Post Office Telecommunications Journal

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Contents

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Comment

IT MAY SEEM STRANGE TO MAKE FINANCE THE subject of editorial comment in this telecommunications Journal, but we make no apology. Finance plays an important part in the ordering of the lives of all of us and it is of fundamental importance in the administration of the telecommunications services, as Mr. Kuhl's article in this issue, on "Telecommunications from the Financial Point of View," shews. The operation and maintenance of the Post Office telecommunications services are financed from monies voted by Parliament in the Estimates year by year, and the provision of new plant for the improvement and extension of these services is financed by loans under the general authority of the Post Office Money Acts passed by Parliament from time to time. The amount of money available from both these sources is being kept to the absolute minimum, so that the Post Office can play its part in furthering the general economic policy of the Government of securing the greatest possible economy at home and the highest possible development of our export trade.

There will not be enough money available to undertake all the tasks that we should like to undertake, and it is more than ever necessary to make the utmost use of our limited financial resources and so give the greatest benefit to the public service. The financial restrictions, too, underline the need to raise productivity to the highest level. All this presents us with a challenge which we must—and will!—accept.

The Hall on the Edge of the Waves

(Plas-Glan-Y-Don)

by E. G. S. Smith, Chester Telephone Area

★ ★ ★

Providing for the expansion of telephone service at Rhyl threw up some unusual and ticklish accommodation and engineering problems. Not the least of these was that the approaches to the exchange are at sea level.

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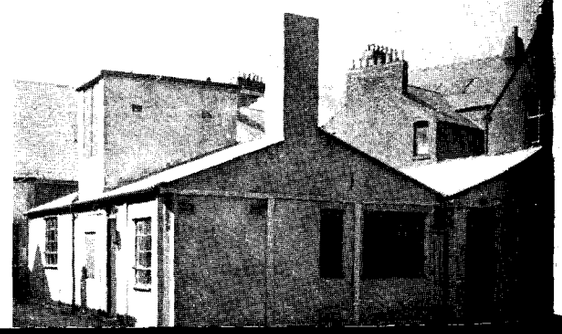
IT IS PERHAPS APPROPRIATE THAT THE Chester Telephone Area, which abounds with ancient castles and ruins, also contained, until recently, at Rhyl, a telephone antiquity in the form of a magneto group centre exchange, the only one of the kind remaining in the country. "Sunny, Bracing, Rhyl," which claims to be one of the chief holiday resorts in the Principality, attained its position with almost startling suddenness, for, in 1820, it consisted of only a few detached dwellings. One of the oldest houses in Plas-Glan-y-Don which houses the Telephone Exchange. For English readers "Plas-Glan-y-Don" means the "Hall on the Edge of the Waves" and, in the early part of its history, the grounds of the building extended to the foreshore. The property was bounded by a high wall built of beach pebbles and parts of this wall still remain. As Rhyl developed, the major portion of the grounds was sold and the Hall became the home of a brewer's agent, who used part of the premises for storing barrels of beer. Some of the older staff allege that the place was haunted, but this story may have developed after a member of the brewery staff had had a hectic night with "homework". The Post Office acquired the premises in 1923, and one of the conditions of sale was that the Post Office would not use the premises for the sale of ale or porter.

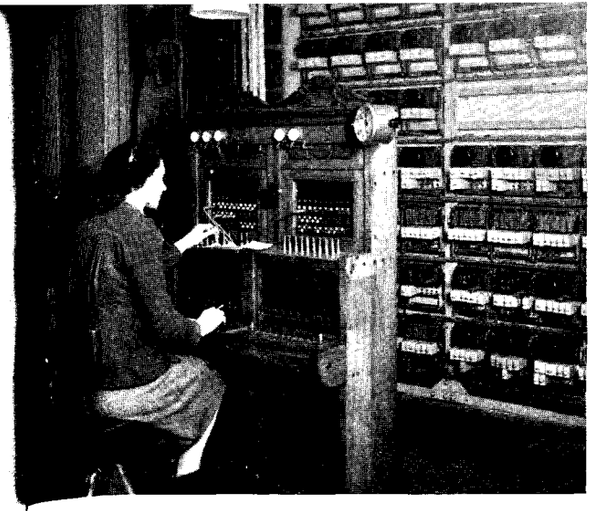
Planning for Replacement

The second world war prevented normal course replacement of this exchange by up-to-date automatic plant. The intention had been to erect a portion of the new automatic building on available ground of the magneto exchange site, and install sufficient equipment to enable transfer to automatic to take place. The old building would then be demolished to permit of completion of the new building.

At the end of the war, it was found that, even with the utmost extension of the magneto exchange in the old building, exhaustion would be reached long before any portion of the new building could be made ready.

