Army, Navy and the telephone system have access to a chain of "general stores" where a full line of telephone goods is kept in stock to meet urgent demands for extensions or replacements to the communications network of the nation. These "stores" are Western Electric's 29 distributing houses, and an important part of the product flows through them. One or more is located in the territory of each Bell System telephone company.

The record shows that of 8,955,000 items requisitioned from these houses in a single year, more than 97 percent were furnished on the day they were wanted. Approximately 10,000 different kinds of items, ranging from machine screws to 20-ton reels of cable, are kept in stock.

In the same building with each warehouse is a repair shop. Here used apparatus is returned by the telephone companies, inspected, and reconditioned—or dismantled for the salvage of the valuable material it contains.

In addition to maintaining this essential repair service for the telephone companies, these repair shops are also channeling an appreciable amount of marginal capacity into direct production for war. As the war program cut more and more deeply into the nation's reserves of materials, with a consequent decline in the amount of supplies of telephone equipment available for civilian use, both manpower and machine capacity in many of the shops was released for manufacturing operations. Geared to war-time tempo, many shops have virtually become "sub-contractors" under the main Works. They are turning out an impressive list of war products in the amount of several million dollars annually.

The Installation Forces

NOT ALL manufacturing processes reach completion in the Works. A significant portion, on occasion, is finished at a remote site. Telephone central offices, for example, leave the factory as sub-assemblies and partially-wired apparatus. The final work of fabrication, of readying the equipment for service, becomes the responsibility of the installation department.

With all the flexibility of an army unit in the field, these installers go everywhere. For many months, parka-clad installation men have been facing the hardships of living and working in the Arctic cold side by side with the fighting men of the Army.

These men installed repeater stations along a route of 2,060 miles stretching from Edmonton, Alberta, to Fairbanks, Alaska. For the installation department, this is one of the most important jobs outside of the United States in the history of the department. In an official appraisal of their work the Army said, "out of the 184 foremen and men

who reported at this station, it would be hard to select any individual as outstanding, all having been instilled with a desire to put this job over as quickly and efficiently as possible under very difficult conditions."

While these installers were battling the ice and cold of the northern Pacific coast, others were helping the Army to transform a bleak stretch of Newfoundland wilderness into a bristling military outpost—one of the largest in the Western Hemisphere.

The enemy struck while the men were on their way to this latter job. The steamer *Caribou* which carried part of them was torpedoed and sunk by a Nazi U-boat. Three installers lost their lives during the attack.

More than 2,500 Army posts, naval stations and other vital war establishments of the continental United States, and its distant territories, today utilize the handiwork of the installation men.

When expanding war industries necessitate additions to telephone central office equipment in a hurry, Western Electric installation men find themselves with a rush job to do. Here two of them are connecting cables on a switching frame

Importance of Subcontracting

During the first six months of 1943, Western Electric supplied the armed forces with electronic combat equipment almost equal in dollar value to its entire output of such equipment for the entire year of 1942—a production, incidentally, amounting to hundreds of millions of dollars. In

addition, it supplied significant quantities of telephones and related equipment for essential civilian services. Of this volume for the first six months of 1943, approximately 45 percent of the total was farmed out to subcontractors.

Buried in this information is a story far more important to the nation than just the indicated production, despite its impressiveness. This hidden story is one of education—of the schooling of small manufacturers in the fine art of making specialized military communications equipment. In 1938, an Army survey disclosed that fewer than half a dozen American manufacturers were qualified by experience to produce such precision apparatus of a quality adequate to meet military specifications. Today, as a result of the forced-draft teaching methods of subcontracting, that original experienced handful has grown to more than sixty firms, all of which now accept prime contracts from the Army and Navy and, in turn, subcontract projects on their own.

Altogether, production from more than 1,300 manufacturers flows in part into the war through Western Electric, and the Company does business with more than 13,000 subcontractors and suppliers. A listing of their addresses covers the nation from coast to coast. They include little organizations with fewer than fifty employees and big ones whose personnel is counted by the tens of thousands.

As a result, some of the vital parts now assembled in Western Electric equipment originate in rather incongruous surroundings. One former manufacturer of marbles, for example, now makes precise glass parts for Command Sets. A firm which in peacetime specialized in bathroom accessories now turns out close tolerance tubing. A former maker of hairwaving machines is producing precision machine parts and jack assemblies. Perhaps the oddest of all is the one-time maker of doll's eyes, and voice-boxes which say "mamma!" This manufacturer now makes a real contribution to a vital electronic instrument. But, on second thought—and running him close competition—is the man who gave up the production of embalming fluid to help the Company make gun directors.

WHAT, with the help of these manufacturers, is made? Here is a partial list of the leading products:

RADAR. Radio-detecting-and-ranging sets which spot enemy planes or ships many miles away through darkness, clouds, and fog to give accurate bearings on their location and speed.

RADIO COMMAND SETS. Commands from ground stations and between planes are flashed over these compact, two-way instruments.

TANK RADIO SETS. Like the men who drive and fight our "land battleships," these sets must be tough to take the rough going. They bring every tankman within earshot of both his commander and his comrades in arms.

FIXED RADIO TRANSMITTERS. Powerful radios which weave a world-wide web of communications essential to the successful prosecution of global war.

VACUUM TUBES. Heart of all electronic equipment, vacuum tubes are doing an all-out war job. As many as 70 tubes may be used in a single unit of equipment, with

several times that number on hand for replacement.

Quartz Crystals. Sentries of the airways, these wafer thin crystals confine both transmitters and receivers to their assigned place on radio dials—and keep them there. One shop of Western Electric now makes as many crystals in a day as the whole industry used to turn out in a year. And *four* such shops now work around the clock. Volume production methods have lowered the price to the Government of crystals to about one-twentieth of their former price.

Teletypewriters. In the Chicago plant of the Teletypewriter Corporation, a Western Electric subsidiary, these essential machines are being manufactured on an intensified schedule almost exclusively for the Army and Navy.

Field Telephones. Wherever American troops fight on land, there you will find these durable telephones with their snug cases, prepared to coördinate the action.

Headsets. An ingenious adaptation of the hearing aid receiver, these effective units are worn inside helmets, free a soldier's hands for battle. They are used for communication in every branch of the service.

Microphones. Their variety is legion: high altitude, moisture-proof, sound powered, throat—each designed for maximum performance on its particular job.

Sound Powered Telephones. The basic intercommunicating system used on all U. S. Naval vessels. These instruments require no power supply—keep on going when other communications systems fail.

Battle Announcing Systems. Aboard fighting ships, every quarter of the vessel is brought within speaking distance of the commander by these "high-volume" systems.

Gun Directors. Intricate mechanisms which instantly solve complicated mathematical problems involving such factors as range, speed, wind velocity, and atmospheric pressure, enabling our gunners to hit fast-moving targets miles away.

Telephone Apparatus, Wire, and Cable. Backbone of the war's communications network is the conventional telephone system. Before any major decision, any strategic move of importance, can be resolved on the fighting front, the telephone lines of the United Nations must first play their critical role in coördination. Fortunately, these telephone systems, including the Bell System, were largely built before the war, and built well. In comparison with the vast size of the telephone plant, the dribble of replacement parts essential to its continued operation is insignificant. But such replacements and extensions as are essential assume tremendous importance. Western Electric continues to devote a portion of its manufacturing capacity to this critical type of work.

Bernard Baruch once said that a nation intent on waging a victorious war should so order its national life as to admit of no other thought or action; that it should work and fight and plan as if the war were destined to last forever. That describes Western Electric's approach to its present job. The war comes first—and there is no second.

It is a grim policy and Western Electric people take no pleasure in manufacturing machines for war. But faith in the victory to come is part of the blood and bone of every American. With the arrival of peace, the Company has its job cut out for it—telephone making, long curtailed, to bind the nation and the world together in a system of communications more inclusive than any we knew before the war.

Of 15,000 Bell System Men in the Signal Corps, Nearly 5,000 Have Been Distributed in 380 Specially Selected Units by Means of the Coöperative "Affiliated Plan"

Skilled Manpower for the Signal Corps

Donald S. Bridgman

THERE ARE TODAY over 50,000 Bell System men and women in military and naval service, of whom more than 35,000 are in the Army and the remainder in the Navy, Marine Corps, and Coast Guard. Of those in the Army, about 15,000, or over 40 percent, are in the Signal Corps —although its total personnel is roughly only 4 percent of the entire Army.

This concentration of System employees in the Signal Corps arises, of course, from its special responsibility within the Army, which was recently summarized by the Assistant Chief Signal Officer, Major-General James A. Code, Jr.:

> "The Signal Corps is responsible for the effectiveness of all communications of the Army, whether the message is from a Field Artillery observation post to its battery, or from a fighter pilot over the South Pacific to another pilot in the same formation, or from the Chief of Staff in Washington to the commanding general of the European theater of operations. It is the unifying agency, developing and procuring the equipment, prescribing the tactics and the techniques of its use, and acting as advisor and consultant on all phases of communications to all commanders through all echelons of command."

The Signal Corps is a component of the Army Service Forces, as are the Ordnance Department, Quartermaster Corps, Engineer Corps, and other organizations which serve the Ground Forces and Air Forces in the field. It operates the War Department's Communication Center in Washington and a vast network for

Army communications covering this country and reaching theaters of operations in all parts of the world. In those theaters, Signal Corps units install and operate the communications systems to every division headquarters and every Army air base.

Although provided by the Signal Corps, the communications equipment used by regiments and smaller tactical units in combat zones is operated by the personnel of the particular arm involved. On this account, many of the Bell System employees in the branches of the Army other than the Signal Corps have been assigned to communications duties and are effectively utilizing their telephone experience. This would be true, also, of those in the Navy, Marine Corps, and Coast Guard. Whether in such assignments or not, all are playing their part.

Of the 15,000 System employees in the Signal Corps, nearly two-thirds entered the Army through selective service or enlistment, and have found their places through the usual channels of assignment and promotion. Their large number has been mainly due to special arrangements for the assignment of as many experienced telephone men as practicable to Signal Corps replacement centers. The record indicates that the background and ability of these men have made great contributions to the work of the organizations in which they are. Several hundred were called to active duty as members of the Officers Reserve Corps or National Guard, and brought to their assignments a combination of telephone experience and substantial military training which in many instances has proved of notable value.

The "Affiliated Plan"

THE SIGNAL CORPS, however, was not willing to depend solely on these normal ways of securing trained communications men in the event of war. More than two years before the attack on Pearl Harbor, it had worked out in coöperation with the Bell System the special plan through which nearly 5,000 additional telephone men, usually of several years' service, volunteered for specific Signal Corps positions, were recommended by the System companies in which they were employed, and were selected as qualified for those assignments.

The plan through which these men entered the Army has become known as the "Affiliated Plan," and is an outgrowth of experience gained in the first World War, when the knowledge and skill of trained telephone men first proved invaluable to the Signal Corps. Forty-six hundred of the 25,000 Bell System employees who served in that struggle were enrolled in Signal Corps units; more than half of them were concentrated in 12 telegraph battalions, each of 216 officers and men, recruited in full from volunteers from a Bell System company. Two radio companies of field signal battalions were entirely composed of volunteers from the Western Electric Company.

These organizations all saw extensive service in France, where some served with the combat forces at the front and others were engaged in construction, maintenance, and operations in the zone of communications behind the lines. After the Armistice, General Pershing spoke of the work of the Signal Corps and of the experienced communications

men in its ranks as one of the greatest accomplishments of the American Expeditionary Forces.

As the tension in Europe became more and more severe during the late 1930's, and as War Department plans here in the United States were formulated to meet any possible emergency, the Signal Corps again requested the American Telephone and Telegraph Company to consider the development of a procedure through which it might use even more effectively than in the first World War the experience and knowledge of men from the System companies. At the same time, it wished to make certain that the extent of its demands for such men would not severely handicap the System in providing within this country the rapid communication service so essential in time of war.

Recognizing the importance of the problem, the American Company worked with the Signal Corps to develop a suitable tentative plan. This was approved by the War Department, and was discussed with the other System companies. The plan was then laid on the shelf—for use only in the event of war.

A few months later, Germany attacked Poland; and before a year had passed, Norway, Holland, Belgium and France had fallen. The

Communications Specialists Cadre

Signal Battalion—Ground Forces

No. of Men	*Army Grade*	*Occupational Designation*
1	Captain	Construction Company
1	Captain	Operations Company
1	1st Lieutenant	Motor Transp. Specialist
2	1st Lieutenant	Construction Specialist
1	1st Lieutenant	Message Center Specialist
1	1st Lieutenant	Wire Operation Specialist
1	1st Lieutenant	Inst. & Mtce. Specialist
2	2nd Lieutenant	Construction Specialist
1	2nd Lieutenant	Inst. & Mtce. Specialist
2	Master Sergeant	Line Foreman
1	Master Sergeant	Chief Telegraph Printer Operator
1	Master Sergeant	Wire Chief
1	Technical Sergeant	Asst. Line Foreman
1	Technical Sergeant	Asst. Chief Tel. Printer Operator
1	Technical Sergeant	Assistant Wire Chief
1	Technician—4th Grade	Insideman
1	Technician—4th Grade	Repeaterman
2	Technician—4th Grade	Switchboard Installer
2	Technician—5th Grade	Frameman

January, 1942

blitzkrieg demonstrated again and again the indispensability of superior communications for this new kind of war.

As the danger to the United States increased, the Signal Corps requested that volunteers be sought for certain commissioned officers' positions in six Signal Battalions, so that they might receive some preliminary military training and be ready to serve in case war were suddenly declared. Each of six System companies promptly found the men needed for one of these units and, some months before the Japanese attack at Pearl Harbor, these men received several weeks' training at Fort Monmouth.

Immediately following that attack, the preliminary plan was revised to meet the Signal Corps' needs under the new conditions and, within a few weeks, it was put into operation. One of the principal changes required was the inclusion of a substantial number of units to serve with the Air Forces, in view of the great importance of their communications problem.

The essential element of this plan was the designation of a communications specialists' cadre to form a nucleus of experienced telephone men within each of a large number of Sig-

PHOTOGRAPHS FROM U. S. ARMY SIGNAL CORPS

SWITCHBOARD OPERATOR and plotter receive telephoned instructions during an anti-aircraft demonstration at an American desert training center

nal Corps units. The accompanying table lists the positions designated for such a cadre in a Signal Battalion in the preliminary plan, when the total strength of that organization, except its Medical Detachment, was 20 commissioned officers and 542 enlisted men. It illustrates the application of a scheme to an important Signal Corps organization. This method, by placing a relatively small number of experienced men in each unit selected, insures the effective use of their knowledge and skill, and is far more economical of trained manpower than would be true if an equal number of men were concentrated in fewer units.

THE PROGRAM submitted to the System companies by the Signal Corps within a few weeks after Pearl Harbor called for about 400 officers and 1,150 enlisted men to be placed in 160 affiliated units, and about 50 men for staff positions in the office of the Chief Signal Officer.

As the scope of the conflict made ever increasing demands upon the Army, the Signal Corps added to its requests; and by the end of the year, the System companies had submitted accepted candidates for about 700 commissioned and 2,300 enlisted positions in 200 units, for 74 staff positions in the office of the Chief Signal Officer, and for 200 Post Signal Officers at Army air bases. In addition, some 150 candidates submitted for commissioned officers' positions under the "affiliated plan" had received other appointments within the Signal Corps.

The total number of men appointed or enlisted, therefore, exceeded 3,400, although 200 or 300 of them were not called to active duty until 1943. This year the requirements are distinctly smaller, as the Signal Corps' own training facilities became better equipped to meet its demands; but by this fall, about 150 additional officers and 1,100 enlisted men assigned to 180 units and to a number of technical staff positions will have entered its ranks through this plan.

In carrying out the plan, the Signal Corps, in consultation with the Ground Forces and Air Forces of the Army, with whom the great majority of the Signal units serve, designated the particular units which were to contain an affiliated cadre of Bell System men and the composition of those groups. The list of units, their probable activation dates, and the organization tables of the cadres were then submitted to the A. T. & T. Company, which in turn canvassed the several System companies as to the numbers and types of units for which they might be able to secure qualified volunteers. The companies then have notified their employees of the available positions for which they might apply, and qualified applicants have been recommended and their applications forwarded to the Signal Corps.

In the case of candidates for enlisted positions, the Signal Corps reviews the experience shown upon their application blanks with relation to the Army specifications for the positions involved. It then requests the enlistment or voluntary induction of acceptable men who prove physically qualified, under a procedure similar to that used for air cadets and other candidates for specialized training. These men become members of the

Enlisted Reserves and return to their work until called to active duty upon or shortly before activation of their units.

Candidates for appointment as commissioned officers must conform both to maximum age limits set as appropriate for the grade and type of duty expected and to minimum limits defined by War Department policy for appointment from civil life, which may be relaxed only for particular types of education and experience. Their personal qualities and capacity for leadership are appraised through interviews conducted by designated Army officers. Their education and experience are matched against the specifications established for their proposed assignment, and the level of their position in the business is compared with the grade for which they applying. The results of their physical examinations are reviewed by the Surgeon-General's Office. All of these factors are then considered by a Signal Corps Board of Officers, and during the past year the appointments which it approves have been reviewed by a special Personnel Board established for the entire War Department.

Up goes a telephone line amid Tunisian ruins as a member of a Signal Battalion helps to restore communications

Although it was recognized that the great majority of the men accepted under this plan would not have previous military training or experi-

ence, in the months following Pearl Harbor it was often necessary to call them to active duty directly with their units or to provide only short intensive training with similar units already in advanced stages of preparation. This procedure placed a special burden upon officers required to take immediate responsibility for a group of men of whom some might have had several months of military duty.

To overcome this difficulty, since the fall of 1942, when the training facilities available first made it possible, all "affiliated plan" officers have been sent to the Eastern Signal Corps School at Fort Monmouth for nine weeks of basic military training and special training for officers. More recently, all enlisted personnel has been given four weeks of basic military training in the Central Signal Corps Replacement Training Center at Camp Crowder.

Both officers and men then are given further training in a well established parent unit of the same type as that to which they will be assigned permanently. In this way they are fully prepared for the activation of their own units and the more advanced training and maneuver experience they will receive in them.

Units of Many Kinds

AMONG THE 380 affiliated units previously mentioned is almost every type required in the operations of the Signal Corps. Some are responsible for the construction of major communication lines in base areas, others for the operation of the extensive communications systems reaching out from the headquarters of a theater of operations, and still others for both operations and the light construction needed from hour to hour close to a rapidly shifting front. A few have established supply depots and repair shops for communications equipment at ports of embarkation or debarkation and have maintained and operated the local communications systems there. A large number have set up and operated fixed or mobile supply and repair depots at other points selected as major centers of distribution or as those suitable for the use of combat forces in the immediate vicinity.

Units of all these types are attached to the Army Service Forces or the Ground Forces and, in many instances, units with similar functions are serving with the Air Forces. Some of the units with the Air Forces have assisted in the development of the far-flung aircraft warning system within the United States, while many others have established and operated communication systems at advanced air fields in combat zones. Of all the units, about four-fifths are serving with the Air Forces; but since the affiliated cadres of those with the Ground Forces generally are much larger, the total number of affiliated men in the two groups is about equal.

Just as there are many types of affiliated units, there are also many locations throughout the world to which have been sent those whose preliminary training is complete. Obviously these locations cannot be closely identified, but they include bases in the Caribbean and Atlantic areas, points in northwest Canada and Alaska, islands in the southwest Pacific, and centers of military activity in Australia, the Middle East, and many parts of northwest Africa.

As this is written, three weeks after the landings in Sicily, some units undoubtedly are helping to establish the communications essential for the rapidly advancing American forces there.

Only after victory is won can there be told the most interesting and important news about these units and the telephone men in them: the story of hardships, tough problems demanding expert knowledge and skill for solution, and achievements based on both experience and the qualities of a soldier. At present only a few scattered examples may be given.

The affiliated cadre of the first unit called to active duty reported at Fort Monmouth on February 28, 1942, and less than three weeks later proceeded to the West Coast, where the entire unit was activated. Soon afterward, it received intensive training in desert warfare when, as one maneuver problem, it built an open-wire pole line across the Mojave Desert and helped to develop a number of construction methods adapted

THE MESSAGE CENTER of Army field headquarters is one of the busiest offices in the Alaskan theater of operations

to such conditions. Among these was the use of a special plow for burying field wire, developed by one of the master sergeants in the unit. The training obtained by these men proved so valuable that a number of the affiliated officers and men have been transferred to other units where

THIS IS the "field office" of a Signal Company Captain somewhere in New Guinea

men of their background have been particularly needed. The unit itself is now overseas.

The affiliated cadre of another early unit was called to active duty in April, 1942. Five months later, the Associated Company from which it had come was asked to replace the entire enlisted group—as seven of the original twelve men had been selected for Officers' Candidate School and five had been transferred to other duties. A week after the new men reported, the unit was on its way to the Southwest Pacific area, where it has won the commendation of higher officers for the effective discharge of many difficult assignments—including the construction of several badly-needed pole lines and the rapid installation and testing of the radio sets in eight newly-assembled jeeps needed for a special mission. Within the last few months, nine more men in the unit from the telephone company providing the affiliated cadre have been selected for Officers' Training.

On Many Fronts

THE TERRAIN, climate, and lack of transportation on the Southwestern Pacific islands lead to the most extreme difficulties in the establishment there of any sort of wire communications. On one island, a pair of wires was strung for 130 miles by a Signal Company, but 32 horses were killed in doing it. In another instance, wire was placed on trees across forty miles of water-covered bog where the mud was too deep for a man on foot and the water too shallow for a boat—so both methods of progress were used.

In much of the jungle, men are fortunate to get through the undergrowth with a trail of waterproof wire. There is no chance to string it, and naturally no place for underground cable. Although radio is used for inter-island communication and to reach the most advanced battle positions, it serves as a homing beam for the enemy and its increased use may give advance warning of

military action. Telephone wire, therefore, is strung right up to the front lines and frequently this is done by Signal Corps men who actually become combat troops.

Among the many Bell System men both in and outside of the Army who have contributed to the construction and installation of the Alaska Communications System along the Alcan Highway have been those in the affiliated unit responsible for the maintenance and operation of that system, with its open-wire carrier circuits over 2,000 miles long. They have experienced the cold and storms of the region and have struggled with problems presented by hard frozen ground and swampy muskeg, automatic cut-outs on motor generator sets in overheated tiny arctic huts, and the mountain glacier across which a line was built with ten reels of wire dropped from an Army bomber at the suggestion of a Signal Corps Lieutenant.

In North Africa

In North Africa the Signal Corps met, for the first time in this war, all the communications problems of an offensive involving large forces, intensive aerial activity, and the use of mechanized equipment covering long distances at great speed. A new theater of operations, thousands of miles from the major sources of supply, had to be established, and the special difficulties of rugged mountains and burning deserts had to be overcome. Here Signal Corps units, working against time, installed large switchboards at theater and army headquarters, often without complete drawings or equipment, substituting other items for standard ones that had been lost or delayed, and set up smaller boards at command posts near the front.

Although the French open-wire lines were an important factor in establishing communications in the area, many of them had to be repaired and new cross-arms and wire added. Both French and American cross-arms, hardware, and wire were used on these lines.

Somewhere in Australia, this is an important part of an American aircraft warning unit

In addition, the construction forces built a number of completely new fixed lines, both overhead and underground, and set up many miles of rapid pole-line construction, which substitutes two by fours for poles.

Sometimes this work was carried on under enemy artillery fire or dive-bombing attacks. At least one construction unit added the task of picking up land mines to that of line construction following a German retreat near Gafsa in March.

One of the Signal Corps' achievements in North Africa was the fine air-raid warning system quickly established there. This effectively spotted the enemy planes while they were still many miles away and enabled our air forces to drive them back, usually before they could attack major installations or troop concentrations.

Another achievement was the provision of adequate communications equipment and supplies where they were needed by both the Corps itself and the communications personnel of combat units. This required careful estimates of demand and energetic efforts of key personnel at every stage of distribution. The final stage frequently involved establishment of signal supply dumps not far from the front lines, where units in the area generally called for their own supplies. At one such dump, shipments averaging ten tons daily were handled by a depot unit of one officer and fifteen men. British as well as American officers in North Africa commended the excellence of our signal equipment, which stood up to an unprecedented degree under the conditions of desert warfare.

THE CHARACTERISTICS of Signal Corps operations in this theater are vividly portrayed in the following extract from the report of an officer:

"As I dictate this letter in our field set-up here in the woods tonight, we are in the midst of a mobile, fast moving operation with a very fluid front. This operation might be compared to a football game where the Corps Command Post is in the position of quarterback, well back of the line of scrimmage, directing a play with its full force on one end of the line; and then, without waiting to call a new set of signals, the play is suddenly shifted to the extreme opposite end of the line—some dozens of miles across from end to end.

"At the moment, the Corps Wire Officer is making his shifts of circuits by a series of telephone calls to various key points where, with the aid of an interpreter, he hopes to switch over the connections necessary to insure telephone and telegraph service at the other end of the lines for the major units within the next three hours. The Corps Radio Officer is also at the phone arranging details to cover emergency radio communication on one end of the line where the enemy has suddenly withdrawn and where communication at the moment is rather uncertain, since wire installations had not been entirely completed.

"Corps radio, wire, teletypewriter, and message center teams are moving at this moment to the other end of the line, to an advance Corps signal center being established there from which we will give more detailed instructions to the teams later tonight as the tactical plan unfolds. Our message center people are planning the revision of their scheduled messenger runs to take care of the new developments. By midnight we hope to have both ends of the line well in hand.

"Such a change of tactical plan in-

troduces new controls as units normally operating under division control suddenly revert to Corps control while still in the field of battle, and units under Corps control switch to division control. The very few open wire commercial circuits available must be assigned to all the different services in the area. Since all circuits are always in use, this presents a tricky wire problem. This office controls the assignment of all commercial long line facilities in our area of operation."

Bell System men in affiliated units played a part in all the types of activities mentioned. They share in the high tribute paid at the close of the campaign to all Signal Corps men there by General Sir Harold R. L. G. Alexander, Deputy Commander under General Eisenhower and in charge of all ground operations, who said, "The victory is of your making, too, and its fame and glory belong to each one of you."

Men in Staff Work

THE AFFILIATED OFFICERS appointed to staff positions in the office of the Chief Signal Officer are carrying on a great variety of activities, ranging from the development of new wire and radio equipment to responsibility for supervision of all office service work in the Signal Corps' Washington headquarters. The problems with which they are concerned include study of the requirements for critical materials in the manufacture of signal equipment; analysis of the relative urgency of the needs for different types of this equipment and of those needs in our Army, our Navy, and the allied nations; and development of programs to insure that all

AN UNDERGROUND radio station is being set up at a newly established American airfield in North Africa

the equipment needed for particular purposes is shipped on time and is so distributed in convoys that losses are minimized if ships are sunk.

Other officers in this group are concerned with the training and personnel problems of the Signal Corps, are responsible for appraisal of the organization and operation of their divisions, or are acting as executive officers for them. A few have been assigned to special field duties. At least two have made extended inspection trips to bases and theaters of operation. One of these trips involved eight weeks in Australia and the Southwest Pacific to determine just what equipment and supplies were needed for the fixed communications systems in that area and to assist in planning for their movement.

THE MORE THAN 200 Post Signal Officers appointed under the "affiliated plan" for duty at Army air bases all were given a special training course nine weeks in length at Fort Monmouth, and generally have been at their stations too short a time for news of unusual activities to be received from them. Their duties involve general coördination of all communications work at the air base, including procurement of signal equipment, maintenance of the local communications system, and operation of the message center.

Although most of these men undoubtedly still are at bases in this country, a number have been sent abroad to those in theaters of operation. A few have been diverted to other assignments because of their special background and unusual needs for men of their type. One is concerned with studying the personnel requirements and commissioned officer assignments in one of the five principal divisions of the Office of the Chief Signal Officer. Another is responsible for difficult land-line and submarine cable construction work at a base in the Caribbean.

Each man with whom it has been possible to discuss the challenge of his work in this war has emphasized flexibility and the capacity for rapid adjustment as the most important element for success in meeting that challenge. New and difficult environment, new types of work, new problems, the lack of familiar tools and supplies, have all made this quality essential. On the whole, there seems reason to believe that the Bell System men who have volunteered under the "affiliated plan" have possessed much of it, and their solid foundation of telephone knowledge and skill has given them the chance to exercise it.

Although the proportion of enlisted men selected for officer candidate school from the unit already mentioned undoubtedly was exceptional, the substantial number of such selections from the units generally and the frequent promotions among both officers and enlisted men in the affiliated cadres are evidence of their calibre.

The Plan's Values

NO ONE can predict what may be necessary to win this war. But it seems probable that the men already enrolled under the "affiliated plan," together with those who have entered the Signal Corps in other ways, will provide it with much of the special experience and skill required. Future increments in its force should come principally through selective

service into the outstanding chain of training schools it has established. There may be special needs for men familiar with particular types of telephone equipment, but the numbers involved are likely to be a fraction of those of 1942 and 1943.

To the group of men now on duty, every Operating Company, the American Company's general staff, the Western Electric Company, and Bell Telephone Laboratories have contributed. Although not included in the numbers given, the independent telephone companies connecting with the Bell System have provided men for the cadres of a good many additional units. Within the System, the number of volunteers with the necessary experience who could be spared naturally has varied from company to company with the pressure of service needs from war industries and military camps, but each has done its share.

No true estimate of the worth of the plan may be given until victory has been won, but some of its values may be suggested even now. For the System companies, it has meant that the science and art of communications built out of sixty-five years of experience and effort could be effectively shared in the defense of the nation, while its loss of highly skilled personnel did not seriously injure their big war job at home. To the men came the satisfaction of using all they had of knowledge and skill to the best advantage in the cause for which they offered whatever might be required of them.

Of the plan's value to the Signal Corps, after the first year of its operation, the Chief Signal Officer of the Army wrote as follows:

"The situation a year ago placed great responsibility upon the Signal Corps. A large share of this responsibility fell upon the communications industry, which, when called upon, came forward without hesitation to supply the highly skilled individuals to serve where their special abilities would be of maximum value. The men who have volunteered their services to the Signal Corps in an effort to make our country stronger and safer, are to be congratulated for their unselfish and coöperative spirit. These men are setting an enviable record which is both a credit to themselves and to the American Telephone and Telegraph Company and the subsidiaries.

"The splendid qualifications of your employees who have entered the services of their country indicate the excellent training they have previously received through the years of affiliation with the Bell System. This was the calibre of man the Signal Corps needed in order to place in operation the units now fulfilling their duties in various theatres of operation and in the Continental United States."

The Bell System is proud to have that statement and proud of the men who have won it by their ability, their grit, and, when necessary, their lives. Yet these "affiliated plan" men and the other System employees in its ranks are a small part of the Signal Corps. They acknowledge their debt to its top leadership, its officers and enlisted men from the Regular Army and reserves, and its other new recruits. They salute the magnificent job the Signal Corps has done.

Cables, Switchboards, Other Equipment—Mainly Salvaged and Reconditioned—Are Held at Strategic Locations to Restore Service in Case of Sabotage or Enemy Damage

War Emergency Stocks in the Bell System

John W. Campbell and Linus E. Kittredge

When storm, flood, or fire destroys communication facilities, reserves of material must be quickly available to permit the prompt restoration of service. In peace-time, it has been the experience of the Bell System that it can meet such material requirements by temporarily depleting the central stocks of wire, cable, and other plant items which the Western Electric Company, the manufacturing and supply unit of the Bell System, maintains to fulfill the regular day-to-day needs of the construction and maintenance operations of the System's Associated Companies.

If the emergency is very great—as it was, for example, in the New England hurricane of 1938—the supply forces fall back on other lines of defense. They draw on the materials intended for construction projects which are under way in other parts of the System. They also secure materials in process of manufacture: not only outside plant but, if it is required, central office equipment as well. These are rushed through to completion and diverted from their intended use in order to meet the particular requirements imposed by the emergency.

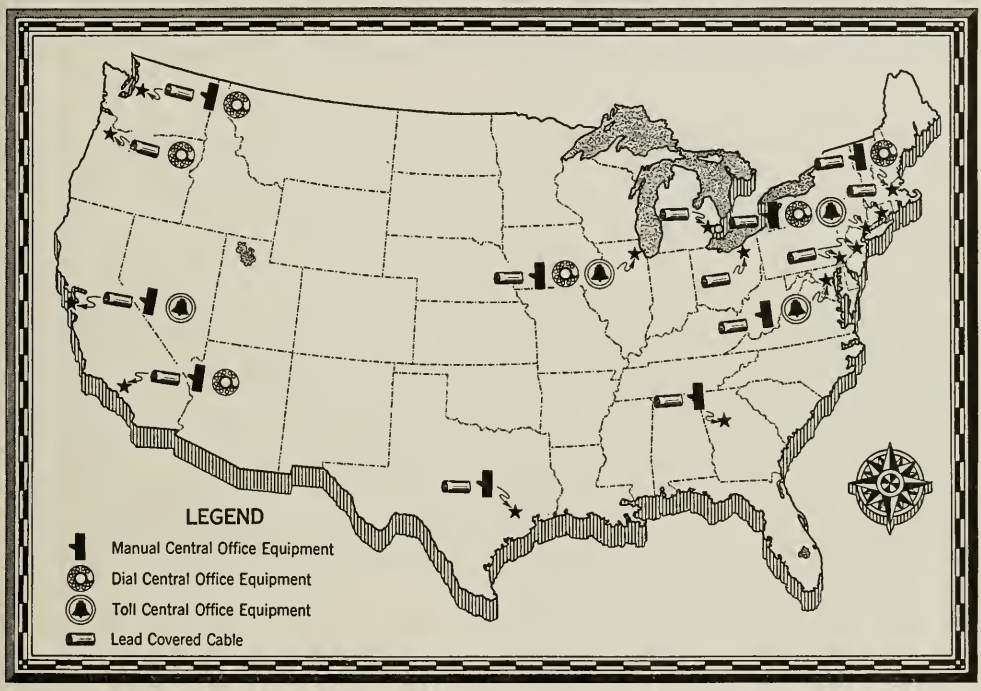
Thanks to standardization, materials derived from these various sources, wherever they may be in the Bell System, form a pool which can be drawn on as necessary to meet a crisis anywhere. Experience over the years has amply demonstrated the System's ability to cope with the most severe peace-time emergency needs.

In war-time, the picture changes. Stocks of materials are shrunk, in

keeping with the lesser requirements of a sharply reduced construction program and the necessity to conserve critical materials. For example, measured in terms of the materials required, the programs of additions to exchange cable and central offices in 1943 will each be only about 5 percent of the 1941 programs. Correspondingly, the amounts in the central stocks, the volume of materials delivered to the field awaiting installation, and the volume in process of manufacture have undergone sharp reductions. Instead of manufacturing equipment for the Bell System, the Western Electric Company has turned largely to the production of war materials.* In short, for many categories of materials the normal peace-time reserves are no longer available to meet emergency requirements.

In time of war, communications companies have to be ready to repair damage not only from the attacks of the elements but also possible attacks from other sources: sabotage and enemy action. Again, materials are required, but materials of a different character.

The Battle of Britain demonstrated that central office equipment and large-size underground cables, which are not likely to meet with concentrated heavy damage during peace-time, are the very types of telephone plant most likely to suffer under bombing attack. It became ap-



Stocks of cables and central office equipment are held at strategic locations

* See "Allo Maroc!" page 149.

parent in the spring of 1942 that, with the prospective rapid drop in the construction and manufacturing program, materials in process would soon cease to provide an adequate source from which to meet possible demands for war emergency material, and that some special means must be set up to provide a pool which could be drawn on in the event of destruction of telephone plant as a result of war.

sult, it has been found possible to provide about two-thirds of the total stocks, in terms of dollar value, by the use of salvaged plant reconditioned as necessary.

In view of the unusual purpose of the war emergency stock—solely to provide a form of insurance against enemy action which might take place anywhere in the System, and to have a common integrated pool of cable and equipment which can be thrown

READY FOR IMMEDIATE SHIPMENT by truck or rail: part of the 300,000 feet of used lead-sheathed telephone cable, inspected and tested, which is stored at locations in various parts of the country

After discussions between staff members at A. T. and T. headquarters and a number of the Associated Companies, it was decided to set up a war emergency stock of exchange underground cable and of various types of central office equipment amounting in total to about $3,000,000. Because of the critical material and manufacturing situation, every effort was made to obtain these stocks from used materials. As a result, it has been found possible to provide about two-thirds of the total stocks, in terms of dollar value, by the use of salvaged plant reconditioned as necessary.

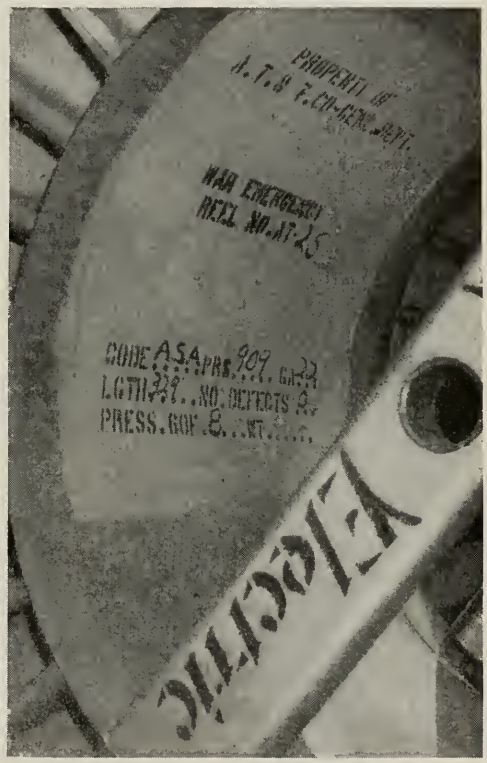
In view of the unusual purpose of the war emergency stock—solely to provide a form of insurance against enemy action which might take place anywhere in the System, and to have a common integrated pool of cable and equipment which can be thrown into the breach wherever it may be required—the decision was reached to have the American Telephone and Telegraph Company purchase and own these materials, but to distribute them strategically throughout the country at locations which would make them available to all with minimum delay in the event of need.

The broad outline of the plan for a war emergency stock which the Bell System proposed was concurred in by

the Communications Division of the War Production Board in July, 1942. Prior to its formal approval by the Board and the granting of the preference ratings required to cover certain necessary purchases by the A. T. and T. Company, engineers from the Associated Companies and from the headquarters group worked out the details of the large number of items of equipment and cable—used material so far as practicable—to be transferred to the war emergency stock: a nice problem of providing the maximum amount of insurance with the minimum of those materials falling in the critical category.

THE FORMAL APPLICATION was granted by the War Production Board on March 10, 1943. With minor exceptions, the stocks are now definitely stored at the selected locations and ready for immediate use. Since the Western Electric Company has facilities and trained personnel to handle the disbursement and transportation of materials such as these under emergency conditions, the stocks have been placed under the custodianship of that organization. As requested by the War Production Board, the stocks will be available to any telephone company, Bell or independent, in the event of need arising from war damage.

If an emergency stock is to fulfill its purpose, it is necessary not only that the stock should include the materials needed but, of almost equal importance, it must be known exactly where each item is: not only what you have but where you have it. Detailed records have been set up at System headquarters, and also placed in the hands of the Western Electric Company and the Associated Companies of the System, giving the location and exact make-up of each item of manual and dial central office equipment, each unit of power plant, each reel of cable, each essential piece included in the emergency stocks.



CLEARLY MARKED on the inner surface of the reel, each section of cable can be quickly identified as to length, make-up, and condition

Particular attention has been given to so packaging and storing the materials that those which would be required first can be started on their way to a scene of damage as soon as word is received as to what to send and where to send it.

In the map on page 179 are indicated the locations of war emergency stocks of cable and equipment. The reasons for the concentrations along the coastal fringes and in the busiest war industry areas of the Great Lakes region—as well as for indefiniteness of the locations on the map—are probably self-evident.

Emergency Cable Stocks

A TOTAL of about 305,000 sheath feet—nearly 60 miles—of non-quadded exchange cable, ranging in size from 300-pair 19-gauge to 1800-pair 26-gauge, is on hand. The distribution of the emergency stock among the different sizes and gauges of cable follows the broad pattern of the working exchange underground cable it is designed to protect; but since the cable included in the pool was restricted to such used cable as was available, it was necessary in some instances to vary somewhat from this ideal distribution if the desired total length of cable was to be secured. The cable included in the emergency stock was not only subjected to careful visual inspection but to rigorous electrical tests, and to gas pressure tests for sheath condition, in order to insure its immediate availability for use.

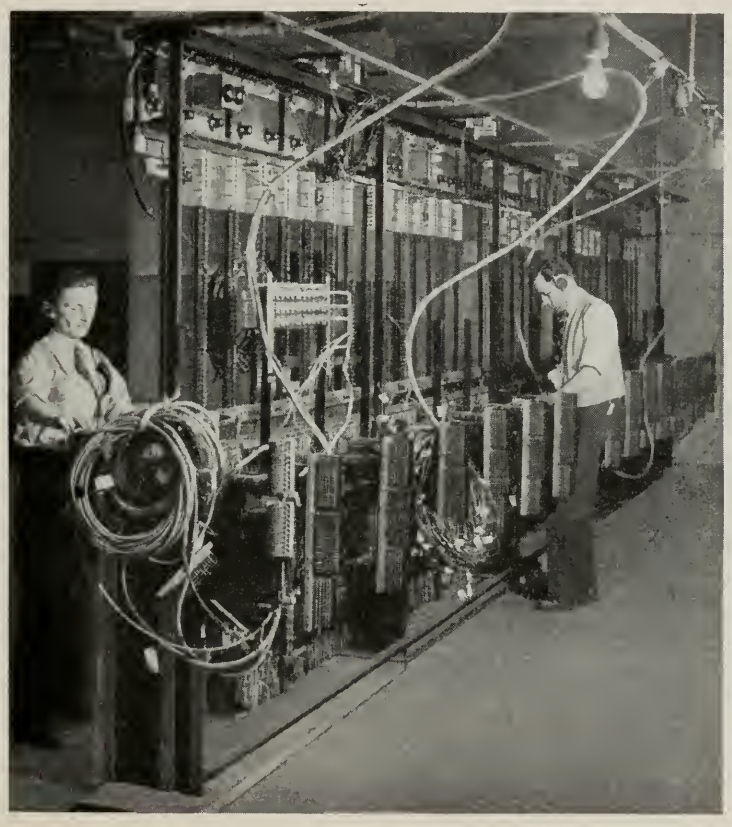
It was not considered necessary to include in the stocks small-size cables of the type used for aerial distribution, since such cables are not concentrated in heavy common runs, as are many of the large-size exchange underground feeder and inter-office trunk cables; and for the further reason that these small distribution cables are generally so located as to be readily accessible and therefore lend themselves to patching or piecing out in the event of damage. Also, even under present conditions, the working supplies of the telephone companies and the Western Electric Company of these small-size cables would be adequate for the repair of a considerable amount of damage.

Neither was any toll cable included in the emergency stock. This omission was in part because toll cables are not so concentrated as are exchange cables. Moreover, because of their great variation in size, type, and design, it is normal procedure to stock sizable amounts of toll cables for the emergency restoration of service, including both lengths of specific cable and also an all-purpose quadded emergency cable designed for general use for quick restoration of toll circuits.

British experience was important among the things which were considered in reaching the decision to confine the war emergency cable stocks to exchange cables of the larger sizes. A report on a major telephone plant restoration in London following a bombing attack in December, 1940, appears in a British technical journal received at the time this article was being prepared. This report provides further evidence that large size exchange cables and central office equipment represent the material items most needed for prompt service restoration after a bombing attack. Because of the scarcity of materials, Bell System engineers naturally wished to limit the war emergency stock of cable to the minimum which seemed adequate.

The photograph on page 180 shows some of the reels of cable in storage at one of the several concentration

points. Every reel is in the clear, and in case of emergency can be loaded directly on a truck or cable trailer at a moment's notice and without unnecessary handling. To facilitate locating quickly the particular length, size, and type of cable desired, and to avoid possible error under the stress of emergency, each reel is plainly stenciled with the necessary identifying information, as pictured on page 181. This plain marking of each reel also serves the purpose of identifying each item in connection with periodic inventories.



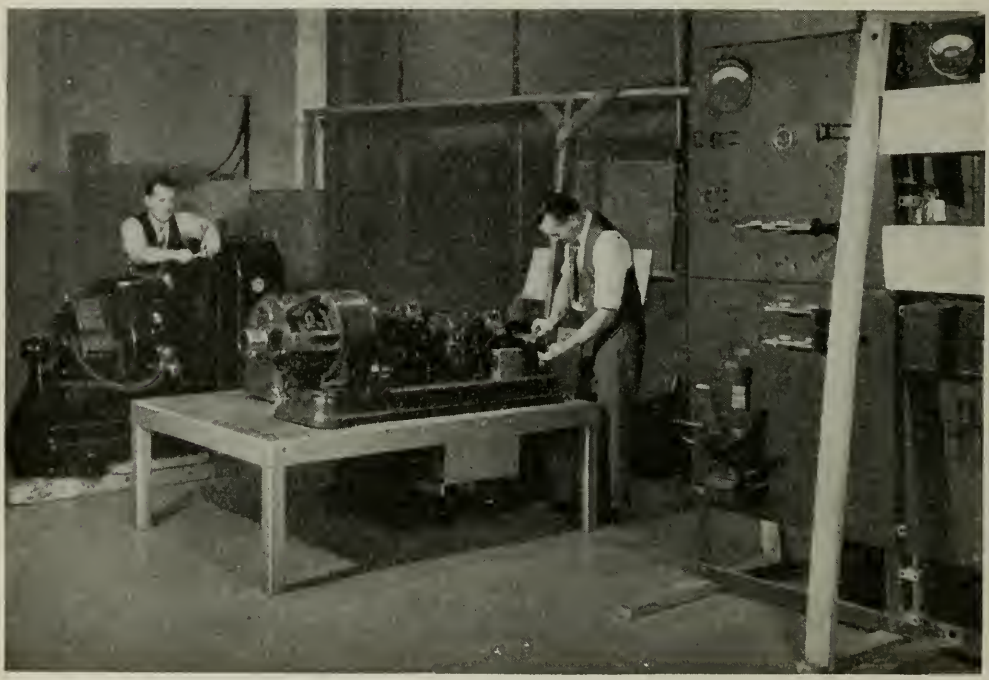
A SECTION of used No. 1 manual switchboard is here being rewired before being stored away ready for immediate use

Central Office Equipment

SPEED CAN BE GAINED in restoring a destroyed central office to service if the equipment to be installed is pre-engineered to workable sizes of units and all of the necessary material for a complete installation is selected, crated, and clearly marked.

Central office war-time emergency stocks were designed to meet these

requirements. In preparing the various packaged units of central office equipment, all shop assembling and connecting that is practicable has been done in advance. Cables have been connected and coiled for immediate use. Every step has been taken that could facilitate portability and quick installation of the units. Items of miscellaneous equipment required for quick repairs have been boxed and distinctly marked and numbered, somewhat as is shown for the cable-reel marking shown on page 181.



TELEPHONES USE POWER to operate. In this picture, units of power equipment are being reconditioned: left, a battery charging generator; center, a ringing machine; right, a power distribution panel

When a central office, either manual or dial, is completely destroyed, it can be restored to service most quickly by the use of manual equipment. Less detailed engineering is needed to adapt the equipment to local conditions; and, since it is less complicated technically, the time required for installation is shorter. Manual equipment also lends itself better to the necessity for pre-engineering into packaged units. Plans for restoration of a completely destroyed central office are based, therefore, on the use of manual equipment.

Eight prefabricated and packaged units of the large capacity No. 1 type of local manual central office equipment, each capable of furnishing serv-

ice to 1200 lines in a multi-office metropolitan area, have been provided. The picture on page 183 shows a portion of one of the used switchboards in the process of being assembled, wired, and connected in the shops. On page 184 is shown the ringing machine and a portion of the power equipment for the same unit. Part of a completed packaged unit being placed in storage is pictured on this page.

Additional No. 1 manual equipment has been provided—but not packaged—for enlarging the packaged units where necessary. The amount of this equipment is approximately equal to 15 of the packaged units. For the smaller cities which are served by one central office building, five complete prefabricated and packaged units of the smaller capacity No. 12 type of local manual central office equipment, each unit capable of furnishing service to 1000 lines, are being provided.