The old building *(Photographs by courtesy of W. J. E. Pready)* Welfare hutting





The relief switchroom *(Photographs by courtesy of W. J. E. Pready)*

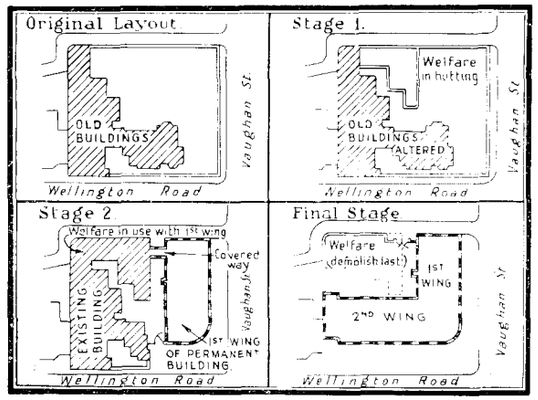
The old main switchroom

The plan ultimately decided upon involved three stages:—

(i) Adaptation of outbuildings for housing a central battery manual exchange switchboard and apparatus. Provision of temporary hutting for staff welfare.

(ii) Demolition of part of the old building to permit erection of the Vaughan Street wing of the new building.

(iii) Demolition of remainder of the old building and erection of the Wellington Road wing of the new building.



Site plans of Rhyl Exchange shewing the proposed transitional stages from old to new buildings. (Portions enclosed in heavy broken lines are not yet erected)

The outbuildings comprised chiefly the old barrel store which was in use as a garage for engineering vehicles. Alternative accommodation was provided by adaptation of an old building in Wellington Road, and Stage 1 was commenced in September, 1947.

In the meantime, Initial Equipment Data for a replacing C.B. exchange, which would take up the whole accommodation capacity of the outbuildings, had been prepared. To prolong the life of the magneto exchange, a two-position relief switchboard was installed in the only available space—in a small, ground-floor room housing, among other things, coaxial terminal equipment and exchange clerical staff.

The Extent of the Relief Scheme

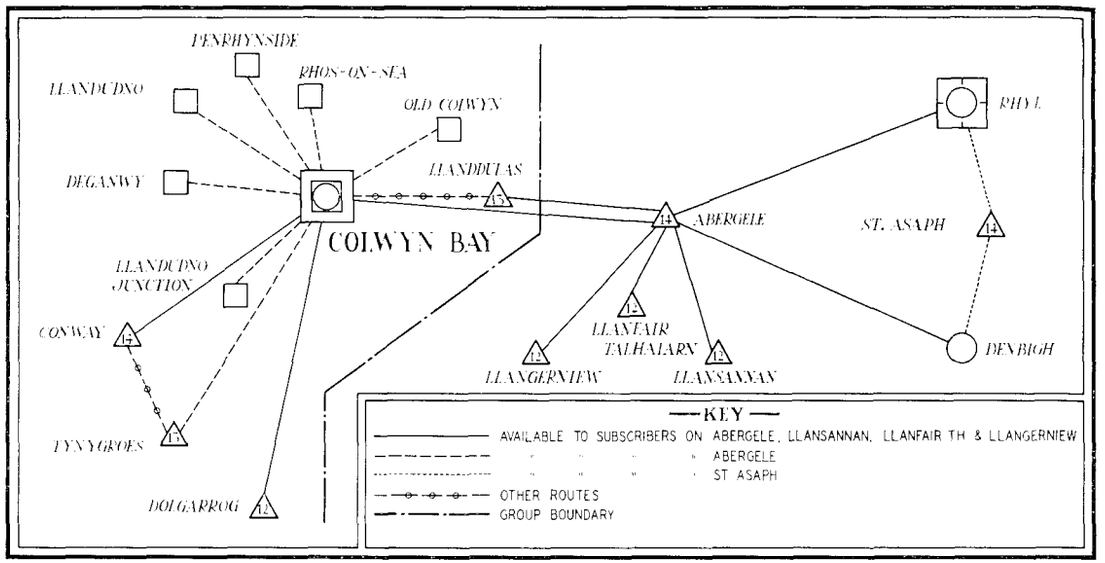
At this point in the story, it will perhaps be useful, in order to appreciate to the full the complicated traffic and engineering problems tied up with Rhyl, to see the details of the conversions made possible by the completion of the manual (CB) replacement scheme. Here they are:—

June 16, 1949. 8.0 a.m. Rhyl magneto group centre transferred to C.B.

June 23, 1949. 1.30 p.m. St. Asaph C.B.S. 1 minor exchange, transferred to U.A.X. 14, parented on Rhyl.