A COMPLETE central office unit, packed for immediate shipment and installation. Comprehensive lists are maintained of the equipment and materials in each of the numbered cases. Box 70, for instance, contains power equipment

As it is considered desirable to provide manual service for any swift restoration of a completely destroyed office, no attempt has been made to stock dial equipment for this purpose. To restore service in partially damaged dial central offices, however, frames, shelves, selectors, banks, and

other miscellaneous material for step-by-step, panel, and crossbar offices have been provided. It is interesting to note that the crossbar stock consists of two complete partial units which were manufactured and shipped to Associated Companies; but government restrictions halted their installation, and they were thus available for the war emergency stock. This material will be retained in its present state and location for the duration, and will be resold to the telephone companies if not required for restoration use.

TOLL SERVICE is of particular importance in war-time, and elaborate precautions must be taken to insure that no important community becomes isolated through damage to its telephone facilities. This problem has been studied city by city, and arrangements have been provided so that emergency calls can go through under the severest conditions of war-time damage. Quick restoration of a substantial toll service beyond these emergency needs presented a difficult problem. It was solved by the design of special switchboard circuit facilities undertaken months before Pearl Harbor.

Four complete units of No. 3 type toll inward and tandem equipment incorporating specially designed circuits, pre-engineered and packaged with all necessary material for installing them, have been provided. Each unit, in association with existing manual or DSA switchboards or any type of emergency central office or PBX position, will handle 500 or more outward calls per hour and a corresponding number of inward calls.

Various miscellaneous equipment required in repairing damage and quickly restoring service has been provided. One example is the subscriber long-line circuits which will permit telephones whose regular central office has been destroyed to be connected to a more distant office. Distributing frames, protectors, cable tips, jumper wire, switchboard cable, power plants, and other such material for repairing or replacing vital parts of central offices which may have suffered war damage are also stocked. In general, this material too is all packaged and the boxes numbered for easy identification and immediate shipment.

Stocks of Open Wire

CLOSELY RELATED to the provision of war emergency stocks on a System-wide basis is the program undertaken by the Associated Companies, as a consequence of the growing scarcity of metals, to establish stocks of used copper wire to be held for storm restoration needs of the System's 2,500,000 miles of toll open wire.

These reserves have been built up chiefly from wire which became available when the circuits on certain open-wire lines were transferred to recently completed paralleling toll cables. This wire was carefully removed, inspected and repaired, reeled into coils, and is held at numerous locations in the territories of the various Bell System companies. A collective total of about 550 tons of wire was made available for this purpose by the several companies before the 1942–43 winter storm season.

Since the amount of this wire held by any one company might prove in-

adequate in the event of a particularly bad storm, arrangements were made whereby one Bell company can quickly draw on the emergency stocks of neighboring companies if its own reserves of wire should prove insufficient to meet its requirements for storm restoration. Fortunately, the storms of the past winter did not result in heavy destruction of toll open wire, and only one inter-company exchange proved to be necessary.

The companies plan to have wire reserves of approximately the same amount—i.e., 550 tons in total—available for the coming winter. All of this will be salvaged wire. Although it will represent less than a quarter of one percent of the toll copper line wire mileage in service, it should, in the light of past experience, prove adequate to meet the immediate requirements of storm restoration.

EXCEPT FOR the copper line wire just discussed, the emergency war stocks here described have been assembled, stored, and set aside wholly and solely for use in restoring telephone service to operation after damage resulting from sabotage, air raids, or similar cause. The materials and equipment represent a substantial sum of money. Obviously, they are unproductive—from the near viewpoint, at any rate, of providing relief to the System's presently overburdened plant. Yet if no reel of cable nor switchboard section nor so much as a bolt or screw were ever to be taken out of storage until the day of peace—as it is devoutly to be hoped they never will—they stand as a wise and necessary investment.

For upon the Bell System rests the responsibility for so much of the country's telephone service, and the continuity of that service is of such incalculable importance to the nation at war, that the System must make adequate provision against every foreseeable contingency. In the creation of war emergency stocks lies one more indication of full recognition of this responsibility.

INVESTING WELL for the future means getting the best personnel, the best materials, the best credit. The best is usually higher priced but less costly than poor credit, poor personnel and poor materials. The theory is to pay fairly for quality and get it, because quality well managed means ultimate economy. That is the long view. A hit-and-run management with a short view can make immediate savings by chiseling on the cost of credit, by chiseling on wages and salaries and chiseling on materials and margins of safety in plant and operation, and cutting down on the staff work and research—the men whose job it is to work for improvement. But such immediate savings will cost heavily in the long run.

From "The Bell Telephone System," by Arthur W. Page, Vice President, A. T. & T. Co. Harper & Brothers, publishers, 1941.

The Re-design of a Screw and the Re-use of Tons of Copper Wire Are But Two Examples of Bell System Conservation of Materials Which Are Vital to the Winning of the War

Getting Along with What We Have

Bayard A. Freed

ONE OF THE very many ways in which the war is affecting the Bell System was stated succinctly by President Walter S. Gifford of the American Telephone and Telegraph Company when he said, on a "Telephone Hour" radio program not long ago: "For the duration of the war, we shall undoubtedly have to get along with substantially the plant and facilities we now have."

Mr. Gifford's reference was, of course, to the now well understood fact that copper, steel, aluminum, tin, rubber, and other materials normally consumed in large quantities in telephone construction, "have gone to war," and that the manufacture and installation of new plant and equipment are strictly limited to uses which either contribute to victory or are essential to public welfare and health.

To get along with substantially the plant and facilities now in use, in the face of the rising flood of demands upon telephone service resulting from the war, calls for ingenuity of a high order—and for plenty of it. It also calls for many departures from the materials and practices which, as both experience and research have demonstrated, provide the best possible service most economically.

A list of the multitude of things that have been done to save materials would fill many pages of this MAGAZINE, and a complete description of them would fill a book. Thousands of pieces and parts of apparatus have been re-designed to substitute the more abundant and less critical materials for the more critical; equipment has been re-designed to use less material; parts are being made to do longer service before being replaced; material which would normally be scrapped for salvage is being repaired and put back in service; and many

new maintenence and engineering practices are being employed.

A few selected examples will serve to illustrate some of the new practices, equipment, and techniques which are making it possible to use so little material as compared with what would normally be required to take care of the great increase in telephones and long distance calls.

THE HOUSING of the outdoor telephone set is now made of wood instead of metal

Telephones

YOUR TELEPHONE SET is a good example with which to start.

In the latter part of 1941, the new "combined" telephone sets were being manufactured at a rate in excess of 2,000,000 a year. That rate rapidly diminished during 1942, and manufacture ceased last Fall. But the number of subscribers has continued to increase at the rate of more than a million a year. How has it been possible to serve them without making as many new telephones as usual? The principal answer is found in the fact that about 750,000 of the earlier types of telephones, including many of the upright desk-stand type, which were displaced by more modern sets, were not thrown out but were set aside so that they would be available for use in an emergency. Thanks to that foresight of some years ago, these earlier sets are now being reconditioned and placed back in service, and stocks of them are being transferred from one Associated

THIS INGENIOUS little contrivance paints drop wires while they are in the air, so that they need not be lowered to the ground

Company to another to equalize the available supply.

Working stocks of telephone sets have also been reduced in order to place every possible telephone in use. Normally each installer had a few spare sets in his installation truck or in his locker to meet such contingencies as breakage, changes in orders, tions where left-in equipment would otherwise be available.

Less new material is being used to repair telephones than was formerly the practice. The flexible cords on your telephone once were replaced when they became frayed, but now they are not replaced until they become electrically inoperative; cords

SALVAGED DROP WIRE not in serviceable condition is returned to a Western Electric repair shop, where it is carefully inspected and spliced into convenient lengths

or special orders. Now he carries only enough sets to meet actual service-order needs. Moreover, the number of sets left in place in vacant premises where there seems to be some likelihood of reconnection before long has been decreased. This sometimes makes it necessary, however, to re-install telephones at locawhich are merely frayed are wrapped with tape. Parts within the set are also being allowed to wear longer before being replaced.

Some customers need telephones in out-door locations, and a special set has been provided for this purpose. The set as manufactured in the past was specially designed to withstand

the weather, and required the use of many special parts. Recently, however, it has been modified so that it may be assembled from parts which are commonly used for other purposes. The housing was originally of aluminum; when that became scarce, cast iron was used instead; and now, because of the scarcity of iron, the housing is made of wood.

SPECIALLY DESIGNED APPARATUS is used to re-impregnate drop wire with weatherproofing compound. Left to right: pay-out reel, compound tank, setting tank, and take-up reel

Drop Wire

WHAT IS BEING DONE in the case of drop wire provides another good example of how the System is continuing to "get along with what we have."

Drop wire, the important last link between the telephone line and the customer's premises, consists of twin copper-clad steel conductors separated by rubber insulation. Over the insulation is a fabric braid impregnated with a weather-resistant compound. Continued exposure to the weather results in the leaching out of this compound, with the result that sunlight penetrates the braid and causes deterioration of the rubber insulation. In normal times, a drop wire which is deteriorated and worn is replaced by a new one, because it is cheaper to use the small amount of new wire that is required than to spend time making repairs. In these

times, however, worn sections are cut out and new sections are spliced in, if the drop as a whole is not too badly deteriorated.

The life of drop wires which are not so badly worn as to require replacement is being prolonged by painting them with a compound. Two new tools have been developed for this purpose. One is intended for use on drops which must be lowered to the ground for inspection or repair. The other permits painting drop wires while they are in the air.

Normally, recovered drop wire showing signs of deterioration or wear is scrapped for salvage. But now, all wire removed from service is carefully picked over, to salvage all sections which might possibly be reused. These good sections are spliced together and the braided covering is reimpregnated with a compound by means of recently designed machines located at strategic points throughout the country. Last year some 35,000,000 feet of worn recovered drop wire were reconditioned and re-used. Its re-use saved 80,000 pounds of copper, 150,000 pounds of rubber, 220,000 pounds of steel and large quantities of less critical materials.

Reforming Small Springs

IN PANEL TYPE dial central office equipment are small, paper-thin, finger-like bronze springs about two inches in length, commonly known as commutator brush springs. When you twirl the dial on your telephone, you cause these springs to move up along a bar somewhat like a yardstick; when they cease their travel and you begin your conversation, they form a part of the electrical path over which you talk. When you hang up, these little fingers slide back down the bar to their original position. In the course of time, the 1/32-inch crooks on the ends of these finger-like springs wear off from repeatedly sliding up and down on the bar on which they press, and when this occurs noise and other troubles may develop.

It was formerly the practice, when these little springs were worn down to the point where they were likely to cause trouble, to take them out and install new springs—this being more economical than repairing the old ones. To conserve copper and tin required to make replacing springs, worn springs are now taken out and, after being reformed and recentered, are placed back in service instead of being scrapped. Because the springs are so small, and because of the accuracy with which the work must be done, the job of reforming them borders on watch-making technique. The amount of metal saved by avoiding replacement of a single spring is, of course, small. But the annual savings assume real significance when it is realized that of the 1,500,000 of these springs in service, about 50,000 must be repaired each year.

The commutator brush spring is just one of many similar springs and contacts that are being reformed or repaired, and methods for repairing still others are in process of development. Another instance of a seemingly small saving is the case of a little screw used for fastening one end of the cord on your telephone. This screw was originally made of brass, an alloy of copper and zinc, but is now made of zinc-coated steel. This change saves more than 8,000 pounds

of copper yearly, although the amount of copper in each individual screw weighs no more than a common pin.

Supplementary Cabinet for Handling Long Distance Calls

WAR INCREASED phenomenally the number of long distance conversations in 1942. To handle this great increase in calls, much larger quantities of critical materials would have been required for additional switching equipment, wires, and cables than were actually used, had not various expedients been adopted. Among these expedients are changes in the methods of handling long distance calls in order to avoid using additional materials. Generally, these changes increase somewhat the time required to complete calls and add to the number of operators that must be used for this work.

A good illustration is the small table-mounted cabinet used to augment switchboards handling outgoing long distance calls, the use of which avoids installation of additional switchboard positions. Each cabinet serves two operators, and these operators, with limited assistance from operators working at the regular switchboard positions, can generally do all work connected with handling outgoing long distance calls.

THESE SUPPLEMENTARY CABINETS used for handling long distance calls contain less than one-sixth of the metal in regular switchboard positions—although requiring twice as many operators to handle the same volume of traffic

Because of certain limitations, the operation of the cabinets requires double the number of operators that would be required to handle the same number of toll calls on regular switchboard positions. In these times, the disadvantage of using twice as many operators is outweighed by the fact

that each cabinet contains only 60 pounds of critical metals, whereas there are about 400 pounds in a switchboard position.

Re-using Copper Line Wire

LARGE QUANTITIES of copper line wire are removed from service by the Bell System each year as open wire lines are replaced by cable, because of shifts in locations of the lines due to road changes, and for other reasons. Normally, recovered copper line wire is scrapped, because its salvage value is high as compared with its cost new and because the cost of removal is greatly increased when it is necessary to avoid the nicks, breaks, and snarls which may occur and which make the wire unfit for further use as line wire.

Early in 1941, when the shortage of copper began to develop, the System was using copper line wire at the rate of about 25,000,000 pounds a year. In order to reduce the requirements for new copper wire, steps were taken at that time to develop methods and equipment which would permit taking the wire down in such condition that it could be re-used. This resulted in the re-use of about 9,000,000 pounds of copper line wire in 1942 for making essential additions to long distance circuits. Currently the System's entire needs for copper line wire are being met from wire thus recovered.

The new methods for getting the wires off the pole lines differ materially from those used ordinarily, and many of them were worked out by linemen and foremen on the job. Pages from their notebooks of experience were consolidated in a single set of instructions by the staff engineers of the A. T. & T. Company, and were in turn disseminated to line crews throughout the System. One bothersome problem encountered in developing the new methods was that of preventing the wire breaks which occurred when wire ends projecting from the old type (twisted sleeve) joints caught on the cross-arms. This was solved by one experienced foreman who said, "When we used to put up wire with twisted sleeve joints, we sometimes used marline to cover up the sharp ends of the joints. We can do the same thing to get it down." This illustrates well how practical ideas contributed by craftsmen are helping to conserve materials.

The "Victory" Joint

FOR YEARS—since long before the first telephone cable was made—it has been the practice to join lead pipes together by means of solder. This technique, borrowed from the plumbers, has also been used for years in making joints in lead covered cables. Sufficient solder was invariably used on each joint so that, when finished, it had a rounded, ball-like shape.

When it became apparent that there was likely to be a shortage of tin, a new type of joint which has become known as the "Victory" joint was introduced. In this joint there is only a small fillet of solder at the junction between the sleeve and the cable sheath, instead of the former ball-like section of solder. The amount of solder in a "Victory" joint is less than 40 percent as much as in the older joint; and inasmuch as the solder used for wiping joints consists of about one-third tin (nearly all of the rest is lead), the "Victory"

joint has been an especially effective measure in conserving the use of tin —of which there is such a scarcity. This new technique saves about 110,000 pounds yearly in the amount of tin that is used for maintaining and repairing existing cables. There is also, of course, the additional saving made in splicing new cables—but there is comparatively little of this being done at present.

THE SPECIALLY designed take-up reel avoids damage to copper wire during removal. Wires are wound into individual coils

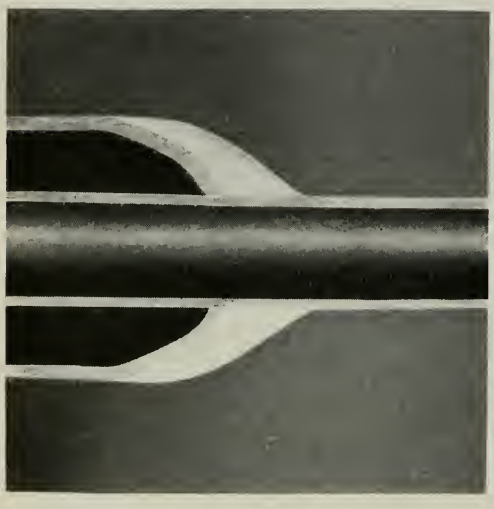
In order to expedite the introduction of this new technique, demonstrations were given at a number of places throughout the country to representatives of all the Associated Companies, skilled in splicing work, so that they could introduce it in their respective companies. These instructors, having learned how to make the new joint, returned to their companies and proceeded at once to teach the technique to the splicers. Within a brief six to eight weeks after the new technique had been introduced, it was in daily use by more than 5,000 splicers throughout the Bell System, most of whom were

highly skilled through years of experience in making the rounded joint.

The "Victory" joint will doubtless be continued in use after the emergency has passed.

MANY MORE EXAMPLES could, of course, be cited, but these illustrate the great variety of things that are being done to save materials, and demonstrate that attention is being given to small savings as well as to large.

All engineering and operating practices have been closely scrutinized, and every individual item of equipment down to the smallest screw has been carefully examined. Modernization programs, such as conversion of central offices from manual to dial operation, have been discontinued. Plant additions since March, 1942, have, in general, been restricted by order of the War Production Board to those essential to the war effort. In combination these conservation measures have reduced the rate of use of copper from more than 90,000 tons per year (the peak rate obtaining in 1941) to the present rate of about 6,000 tons. Use of aluminum has been correspondingly reduced from 1,200 tons to 25 tons, and of rubber from 2,100 tons to 130 tons.



THE OLD SHEATH JOINT had a large cross-section of solder

SOLDER MUST be of exactly the right composition and temperature

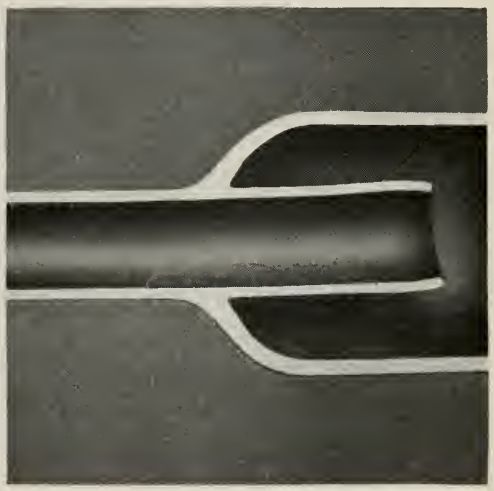
The situation surrounding the supply of raw materials is shifting rapidly. Substitutions are now being made for materials which themselves had previously been used as substitutes, as is illustrated by the housing of the outdoor telephone set. Likewise, other conservation measures are having to be modified to meet changing conditions. So the general staff organization of the A. T. & T. Company, through its close association with engineering and operating per-

sonnel, is constantly seeking new ideas on ways to save materials. All ideas which appear to have possibility of general application are studied carefully and, if needs and possibilities warrant, are developed further. Information on new practices which are found to be of general value is quickly disseminated to all of the Associated Companies.

Development and application of conservation measures have been greatly simplified by the fact that standardization is one of the cornerstones on which the Bell System has been built. Because of the high degree of standardization that pervades the System, ideas and experiences originating in one Associated Company can generally be applied directly by all other companies; a worth-while idea for saving material originating with an installer in Sequim, Washington, may be applied directly by an installer in Miami, Florida, since both men work with the same materials and tools and do their work in the same way.

The development of ways of saving materials has not been confined to any one branch or department of the System. All branches have made important contributions, and there is scarcely a phase of the telephone business that has escaped scrutiny. The Bell Telephone Laboratories, from the fund of information accumulated in years of systematic research, have found substitutes for the scarce materials. The Western Electric Company, through its knowledge of materials and manufacturing operations, has greatly expedited introduction of these substitutions and has developed other changes in manufacture which have resulted in large savings in material. The Associated Companies, with the coöperation and

IT TAKES a skilled craftsman to wipe a joint in a cable



THE NEW "Victory" cable joint has only a thin fillet of solder

assistance of the general advisory staff of the A. T. & T. Company, have devised and put into effect many material-saving modifications of their engineering and operating practices.

All of the ingenuity, all of the strategems and expedients being employed to save materials have been developed with the double purpose of aiding the war effort in the greatest possible degree and, at the same time, continuing to give as good service as possible to as many customers as supplies and limitations will permit. The Bell System, rendering an indespensable communication service to the nation at war, will continue to stretch what it has to encompass what it must do. The materials it uses and those it saves are both contributing to victory.

HERE'S A STORY that has come to light about war communications and a small body of commandos on the island of Timor, north of Australia.

The Japs came suddenly and the party of commandos was cut off—stranded. They had precious little equipment, and no communications whatever to the Australian mainland.

One day scouts came in with a couple of battered old radio sets they'd hauled through 40 miles of enemy territory. "This stuff do us any good?" they asked.

Well, there were five radio men in the squadron. They looked at the tangled mess, scratched their heads, then started to work. Before long, out of scraps of wire, solder, and tin, plus some parts of their old transmitter, they had rigged up something. They got electric power from an old automobile generator. They swiped a battery charger from the Japs. Then, with their hearts skipping a beat, they sent out a signal. It got through. Communications with Australia were reopened after two months' silence.

Fighting men of the United Nations usually have the best communications equipment in the world. But they also have the ingenuity to get along even when they have only odds and ends to work with. In jungles, deserts, and icy wastes our own Signal Corps men are performing miracles every day. We like to keep track of these men and their accomplishments—for of the 50,000 Bell System men and women now in the armed forces, thousands are in the Signal Corps, working on vital communications jobs. And backing them up here at home are 415,000 other workers in the Bell System alone. They are in the war—keeping up the nationwide network of telephone lines that helps tie together all parts of the biggest job this country has ever undertaken.

From a "Telephone Hour" radio program.

Science Is International

Karl K. Darrow

This text of one of a series of radio broadcasts under the auspices of the American Philosophical Society, delivered by Dr. Darrow on June 24, is given here as illustrating another side of the story which was told in "American Science Mobilizes for Victory" in the preceding issue of this MAGAZINE.

I HAVE BEEN ASKED to speak on internationalism in science, or rather in the particular field of science which happens to be mine, the field of physics. The quickest way to handle this subject would be to reverse it, and speak of *nationalism* in science. This would be a conveniently narrow subject, for in science there is hardly any nationalism. The laws of Nature are everywhere the same, and the ways of describing them do not differ from land to land. You may indeed remark that in different lands they are described in different languages. Insofar as this is true it is not important, except as an inconvenience; and it is not even entirely true. The laws of Nature are described by mathematics, and mathematics is a universal language. You can look at a book of physics in some language of which the very letters may be unfamiliar, and still you can tell what the author is treating by following the train of his equations. If you can read his words or get someone to translate them, you find that there is no imprint of nationality on his ideas, any more than on the laws which he happens to be describing.

So, the journals and the books of science are a cosmopolitan literature, and indeed the most cosmopolitan thing which now remains to us. In the happy days before the other war, there were other cosmopolitan things: the gold standard, and the free circulation of art and of artists from country to country, and the worldwide diffusion of travel and trade with limitations so light that they now seem like freedom. These did not survive the other war, or survived it only in a crippled fashion; but the literature of science continued still to pass all boundaries even when its creators could not, a sort of intellectual gold standard by which the worth of every contribution and the standing of every contributor were appraised. Englishmen were not judged by Englishmen exclusively, nor Germans by Germans nor Americans by Americans; the common opinion of the scientific world was the court of first and last resort.

No experiment was disregarded, no idea neglected because it came from the opposite side of a frontier. Few if any scientists strove to keep their ideas confined within their own countries. The notion of keeping a

discovery undisclosed is repugnant, I can without exaggeration say it is revolting, to nearly every man of science. So few are the exceptions to this rule that we still look with wonder on Newton and on Cavendish, who were exceptions to it, and try to divine what peculiar quirk of personality made them such deviations from the norm. Nearly every one in science spoke to all who would listen, and nearly everyone in the entire world of science was ready to listen to a new experiment or a new idea, from whatever part it came.

BUT EVEN SO, were there not some nations which were always the discoverers and the teachers, and others which were always the copyists and the learners? Nothing would seem more natural, and nothing could be further from the truth.

Take the four men whose consecutive labors enabled us to understand the motions of the heavenly bodies: Copernicus the Pole, Galileo the Italian, Kepler the German, and Newton the Englishman. They were astronomers but they were physicists also, for the laws of motion of the heavenly bodies are those of earthly bodies also, exemplified on a grander scale.

Take the story of radioactivity. Radioactivity was discovered because X-rays had been discovered. The discoverer of X-rays was a German, but the man whom his work inspired was a Frenchman. Another Frenchman and his Polish wife carried on the study, and for a time it might have been thought that Paris was destined to be the centre of all wisdom about radioactivity for ages to come. Not for a very long time, however! Not a decade had elapsed before everyone who cared at all about this field was looking eagerly to England, and not because of an Englishman either, but because of a New Zealander whom a fellowship endowed in Britain had brought to Cambridge. The focal point of research in radioactivity traveled with this man to Montreal and then back again to England.