June 30, 1949. 1.30 p.m. Abergele magneto minor exchange, transferred to U.A.X. 14, parented on Rhyl. Llangerniew C.B.S. 2 minor exchange, transferred to U.A.X. 12, dependent on Abergele U.A.X.

The completion of this programme enabled a complex interdialling scheme to be implemented



The tandem dialling scheme

as will be seen from the diagram above.

Traffic Considerations

The pre-war scheme visualised Rhyl as a non-director automatic exchange with associated automanual switchboard serving the Rhyl group which comprised, prior to June, 1949:—

Abergele *M*	Llanfair Talhaiarn U.12*
Bodfari U.12†	Llangerniew C.B.S.*
Clawdd Newydd U.12†	Llansannan U.12*
Cyffylliog C.S.†	Nantglyn U.12†
Denbigh C.B.S.	Prestatyn C.B.S.
Dyserth C.B.S.	Rhuddlan U.6
Llanarmon-yn-Iâl U.5†	Rhyl *M*
Llandegla U.12†	Ruthin C.B.S.
Llandyrnog C.B.S. 2	St. Asaph *M*
	Trefnant U.6

M—Magneto
†—U.A.X. or country satellite not parented on Rhyl
*—U.A.X. or manual exchange dependent on Abergele

Of these exchanges, even with maximum extention of the magneto exchange, no U.A.X's other than Trefnant (U.6) and Rhuddlan (U.6) could be accommodated. Denbigh and Ruthin could be extended on a manual basis and made to last, but Abergele and St. Asaph were exhausted and, with Llangerniew, Llansannan and Llanfair Talhaiarn dependent on Abergele, had to be transferred as soon as arrangements could be made. It was impossible to take their "O" level traffic on the old Rhyl exchange, and plans were therefore laid to complete the replacing U.A.X. 14 exchanges by the time the new Rhyl manual exchange should be ready.

The External Work

Once it had been decided to locate the C.B. exchange in the outbuildings adjoining the old exchange, a number of external factors had to be contended with. These consisted of the congestion of underground plant in the immediate vicinity of the old exchange; leading-in of cables to the new exchange; preparing for lead-in into the ultimate automatic exchange; method of transfer; presence of water two feet below ground level; and the provision of a suitable cable trench for leading-in external cables.

For a number of valid reasons, departure from standard practice is not encouraged by the Engineering Department and, in order to secure approval, it became necessary to supplement the usual scale drawings with ingeniously constructed models which were demonstrated in London. These models, true to scale, were constructed from a soft, clay-like substance (Mixture No. 2), leather, matches, wood and pins, with the actual positioning of the cables indicated by flexible cored-solder which, in appearance, closely resembles a miniature cable. One manhole, constructed outside the old exchange, was of octagonal shape and designed,

not only for the transfer from magneto to C.B., but also for the transfer from C.B. to automatic working at some future date. All cables are so positioned, in this and other manholes, to facilitate the future transfer to the automatic exchange.

The design having been completed and approved, the execution was the next problem. Rhyl is at sea level and, at times, one would say it is below sea level during high tides. It is possible for a manhole to be dry at low tide but full of water at high tide. Difficulty in construction of these manholes was anticipated and, in order to overcome it, de-watering plant was used, eight and ten well points being in operation at times.

The number of ways led into the exchange had to be cut down. The ultimate requirement was 24 ways, but a maximum of 16 ways could only be allowed owing to the depth and width of the non-standard cable trench. The Ministry of Works would not allow the cable trench to be more than three feet deep. This meant congestion in the trench, and presented some difficulty in jointing operations. This was overcome, as will be seen by the photograph of the completed cable trench. Because of the short periods between tides, it was necessary to eliminate as much jointing work as possible. Therefore it was decided to provide an internal tie cable between the old and new exchanges rather than use the teeing method of external transfer. The result was that all cabling and jointing work was completed well before the actual transfer.

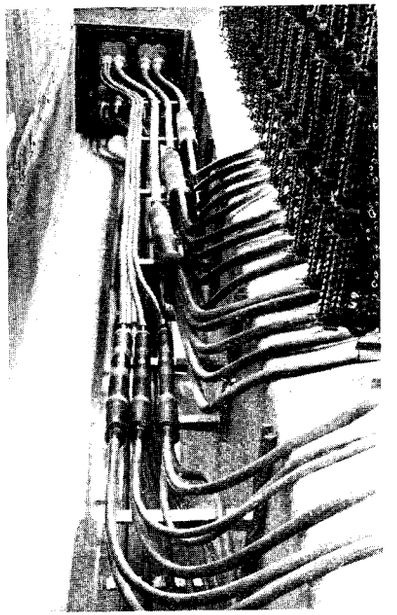
Cabling operations were retarded at times due to the non-receipt of certain types of cables. All cables are so planned that they will be repeated in their same position in the automatic exchange, thus avoiding any change in external records.