It is Rutherford of whom I speak, the very man who later became the first of all men to achieve the transmutation of the elements. So long as he lived, the great Cavendish laboratory at Cambridge was the greatest scene of transmutation in the world. Now the art and science of transmutation are dispersed throughout all countries; they are cultivated in America most of all, largely because Americans invented the two very ingenious devices which are used to produce the very high voltages demanded for transmutation. It was, however, an Italian who first taught the world to use the most variously efficient of all of the agents of transmutation, the agent which we call "the slow neutron."

I could tell the same sort of story for almost every achievement in physics, and the lesson would always be the same. Progress in science depends on the spirit of the brilliant man; and in this case above all, the spirit bloweth where it listeth, heedless of national boundaries and heedless of racial groups. There has never been a city which was the capital of physics as Vienna for a century was the capital of music. There has never been a nation which was preeminent in physics as France for so many years was preëminent in paint-

ing. Metaphorically speaking, if you walk through the galleries of physics you do not find the masterpieces labelled "French School" or "Dutch School" or "Italian School." There is just one school of physics, and from its inception it has been the school of all civilized nations.

THOSE OF MY LISTENERS who heard the prior programs of this series are probably expecting something more. You may be waiting now to hear me tell of some great scheme or schemes of formal international cooperation, set up and going on for the benefit of physics. But those who speak for other sciences, astronomy for instance, can give you more striking examples than I can. I might indeed mention the laboratories built and the equipment given by the Rockefeller Foundation for physicists in certain European lands—laboratories now, by tragic irony of fate, ruined by civil war or taken over by the Nazis. It is allowable to hope that soon they may again be serving their intended purpose, and that the example of great donations by private wealth across frontiers may survive to be followed by future generations.

More significant as yet has been the living aid interchanged by the nations. I mean the students who have gone from their homelands to some other country, not to sit at the feet of a famous master (as the saying used to be) but to stand beside him and work with him upon some problem of his own selection. Few of the leaders of physics have worked entirely by themselves. Normally, the brilliant physicist requires aid, and the skilled, intelligent aid of men who are almost his peers, to follow out the ramifications of his thought and to perform the experiments suggested by his ideas.

Mostly his fellow-countrymen supply the aid, but not by any means always. Many a Canadian and many an Australian has brought his stone or stones to the edifice reared by a British physicist; many an American has done the like for a German in the days before the other war and in the days of the Weimar republic; many a Chinese and many a Japanese has done it for an American.

The graduate schools of many a university were microcosms of a non-embattled world, little groups composed of many strangers working together in a comity and with a mutual understanding such as we all should like to see realized in the world at large. We ought to try to increase their number after this war, and do away with certain formal restrictions which impeded them from arising in certain parts of the world. Yet if there had never been any such group, or if there were never to be any such group again—even in that deplorable and highly unlikely case, science would still be international. It would be inevitably international, so long as the books and the journals were allowed to cross the frontiers. Every physicist sooner or later, and glad or sorry as he may be, finds collaborators springing up all over the world. They are taught by his experiments and by his calculations, and he is taught by theirs.

It could not be otherwise. Ideas flow about the world like the life-blood in an organism. If from any part of an organism the flow of blood is withheld, that part decays. The

same is true of the organism of science and of thought. If anyone doubts this, let him look upon the demonstration which for the past ten years has been presented by the enemy.

From Malang to Omaha

WHAT PRICE an overseas telephone call? Here is one answer, quoted from "Queens Die Proudly," the saga of the Flying Fortresses of the 19th Bombardment Group of the U. S. Army Air Force, which was stationed in the Philippines in 1941. Most of the squadron's planes were destroyed and many of the personnel were killed when the Japanese attacked Clark Field on December 8, 1941—which was, of course, December 7 on the other side of the international date line. Later that month the remnants of the squadron were ordered to Australia, and then, on December 31, to Java. There they set their planes down on an airfield near Malang and went to a hotel in that city for dinner. The narrative is in the words of Lieut. Col. Frank Kurtz, holder of the Distinguished Flying Cross and the Silver Star, who was pilot of one of those queens of the sky which fought to the death above the Philippines, Australia, and Java; and of his wife, Margo:—

"AS SOON as we'd ordered," said Kurtz, "I asked the manager what was the best way to get in touch with America (I didn't know what the war might have done to the cables) and was completely floored when he asked me why didn't I telephone? Seems he'd talked to New York just two days before. So I rushed to the telephone, and there in the center of Java I gave the operator Margo's phone number in Omaha. It seemed crazy. Halfway around the world. Here in Java it was the evening of one day, and if the call went through Margo would be talking in the morning of the day before. God knows the old Fortress gobbles up time and space, flicking off the meridians like a boy rattling a stick along a picket fence, but the radio telephone could turn night into day with the click of a receiver. I just couldn't believe the call would come through, but meanwhile I didn't have the $27 for three minutes, and went back to the table, where we pooled our money."

"I was doing volunteer work at air corps headquarters in Omaha," said Margo, "when they told me the overseas operator was trying to reach me out at the house. I knew it could only be from Frank. Or about Frank. I ran out of the building. It was five blocks to the parking lot

where I kept my car. I remember I decided I'd better stop running because if I was out of breath I couldn't talk.

"I remember the man in charge of the parking lot looking at me curiously and asking if something was the matter and didn't I want him to drive me home. I guess I must have been crying. I said no but please hurry and get the car out.

"When I got home the overseas operator in San Francisco said a tropical storm was delaying the call, and it might be an hour. It was three. Then I could hear them working, telephone girls talking all around the world, trying to help us, trying to set up a line. You get to love those operators—they're like nurses at the sickbed of someone you love—doing everything they can. Finally it's the girl in Batavia, Java, and then some town I'd never heard of—girls with queer accents—all helping you, and then a hotel switchboard and at last Frank's voice. I couldn't understand the words but that didn't matter at all—that was the least I cared for. Because you can get a cable and by the time you slit the envelope the boy who sent it may be dead in a trench or on a pine-clad mountainside, but when you hear the voice you know he's alive.

"But the words were all chewed up by the crackling of that tropical storm—or it may have been a storm over Finland—and I could hear the censor clicking in and out. And then somewhere a layer of electrons would bulge upward and Frank's voice would fade out entirely for a few seconds and then come back in. At last I understood he was trying to tell me where he was, and for me to call him back because he didn't have any money left.

"Now he was trying to spell out the name of the town! 'M— A—' I would get that much and then it would fade out and I would get a terrible feeling of panic—that the little thread would snap, and I'd never know how to get in touch with him. But just then that sweet censor broke in and relayed the name to me —Malang, Java.

"Then Frank was trying to tell me the name of the hotel. And I was shouting, 'Frank, are you saying the Alice?'

" 'Like in San Francisco,' he was telling me.

" 'The Palace?'

" 'Yes.'

"Then I could hear a girl's voice with a Dutch accent telling him his time was up.

"And now it seemed I was floating on air and I wanted to run out and tell everyone I had a live husband who was in the Palace Hotel in Malang, and I knew he was alive because I'd heard his own voice two minutes ago. That nice feeling stayed with me for days, and made everything all right for a long time."

Who's Who & What's What

(*Continued from page 147*)

system development for five years, and returned to the parent company in 1939. In 1941 he was appointed to his present position of Equipment and Building Engineer of the O. & E. Department.

How can the coat of increasing service demands be cut to fit the cloth of drastically curtailed stocks of materials? Some part of the answer to that poser is found in the examples which Bayard A. Freed cites of how the Bell System is stretching the cloth to fit the pattern of its needs. Mr. Freed was with the Pacific Telephone and Telegraph Company in outside plant work from 1921 to 1929. With the A. T. & T. Company since then, in the O. & E. Department, he has been engaged in both outside plant and sales activities, and since 1942 in plant extension work.

The broad objectives of science—and scientists—may be temporarily diverted by war to nationalistic ends; but, as Karl K. Darrow makes clear, in true perspective science knows no boundaries of country nor of race. With B.S. and Ph.D. degrees from the University of Chicago and with two years of study abroad, having specialized in physics and mathematics, Dr. Darrow in 1917 entered the Engineering Department of the Western Electric Company, which in 1925 became the Bell Telephone Laboratories. There his work has included the study, correlation, and representation of scientific information for his colleagues to keep them informed of current advances made by workers in fields related to their own activities. As a corollary to this work, Dr. Darrow appears from time to time before scientific or general audiences to lecture on current topics in physics and the related sciences. He is the author of "Introduction to Contemporary Physics" and "The Renaissance of Physics."

The hotel had no elevator. Guests had to climb the stairs to their rooms, and the staff was always happy to see an inebriated stranger arrive. When he asked where the elevator was, we gravely directed him to the telephone booth. This was a huge contraption at the end of the office that might be mistaken for an elevator car if you didn't look too closely. I have seen a man sit in the telephone booth for twenty minutes, sticking his head out of the booth to holler frantically, "Where's the elevator boy?" We always replied, in modulated tones, "He'll be there directly, sir."

From "Tales of a Wayward Inn," by Frank Case. Reprinted by permission of the author and Frederick A. Stokes Company, publisher.

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Bell Telephone MAGAZINE

erican Telephone & Telegraph Company · New York

Bell Telephone Magazine

Winter 1943-44

"The ideal and aim of the American Telephone and Telegraph Company and its Associated Companies is a telephone service for the nation, free, so far as humanly possible, from imperfections, errors, or delays, and enabling anyone anywhere to pick up a telephone and talk to anyone else anywhere else, clearly, quickly and at a reasonable cost."

A Medium of Suggestion & a Record of Progress

Published for the supervisory forces of the Bell System by the Information Department of American Telephone and Telegraph Company, *195 Broadway, New York, N. Y.*

Who's Who & What's What

in This Issue

IT WAS in 1904 that WALTER S. GIFFORD (whose picture appears on page 211) joined the Bell System as a clerk in the payroll department of the Western Electric Company in Chicago. The following year he was transferred to New York, becoming assistant secretary and assistant treasurer of the company. In 1908 he joined the American Telephone and Telegraph Company, and from 1911 to 1916 was its Chief Statistician. Returning to the company in 1918, from his war-time responsibilities, he was appointed Comptroller. In 1919 he was elected a Vice President; in 1923, Executive Vice President and in 1925, President.

Early in 1916, at the request of the Naval Consulting Board, Mr. Gifford directed the work of the National Industrial Preparedness Campaign. Late in that year Congress created the Council of National Defense, and from December of 1916 to November of 1918 he was Director of both the Council and its Advisory Commission. In July of 1918 he went to Paris, where he served for four months as Secretary of the American section of the Inter-allied Munitions Council.

At present, Mr. Gifford is Chairman of the Industry Advisory Committee of the Board of War Communications.

Concerning Mr. Gifford's many charitable, educational, and scientific interests it is perhaps sufficient to cite that in 1938 he received the gold medal of the National Institute of Social Sciences in recognition of his services "as Director of the Council of National Defense; President of the Charity Organization Society of New York; Trustee of Johns Hopkins University, General Education Board, Carnegie Institution of Wash-

Mr. Dixon

Mr. Hosford

Mr. Baker

Mr. Parker

Mr. Kostkos

ington; Director of the President's Organization on Unemployment Relief; President of the American Telephone and Telegraph Company, the greatest non-governmental organized service in the United States; and as trustee of numerous educational and scientific foundations." The Franklin Institute's citation accompanying the Vermilye Medal, quoted on page 211, is but the most recent of similar honors.

THE PLANT training and personnel work which ALLAN R. DIXON of A. T. & T.'s plant operation division was carrying on with the operating companies before the war is much a-kin to the type of instruction given to military personnel in Bell System plant schools. Mr. Dixon has been intimately concerned with the war training activities he describes ever since they began to take shape as an organized program. Starting with the Chesapeake and Potomac Telephone Company in Washington in plant engineering work in 1921, Mr. Dixon transferred in 1926 to the Department of Operation and Engineering of the A. T. & T. Company, where in the plant operation division he worked on plant practices assignments until 1931. For the next six years he was in the sales section of the commercial division, and returned to the plant operation division in 1937.

IT IS an undertaking of momentous potentialities for the future as well an an important present project which HOWARD L. HOSFORD describes in his article on a dial switching system for toll calls. Since joining the Long Lines Department as a traffic student in 1920, Mr. Hosford has had assignments in all four Long Lines traffic divisions. He became Division

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Index to Volume XXII

AN INDEX to Volume XXII (1943) of the BELL TELEPHONE MAGAZINE may be obtained upon request to the Information Department of the American Telephone and Telegraph Company, 195 Broadway, New York 7, New York.

Two Marine Corps students make a practice repair on a plant school telephone cable as an operating company instructor supervises their work. See "Bell System Schooling for Service Men," beginning on page 215

The Head of the Bell System Gives His Views on Managerial Responsibility in the Post-War Period and on the Course of Business in the Democracy Which Is America

Private Enterprise and Freedom from Want

Walter S. Gifford

The following is the text of an address delivered by Mr. Gifford on November 9, 1943, on receiving the Vermilye Medal, which is awarded biennially by the Franklin Institute, of Philadelphia, to individuals "in recognition of outstanding achievement in the field of industrial management."

I AM GLAD that there is a medal in recognition of industrial management and I am happy and honored to receive the Vermilye Medal with your generous citation. For nearly a century and a quarter the Franklin Institute has closely surveyed the fields of science and technology; and no man could fail to be pleased to learn that his endeavor to afford effective management to a business enterprise which involves the extensive application of those forces finds favor with you.

The art of living may be a higher art than the art of making a living, but the art of making a living is quite fundamental to the happiness of mankind. Industrial management has enabled great numbers of people to combine their talents and vastly increase their effectiveness. It has made possible wide-spread use of the inventions of mankind. It has played a vital part in the rise of mankind from the certainty of want to the possibility of plenty and this change has come in the last 150 years. This change was generated in the lands where political and industrial freedom were greatest and where man and management had the greatest opportunity.

It has been one of the most sensational improvements in the lot of mankind since the dawn of history.

But it has not produced Utopia, nor a perfect race of human beings, nor has it stopped war, nor has it guaranteed complete employment for everyone at any and all times.

IN THIS very human world our country leads in many ways; in none perhaps more than in the art of management. Yet management was for some years prior to the war not only the "forgotten man" but the much abused man. It was wrongly blamed for much during the depression years. Fortunately the criticisms and attacks were not too destructive. I say fortunately because it has been largely the skill and leadership of American management directing American labor and capital that have made it possible for America to become the Arsenal of the United Nations in this global war.

The achievements of American industry before the war and since have been nothing short of miraculous. Right now, measured by output per worker, we produce half as much again as Canada and twice as much as Great Britain or Germany and three to four times as much as Japan. Precisely how much of that is due to American management and how much to the American worker or to American capital, no one can tell, but clearly the ingenuity and resourcefulness of American management have played an outstanding part in furnishing our armed forces a quality and quantity of equipment that give them better than an even break with the enemies who were preparing for war years before we started.

When the war began, the United States, with only one-sixteenth of the world's population, had more automobiles than all the rest of the world combined, and as many telephones. We had over one-third of all the radio sets and about one-third of all railroad mileage in the world. We were the leading nation in the world in air transport. We were producing about one-third of all the electric power and also about one-third of all the steel produced in the world. Since the war began we have with extraordinary speed converted our peace-time industries into war industries and increased our output so that our present war production is more than half again as large as that of Germany and Japan combined.

The tonnage of merchant ships completed in September, 1943, was 25 times the tonnage produced in the same month two years ago. Also, more than 2,380 fighting ships and auxiliaries of all kinds have been completed since May, 1940, and in addition 13,000 landing vessels. The Navy Department says, "No naval construction program of comparable size and speed has ever been accomplished by any other nation."

I KNOW of no more typical American story than the history of the airplane. Two brothers who made their living by mending bicycles in a medium-sized town, invented it. They lived in a free country where inhibitions were few, where anyone could try anything, where invention and industry were encouraged. Such things happen more often in the free atmosphere of America than elsewhere. Likewise, this atmosphere invigorates industrial management so that when war came the airplane industry here was able to expand so rapidly that we now lead the world

with the production of more than 8,000 airplanes a month; probably at least twice the output of the Axis Nations, and as much as that of the other United Nations and Axis Nations combined. And what is more, we can keep up and even increase the quantity of production and at the same time change to new and better types to a degree and with a speed our enemies cannot match. The teamwork of research, design, engineering and production is one of the most notable achievements of American industrial management.

MR. GIFFORD (left) receives the Vermilye Medal from Charles S. Redding, President of Franklin Institute. The citation accompanying the medal reads: "To Walter S. Gifford, President of the American Telephone and Telegraph Company, who throughout the past two years of war has directed the managerial affairs of the Bell Telephone industry in such a way as to afford singular satisfaction to the users of the service, to the employees of the organization, to the owners of the property and to the public at large; admirably meeting a greatly increased demand for the telephone service in face of sharp limitation of priorities on materials and men, and devoting the entire resources of his company's research laboratories as well as the great part of its manufacturing establishment to the special requirements of the armed forces of this country and of its allies."

Nearly everyone on the home front has a son, husband, friend or sweetheart in the armed forces and they,

as well as those on the fighting fronts, have a vital interest in this job that American industry is doing. In fact, modern warfare is so much a matter of ships, airplanes, tanks, guns and electrical and mechanical gadgets that success is bound to come in the long run to those who have the will to win and can produce the most; and the shorter the time needed to produce, the quicker the victory. We Americans can be proud of the record we are making in our war-time production.

BUT HOW ABOUT the post-war world? One of the freedoms of the Atlantic Charter is Freedom from Want. Clearly there is no country in the world that is as free from want as ours. I refer to what I think the drafters of the Atlantic Charter meant—freedom from hunger and cold. That type of freedom from want, America has already largely achieved; indispensible in this achievement have been the skills of management and management's ability to put to practical use the increased knowledge of science and research. The scientists have pushed back the frontiers of knowledge. They have been encouraged to do that and their results have been put to practical use by management. Moreover, although all scientific discoveries are available ultimately to all the peoples of the world, somehow we in America have made the most use of them. It is because of the genius of the American people and especially, I believe, because of the genius of American industry given free rein in a free country.

There is no question but that we have come nearer to securing freedom from want than any other country in the world. We had enough food, clothing and shelter for all even in the depths of the depression. In fact, government programs were put into effect to reduce what was called over-production of food. Today we are supplying ourselves and our armed forces with food and clothing and at the same time are shipping large amounts to our Allies on Lend-Lease. But a standard of living that consists merely of enough of the necessities of life to go around even in a depression, or enough to spare to send great quantities to our Allies in war-time, is not a satisfactory goal for Americans. Man does not live by bread alone. It is the frustration, the terrible feeling of futility, that defeats human beings in our country when mass unemployment makes it necessary for them to live "off the government." In our America, the dignity and worth of the individual are of prime importance.

WE AMERICANS strive for not only freedom from want and a high standard of living, but for equal opportunity for all; for opportunity for a job, opportunity for each one of us to develop and enjoy to the utmost our innate abilities—in short, opportunity to make the most of ourselves. And we want for each new generation the opportunity to marry young and bring up their children with even better opportunities than we had. America, the land of private enterprise, still leads the world in freedom from want, in its high standard of living, and as the land of opportunity. This is not just because of an abundance of natural resources. Other countries have an abundance of na-

tural resources. It is because we have made better use of our natural resources. I am convinced that this is because we have encouraged private enterprise and have striven to keep opportunity open to each and every one of us. In this way we have developed our skilled management that has come more often than not up from the ranks. In the organization with which I have been associated for nearly forty years, management, from foreman and supervisor to president, has been drawn almost entirely from the ranks. In fact, all of the top executives started at the bottom. This is true generally of American industry. Worker and management are largely the same people in America—only at different stages of their careers. If ability is there, the way has been open for a man to rise from whatever point he starts.

THERE ARE, of course, many millions of persons who make the most out of their lives in ways and careers that are remote from business as such. These people, whether they realize it or not, are dependent upon business for their opportunity to make the most of themselves in the field of their choice; for without the production of at least the necessities of life in abundance for all, only a few—too few—can be free to follow pursuits not directly connected with the production of food, shelter and clothing.

It would be ridiculous to be satisfied with the progress we have made toward freedom from want and toward opportunity for everyone—but we can have the satisfaction of knowing that our progress has been greater than that of any other country. There is much to be done to make life after the war more livable for millions of our fellow citizens. It calls for the best thought of all of us and the answer, or rather answers, for I expect there are many, are not easy. It is unbelievable, however, that we shall be so short-sighted that because we had mass unemployment in a period of depression that was world-wide and because we have not yet reached perfection, we should tear down and destroy the very basis of the relatively high standard of living and equality of opportunity which we already possess.

WITHOUT FREEDOM of individual enterprise we would, I am sure, lose our high standard of living and cease to be the land of opportunity. We would lose our world leadership and we would greatly weaken our national safety; for we might well no longer be the strong, resourceful nation able to surpass any other nation or combination of nations in the production of the weapons of modern warfare, so vital for defense. Let us not forget that we always have had and will continue to have competition from other countries. Clearly our safety and our well-being depend upon the fullest encouragement to American ingenuity, upon maintenance of our system of freedom of private enterprise. In fact, I strongly suspect that this freedom is basic and that, without it, in the long run other freedoms cannot exist.

Industrial management is concerned with producing more for all—not merely dividing up what we have. To be successful it requires technical skill, but it requires more than that.

It requires the leadership that can only come from faith in the worth of the individual, from confidence in the future of our democracy and its encouragement of private enterprise and confidence in the ultimate solution of problems, no matter how difficult. I believe much of our recent pre-war troubles were due to a wide-spread defeatist attitude on the part of people generally. I am not referring to those people who were unemployed and had a real cause for despair. It would be difficult to overestimate the damage done by this defeatist attitude and it was so un-American that it was hard for me personally to understand it. We must approach our post-war problems more realistically. To expect wide-spread unemployment and the end of private enterprise is, in my view, not being realistic. It is more realistic, I believe, to expect plenty of employment and the abandonment of government war-time controls, including taxes that discourage enterprise, as rapidly as practical with resulting further progress in improving our standard of living and in providing equal opportunities for all. Defeatism has no place in America. I know many who are responsible for management of large and small business enterprises. I know none who are not confident of the post-war future. It is with such confidence that management has accomplished so much in the past and will, if not unnecessarily hampered, accomplish so much in the future.

I look forward to good times, to good wages—to a period that will create capital and well-being. That is the usual history of our people. In that creative progress industrial management is one of the important forces. I am proud to be an officer in the army that is producing the wherewithal with which the fighting men will win victory over the Axis—over the planners of National Socialism in Germany and Fascism in Italy and Militarism in Japan and which likewise will produce the wherewithal with which Americans can continue to win victories over poverty and want as they have since the Constitution set up that liberty which insures economic opportunity. Let us have faith in the democratic way—the way of America.

ON THE WHOLE, it seems to me that the organization of modern business, of which the Bell System is but one example, which mixes reason with authority and routines with initiative so that more than a quarter of a million people can engage in a complicated art, each using his or her brains, and yet have the whole thing move toward a desired end without confusion, is as significant as the discovery of new facts about nature that allow what is called technological progress.

From "The Bell Telephone System," by Arthur W. Page, Vice President, A. T. & T. Co. Harper & Brothers, publishers, 1941.

The Operating Companies' Long-established Plant Schools Have Given Instruction in Communication to Thousands of Men from All Branches of the Armed Forces

Bell System Schooling for Service Men

Allan R. Dixon

When the Japs were first blasted out at Guadalcanal, United States Marines promptly grabbed the telephone exchange serving the airport which was soon to become Henderson Field. The switchboard, of Nazi make, was connected to open-wire lines which fanned out to all parts of the island. After the terrific shelling by the American forces, these lines were reduced to a tangled mass of wire in the surrounding jungle. American ingenuity and skill soon restored all this to working order. When the leathernecks celebrated the "cut-over" to American operation, they tacked up a sign outside the door of the exchange which read, "Guadalcanal Tel. & Tel."