The Internal Work

Whilst work on the U.A.X's proceeded fairly uneventfully, complications soon arose on the parent exchange scheme. We will mention but one. It arose when a paper was received containing the following request. "In view of the acute shortage of materials and textile-covered switchboard cable in particular, perhaps you will consider your layout proposals. If a 6-panel multiple were provided instead of 4-panel, it would reduce the number of jacks required from 1,760 to 1,170; reduce the cable required from 6,000 yards to 5,000 yards; reduce the labour of making the multiple by approximately 30 per cent.; and enable a full 3,000-multiple to be provided at the outset". The suggestion was carefully examined and accepted. Some difficulty has since occurred at angle sections, but provision of longer cords will overcome it.

By early 1949, it became clear that delaying factors might seriously upset the possibility of completion before the 1949 season. The operating staff at the old exchange were already handling an overload and this, together with the antiquated equipment at their disposal, made early conversion most desirable. A further, and very important factor, was that the Abergele and St. Asaph U.A.X's had already been virtually completed, and would soon constitute a serious wastage of capital unless put into service. From the Traffic Division's point of view, apart from avoidance of a serious season overload, a Spring transfer would result in redundant operating staff at St. Asaph and Abergele, and would almost completely remove the need for recruiting season staff for Rhyl, a very desirable feature.

The completed cable trench



To speed up the conversion therefore, a piecemeal scheme was evolved as follows:—

Stage 1. Completion of sufficient switchboards, calling equipment and multiple to cover only the needs of 1949 season. Conversion of all coin boxes to prepayment working.

Stage 2. Removal of local batteries and modification of ordinary subscribers' telephones.

Stage 3. Completion of switchboard and so on, equipment to Initial Equipment Data requirements.

Completion of Stage 1 was set for early June. Even as late as March, various essential stores appeared to be completely out of reach, among them being mountings for subscribers' meters, and the control clock for chargeable time clocks. The Monitors' Desk and Supervisor's Desk, which arrived at about the same time, were non-standard and unsuitable. The former, however, had possibilities and the desk, after the Department's craftsmen had modified it to Traffic Division requirements, is clearly shewn in the photograph of the new switchroom. The Supervisor's desk, however, was beyond help of this kind and, *pro tem*, the officer in charge has been supplied with an Admiralty-type table and telephone.

The Final Stages

In view of the inability to predict, with certainty, when various stores and so on would arrive, it was impossible to fix the transfer date until a week or so in advance. This meant that many matters concerned with the transfer arrangements had to be dealt with in days instead of, as is usually possible, in weeks. Nevertheless, whilst the "ready-for-service" date for Rhyl, Abergele, St. Asaph and Llangerniew, was finally fixed for Saturday, June 11, all essential traffic and engineering arrangements were made and successfully carried through for the transfer of the main exchange five days later on June 16.

The transfer of the U.A.X's followed on June 23 and 30.

As examples of excellent and speedy engineering work, it might be mentioned that a complete emergency gas installation, involving fitting of switches and so on, was put in between Monday, June 13 and Wednesday, June 15. Installation of a two-way pneumatic tube system between Test Room and Switchroom was commenced on Monday afternoon of June 13 and completed by the afternoon of June 14.

It would be incomplete to refer to engineering staff only without reference to the good work of the traffic and operating staffs. The scheme involved many changes in procedure and equipment, training in which was seriously hampered by the manual switchboards not being available for live traffic until a few days before the transfer. Reliance had inevitably to be placed on other expedients. Lest some should pass lightly over this problem, it must be remembered that the following changes had to be absorbed and understood:—chargeable time clocks instead of Zenith clocks; prepayment coin boxes instead of post payment; multiple numbered 0-99 instead of 1-100; use of common dial key instead of dialling cord; multi-registration of calls instead of tickets; an involved inter-dialling scheme; routine tests appropriate to C.B. working compared with simple magneto; and test position manipulation.

The way in which the staff confidently took over the new exchange proved their adaptability and the soundness of their training.

The new switchroom *(Photograph by courtesy of W. J. F. Pready)*

From left to right: A. BAXTER, Chief Clerk; P. R. COUCH, B.Sc. (Eng.), A.M.I.E.E., Area Engineer; MISS A. MAUDSLEY, Secretary; F. WOOD, Telephone Manager; L. G. HAWKER, Chief Traffic Superintendent; S. A. F. ADAM, A.R.C.S., B.Sc.(Hons.), D.I.C., A.M.I.E.E., Area Engineer; W. J. O'BRIEN, Senior Sales Superintendent.

LEEDS TELEPHONE AREA

The Area is a compact one geographically, covering the centre of the clothing manufacturing industry, and including important coal mining areas, engineering industries, and a section of the centuries-old woollen trade. Although almost entirely an industrial area, it does embrace to the North a portion of the Yorkshire Dales. Leeds is mentioned in Lord Clarendon's History of 1642 and, according to earlier records, the city was known as Loidise-en-Elmet.

Leeds was one of the first cities to have an automatic telephone system. The main exchange, which employed the "Keith line-switch," was installed in 1918, but was replaced by the "2,000-type" equipment in 1945. The system is rapidly approaching the maximum capacity for a non-director system, and the introduction of director working is being planned.

The 55 exchanges in the Leeds Telephone Area serve some 52,700 exchange lines and 91,000 stations; the total staff, excluding the operating force, numbers 1,344.

LIVERPOOL TELEPHONE AREA

Merseyside, with its river, ships and docks, forms the hub of the Area. Consequently, the Liverpool Telephone Service plays a large part in furthering the export drive. But, besides shipping, many other industries are carried on. The Area contains a sample of nearly every business activity in the country, and supports a population of about two millions. The industrial centre is surrounded by rich agricultural lands in South-West Lancashire and North Cheshire, centred on Ormskirk and Warrington. To the East are the towns of Warrington, St. Helens, Widnes and Runcorn, with their heavy engineering, chemical, glass and coal mining industries. To the West is the residential Wirral Peninsula. Far out in the Irish Sea is the Isle of Man, renowned as a holiday resort and the Mecca of racing motor cyclists. The Area covers 680 square miles, wherein 175,000 stations are served by 78 exchanges (47 are automatic) and by 812,000 miles of wire (784,000 miles are underground). About one-third of the stations have been connected since 1945. This has involved a very heavy programme of plant expansion, and the adoption of many expedients to exploit the Area's resources to the full. The total staff, including 1,700 engineering and 2,250 operating grades, numbers about 4,500. The annual revenue exceeds £3 millions.

From left to right: MAJOR W. K. DUNN, H. G. CROOK, E. BLACKBURN, B.Sc. (Eng.), A.M.I.E.E., F. A. MELDRUM, A.M.I.E.E., Area Engineers; H. C. JONES, O.B.E., B.Sc. Eng., M.I.E.E., Telephone Manager; C. W. DAVIES, Assistant Telephone Manager; G. M. SILVER, Chief Sales Superintendent; J. WILSON, Chief Clerk; J. BRYANT, E. L. PERKINS, Chief Traffic Superintendents.

Telecommunications from the Financial Point of View

by E. H. G. A. Kuhl, I.S.O.

Deputy Comptroller and Accountant General.

IT IS A GRATIFYING FEATURE OF THE PRESENT day that other Departments of the Post Office besides the Accountant General's Department are taking an increasing interest in the financial problems of the telecommunications service. This was not always so; indeed, in earlier times, other Departments were inclined to be critical and to regard the Accountant General's Department as an inverted form of Micawber, always on the look-out for something to turn down! The minds of officers engaged in providing service, whether in the engineering or operating field, were so dominated by this aspect of their responsibility that all considerations of finance were excluded as if by an Iron Curtain. One can, of course, have a good deal of sympathy with this point of view but it is necessary to realise its shortcomings. The outlook of those who held it would undoubtedly have been very different if they had been the owners of the business, and losses (if any) had to come out of their own pockets. Requirements are no different because, in a large concern, different aspects of the organisation are dealt with by different persons or units. In a society based on a money economy, however, the soundness of the running of any business is judged by its success in making a profit; indeed, the privately-owned firm would soon have to shut down if it ran at a loss and could not hold out a convincing prospect that it would be able to turn the corner; while a nationalised concern would be subject to severe criticism and be expected to take appropriate steps to remedy the adverse position. Starting from this basis, figures 1 and 2 below which show the deficits and surpluses of the telegraph and telephone services respectively are of interest.