Since "Guadalcanal Tel. & Tel." came into being, many more additions have been made to the United States military network which is the world's fastest growing communication system. Centered like a giant web in the Army's Pentagon Building at Washington, this network reaches out across land and sea to link up our forces in all theaters of war. Five thousand tons of copper a month (an amount comparable to normal Bell System peace-time usage) go into expanding and interconnecting it. Equipment of all kinds is needed at outlandish terminal points: a high-powered radio at Algiers, repeater stations along the Alaska Highway, teletypewriters on the flat-tops and battle wagons, direction finders in Iceland, and subsidiary networks to serve military needs in occupied territories.

To put such a system together and make it work takes an almost endless number and variety of skilled personnel. It has been said that one man out of twenty in our ten-million-man fighting force is needed for the communication services. Most of these men require special training in com-

HOW SIGNAL CORPS TRAINING IS PLANNED AND COORDINATED

HEADQUARTERS ARMY SERVICE FORCES

Director of Military Training

OFFICE OF CHIEF SIGNAL OFFICER

Programs of training requirements in each of the Service Commands are prepared to indicate number of men to be trained, courses required and completion dates of classes, to meet Army schedules.

Standards are established as to qualifications of students, content of courses, and service ratings of students on graduation.

ARMY SERVICE COMMAND HEADQUARTERS	
1ST	BOSTON
2ND	NEW YORK CITY
3RD	BALTIMORE
4TH	ATLANTA
5TH	COLUMBUS
6TH	CHICAGO
7TH	OMAHA
8TH	SAN ANTONIO
9TH	SAN FRANCISCO

Following approval of training programs prepared by the Office of the Chief Signal Officer, schedules of classes of trainees are arranged between each service command and the nearby Bell Operating Companies.

BELL OPERATING COMPANIES
NEW ENGLAND
SOUTHERN NEW ENGLAND
NEW YORK
NEW JERSEY
PENNSYLVANIA
CHESAPEAKE & POTOMAC
SOUTHERN
OHIO
CINCINNATI & SUBURBAN
MICHIGAN
INDIANA
WISCONSIN
ILLINOIS
NORTHWESTERN
SOUTHWESTERN
MOUNTAIN
PACIFIC
LONG LINES DEPARTMENT

Trainees from the various service commands are trained in vocational schools in the nearest Operating Company having available school facilities. Flexibility in scheduling classes is provided through direct contact between the Operating Company and the Local Service Command.

A. T. & T. GENERAL STAFF

Surveys are made to determine available school capacities in the various Operating Companies. Programs are prepared in coordination with the Office of the Chief Signal Officer to match Army requirements with available school facilities.

munication work to fit them for duty. The training of so many thousands of communication specialists is a stupendous job.

The training problem was particularly acute in the year following this country's entry into the war. In that year—1942—the needs of the growing Army threatened to outstrip the capacity of the training facilities at the Army Signal schools. Every available facility for training, industrial as well as military, was called upon to assist.

It was a most natural thing that the Bell System, with its long established training schools and instructor staffs, should volunteer to assist the Signal Corps in its communication training program. That help was later expanded to include other Service branches. In 1942, more than 4,000 service men—soldiers, sailors, and marines—attended communication courses conducted in Bell System plant training schools by Bell System instruction staffs. This year (1943) there will be many more, to keep pace with expanding military requirements.

IN THIS GROUP are 38 Marine Corps students, 97 Army Signal Corps students, and 21 telephone company instructors. This is one of the largest groups to receive Bell System training

Broadly speaking, there have been two principal reasons for the Bell System's part in the over-all military communication training pro-

gram. The first was to take the "overflow" from the Signal schools at the time when their own facilities were overtaxed by the expanding demands. The second was to provide special technical courses in which telephone craftsmen might be called upon to help in the war training program. But it was difficult to foresee the extent and direction in which assistance could best be rendered.

The first requests received for

Locations of the principal Bell System schools for training service men

phone company instructors and facilities are especially qualified to render training assistance without entailing costly delays. A glance at the map on this page shows that nearly all Bell System companies have had a part in this program.

Before Pearl Harbor

It became increasingly evident, in the days before Pearl Harbor, that Bell System schools for training installers, repairmen, and other telephone company instructors and facilities are especially qualified to render training assistance without entailing costly delays. A glance at the map on this page shows that nearly all Bell System companies have had a part in this program.

Before Pearl Harbor

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The first requests received for training assistance were handled purely on a local basis between the Bell operating company and the local service command. Usually such requests reached the various Bell operating companies by way of the local Army Signal Officer in a nearby camp with a group of men in his outfit who needed a little brushing up on telephone and switchboard circuits in use about the army post. Help of this sort was given wherever it was requested, and this early experience, as

it turned out later, was a good thing. It gave the training staffs in the Bell companies an opportunity to become better acquainted with Army personnel at the camps and Signal schools, and to learn about Army training methods and requirements.

As these requests for assistance became more frequent, the staff organization of the American Telephone and Telegraph Company sensed the need for a more unified program of Bell System instruction for service men, and arranged for conferences between the Associated Company men responsible for training and officers of the Army's general staff in Washington having similar responsibilities. The System men were also invited to visit the Eastern Signal Corps School at Fort Monmouth. Out of these closer and more personal contacts the telephone men achieved a better understanding of Army training courses and methods and a clearer picture of the Army's objectives and how the telephone courses could contribute to them.

Despite the doubts and uncertainties which plagued so many activities prior to American entry into the war, considerable help was rendered by telephone company schools to the armed forces even in 1941. In that year instruction was given by the telephone companies to quite a number of service men, and training staffs throughout the System were gaining valuable experience for what was to come.

TELETYPEWRITER CLASSES are kept small in numbers so that the instructor may give more attention to individual students

Meanwhile, as the handwriting on the wall became increasingly more legible, coöperation between the tele-

phone companies and the office of the Chief Signal Officer in Washington resulted in comprehensive plans to make fully available to the nation's armed forces the Bell System's training facilities and teaching staffs for courses in communication.

The System's Own Training Schools Were Available

IT SHOULD be noted here that the Bell System's program for training its own telephone craftsman and technical men is one of long standing and is designed to meet the current needs of the business. Each of the operating companies conducts organized courses for training telephone installers, linemen, cable splicers, and other skilled telephone men. In the larger cities these courses are given in regularly established telephone company schools provided with a complete complement of telephone equipment and staffed with instructors who are experts in their particular fields. In smaller places, training is carried out in temporary schools or on the job, as the occasion requires.

In the over-all, these Bell System facilities and instructors constitute an immediately available reservoir which could be tapped for use by the military forces wherever training needs might arise. Since Army courses of instruction parallel closely those given in the telephone company schools, the adaptation of these company schools to training of service men has been accomplished with a minimum of delay.

In working out a training program with the Office of the Chief Signal Officer, the A. T. & T. training staff suggested a few simple ground rules based on earlier experience.

Requests for training assistance, it was agreed, would be initiated by military headquarters in Washington having a view of the over-all requirements. These requests are directed to the A. T. & T. Co. in New York, where decisions can be worked out as to which of the System operating companies are in the best position to carry out the training on specific projects. In this way full use is made of existing telephone company schools throughout the System before expanding school facilities and instructor staff at any one location. This, of course, helps to avoid overtaxing the facilities of individual Bell companies, particularly those having in their territories the heaviest concentrations of new camps and war industries. It was further agreed that training undertaken would be on a programmed basis, and would be focused on services which the System was best adapted to render.

THESE WERE the main considerations. There were, of course, other problems to be worked out as the program developed. Principal among these were the usual war-time scarcities of equipment and manpower; shortages of school equipment, such as teletypewriters, which are proving such a boon to military communications; shortages of school space; and shortages of instructors. Many telephone company instructors were already in the armed forces, or engaged in training new recruits and upgrading craftsmen in the telephone business.

What happened on December 7, 1941, called for prompt action. It was vital to avoid being too late. Over night, surveys were rushed in to

A. T. & T. headquarters from the Associated Companies to help line up training schedules. Priority requests for school equipment flashed over the A. T. & T. lines to Washington. Plane shipments of instructors and equipment sometimes helped to push back the hands of the clock. The airport at Chicago on one occasion held up a stratoliner for a bulky package of school apparatus en route to a company school on the Pacific Coast. They had to take the door off the plane to squeeze it through. But the service men graduated from school on time to sail with their outfit and that was what counted. Sometimes the Army would lend the telephone company new equipment needed for training, only to snatch it back a bit later to meet more urgent needs at the front.

Some of these initial hurdles occurred immediately following Pearl Harbor; but plans for the handling of training arrangements quickly shaped up along lines graphed on page 216.

STUDENTS LEARN to install telephones and maintain lines by practicing with actual equipment in telephone company class rooms

Training for Spiral-4

ONE OF THE FIRST JOBS the Bell System took over at the request of the Signal Corps was instruction needed on "Spiral-4." The Spiral-4 system operates over four wires tightly encased in a rubber sheathing to form a cable not much thicker than a lead pencil. Miles of this cable can be reeled off a speeding truck

to bridge long gaps between the larger headquarters at the front. Telephone carrier and repeater equipments are used to boost up the message capacity to three voice channels and four telegraph channels—all working on just two pairs of wire. In the last war, it took miles of open-wire pole line across Flanders fields to do much the same kind of job.

SIGNAL CORPS technicians, called repeatermen, are needed to hook up Spiral-4 and make it work. The Army said they wanted their men given a thorough grounding in electronics and telephone transmission, backed up by practical experience in connecting and tuning up circuits and equipment similar to that used on regular long lines networks in the Bell System.

In a brief few weeks after this project was put up to the Bell System, courses of instruction were "tailor made" by the Long Lines Department, and instructors and schools were mobilized throughout the country. Trainees in groups of twenty service men at a time were selected from the Army Signal Schools and shipped in to a series of classes held at test rooms in Denver, Chicago, Louisville, West Palm Beach, San Francisco and other places wherever openings could be found. Telephone company instructors sometimes shuttled back and forth across the country to fit in with the shifting tides of available facilities which controlled the locations of classes from month to month. Army trainees totaling over a thousand men have since been turned out from these schools in time to join activated units bound for service overseas.

The Alaska Highway communication system found the need in recent months for more repeatermen, and the Western Defense Command sent trainees to a special school that Long Lines opened for them at Denver. In this case the Signal Corps decided that some on-the-job training would be worth while. To handle this, the instructors from the Denver school packed their bags for a northern climate and worked right along with their Army students who were assigned to the 15 repeater stations on the 1,375-mile line between Edmonton, Alberta, and White Horse in the Yukon territory.

Pulling Together

AN INTERESTING side-light on these training projects is the opportunity they present for team-work between various units of the Army and the Bell System.

An illustration of how this teamwork comes into play is the case of Spiral-4. Advance estimates were made of the number of equipment units required and their scheduled delivery dates at embarkation ports. Parallel estimates were made of the number of skilled men needed to service the equipment at points where it might be used overseas. From these estimates, manufacturing and training schedules were coördinated so that trained service men would be available at the time equipment was ready for shipment.

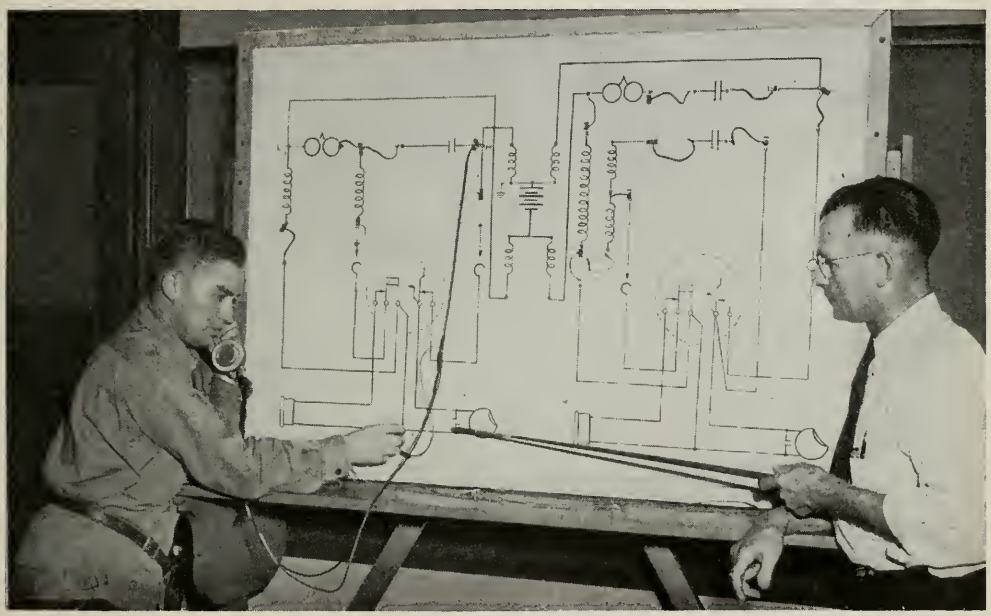
In this coöperative effort, the Bell Laboratories carried the torch in design work, Western Electric in manufacture, Long Lines and Associated Companies in training, and the A. T. & T. general staff in engineering and coördination. Working hand in glove

with telephone people were Army officers assigned to similar work in the Signal Corps like the technical staff at the Signal Corps Laboratories at Fort Monmouth; the staff officers in the Military Training Division, Army Service Forces, and in the Office of the Chief Signal Officer in Washington; and those serving on signal assignments in the various Service Commands throughout the country.

The same kind of coördination has been worked out with the Navy and other branches of the Service. Organization of the Bell System, with its line and staff set-up, bears a close resemblance to that of the armed forces. This has gone a long way to supplement the fine spirit of coöperation and teamwork between the two organizations.

Basic and Advanced Courses

THE REPEATERMEN trained for Spiral-4 and for the Alaska communication system comprise a large group of service men trained in Bell System schools, but they represent just one of the many kinds of skilled craftsmen turned out by these schools. For the Navy and the Coast Guard most of the training has been on teletypewriter and radio telegraph systems, to take care of expanded overseas operations. Courses for the Coast Guard personnel include maintenance of facilities for shore patrol anti-submarine and aircraft warning services needed along remote coastal



DEMONSTRATION BOARDS help the service man to visualize telephone circuits. This board is wired to reproduce "trouble" of various kinds

sections to supplement land line facilities.

For the Marines, as well as for the Signal Corps, land lines and wire systems come into play and a much wider range of subjects has been taught. Most of these courses for installer-repairmen, switchboard men, linemen and allied crafts, have been conducted in schools of the Associated Companies to take care of "overflow" from the Signal Schools and to meet the needs of the various Service Commands in different parts of the country. Now that the Signal Schools have expanded their school facilities to a point where they can carry out most of this type of instruction at their war schools, the general level of this type of activity in Bell System schools has been reduced, and most of the classes now running are in advanced work. The Bell Telephone Laboratories, too, has made substantial contributions to training of technical men in the armored forces in connection with radio sets for tanks, and special devices. Much of the training at the Laboratories cannot be discussed until the close of the war.

To provide an over-all view of the part played by Bell System schools, the principal subjects covered are listed in the box at the right.

Teaching Methods

How do the military people view the Bell System's training job? The following, quoted in part from a letter from a Signal Officer in one of the Corps Areas, is perhaps a typical response:

"Many favorable comments have been received in this office from Signal Officers throughout the Third Corps Area regarding the fine training given to enlisted personnel from the Signal Corps at the recent courses of instruction conducted by Associated Companies of the Bell System. Although these courses were for only four to six weeks' duration, a great improvement has been noted in the ability of the men receiving this training, not only to perform their normal duties but to assume additional duties and responsibilities."

Similar comments have been made by other staff officers on inspection trips through Bell System schools. Fundamentally, this may be accounted for by a long background in teaching telephone craftsmanship, dating back to the early days of the

Bell System Courses for Service Men

Basic Courses	Length of Course in Weeks
Installer—Repairman	6
Switchboard Installer	6
Central Office Repairman	6
Lineman	6
Teletypewriter man	6
Advanced Courses	
Carrier—Repeater man	8
Radiotelegraph man	8
Radio-Telephone man (Tank Corps)	6
Vocational Instructor Training	2
Line Foremen	6
Wire Chiefs	5
Teletypewriter Supervisors	7
Teletypewriter—Staff assistants	12

business. Telephone people all along the line are training-conscious, due, if for no other reason, to the industry's rapid growth and to its many technical developments.

Instructors in Bell System schools are top-grade craftsmen or foremen specially selected for their job knowledge and skill plus the ability to impart this to others. This last element—teaching ability—depends a great deal upon use of sound teaching techniques coupled with the inspirational qualities which motivate the learner, lots of patience, and a sympathetic understanding of human nature. These qualities have been sought out and built up in Bell System instructors and have helped greatly to pave the way for Army or Navy students—particularly for the beginners.

When it comes to skinning and soldering wire, adjusting relays, and tracing circuits for the first time, the beginner is in a new and strange world. His related mental responses too are sometimes slow and faulty. Learning at this stage, as golfers will testify, is largely a matter of habit-formation involving mental processes as well as manual dexterity. These are gained through supervised practice in doing the job the right way at the very beginning and by learning in easy stages, one step at a time. To get this, classes in telephone company schools are kept down to eight or ten men under one instructor. He follows with the service men the same

THEIR INSTRUCTORS posed with these Navy men whose course covered the installation and maintenance of teletypewriters

step-by-step teaching pattern which has long been in use by plant department foremen and supervisors on the day-to-day job. This teaching pattern, incidentally, is now being used by foremen and "lead men" in breaking in new people in many war industries throughout the country. Visual aids in the form of movies and slide films have a place in System training programs, and they are freely used in courses of instruction for service men.

Building up safe working habits is all-important in the Army's dangerous job. In new work situations and strange surroundings, men are prone to accidents and one of the first things the service man has to learn is how to take care of himself and at the same time keep a weather eye out for the safety of his buddies. These things, of course, are all a part of Army indoctrination but they bear reiteration and have always been stressed as "key points" in the telephone companies' schools.

NOT ALL of the Bell System schooling for service men is on a classroom basis. In fact, wherever possible they are sent out with working telephone crews where they can learn the job under field conditions.

Service men in training to serve as linemen and line foremen, for instance, work with regular field construction crews to get practice in digging pole holes, stringing wire, and making emergency storm repairs.

In the case of the line foreman's course, trainees are sometimes grouped to form a practice gang in which each student takes his turn at acting as the gang foreman while the others serve as linemen—all under the direction of a seasoned foreman from one of the regular telephone construction crews.

Service men taking the wire chief's course usually are assigned to accompany a telephone company plant wire chief in rural territory where they can watch the wheels go 'round and learn at first hand about the many details which make up the administrative side of the district plant chief's job.

Among the letters coming back from the boys overseas was this comment from a Signal Corps student: "Yours is one of the best, most efficient and quickest ways of getting over to a soldier the fundamentals of the communication system. This is due to well trained instructors, well planned methods of teaching and the instructors being men of high quality with a background of years of experience in telephone work. As one of the boys in our outfit said, 'When you start you feel as though you were in a dark tunnel but when you finish you feel as if you were a veteran in the business!' "

Life at the Schools

NO REPORT on training activities for service men would be complete without a few sidelights on the students, their background, and their daily life while they were attending telephone company schools. A report from one of the Associated Companies gave this picture:

"Altogether 121 men have completed one or more of our basic courses and they are now back with Army organizations, either instructing others or performing the various duties essential to extending, operating, and maintaining the Army's lines of communication. They came from

32 states and Canada, and their previous jobs include almost every walk of life. Among them are an Indian rancher from Montana, a motion picture casting director from Hollywood, a bartender from Chicago, a sculptor from Ohio, coal miners from West Virginia, a woodsman from Vermont and a steeple jack from Michigan."

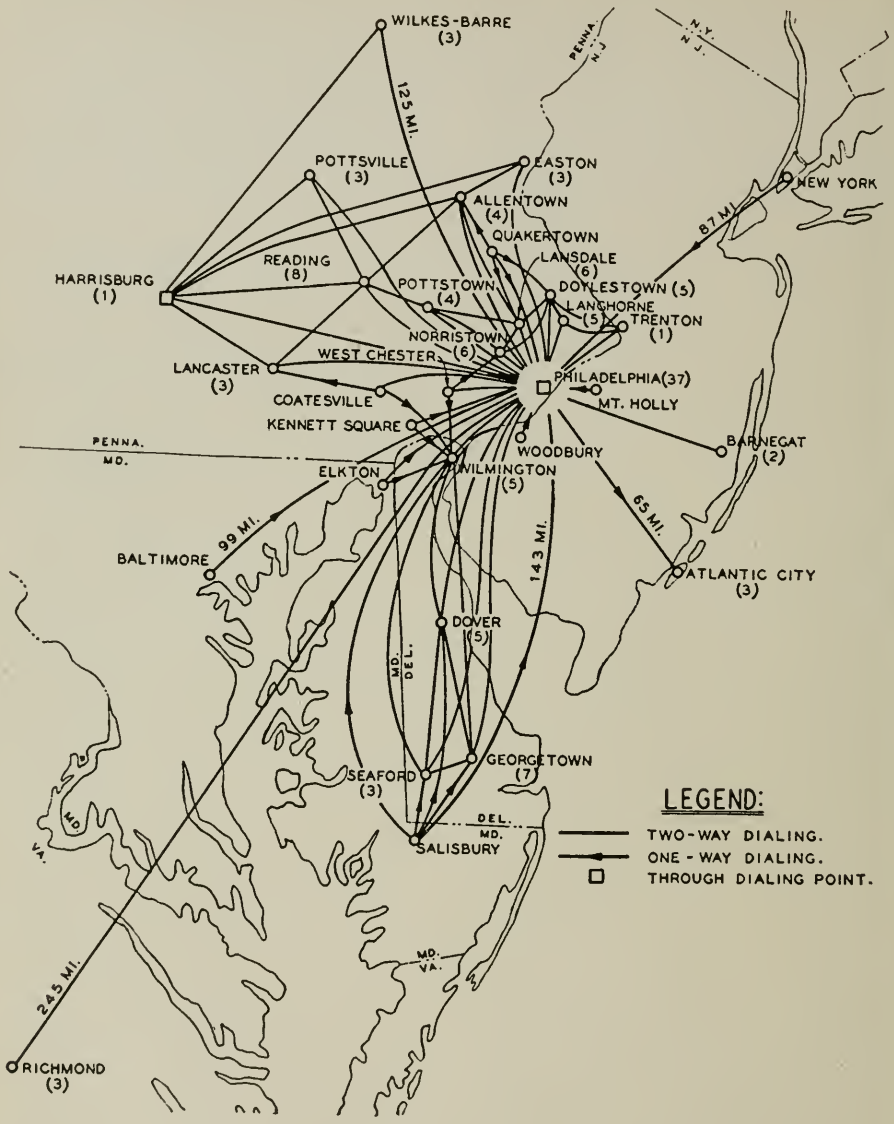
The other students ribbed one lad who had spent all his life on a farm in a remote section of the Dakotas when he told them that he had never even used a telephone during his life back on the farm. To their surprise, he took the telephone training in his stride and on graduation he could put in telephones and clear troubles with the best of them.

Another soldier came in to school bronzed and breezy from cow punching in the Wyoming cattle country. His first try at pole climbing revealed boundless energy untempered with caution. His instructor told him to climb up the pole only a few feet at first until he got the hang of it. Not for him. He stepped right on up the pole before his instructor could stop him. Then, at some distance above the ground his climbers cut out and down he came. Fortunately he landed like a cat on his feet and with a sheepish grin on his face which seemed to say—"This is just another one of those bucking broncos at the rodeo back at Cheyenne." Then with a grim look, he jumped on the pole and before his amazed instructor could stop him, he was grinning down at the rest of the gang from the top of the pole.

Most of the boys in basic training were young and inexperienced, but spirited and eager to learn so that they could get over there, beat the Axis, and get home again—just like that. Naïve, too—one wrote back, "I thought when I left your school that I was through with Ohm's law, but I was wrong. The army just loves that guy Ohm!"

For a place for students to live, the Army often arranged board and lodging in the neighborhood of the company school, or at the local YMCA. If military barracks were handy, they stayed there, and marched smartly back and forth to school under the inevitable top sergeant, who maintained discipline and saw that the boys burned their quota of midnight oil.

Nor was life all work and no play, thanks to the friendships which sprang up at telephone company gatherings or on week-end visits of the service men to homes of instructors and other telephone people. Graduation day, ("it came all too soon," they would write back later) was topped off usually with a farwell dinner, presentation of diplomas, and speeches in the usual fashion. After graduation many appreciative letters have filtered back from students from all parts of the world. One wrote this to his instructor: "In regard to your instructions you have done a swell job for us. You may not be in uniform in the Army but your job is just as important as the man behind the guns." His words but echo the statements of high ranking officers, more formally expressed, to the effect that the importance of communication in this war is such that telephone people everywhere are virtually members of the communication branch of the military services.