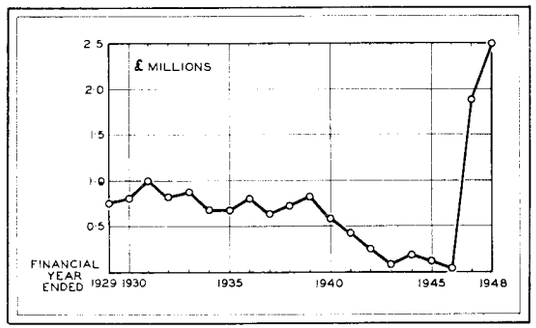


FIG. 1. TREND OF TELEGRAPH DEFICIT, 1928-1948

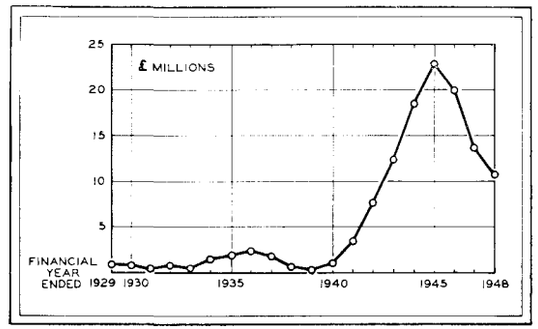


FIG. 2. TREND OF TELEPHONE SURPLUS, 1928-1948

Annual Surplus Trends

It will be seen from the graph showing the position of the telephone service (figure 2) that, during the period 1928 to 1933, the annual surplus hovered round about the £500,000

mark. This was followed first by a period of four years of high profits, in spite of a series of substantial tariff reductions, and then by a drastic decline in the surplus, a trend which was only altered by the war. Profits (to some extent due to surcharges) during the war rose steeply and, beginning with the Peace, there was a rapid downward trend in the incidence of the telephone surplus.

The first forecast of the post-war telephone position which the Accountant General's Department produced in November, 1945, indicated this trend but was received with a good deal of scepticism. The Accountant General's Department itself recognised that there were many imponderable factors and laid no claim to the certainty of any of the individual estimates being realised at the particular point of time forecasted. It stressed, however, that the important thing was that, even with the continuation of war-time tariff increases, the surplus of the telephone service was likely to fall in a few years to a very low level and, in time, would be followed by actual losses. Evidence since accumulated has justified this view and the importance of acceptance, or otherwise, of this prospect in relation to tariff policy hardly needs emphasising.

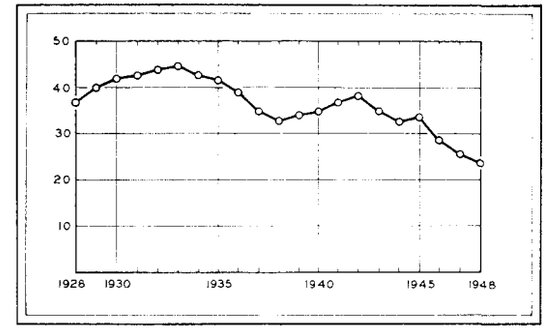


FIG. 3. LOCAL LINE PLANT—PERCENTAGE OF SPARE PAIRS THROUGH TO EXCHANGES

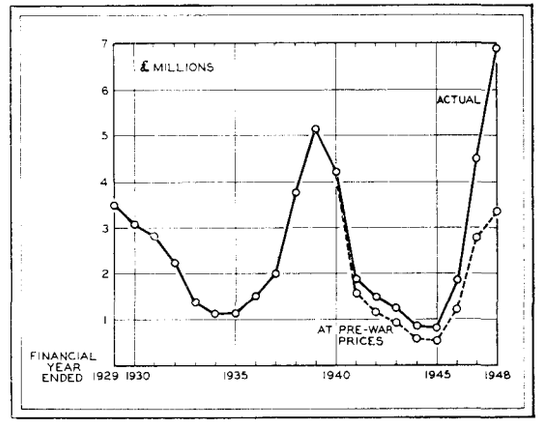


FIG. 4. DIRECT EXPENDITURE ON LOCAL LINE PLANT INCLUDING JUNCTIONS

Influence of Margin of Spare Plant on Expenditure

Let us consider the position over the years on the available margin of spare telephone plant and the degree to which it was allowed to influence the level of expenditure. Taking, in the first instance, local line plant including junctions, the position is illustrated by figures 3 and 4. It will be seen how, during the slump period, the percentage of spare plant to total plant grew from 37.4 to 44.3 and had fallen by March, 1939, to about 33. The figure of 37 per cent. can be regarded as being something like the average burden of spares that would result from the provision of plant on the basis determined in economical planning periods, and the excess over this figure which accumulated during the slump period made it possible to give service to a substantial number of new subscribers at a low cost, thus producing profits beyond the normal, but for a limited period only. The number of subscribers which it was possible to serve in this manner was of the order of 300,000 to 400,000.

As regards the effect on expenditure, it will be seen that the expenditure graph (figure 4) shows how capital expenditure was reduced owing to the existence of a super spare margin, and then had to grow again as the margin fell below normal. The following figures are significant in illustrating the inter-relationship between the margin of spares and expenditure which occurred.