THIS IS the intertoll dialing network, centering at Philadelphia, which is described in the article beginning on the opposite page. About 1,500 dial intertoll trunks are involved, and over them calls are being completed more swiftly than by previous methods. The numerals in parentheses under the cities indicate the number of tributary exchanges reached at each point for direct dialing

Adaptation of Crossbar Switching to Intertoll Purposes Helps Speed Up Handling of Increased Traffic and Marks a Forward Step in Improvement of Service

A Dial Switching System for Toll Calls

Howard L. Hosford

EVEN FOR THE MOST seasoned of telephone veterans, there is something about a cutover that makes for drama. Always it marks a change from the old to the new; a step in the direction of something better. Before it come long weeks of careful preparation; days and sometimes nights of trying to foresee and guard against the slightest detail that may go wrong. But always, in the most commonplace of cutovers, there are the few moments before the zero hour when everybody, from operators to engineers, silently prays that all will be as it should.

There was such an air of tenseness at Philadelphia on the night of August 21 and the early morning hours of August 22 last. For the cutover that was scheduled for that time and place was no mere episode; it was one of the milestones of telephone history. It marked the introduction into commercial service of a toll crossbar switching system, adapted for intertoll dialing by operators, which had been designed by Bell System engineers as a means of meeting some of the problems arising from the increasing volume of toll calls in recent years. In the few months during which it has been in use, the new system has operated so successfully that it has become apparent that its inauguration was the first step in a development that will have far-reaching results.

The magnitude of the toll plant in most of our larger cities has made it increasingly difficult to furnish to toll operators means of direct access to much of the equipment which they must utilize to complete toll calls. It is evident that future demands for service will be such that conventional switching systems and operating methods must continue to be more complex and therefore less suitable for handling the volumes of traffic,

to say nothing of permitting improvements in the quality of service. To meet this situation, the new system was designed.

Intertoll dialing in itself is not new, for operators in various parts of the country have been completing toll calls for several years by dialing directly. This Toll Switching System is especially significant as it has been designed so as to extend the field of toll dialing by operators to include the largest cities, and joins together various types of dial equipment.

THIS JOINT PROJECT of the Bell Telephone Company of Pennsylvania and the Long Lines Department known as the No. 4 Toll Switching System has been in service in Philadelphia since August 22, 1943. A thorough canvass showed Philadelphia to be an ideal location for the initial installation of the No. 4 Toll Switching System. In addition to a toll traffic increase resulting in a major relief requirement, this area affords an opportunity to link various types of equipment presenting virtually every known toll requirement characteristic.

The intertoll dialing network associated with the Philadelphia project includes many points in an area reaching from Richmond, Va., to New York, and from Harrisburg, Pa., to Atlantic City, N. J. Calls involving other points are handled in the normal manner.

Toll operation in most large offices implies the provision of certain equipment and switchboards for the handling of outward, inward and through traffic and the associated tandem equipment. How this new development affects each of these steps in long distance telephoning can be briefly stated.

In connection with outward toll calls, an operator usually obtains the circuits to be used in completing calls either directly in the multiple at her position or, in the case of some of the larger cities, through an intermediate toll tandem switchboard. The No. 4 Toll Switching System represents an improvement over this switchboard.

Ordinarily, inward calls are handled at switchboard positions where inward operators receive requests from outward operators at distant offices, and either dial or enlist the aid of local operators to complete these requests. Here too the No. 4 Toll Switching System presents an improved method of completing such connections.

Similarly, the specialized functions of the conventional through board are performed to advantage through the medium of the No. 4 Toll Switching System.

Components of the System

FROM A TRAFFIC standpoint, the No. 4 Toll Switching System actually comprises three units—the switching equipment itself, which is wholly mechanical, together with so-called No. 4 and No. 5 switchboards. The No. 4 Board is a cordless, key-type call distributing board which is used in conjunction with the new switching system for such calls as must be given to an operator by offices not equipped for intertoll dialing. The operators at this board function as combined inward, through and tandem operators—thus eliminating the provision of separate units to provide these particular services.

With this information in mind, certain representative phases of the operation of the new system may be somewhat clearer. However, even non-technical descriptions of telephone operating are apt to be misleading to those who are unfamiliar with traffic operation, and it may be well at this stage to draw an analogy between the functions of this system and the local dial central office with which most readers are doubtless familiar.

The outward toll operator in Philadelphia bears the same relationship to the functioning of the No. 4 Toll Switching equipment that the subscriber who has a dial telephone bears to the functioning of the dial equipment in a local central office. The same is true of outward toll operators in those cities which have

Operators at the No. 4 toll switchboard in Philadelphia handle inward and through calls. The keys which they press set up electrical impulses just as do the dials which subscribers use to make local calls

now been equipped to enable them to dial Philadelphia telephone numbers directly. Part of the time both the No. 4 Toll Switching equipment and the local dial central office equipment function in response to impulses transmitted to it by an individual, while in other cases it is necessary to signal an operator to assist in handling the call.

If you live in Harrisburg—by way of illustration—and wish to call a subscriber who lives in Philadelphia or in Richmond, Va., the Harrisburg toll operator will reach the number in either city by simply performing a few dialing operations which are the virtual equivalent of the steps a subscriber takes when dialing a local number.

On the other hand, at offices which are not equipped to dial into the No. 4 Toll System, it is necessary to reach an operator in Philadelphia in the same manner as was done before the advent of the new system. In completing such a connection, however, the Philadelphia operator does so through the use of equipment in the No. 4 System.

IN THE PROVISION of toll circuits, it is not contemplated that a circuit will always be immediately available for an operator's use. Again, the economics of through switching limit the time a circuit can be held at an intermediate point awaiting completion to another circuit. Thus, in many instances on switched traffic the calling operator is dismissed after having left a request for the desired circuit. This brings us to the No. 5 Board, where traffic of this nature is handled.

In brief, there is no basic difference between the essential operation of the No. 5 Board and the conventional through board where such delayed traffic is handled. However, operators handling calls at this board must make use of the new switching system to obtain both the calling and called offices by dialing. Through the medium of special equipment arrangements, any operator who attempts to obtain circuits through the new switching system on which traffic is subject to a posted delay is automatically routed to the No. 5 Board. Here the delay is quoted to the calling operator. In the case of a call switched at Philadelphia, the No. 5 operator will, in addition, record the request for the desired circuit.

TO HANDLE the traffic routed through the No. 4 and No. 5 Boards, 150 operators, together with the necessary supervisory personnel, were trained by the most up-to-date training methods and at the initial cutover there was a force totaling some 170 people to run the office. Prior to the cutover, the first trainees were given experience by handling some 300,000 test calls of every conceivable traffic characteristic. These were routed through the new system to break in the equipment and shake down potential troubles.

The far flung aspects of the Bell System also made it essential that other toll operators, who might be handling calls to and through Philadelphia, be made familiar with the new practices. As a result of the close coöperation and intelligent coordination of effort on the part of the Bell System personnel at outlying offices with the Philadelphia people, the cutover and operation of the No. 4 System proceeded smoothly.

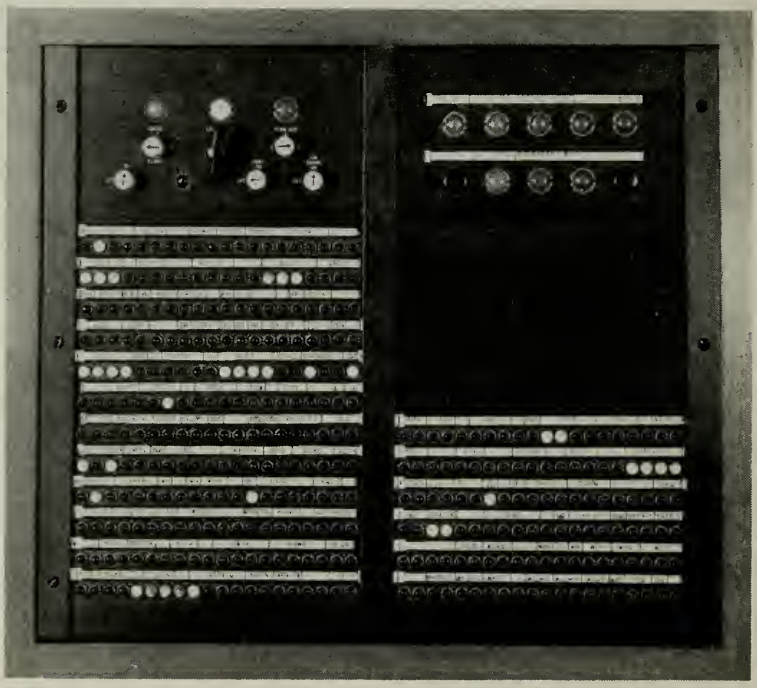
The Cutover—and After

THE MULTITUDE of steps necessary to cut this new system into service were taken during the afternoon and night of Saturday, August 21st. The cutover committee which had spent many months in setting up the detailed plans and the necessary organization to do a workmanlike job had estimated that the new equipment would be ready to put in regular operation on the following Sunday morning at 3:00 A.M. Two weeks prior to cutover, a dress rehearsal was held at which time about ten per cent of the circuits were put through their paces. This preview of the cutover gave assurance that the procedures were satisfactory and permitted the cutover personnel to obtain actual experience. It also showed that the estimates of the time to do the job were about right.

CALLS WHICH could not be completed originally through the No. 4 System because of busy circuits are handled at the No. 5 switchboard

Visitors in the operators' restroom just before the cutover heard a buzz of questions: "How will it work?" "Will I be the one to handle the first call?" "What will the offices working into Philadelphia think about it, and will they know what to do?"

Shortly before the appointed time a group of operators took their positions at the new No. 4 switchboard and anxiously awaited the first incoming call. At precisely 3:00 A.M. it came in and any pre-arranged selection could not have been more appropriate for a system serving a operator, though visibly excited, performed her duties efficiently and accurately. Thereafter, additional calls began to come through, and in no time every operator had her opportunity to use the new equipment. The No. 4 Toll System was officially launched.



USEFUL IN the day-to-day administration of the office is the quick picture which this control cabinet gives of circuit conditions, stored-up calls awaiting completion, and the equipment situation as regards senders and repeaters

nation-wide toll network. The call spanned the continent from Martinez, Calif., to Germantown, Pa. In accordance with standard routing instructions, the Martinez operator routed this call to San Francisco, then to Pittsburgh, then to Philadelphia —where a No. 4 operator was brought into play. The Philadelphia

In the day-to-day administration of the office, there are many helpful features, not included in currently conventional toll switchboards, which are a distinct aid to the traffic operating people who are responsible for the maintenance of service. For example, the System automatically routes each incoming call to the next

available idle operator and, if all operators are busy at the moment, waiting calls are stored up and thereafter are handled in their proper order. This contrasts with the conventional toll inward board, where the operator answers signals as she recollects the order of their appearance.

Records and Measurements

To PROVIDE information of value for future installations, arrangements were made for the liberal provision of registers and meters to measure any and all phases of the various steps performed by the equipment. Some 600 registers and meters were provided. These aids are not entirely new to telephone work but their application to toll inward and through service is a departure.

As a further aid to the maintenance of a satisfactory service level, the No. 4 Board is equipped with colored lamp signals to indicate the volume of stored-up calls awaiting completion. In addition, a continuous pen register record of this information is kept on a 24-hour basis. These features permit a better administration of the office than is possible with the older types of toll equipment.

The load imposed upon various parts of the equipment must be balanced and carefully controlled, in order to expedite the routing of calls through the new facilities. This balance is achieved by an analysis of register readings. In addition, ammeter readings may be taken to check the load at any given time.

Is the No. 4 System "earning its keep?" Day in and day out it is running satisfactorily and both the equipment and the operators who use it deliver a high grade of service. Daily some 80,000 tandem, inward and through connections formerly handled by operators are routed through the equipment.

What do the operators think of it? Whether in the No. 4 Toll office and in other Philadelphia offices, or in the many cities which originate toll calls to or through Philadelphia, all indications are that they like it, and look toward the day of more installations of this type.

THIS CONTINUOUS RECORD of the volume of stored-up calls is an important aid to the maintenance of satisfactory force adjustment

PERHAPS IT IS fortunate that the Philadelphia System was placed in

service under conditions of wartime overloads on our toll plant. This is a severe test, and it is clear from the results being obtained that the No. 4 layout is equal to the situation.

However, in the use of intertoll dialing systems, there are certain advantages and economies which cannot be fully realized until such time as offices are not operating under conditions of wartime overloads. In connection with post-war planning, studies are now being made to determine future installations in order to take advantage of the possibilities of the new system. It is confidently expected that this will provide faster service on outward, inward and through calls, and that transmission will be improved. These advances should result in overall economies in outside plant and operating. Thus, the Philadelphia installation providing for toll line dialing by operators may well be regarded as a definite contribution to a program designed to lead ultimately to toll line dialing by customers.

The "Affiliated Plan" Is Ended

Operation of the "affiliated plan" for appointment of Bell System men to designated cadres of the Signal Corps has been terminated. Readers of "Skilled Manpower for the Signal Corps" in last September's issue of this Magazine, which described how the plan functioned, may be interested in the following letter to the A. T. & T. Company from Major General H. C. Ingles, Chief Signal Officer, U. S. Army:

"The Signal Corps program for procurement of military personnel by direct appointment of civilian employees from the organizations sponsoring the affiliated units, in which your organization wholeheartedly participated during the past several years, is being brought to a conclusion. The achievements of the men and the units in the service of our country will be forever inscribed in the annals of the Signal Corps. I wish to extend my appreciation to both the officers and employees of your organization who so unhesitatingly devoted their time and efforts in making the plan a success."

To General Ingles, A. T. & T. Vice President Keith S. McHugh replied as follows:

"It was good to hear from your letter . . . that the achievements of the men and the units in the Signal Corps under the affiliated plan have been so satisfactory in the service of our country. I am sure that all Bell System people take pride in the fact that our men who entered the service under this plan had the experience and training which has proven of value to the Army and to the country in this emergency. In acknowledging your decision that the operation of the affiliated plan is being brought to a conclusion, I should like to express our appreciation of the cooperation of and pleasant associations with your organization."

Carrier and Other Toll Equipment, Assembled in Compact Units, Provides the Means for Fixed Communications for the Armed Forces behind the Battle Areas

"Packaged Carrier" for the Signal Corps

Ernest W. Baker

THIS WAR has been referred to by someone as an "Engineer's War." With the marked trend toward mechanization and a war of rapid movement, the skill of the engineer is urgently needed in nearly all branches of the armed forces. This is particularly true in the field of communications. The faster the war moves and the more complex it becomes, the more vital is the need for adequate communications. The importance of reliable and speedy interchange of information is obvious in carrying out a combined land, sea and air operation such as the invasion of Europe.

Broadly speaking, communications systems of the Army are of two types—mobile and fixed. In the actual battle areas, mobility is essential for continuous communication between all the fighting units. Farther back, between headquarters of the larger army units and, in fact, clear back to Washington, there is need for fixed communications.

The Plant Engineering Agency of the U. S. Army Signal Corps, located in Philadelphia, is responsible for the engineering of fixed wire and radio communications for the Army in all parts of the world. This plant, in many respects, is like Bell System toll plant and its design involves similar problems. Therefore, as might be expected, Col. Will V. Parker's staff of officers and civilians responsible for design consult frequently with Bell System engineers in the solution of unusual problems that arise. During one of those discussions the Army suggested the further development of the idea of "packaging" which had been employed previously in the Bell System for certain types of equipment.* This involved extension of the packaging

* See "War Emergency Stocks in the Bell System," MAGAZINE, September, 1943.

plan so that the equipment for a complete communications network could be set up in this manner.

The Need for Packaged Equipment

THE COMMUNICATIONS layout along the new Alaska Highway is an example of the type of project engineered by the Plant Engineering Agency. From consultations on this and several other similar projects, it became evident that the work could be done quicker if it were not necessary to consider each job on a "tailor-made" basis. The Signal Corps seemed to need a set of "building blocks" which could be put together quickly to produce a complete communications layout. They wanted to be able, for example, to order a carrier system in advance of specific need in much the same way as they might order shovels, guns, trucks, etc. With such a scheme the detailed engineering and ordering could be much simpler and, in fact, it seemed that all the moves, from the time a project is conceived until it goes into service, would require less effort if it were done on this basis.

In using the equipment to meet the Army's needs, certain of the small building blocks are always associated with each other so the logical thing to do was to put them all together in the same container—a "package" of such small building blocks. Then the package unit itself could be used as a bigger building block. That is exactly what the packaged equipment is; each package is an assembly of small units of apparatus normally associated together in furnishing toll circuits.

After some work to decide what pieces of equipment to put in each package, the Signal Corps placed orders for the equipment and the Bell Telephone Laboratories went ahead with active development of the desired arrangements. Three-channel open wire carrier systems (Type C), telephone repeaters, and signaling apparatus were the first items undertaken. There were conferences from time to time with the Army people as the work progressed, to review the designs, perhaps to change things a bit in order to take care of a new problem the Signal Corps may have encountered in some war zone. Also, other items of equipment were added to the development program in an effort to provide a packaged arrangement for each of the units required to put together a complete telephone and telegraph communications system.

Design Objectives

THE AIM HAS been to design and make equipment which would satisfactorily meet the needs of the Signal Corps for fixed wire communications in the various military theaters in all parts of the world, with a minimum of specific project engineering, installation, and maintenance effort.

The first requirement was speed. During a recent address in New York, Brig. General Frank E. Stoner described three "bests" that might be desirable for a particular job:

1. Scientific best—which comes closest to perfection but takes longest to produce.
2. Engineering best—a slightly less faultless job requiring somewhat less time.

3. Best that's available—This, General Stoner said, is the "best" that the Army frequently has to use because it is needed right away.

In the case of package systems, time was a controlling factor, so the initial designs employed units of standard Bell System apparatus wherever practicable. The compact equipment assemblies were quite different, however, from existing arrangements of System equipment for central office installation. These first designs were then followed by improved ones to make the equipment moisture resistant and otherwise suitable for use under a wide variety of climatic conditions.

Ruggedness was one requirement. Under war conditions, the equipment must stand up under rough treatment. Also, equipment packed for export must be protected during transit against the effects of tropical rains, high humidity, and extreme temperature ranges.

The size and weight were limited so that the individual packages could readily be moved. Though the apparatus is intended for fixed communications, a considerable amount of handling may be necessary, often under difficult conditions, before the location of the equipment becomes "fixed."

Another important consideration was flexibility. The major items of apparatus selected for the several assemblies were chosen for the kind of wire and pole lines most likely to

Signal Corps officers inspect cases of packaged equipment which have been delivered for an Army field trial. They represent a typical shipment of equipment for one communications office

be employed, but something had to be done to take care of the unusual cases.

In war the unusual cases are common. Where this equipment is to be used, there will not always be a supply depot or a hardware store close by, so it was important to put into the packages all the apparatus required to establish communications quickly wherever they are needed. Of course, this did not mean putting two of everything in the package as Noah did in the ark—the package couldn't be made that large and there was a shortage of critical materials. What it did mean was that the Laboratories had to design a number of special pieces of apparatus so that one unit, with simple adjustments, could do the job of several pieces. For example, a piece of equipment designed to be used with copper wire could also be used with copper-steel wire. In this way the packages were made readily adaptable for use with a wide variety of types of line facilities. This feature should be very helpful in making extensive use of existing communications plant in occupied territory.

The Various Packages

QUICK INSTALLATION was a controlling design requirement. In general, each box of equipment is arranged so that it may be put into service in a short time by plugging into a primary source of a-c power and making relatively few line-up tests. Storage batteries are not used. The installation and line-up procedures are outlined step-by-step in the proper sequence in special instruction pamphlets shipped inside the box with the equipment to which they apply.

The development project included complete equipment for telephone and telegraph circuits. As a typical example, suppose our army arriving in Italy found a telephone line several hundred miles long and carrying two pairs of wire, perhaps with the wire missing here and there in several spans. By patching up the missing links of wire and using the package equipment, six telephone and 28 telegraph circuits could quickly be set up for the entire distance; or they could be cut into pieces and used for a still greater number of shorter circuits to intermediate points.

The circuits and apparatus employed in this equipment have been made more highly moisture resistant than is required for corresponding Bell System types, and will stand up over a wider range of temperature. The number of types to be considered in ordering has been minimized by supplying a small amount of extra apparatus in each package for making simple modifications in the field to care for a variety of plant conditions. The equipment can be ordered and manufactured in bulk, shipped in bulk to a theater of operations, and there assigned to fit the requirements then existing. A typical unit of packaged equipment, the Type C carrier terminal, is shown in the photograph on page 243. This unit takes three separate telephone conversations and bundles them together for transmission over the wires. A similar unit sorts them out again at the far end.

Carrier Telephone Epuipment

ON A PAIR of open wires it is customary to transmit one two-way conversation at voice frequencies: that is,

the speech sounds are converted into electrical impulses in the telephone set and are sent over the toll circuit at these so-called "voice frequencies." One or more additional two-way conversations can be handled over the same pair of wires by employing the carrier technique. With this means "demodulated" to the original voice frequencies.

Naturally, the Signal Corps wanted packages of carrier equipment because fewer shiploads of wire will be required than would be needed if carrier were not used. Two types of carrier equipment are being used, the

SIGNAL CORPS MEN are removing the packing case from one unit such as is shown on page 243 before up-ending it onto the base which has been prepared at the left to receive it

the voice frequencies of the separate conversations are changed or "modulated," to use a technical term, by different amounts, so that in effect they are piled on top of each other for transmission over the toll circuit. At the distant end filters are used to sort out the separate conversations and they are changed back again, or first providing one circuit and another providing three circuits (Type C). By using repeaters every 100 to 150 miles, the length of these latter circuits can be extended to great distances.

The Type C carrier system involves separate packages for an East terminal, a West terminal, a repeater and

a test package. The equipment will be mounted in cabinets seven feet high. Spare vacuum tubes, wire, tools, concise installation and operating instructions, drawings and miscellaneous items are all included.

Carrier Telegraph Equipment

THIS PACKAGE includes equipment which may be used to slice one telephone circuit into 12 pieces, each piece suitable for handling a telegraph message. Thus, a Type C carrier telephone system plus this package could be used to furnish two carrier telephone circuits and 12 carrier telegraph circuits—in addition to the voice frequency circuit—all on one pair of wires.

The operation of this carrier telegraph equipment, as it is called, is similar to that of the standard Bell System 12-channel V.F. carrier telegraph system. For flexibility, however, instead of a 12-channel system there are two parts to the Signal Corps arrangement. The first part includes channels one to six and the second part includes channels seven to 12. They can be used independently as six-channel systems, or together to constitute a 12-channel system.

Voice Frequency Telephone Repeaters

THE LATEST TYPE of standard Bell System telephone repeater has been adapted to Signal Corps use. One piece of apparatus, a universal line-balancing network, included in the same package with the repeaters, can be adjusted in the field so that the repeater may be used with any type of open-wire or cable likely to be placed by the Army or found in occupied territory.

Two types of repeater packages have been made available. The first contains three repeaters. It also includes a bridging circuit which provides for talking at an intermediate repeater location. The second is a single repeater unit which has been made as complete as possible—including a ringer—for use at isolated points where only one repeater is needed.

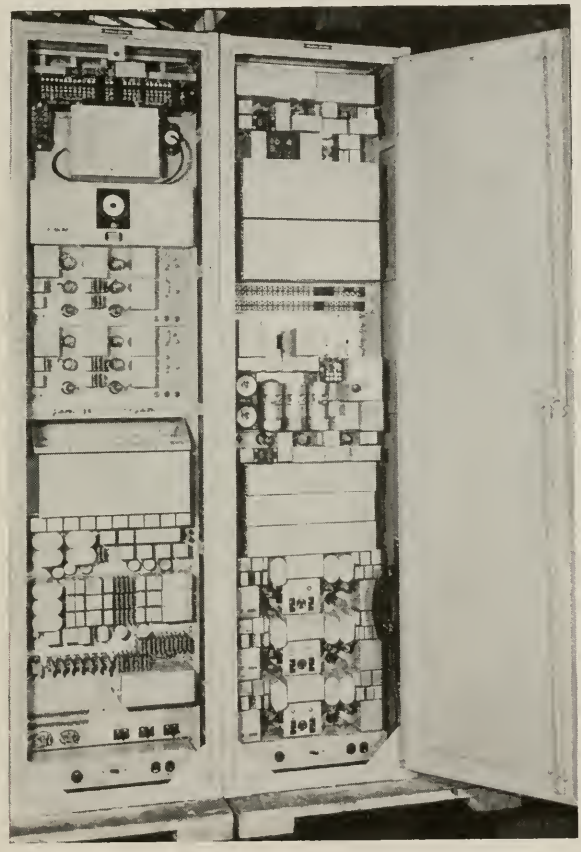
Other packages include voice frequency ringers to signal over the toll circuits, telegraph apparatus for circuits where use of the carrier telegraph is not desirable, testboards and testing equipment—in short, all the equipment the telephone man needs in order to build a high grade toll plant.