EXPENDITURE (DIRECT CHARGES ONLY)
(LINE PLANT)

Year	Local Line Plant including Junctions	Percentage Margin of Spare Plant
1928–29	£3,512,000	37·4
1933–34	£1,147,000	44·3
1934–35	£1,141,000	43·0
1935–36	£1,537,000	41·7
1936–37	£2,004,000	39·1
1937–38	£3,810,000	35·4
1938–39	£5,104,000	33·1

(The 1928–29 figures illustrate approximately the conditions of a normal year.)

The position in regard to telephone exchange equipment is shown by figures 5 and 6. Here, also, the slump produced a large increase in the margin of spare equipment from a normal of something like 18.1 to 28 per cent. of the total equipment, and this margin had fallen by the end of March, 1939, to just under 10 per cent.

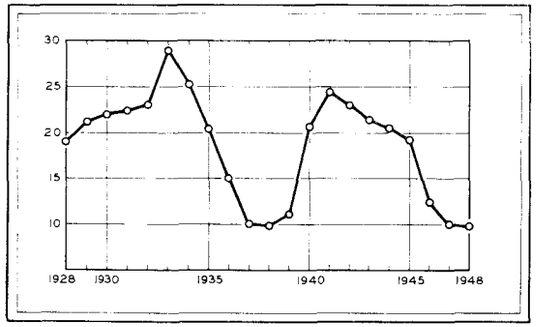


FIG. 5. PERCENTAGE OF SPARE INTERNAL PLANT AT TELEPHONE EXCHANGES

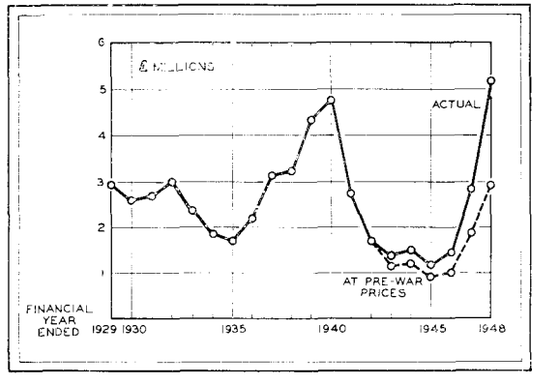


FIG. 6. DIRECT EXPENDITURE ON EXCHANGE EQUIPMENT

There was a similar effect on expenditure and here again the following figures are significant.

EXPENDITURE (DIRECT CHARGES ONLY)
(EXCHANGE EQUIPMENT)

Year	Telephone Exchange Equipment	Percentage Margin of Spare Equipment
1928–29	£2,978,000	18·1
1933–34	£1,890,000	28·0
1934–35	£1,720,000	25·3
1935–36	£2,202,000	20·5
1936–37	£3,066,000	14·9
1937–38	£3,233,000	9·9
1938–39	£4,270,000	9·7

(The 1928-29 figures illustrate approximately the conditions of a normal year.)

It has been mentioned in an earlier paragraph that local line plant conditions at one time made it possible to provide service to from 300,000 to 400,000 additional subscribers at low cost. The position on the telephone exchange equipment side, of course, also contributed towards this possibility. A measure of the profitability of this influx of new subscribers at low cost can be gained from the fact that, although it was estimated that the 1934 tariff concessions would cost £1,590,000 in the first full year (1935-36), reducing an estimated surplus of £1,850,000 at the old level of charges to £260,000, the surplus was actually £2,127,000.

Effect of the 1934-1936 Tariff Changes

There remains for consideration a factor in the build-up of the 1934 exchange line tariff which assumed importance in view of subsequent developments. It was estimated in fixing the lower rental for residential lines that the proportion of new "business" to new "residential" subscribers would be between 1 : 2.5 and 1 : 3. The actual development on the basis of installations was as follows:—

RATIO OF NEW "BUSINESS" TO NEW "RESIDENTIAL" LINES

Year	"New Business"	"New Residential"
1934–35	1	2·7
1935–36	1	2·7
1936–37	1	6·6
1937–38	1	7·4
1938–39	1	7·9

It will be seen that, for the first two years, the actual conditions were within the ratio assumed for the 1934 tariffs. The considerable increase in the proportion of new residential subscribers in the three following years was undoubtedly the result of further tariff concessions designed to attract more residential subscribers, namely,

October, 1, 1935 : Extension of free radius from 2 to 3 miles.

October, 1, 1936 : Local calls to the value of 50 units included free in the residential quarterly rental.