The packaged equipment, except the testboard and the testing equipment, is mounted in steel cabinets with doors front and back and panels mounted on a vertical rack approximately in the middle of the cabinet. The cabinets are made 7′, 3′–6″, and 2′–4″ high to line up in rows 7′ high. The largest cabinet fully equipped weighs about 600 pounds. There would be no trouble at all finding space for a few such cabinets somewhere in Berlin or in the Imperial Palace in Tokyo.

Field Trial

BELL SYSTEM practice is to subject a new development to a thorough field trial before introducing it into the plant. Such a trial under expected operating conditions usually discloses any undesirable features and some-

times indicates certain changes in the design. In the case of these package systems for the Signal Corps, there were obvious difficulties in attempting to conduct such a trial in an actual theater of war. But, despite the fact that urgent need required that the first few systems be shipped to war zones as soon as they could be produced, it did not seem wise to forego a trial entirely. The equipment might be sent to any part of the world and a considerable time might elapse before comments concerning operation would get back to the Laboratories from Army people using the systems in distant countries. Accordingly, a field trial was made in the Long Lines plant under more or less simulated war conditions. For instance, a line was purposely chosen which had not previously been arranged in all sections for three-channel carrier operation. The equipment was installed



PACKAGED "Type C" terminal and associated line and power bay. Together they provide three additional telephone circuits on a pair of wires which could otherwise furnish only one

and put into operation by Signal Corps personnel and subjected to expected operating conditions by using it in connection with various assigned war problems. The trial included tests and observations by Bell System engineers but an effort was made to approach as closely as practicable some of the conditions that may be encountered in actual use for military purposes.

THE EXPECTED EXTENT of use is perhaps a good indication of the importance the Signal Corps attaches to the package project. Just how much equipment of this type has been ordered cannot be disclosed. Some idea of the magnitude of the job can be given, however, by saying that the carrier telephone equipment contemplated could provide nearly as many circuit miles of Type C carrier as were in operation in the Bell System plant when we entered the war, about 23 years after carrier was first used. Proportionate quantities of the other items of packaged equipment are expected to be used. The Plant Engineering Agency of the Signal Corps has estimated that use of the equipment for military wire systems will save more than a million pounds of copper. Initial deliveries were made in June and the Western Electric Company is now producing the equipment at an increasing rate.

As is the case with many war developments, some of the principles involved in the package project will find useful application in the peacetime communications plant.

THE RADIO TELEPHONE SYSTEM which for the past three years has connected the Island of Santa Catalina with the rest of the Bell Telephone System was closed down on August first. An enlarged service to the Island is now being given over two submarine telephone cables, which were laid to the Island a few weeks before the closing of the radio.

The passing of this radio system is of more than usual interest, both from an historical and a technical standpoint. It was the first, and so far as known, the only radio telephone system which has ever given a commercial telephone service, meeting in both transmission and signaling (although not as regards secrecy or economy) the ordinary requirements of wire telephone circuits.

The system was originally installed because, under the conditions at that time, it was the only form of communication which could be established to the Island without considerable delay. Its three years of reliable service, combined with the large volume of traffic handled over it, are an ample demonstration of the success with which the system met the requirements of commercial operation.

From the BELL TELEPHONE QUARTERLY, *October, 1923.*

The Public and the Telephone Companies Co-operate in Meeting the Demands of War that Telephone Information Service Be Limited to Essential Calls

Information About "Information"

Howard F. Parker

In the era now known as "Before Pearl Harbor," thirty-three out of every one thousand telephone calls made were for Information. Now this statement, in itself, does not seem impressive. But in terms of *all* the telephone calls made each day from Bell System telephones in the United States, three and one quarter million were for Information; and to furnish the desired service on all these calls required a daily force of about eleven thousand telephone employees.

Were all of these three and one quarter million Information calls necessary calls? That is, was each Information call a call for a telephone number that could not be found in the telephone directory, such as the number of a recently installed telephone? Unfortunately the answer is "No." Well over one half of the total, or some two million Information calls were "unnecessary," since they were for numbers correctly listed in the current telephone directories. These "unnecessary" calls required many pairs of copper wires to connect them to Information and many operators at Information to look up and furnish the telephone numbers.

Suddenly the nation was hurled out of the "Before Pearl Harbor" state of mind and into war. Just as suddenly, it became essential that every individual's time and service (telephone operators included) be devoted exclusively to one purpose, that of furthering, in every way possible, the vital war effort. Obviously, one immediate step the telephone companies could and did take was to inform telephone users that one of the American ways of doing things in war times was to use the telephone directory first and to call Information only when necessary.

By thus eliminating most, if not all, of the two million needless calls a day to Information, three important

contributions to the war effort would be achieved. First, several thousand employees could be transferred to essential work, such as handling vital long distance calls to and from the military, the government and other essential customers. Second, many thousands of miles of copper wire used to connect these non-essential calls through to Information could be released for use on vital war calls. Third, it would not be necessary to provide additional Information desk positions, involving new critical materials such as copper, lead, tin, etc., and the additional thousands of miles of copper wire to connect still more calls to Information as the number of telephones increased rapidly under war time requirements.

Seeking Public Coöperation

THE STEPS taken by the telephone companies to obtain the coöperation of the public are probably familiar to everyone. For one thing, there have been the many advertisements placed in newspapers, periodicals, etc., all with bold-faced headlines, such as "Needless Calls to Information Slow Up War Time Telephone Service"—"Why Make Two Calls When One Will Do?"—"Please Do NOT Ask Information to Look Up Numbers That *Are* Listed in the Directory" and many others.

Another step is to have the Information operators indicate on these needless calls that the number wanted *is* in the telephone directory. For example, you may have heard an Information operator say in response to your call "That number is listed in your directory as Main 1234," or "That number is listed in your directory. Will you look for it there the next time please? The number is Main 1234," or perhaps the more positive phrase "That number is listed in your directory. Will you look there for it please?" In the last case, the operator does not give the number to the customer unless he indicates that he has looked in the directory and is unable to find the number, or that for some other sufficient reason he is unable to obtain the number himself.

All of this discussion, down to this point, indicates that there is a very definite job that every telephone user can do to help the war effort, by using his telephone directory *first* on every call and calling Information only after he has done so and has been unable to find the number. Even when the calling customer knows that the party he wishes to talk with has moved to another address in the same city, he does not need to call Information, as in many cases the party still has the same number. If the number has been changed and the old number is called or dialed, an operator (not Information) will intercept the call and give him the new number. If the number has not been changed, a call is saved, and the telephone company is aided in doing its job of getting the vital war telephone calls through on time.

WHAT HAS BEEN the result so far? How well have the telephone users coöperated in this part of helping the war effort? The results to date have been fine. As with almost everything in life, however, there is room for further improvement. A few figures that show the present results may indicate the extent to which they

can be further improved. In the interval since Pearl Harbor, the number of telephones in the United States has increased substantially. If Information calls from these new telephones had been at the same rate as from the old telephones, there would now be about three and three-quarter million calls per day to Information.

AN EXAMPLE of a modern type of No. 1 Information Desk, equipped with team-work circuits. This type of desk normally provides an average-size team of 12 operators

Actually, however, such calls now number only about two and three-quarter million calls per day. This means that about one million Information calls per day have been "saved," most of these being of the unnecessary type. The net result has been a reduction of one-half million calls per day below the pre-Pearl Harbor rate and this has made it possible for the telephone companies to divert to vital war traffic some two thousand employees, about ten thousand miles of copper wire, etc., that otherwise would have been needed to handle these half million calls. However, nearly one and one-half million unnecessary calls per day are still being made. The battle is far from being won and everyone can still help, and help more.

With the telephone users doing their part so well in putting labor and materials to work for essential war purposes, it is pertinent to ask whether the telephone company's Information equipment is such that the *necessary* Information calls can be handled with a minimum amount

of labor and materials. In other words, how well is the telephone company doing its part? That is a difficult question to answer in anything like precise terms. To quote from a previously published article,* "From its early beginnings, the provision of Information service has been the subject of the study and development which are characteristic of the Bell System's approach to the task of rendering a pleasing and efficient service to its customers. Staff Engineers . . . have constantly under review the various phases of this important specialized service—the training of Information operators, the design of equipment, the adequacy of records and other aspects of the job." The broad implications of this quotation form the basis for the statement that it seems entirely reasonable to put the telephone company's score up fairly close to the top figure.

Beginnings of the Service

IT IS DIFFICULT to say just when Information service, as such, first started. While telephone directories have been published since 1878, the earliest of these were simply lists by name of the subscribers to telephone service. No numbers were used and every operator had to know the name of each subscriber in the office and just where on the switchboard "Mr. Brown's line" or "Mrs. Smith's line" was to be found.

An interesting explanation of the genesis of the use of telephone numbers was given in 1903 by the late C. J. H. Woodbury, at that time an assistant engineer of the American Telephone and Telegraph. Said he:

"When telephone central stations were first established, the names and positions on the switchboard of the subscribers were known to operators with strong memories; an epidemic of measles occurred in Lowell, Mass., and Dr. Moses Greeley Parker, a member of the Board of Directors of the telephone company, viewed with alarm, from his standpoint as a physician, the possible condition of affairs if more than two of the four operators should be taken with the measles, and proposed that the subscribers be numbered.

"His associates demurred, as they were of the opinion that the subscribers would give up their telephones sooner than submit to the indignity of being known by number, but in view of the contingency they finally yielded, and to the surprise of all, the new arrangement was cheerfully accepted by the subscribers, who appreciated the improvement in service which resulted from the change."

IN MANY of the cities, especially the smaller ones, it was not until late in the last century that the use of numbers for designating subscriber lines became common and printed directories showing these numbers were necessary. At that time, with all regular calls placed by number, it was relatively easy for the operators to remember the name and number of new customers and therefore each operator became her own Information operator. Very early in the present century, however, a few offices became so large that it was necessary to have a separate table or desk where one or two operators

* See "Providing the Information Service," MAGAZINE, August, 1941.

could concentrate on giving out new and changed numbers from various forms of "improvised" records, frequently written out in longhand or perhaps typewritten.

With the rapid expansion of telephone service in the decade prior to the first World War, this form of Information service was quickly outmoded for the larger cities. These had grown to the point where several central offices were required in each city. Each office had its own small Information desk of usually one to three or four positions. The inadequacy and inefficiency of this arrangement to meet changing conditions led to the idea of centralizing the Information service for all the offices of a city at one desk. The number of pairs of copper wires to be carried from each particular office to the centralized desk would equal the expected number of simultaneous calls to Information from that office. Telephonically, each pair of copper wires would be known as an Information trunk. The answering end of these trunks would be so arranged that any one of several operators could answer any call.

HERE IS an installation of the No. 3 Information Desk with positions for about 120 operators and a team size of about 40

The first centralized desk was installed in 1910 and was known as the No. 1 type of Information desk. It was designed to accommodate book type records * and to provide for a

* For a description of these and other records referred to herein, see "Providing the Information Service," MAGAZINE, August, 1941.

maximum of thirty Information trunks in front of an operator. These thirty trunks were multipled before as many operators as were required to handle the simultaneous calls that would normally be connected to these trunks. It was at this point that Information service really began to warrant "study and development" with staff engineers having "constantly under review" its various phases. It is of interest to note that the major considerations in designing the first centralized desk were basically the same as they are today, although the state of the art in those days did not permit as close an attainment of the goal as is now possible.

Among the principal objectives, two may be cited to illustrate the approach to the problem. One was that the desk should be specially designed to make it possible for the operators easily and quickly to reach the most up-to-date form of ready reference records that could be adapted to Information service needs. A second had to do with making the "speed of answer" by the Informa-

THIS CLOSE-UP of an Information position illustrates desk design to make voluminous records, such as those for a metropolitan area, readily available to the operator

tion operator reasonably fast. This "speed of answer" is the interval between the time a call is connected to the Information desk and the time that an operator is able to answer it. A primary purpose of both of these objectives was to provide better service for the customer; and the first general information on the centralized desk sent to the Bell System tors who can actually answer a call that has been connected to a particular trunk. This number of operators is known as the operator "team" size. To illustrate:—with the best records available in those days, the Information operator required about one minute on the average to look up the desired number and give it to the customer. If, at a decentralized

This is the No. 4 Information Desk, designed for rotary files

Companies by the staff engineers stated, "With the new equipment the Information service will be improved."

The speed of answer is largely dependent upon the number of operadesk, there were only one operator and she were busy on one call when a new call arrived, it might mean a delay of as much as a full minute before she could answer this second call, perhaps even more if she had to

choose between two or three waiting calls. If there were a team of two operators at the decentralized desk, it would mean that every half minute, on the average, one of them would become available to take another call and thus waiting time for an answer by Information would be reduced accordingly.

WHAT HAPPENED TO the team size when a centralized desk was used and what effect did this have on speed of answer? The early No. 1 desks, with a total of about thirty Information trunks in front of each operator, could ordinarily have these trunks multipled before a total of about eight operators. So the team size became eight instead of one or two. With each call taking about one minute of the operator's time, some one of the eight operators would become available for a new call about every seven to eight seconds, instead of thirty to sixty seconds.

The point may be raised that, with thirty trunks and the average call requiring about sixty seconds, the team size should be much larger than eight and the speed even faster than seven seconds. This would be correct *if* Information calls were evenly spaced just so many seconds apart by the customers who make them. But they don't come that way. They come in to the operators in a sort of random distribution.

For example, when one person decides to call Information, he may be the only one in that city who wants Information at that instant. On the other hand, perhaps five or ten or even twenty other people want Information at that same instant. The result is that during certain minutes of an hour there is a tendency for the number of calls to Information to pile up and be higher than the average and substantially higher than in the low minutes of that same hour. Consequently, thirty trunks were necessary just to avoid delays during these momentarily high peaks, but at other times in the hour, less than thirty trunks would have been adequate. Likewise, the operators had to have some spare time included in their total work time, if enough operators were to be available in the peaks to avoid some excessively slow answers.

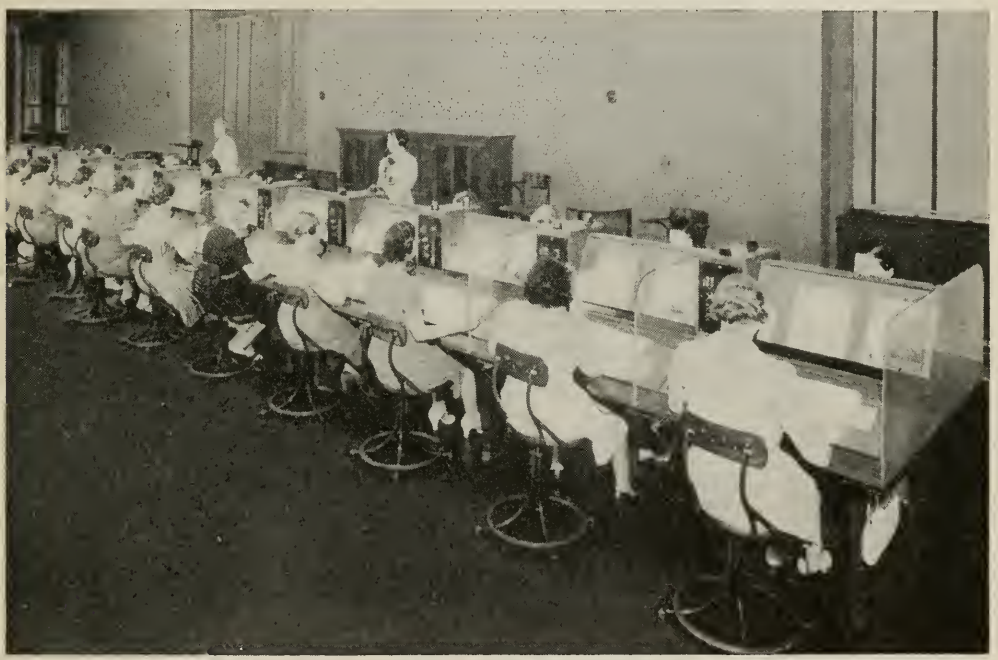
Improving the Equipment

AS A RESULT of increased experience in the giving of Information service, numerous improvements in the No. 1 type desk and its arrangements were made. The first was to increase still further the size of the team of operators. It soon developed that each operator should have a chance at more than thirty trunks, if fast and efficient service was to be given. It had already been necessary to rearrange the equipment from a desk with one team of operators serving thirty or less trunks to a desk with two or more teams of operators, each with up to thirty trunks. However, when all operators in one team were busy, there was no way that a momentarily idle operator in another team could take one of the calls waiting for an operator in the first team. To meet this difficulty, a set of teamwork circuits was provided between each two operators in such a manner that one operator who had at the moment no waiting signal at her position could take up a signal that she could see waiting on the adjacent

position. The effect was to increase the team size by about fifty per cent or from a normal team of say eight to a team of twelve operators, with some one of the twelve operators becoming available to answer a new call about every five seconds.

A second improvement had to do with the condition where all the operators in a team were busy and several calls were waiting to be answered. In order that the operators could recognize and answer first the calls which had been waiting longest, it was arranged for each call signal to change from a steady lamp to a flashing lamp at the end of a few seconds. A third improvement was to provide a sloping surface for the space where the books lie open as the operator looks for a number, in order to reduce eye strain and, therefore, make it easier to read the records. A fourth improvement consisted of enlarging the space for records to accommodate larger sized books of a more modern type.

In the middle nineteen twenties a new form of record known as a "rotary file" became commercially available. Due to limited capacity, it was adaptable, in general, only to the smaller and medium sized cities. The advantage of the rotary file was that operators could find a desired number somewhat faster than in the type of book records then available. A rotary file consists of a stand on



THE No. 6 Information Desk, developed for use in medium-size cities

HERE ARE some examples of newspaper advertising used to request customers to call Information only when necessary—as discussed on page 246

which one or two rotating racks are mounted. Fastened to these racks are frames which carry a large number of narrow card inserts. Each insert has printed on it the name, address and telephone number of one subscriber. While rotary files could be and were placed on existing No. 1 desks, the structure of this desk was not well adapted for this record. Consequently, a new No. 2 Information desk was designed with adequate space for these new files and to include also the principal features and improvements of the No. 1 desk.

At Nos. 1 and 2 desks, the operators, in answering an information call, must first see a lighted lamp indicating a waiting call and must then operate a key associated with the lamp signal. A lamp and a key together constitute an Information trunk at the operator's position. At these desks, because of this lamp and key arrangement, no very large number of trunks is provided in front of each operator and the size of the operator team is limited to a maximum of about twelve. By the middle nineteen twenties, however, the amount of Information service required by telephone users had grown to the point where many of these centralized desks needed thirty, forty, fifty or even more operators at one time. This required, in effect, several teams of about twelve operators each, in one centralized location.

Other Types of Desks

MANY ADVANCES in the telephone art had, by now, come into being. Among these was the dial telephone and its associated electrical switching apparatus. The staff engineers' knowledge of this new form of apparatus enabled them to apply certain features of it to a new type of Information desk.

This desk provided for automatic distribution of calls to a relatively large team of operators, who could answer these calls in the order or sequence in which the calls were made. Under this scheme, each Information trunk, instead of being wired directly to a signal at an operator's position, is connected to a position selecting switch. This switch automatically associates the call on that trunk with the next operator who becomes available to receive a new call. There may be as many as forty operators in the team from which this one operator is selected. This operator hears a tone signal in her telephone receiver which tells her that she has a call to be answered and she is then in immediate communication with the calling party.

The first desk of this type, the No. 3 Information desk, designed to accommodate book type records and to meet the needs of the largest cities, was installed in 1929. In order that the call distributing, sequence answering, and large team size features might also be available for use in medium sized and smaller cities as well, two other desks were designed. A No. 4 desk similar to the No. 2 in appearance and arranged for rotary files was the first of these. This was followed by the No. 6 desk, arranged like the No. 3 for book records but smaller in over-all size and floor space needs, since medium sized cities do not require the many and voluminous records which the few very large cities must have.

In addition to increasing the team size to forty at the Nos. 3, 4 and 6 desks, there have been many improvements in equipment, in the records of subscribers' names, addresses and telephone numbers and in the operating practices by which the operators use the equipment and records. These improvements have made it possible for an operator to furnish the desired number now in about one-half minute instead of the original one minute. Therefore, with the present team of forty, some one of the forty operators becomes available to answer a new call each second or less. While some spare time must still be included in the operator's work time, to allow for the momentary high peaks of calls, the amount of this margin is correspondingly less than in the early days. Consequently the increase in team size has been important in improving service (fast speed of answer and speedy search of records for desired number) and increasing the efficiency of the operators.

Measuring the Savings

NOW TO COME BACK to the question of how well the telephone company has done its part in this battle to save all non-essential labor and material and divert it to essential war usage. Data are lacking to show the cumulative effect of all the improvements since the 1910 period. However, at the time of Pearl Harbor, the Bell System was using about 5,000 desk and switchboard positions to furnish Information service. These positions required a staff of more than 11,000 employees and something over 65,000 miles of copper wire for the Information trunks needed to connect the then 3,250,000 calls per day to Information. Assuming that no improvements had taken place since about 1925, the effect would have been to increase the 5,000 positions to about 6,000, the 11,000 employees to some 14,000 and the 65,000 miles of copper wire to about 100,000 miles. All this for the then 3,250,000 calls per day. Had the telephone users not responded to the wartime plea to avoid unnecessary calls and the potential 3,750,000 per day figure for the present time been realized, the requirements would, of course, have been more.

THE HISTORY of telephone Information service, like that of the general telephone service which the public knows so well, is one of progressive changes and improvements from the beginning down to the present time. These changes and improvements, in addition to providing vastly better service to telephone users, have contributed materially to the efficient use of materials in war time. Coupled with the fine coöperation of the public, these achievements of telephone engineers have resulted also in the efficient use of a minimum number of employees to furnish this service. The manner in which these results have been accomplished is an inspiring example of the fact that a team made up of the American public and American industry can always be depended on to be a winner in any common undertaking.

A Device for Accurate Aiming of Anti-aircraft Artillery, Developed by the Bell Telephone Laboratories and Made by Western Electric, Has Its First Demonstration

Electric Brain

Henry J. Kostkos

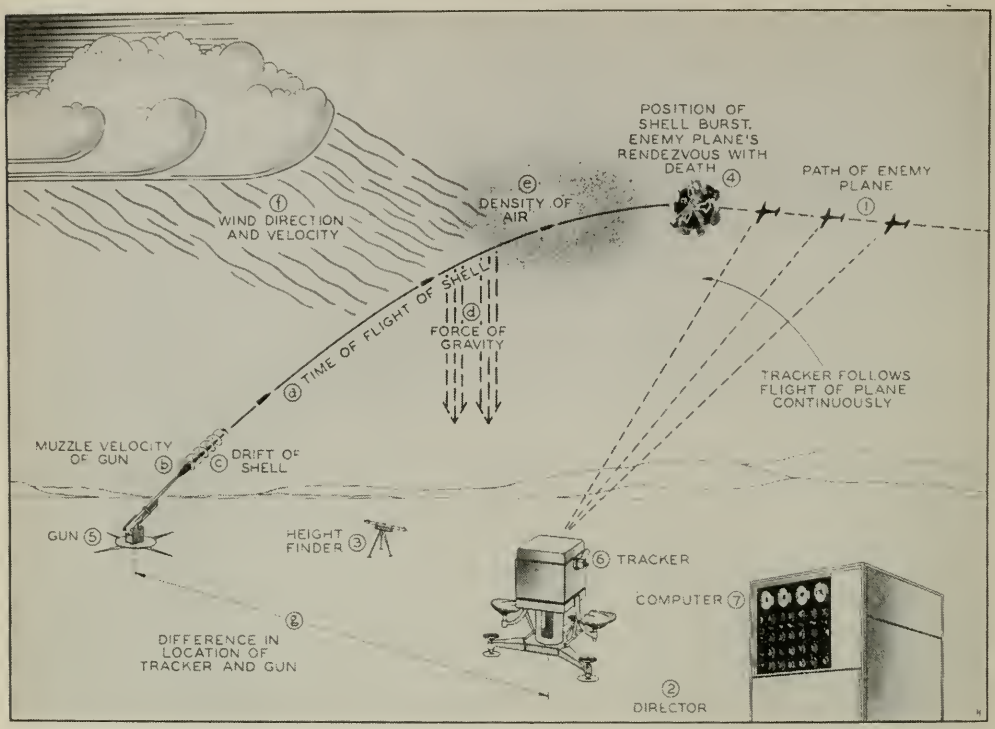
THE QUIET of New Jersey's Watchung Mountains in the vicinity of the Bell Telephone Laboratories' buildings at Murray Hill was shattered one early November afternoon when a column of big Army trucks, headed by an agile jeep, turned off the main road and rolled up the driveway leading to the Laboratories' spacious grounds. The driver of each truck knew the destination of his unit on the field that had been prepared for it, and smoothly landed it exactly there. With precision made possible only by constant coördinated drill half a hundred soldiers leaping from the caravan went into action simultaneously. They slipped off tarpaulins, unbolted gun carriages, assembled platforms. In a few minutes, four 90-mm. guns were ready for action against enemy planes.

At the same time other troops, specialists in their line, had set up, leveled, and adjusted the components of an electrical gun director system for fire control. Rifles swinging on straps over their shoulders, men in the detail unreeled wire and cable to tie together the power transmission and communication systems of a complete anti-aircraft battery. Machine gunners unloaded their weapons at strategic points around the grounds and stood on alert against attack.

But this was only mock warfare. The real use for the weapons that an anti-aircraft battery of the Eastern Defense Command of the Army had brought to the Bell Telephone Laboratories at Murray Hill for demonstration was on the battle fields in Europe, the islands of the South Seas, perhaps other parts of an embattled world too.

Two days later, on November 9, 1500 men and women of the Laboratories, distinguished Army guests, newspaper and magazine reporters and photographers, and representatives from other Bell System companies who had assembled on the Murray Hill grounds saw these weapons in simulated action against target planes. All of these events meant only one thing: the Bell Telephone Laboratories, using its years of com-

(*Please turn to page 259*)



DIAGRAMMATIC EXPOSITION OF THE FUNCTIONING OF THE SEVERAL UNITS COMPRISING THE BELL TELEPHONE LABORATORIES' ELECTRICAL GUN DIRECTOR:—

AN ENEMY PLANE, 1, looms in sight. The crews of the tracker, 6, and of the height finder, 3, spot the target and follow it in its flight. The computer, 7, of the electrical director instantly measures the position of the target and then predicts where the anti-aircraft gun, 5, is to be aimed and how the fuze of the shell is to be set so that the shell will burst in the path of the plane at the predicted position, 4.

The electrical information derived by the computer is translated into mechanical movement at the gun to swing its muzzle automatically to the correct horizontal and vertical angle to score a hit. Not only must the computer make its calculations continuously during the entire period the target is being tracked, but it must make constant and instantaneous corrections for these factors:—

The time of flight of the shell, a, to the predicted position of the target, 4, is dependent upon the muzzle velocity of the gun, b, which in turn is governed by the temperature of the powder and the number of times the piece has been fired. The ballistics of the shell is also influenced by its drift, c, which is the spin caused by the rifling of the gun, curving the shell to the right. At the same time the pull of gravity, d, deflects the shell downward, and the varying density of the air, e, slows down the projectile more or less; while the direction and the velocity of the wind, f, either retards or pushes the shell ahead or to one side. To add to the complications of the problem, the difference in the location of the tracker and the gun, g, must also be taken into account in making the computations.

munications background, its telephone "know-how," had applied these attributes to the problems of anti-aircraft fire control and had developed the M9 electrical gun director, which according to Major General L. H. Campbell, Jr., Chief of Ordnance ". . . is one of the greatest advances in the art of fire control made during the war."

Laboratories' School for War Training:

"Almost exactly three years ago today final approval was given to proceed with the development of the electrical director now performing an important part in the control of anti-aircraft guns. Within about a year from that time, a model of the first director

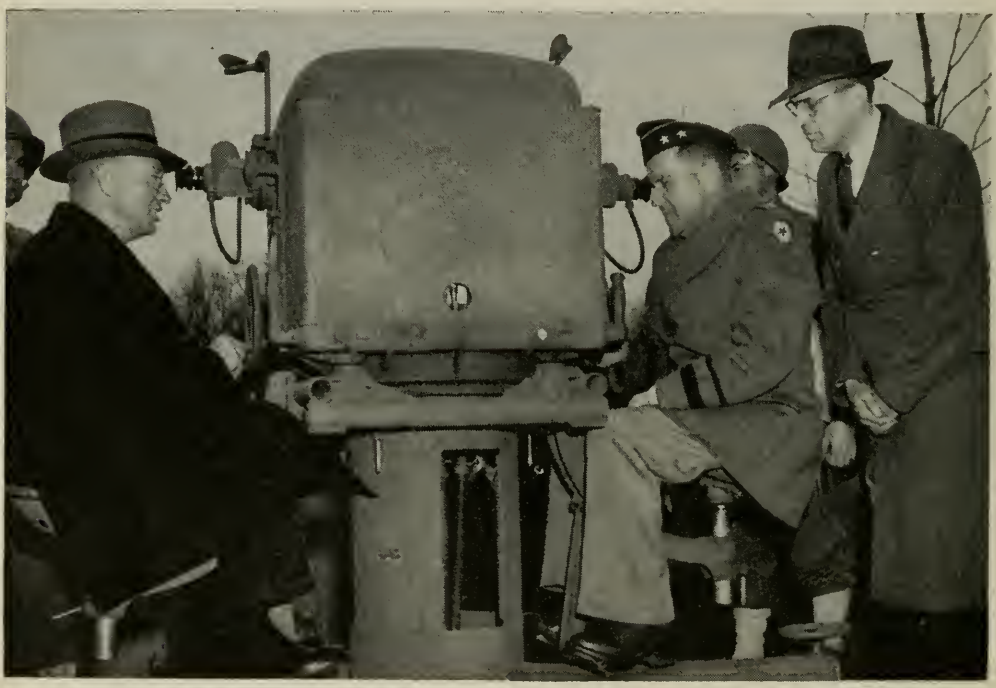
NEWARK EVENING NEWS

One of the four anti-aircraft guns of the battery which at the Laboratories' demonstration was aimed by the electrical gun director. Directly behind it is the "tracker" and at the right is the "computer." In the right background appears some of the Laboratories' Murray Hill development

The demonstration was given with the approval and coöperation of the U. S. Army Ordnance Department and was occasioned by the third anniversary of the beginning of development work on the electrical director, as explained in the introductory remarks by R. Karl Honaman, Director of Bell Telephone

had been sent to the Army for test. Within another year the tests had been completed and the Western Electric Company was provided with the data necessary to begin production. Today, three years later, many of these instruments are in the hands of our armed forces."

Thus the Murray Hill grounds became a typical anti-aircraft position. Four 90-mm. guns formed a quadrangle. Dr. Harvey Fletcher, Director of Physical Research, explained to the audience that the guns are aimed and fired, either automatically or under control of the gunners, in accordance with information calculated and transmitted by the electrical director.



PRESS ASSOCIATION

DURING THE DEMONSTRATION at Murray Hill, President Oliver E. Buckley of the Laboratories (left) and Major General L. H. Campbell, Chief of Ordnance, manipulate the tracker as Dr. David B. Parkinson, originator of the concept, looks on

How the Device Operates

SIGHTING THE TARGET is done by means of a tracker. Two operators peer into telescopes, one on either side of the unit, and hold the cross hairs on the moving target by operating hand-wheels or by setting an automatic device that aids in the tracking. The man who follows the plane in azimuth—the horizontal angle—holds the vertical cross hairs on the target. In doing this the entire tracker, including the men on the seats, is rotated to follow the movement of the hostile plane. The second man elevates or depresses the telescopes by holding the horizontal cross hairs on the target—which may be rapidly changing its elevation. He thus determines the elevation angle. These two angular positions, which fix the direction of the target from the tracker, are automatically

and instantaneously converted into electrical terms by the device and transmitted to the computer.

In order to determine the exact position of the plane in space, the and controls, considers the present position of the target as well as its movement; and from the changes in the target's position, the computer determines the point in space where the

NEWARK STAR LEDGER

Two SOLDIERS operate the "computer" which automatically aims the guns and sets the shell fuzes. For a description of how the units pictured on this and the opposite pages function, refer to the diagram on page 258

range—straight-line distance—to the target must be added to the information provided by the tracker. This is done by means of a height or range finder and an associated altitude converter.

While the tracker and the height finder continuously sight the target, the electrical data from these instruments are sent over cables to the electrical brain, the computer. This complex device of electrical circuits, dials, plane will be at the moment a shell, fired at any instant, will reach it.

One of the most important functions of the computer is to make corrections for the ballistics of the gun and the outside forces acting upon the shell, such as gravity and wind. As shown in the diagram on page 258, the computer must consider all of these factors and come up with a solution not only instantaneously but continuously. To perform these com-

putations by the usual methods of using firing tables and slide rules would require so long a time that the enemy plane would have dropped its load of bombs and would be winging its way safely home.

In addition to pointing the battery of guns at the lethal spot in the sky, the computer provides information for setting the fuze to insure a shell burst at the predetermined point in space. One of the most important features of the electrical director is its ability to average or smooth out deviations in the course of the plane which are unavoidable even when the pilot is attempting to fly a straight course necessary during a bombing run.

Individual Initiative and Coöperative Effort

THE BASIC IDEA of the electrical gun director originated at the Bell Telephone Laboratories. It was in the middle of May, 1940, when the Panzer divisions were sweeping through the Low Countries and their Luftwaffe seemed invincible to the harrassed Allies, that Dr. David B. Parkinson of the Bell Telephone Laboratories technical staff conceived the idea of the electrical director. So logical did his solution to the anti-aircraft problem appear that in collaboration with his associate, Dr. Clarence A. Lovell, he immediately began to formulate his ideas in terms of electrical circuits.

The plans for the director he and his associates developed were reviewed by the Office of Scientific Research and Development in Washington and submitted to the Ordnance Department of the Army. The Laboratories were subsequently authorized to proceed with the building of a complete working model, and when the model arrived at Fort Monroe on December 1, 1941, a few days before Pearl Harbor, tests showed that the new electrical gun director did the job for which it had been designed and did it well.

Drawings and specifications were thereupon sent to the Western Electric Company, manufacturing organization of the Bell System, and mass production was begun. A satisfactory device of this kind requires not only good engineering design but also the application of the techniques of manufacturing necessary to produce a product which will stand up in field service. Here the long experience of the Western Electric Company in making telephone equipment for reliable performance in the Bell System has been applied to making these Directors dependable units in field service.

Although the basic idea for the electrical gun director was conceived by a few minds, its complete development was the product of coördinated effort. Dr. Oliver E. Buckley, President of the Laboratories, pointed this out in his address at the demonstration:

> "The electrical gun director involved in its development, design, and production the coöperation of many groups. Its progress in this regard was typical of many other hundreds of war projects on which we have worked and are working. In this case, a problem was recognized, and in seeking its solution inventions were made. As usually happens, both recognition of the

problem and the means for its solution came not from the top levels of the organization but from what I might call the productive level: in this instance, scientists of our physical research department. The importance of their findings was immediately recognized by the 'higher-ups.' "

In outlining the steps in the development of the electrical director, Dr. Buckley made note of the fact that this development followed the same series of functions normally performed on all new devices for the Bell System in ordinary peace-time activity of research and development. "Taking the user's point of view," he said, "we are vitally interested in reliability and life and also in ease and speed of maintenance."

In the case of the electrical gun director, the Army is the user. Its opinion is expressed in the remarks of General Campbell:

"As Chief of Ordnance of the Army I am certainly very much pleased to be standing here taking part in these ceremonies. I am especially pleased because we in Ordnance have always felt very close to the Bell Laboratories. We have been close for many reasons. The chief one of those, I think, is the fact that when we have wanted really high-grade, scientific work done we have come to the Bell Laboratories. . . . I often stop and think of the immense amount of effort involved to get an artillery projectile to an airplane. When we go back to the manufacture of the gun, the ammunition, the fire control apparatus itself, the training of the men, transportation over countless hundreds of miles of water and the dangers involved, then we must recognize the fact that the fire control is, after all, the heart of the whole proposition. If we can only control firing accurately, the rest will take care of itself, and that's why the work you have done in Bell Laboratories is, in our judgment, of such great importance. Do not underestimate what you are doing. We want you to know that we are all very proud of you and are looking for greater things."

"If you have sent returns under a name or an address differing in any particular from those used on this letter, please inform us, that our records may be corrected. Had Shakespeare worked with income tax files, he would not have dismissed so glibly the importance of a name. Doubtless a rose by any other name would smell as sweet, but when dividends are paid to Mary Jane Smith and reported to this office by Mrs. Thomas A. Smith, it is well-nigh impossible for those dividends to be identified."

From a letter from a state income tax department to an A. T. & T. stockholder concerning returns on dividends received.

Bombs Over Britain's Telephones

How England's telephone and telegraph services, and the men and women who operate them, faced up to the Nazi bombing raids of 1940 and 1941 is described by Mr. W. Chetham-Strode, Commercial Relations Division, Telephone and Telegraph Services, London, in a recent letter to Mr. D. M. DeBard, Vice President, Stone and Webster Service Corporation, New York. The following excerpts from that letter are published through the courtesy of Mr. DeBard.

THE FIRST ENEMY BOMB on the mainland of Great Britain since the 1914–1918 war fell near Wick in north Scotland on the night of April 10, 1940. On May 24 in the same year the first industrial town was attacked —Middlesbrough. The first bomb on the London area hit ploughland at Addington in Surrey on June 18, 1940.

In the eleven months from September, 1940, to the end of July, 1941, between 45,000 and 50,000 high explosive bombs fell on the London Region; incendiaries were numbered by the million.

During that September the attacks were concentrated on London. In the following month, however, they spread to the Provinces: to the Arms Towns—Coventry, Bristol, Sheffield, Manchester; to the shipping centres —Liverpool and Merseyside, Southampton, Cardiff, Portsmouth, Swansea, Plymouth, Belfast, Clydeside and Hull: to the quiet places of the agricultural districts and to the cathedral towns. Nearly everywhere the bombs came down, and they did not all fall harmlessly in fields and parks.

They fell on the railways and main roads; on houses, post offices and telephone exchanges. Telegraph and telephone communications were seriously interrupted. In the London area alone between September, 1940, and September, 1941, bombs fractured 1,695 cables. The repair of this damage meant the plumbing of nearly 3,000 joints and connecting more than 500,000 wires.

There is hardly a main road in the country without at least one cable somewhere beneath its surface. Frequently where cables converge towards the exchanges there may be as many as 100 buried below one thoroughfare. In the towns these often run alongside gas, water, electricity, sewer and other services—services which do not mix well when all are smashed by high explosives. And, on many occasions, they have been smashed and mixed together.

THE COMPANIES rule books issued to their engineers contain no sections dealing with what to do when a ton high explosive bomb hits a cable chamber and blows bricks and cables to fragments. So the men had to work out the answers to the questions as they went along. One bomb penetrated a road surface and destroyed

an underground tunnel through which two telephone cables ran. The tunnel was blocked to the roof with London clay. The circuits were temporarily diverted and the engineers faced up to another new problem—how to bridge the gap and join the ends of the cables again under the ground.

It would have taken too long to drive shafts from the road above to link up the broken ends, so they decided to bore through the clay.

They used a method known as "thrust boring," where a hand-operated hydraulic ram forces a strong steel rod through the ground until it has penetrated to the far end, when a steel tube is fastened to it and then pulled back again by the ram. It is a job that demands skill and experience even in favourable conditions. Here the conditions were far from favourable, as a sharp corner in the tunnel had to be negotiated.

The crater was full of debris from the road above and there was no way of anchoring the ram. But the effort had rather surprising success and the rod was driven through the clay to the far end of the obstruction. The worst part of the work seemed to be over. In fact, however, it had only just begun.

There was a slight down-hill slope at the far end of that tunnel, and sewage seeped through the crater and started to fill the hole; evil, stinking sewage. It was going to be a race against time to finish the repair work at the end of the tunnel before the water reached the roof.

The steel tube that was being pulled back became obstructed about half way and parted company with the boring rod: there was nothing else for it but to burrow through the clay to reach the pipe.

That work in the small tunnel was dangerous; the clay was likely to fall in and bury the men, the sewage was creeping ever higher, ventilation steadily worsened, and the tunnel looked like collapsing at any moment. The men carried on; they failed to reach the tube because of the obstruction it had fouled.

Another method was tried. Sweep rods were jointed and pushed through the steel tube and on through the wet clay to the other side. Where rods could go so could a small cable. Thus, by sheer hard physical effort, a hundred-pair cable was dragged through. By now the water was waist deep, but the cable was successfully jointed.

THAT WAS cable Number One. There still remained cable Number Two, with 254 pairs in it. The clay at the top of the tunnel appeared to offer less obstruction than on the floor, but a thrust borer could not be used other than at floor level. Therefore, the engineers drove steel piping through with sledge hammers, and a second cable was drawn through the hole.

All this time the air was becoming more foul and the sewage never ceased rising. There were incessant air raids, but the job had to be done because many of those circuits were vital.

The jointing was completed. There were seven feet of water and sewage in that tunnel when the last man was dragged out of it. The official report concludes with these words: "These men sought no reward but the satisfaction of knowing that

they had done well all that was asked of them. It was their privilege to restore to service vital communication circuits."

Some reports tell of lone men tackling jobs without help. There was one man of whom his supervising officer wrote: "His chief object in life appears to be to defeat the enemy." During one raid he was sent out to repair a severed main cable holding many circuits. He had to wade through icy water and grope about in the crater to find the broken ends. As he worked he heard another bomb falling immediately overhead, but the mud and his rubber boots barred any rush to safety. He threw himself flat in the filth as the bomb exploded across the street—then he carried on until the circuits were restored.

There was another case in which repairs had been pressed on hurriedly for several days when one of the men did a bit of digging to find out what the hard object was on which he kept treading. It was just covered with dirt at the bottom of the crater. He uncovered it: it was a heavy unexploded bomb.

If work on the lines outside was hectic it was not exactly all quiet fun at the switchboards indoors. In Great Britain telephone exchanges are usually on the top floors of buildings where good light is obtainable. And many of them have glass roofs. However severe a raid may be, a nucleus staff remains in that switchroom to complete essential calls. And, in most cases, the staff do not comprise tough old ex-service men but girls and young women.

At one exchange a heavy bomb fell through the roof. It did not wreck the switchroom but tore a great hole in the blacked-out glass which meant that all lights had to be switched off to preserve the black-out. The "calling lamps" on the board were too bright to be used unshielded: enemy aircraft were overhead in hundreds and keen eyes were looking down seeking lights on which to drop their bombs.

A number of girls volunteered to stay on. Tarpaulins were draped over them and their instruments, and, under these, hot and stifled, they put through the calls. Their "Number, please?" mingled with the crashing of glass and the droning of the bombers. The raid lasted all night but the girls stuck it out.

Official reports are supposed to make dull reading but here is one given exactly as it was received at Headquarters in London—and it is not dull. "At 10.00 P.M. during a heavy raid volunteers were sought to go up to the roof switchroom. Two girls responded and ascended amid broken glass and rubble, their way being lighted only from the red glare of burning barges on the canal. A special call took fifteen minutes to mature owing to dislocation of the telephone services, but the important message was safely passed and the reply obtained with the guns in action throughout."

At some of the quieter country exchanges the work is done during the night by elderly caretakers. An exchange in a Yorkshire village is looked after by a seventy-four year old man and his wife. During one raid thousands of incendiaries fell in the neighbourhood, and hundreds of high explosives were dropped in a

raid that lasted for nine hours. But this old couple sat at their switchboard on the top floor of that country exchange and handled a flood of fire, ambulance and rescue calls. When asked why they did not take cover they answered that it had not occurred to them.

Just to sit there and carry on as though nothing was happening outside is not easy. The reactions of new operators during the first raid are always interesting. To one girl of 16 years of age who glanced around a little furtively when the bombs came down and the machine guns chattered, it was suggested that she might like to go to the basement for a while. But she replied, just as a bomb shook the building: "Oh no, I must see it through."

Probably telephone operators in Canada and America are trained to use set phrases while handling calls at the switchboard the same as the British operators, but mistakes do creep in now and again. It happened once at Dover, the town nearest to France. Dover has to put up with shelling in addition to the raiding aircraft. During one attack a newly trained telephonist was dealing with a call from a kiosk. As the first three minutes expired, the telephonist with one eye on the red time lamp and one ear turned to the falling shells, broke into the circuit to advise the caller "Your time is up, please." Outside events, however, must have gained control of her subconscious mind for just then a large shell exploded and she said, "Your number's up!" That gave the caller such a shock that it was a few seconds before he could regain enough control to ask for an extension of time.

And so the story could continue; the human side facing up to keeping the communications going however heavy the raids.

Damage to telephone exchanges has ranged from broken windows to a complete knock-out. The latter, fortunately, has been a rare occurrence, and, owing to the exercise of foresight and engineering ingenuity, alternative provision has been rapidly made.

The end is not yet, but the telephone and telegraph folk of Britain face the future with quiet confidence, and consider that they can keep communications going despite anything that the enemy may do.

Who's Who & What's What

(*Continued from page 207*)

Traffic Engineer of the Eastern Division last February, and since that division includes Philadelphia he at once found himself in the thick of the installation and preparations for the cut-over about which he tells.

SIMILARITIES between Army requirements for fixed communication facilities and the Bell System's toll plant naturally led Signal Corps engineers to enlist the interest of telephone engineers in the handling of some unusual problems. That is where ERNEST W. BAKER entered the picture, since for the past four years he

has been in charge of the group handling toll transmission matters in the assistant chief engineer's division of the A. T. & T. Company's Department of Operation and Engineering. After six years of plant engineering work with the Bell Telephone Company of Pennsylvania, Mr. Baker joined the O. & E. Department in 1930 and, except for a year and a half spent on other departmental assignments, has been in the transmission section since that time. It is an interesting coincidence that most of the contacts on "packaged carrier" with the Signal Corps' Plant Engineering Agency have been with Major A. M. Rose, a former Long Lines Department engineer; and it is obvious that a project of such size has also drawn upon many other Bell System men in the O. & E. Department, the Bell Laboratories, and the Western Electric Company.

THE PRIMARY PURPOSE of Information service is to make it possible to obtain the number of a telephone not listed in the directory. But many telephone subscribers have the habit of using this service to obtain numbers which *are* listed in the directory. This requires the provision of many more operators and more equipment than needed for the essential number service alone. How the Bell System has attempted to divert these additional employees and the associated equipment to vital war-time purposes is described by HOWARD F. PARKER, a member of the Traffic Engineer's division of the A. T. & T. Company's Department of Operation and Engineering since 1913. For several years after 1913, Mr. Parker was involved with the early development of the dial telephone system and with the preparation of the traffic engineering practices used for some of the first dial installations. Since 1927, he has been concerned with the engineering of manual central office switchboards, information desks and their associated records, and other related matters.

ACCLAIMED by Major General L. H. Campbell, Jr., Chief of Ordnance, U. S. Army, as one of the greatest advances in fire control made during this war, the electrical gun director developed by the Bell Telephone Laboratories and manufactured by the Western Electric Co. was featured by the press throughout the country following the first public demonstration of the equipment. HENRY J. KOSTKOS, of the Laboratories' Bureau of Publication, who helped plan the demonstration, tells about it in his article. It was in 1917 that Mr. Kostkos joined the Bell System as an installer for Western Electric. He later worked for the New York Telephone Company and the Southern Bell Telephone and Telegraph Company in plant assignments, and again for Western Electric as equipment engineer and supervisor of reports and publications. More recently he had been production planning engineer at the Kearny Works. Writing has long been his avocation, in the form of articles, fiction, stage and screen plays, so his present work —publicity connected with the war projects of the Laboratories—takes advantage of an "extra-curricular" skill.