Of these, the latter was the more important and it led not only to a loss of revenue to the extent of the total volume of free calls, but also destroyed the balance between business and residential subscribers on which the differential rental in favour of the latter was calculated in 1934. By fostering a high telephone development,

it also accentuated the need for additional plant and was, therefore, a factor in the rapid rise in expenditure on new plant and equipment in the years preceding the war, to which attention has already been drawn.

It will be seen, therefore, that the significant features of the commercial trend in the decade before the war were:—

(i) a rise in the surplus owing to the utilisation of a large margin of spare plant, the existence of which also made possible, for a time, a low level of capital expenditure, followed by (ii) a decline in the surplus, partly due to tariff concessions (which, apart from the immediate loss of revenue, had the effect of destroying the balance between new business and new residential subscribers on which the 1934 differential tariff was based), and partly due to heavy capital expenditure as spare plant resources were depleted.

War-time Trends

The changes in the commercial results during the war are of special interest. Surpluses quickly showed an upward trend rising from a little over a quarter of a million pounds in 1938-39 to £23 million in 1944-45. A number of factors contributed to this course of events, namely,

(i) by the deliberate limitation of service mainly to essential subscribers, the influx of residence subscribers was considerably reduced. Thus, between 1939-45, the ratio of new business to new residence lines changed from a level of nearly 1 : 8 to an average of 1 : 1.5 with a resulting higher return of revenue per added subscriber without a corresponding increase, if any, in cost;

(ii) the very considerable restriction of service to essential subscribers also made it possible, so far as the local service was concerned, to reduce annual capital expenditure in that field from a level of £5 million on local line plant and of £4 million for telephone exchange equipment to under £1 million in each case during the closing years of the war;

(iii) the increase in essential subscribers, particularly the Defence Services, led to a very large growth in trunk traffic and the user of long private wires. Both these services were already, before the war, the most profitable sides of telecommunications business, and the substantial measure of spare plant (35 per cent. of total plant), which existed on the outbreak of hostilities, made it possible to give service at low cost by the fuller utilisation of this margin without, at the same time, necessitating a proportionate increase in line plant;

(iv) profitable as the long distance telephone services were before the war, they were made still more so by technical developments in the field of carrier and coaxial circuits, the circuit cost of which beyond a certain distance is lower than that of audio channels;

(v) on the expenditure side, therefore, the situation was similar to that which existed in the Middle Thirties with the additional factor that the main line services played a more prominent part. The general reduction in the level of expenditure in itself contributed to larger surpluses, but this trend was accentuated substantially by tariff increases (either by direct or indirect surcharge) which, for a considerable time, were unaccompanied by corresponding increases in costs, partly because of the lower level of expenditure, and partly because cost levels, owing to price controls, did not rise at once in the same ratio as tariff increases.

Post-war Trends

During the post-war years, the trend has been, and will, continue to be one of declining surpluses unless at least some tariffs are raised. Thus, whereas in 1944-45 the surplus was of the order of £23 million, by 1947-48 it had declined to a little over ten and a half million pounds, and forecasts for future years indicate that, with present tariffs, this downward trend will continue. (Note: Local call charges have now been raised to three halfpence per unit from July 1, 1949.) Various factors are producing this position, namely,

(i) tariff increases by direct or indirect surcharge amount to only about 27 per cent. over pre-war rates (excluding the effect of the recent local call increase referred to above), whereas expenditure price levels, other than interest and depreciation on plant provided before and during the early years of the war, taken overall, have at least doubled;

(ii) the effect of the foregoing becomes greater with every addition to existing plant, additions which have had to be stepped up very considerably and will require still further increases if arrears of plant provision are to be made good. The following figures show the growth in

Capital Investment in recent years, and that contemplated in the near future:—

CAPITAL EXPENDITURE ON TELEPHONE PLANT AND EQUIPMENT

1945–46	Actual	£6,626,000
1936–37	..	£13,513,000
1947–48	..	£20,286,000
1948–49	Estimated	£23,600,000
1949–50	..	£30,700,000
1950–51	..	£31,800,000
1951–52	..	£33,000,000
1952–53	..	£34,000,000

Even with this increasing rate of expenditure, it is hardly possible to prevent the waiting list from growing, and *to give service to those at present waiting would involve a total capital investment of some £100 million with consequential annual charges approaching £10 million.* Two pointers to the lack of plant are, (*a*) the growth of a waiting list of 150,000 at the end of the war (a figure which was already excessive) to approximately 500,000 at the present time and, (*b*) a reduction of the margin of spare plant as under:—

PROPORTION OF SPARE TO TOTAL PLANT

	Local Lines	Telephone Exchange Equipment	Main Lines
Normal Proportion (say)	37%	20%	36%
Proportion in 1947–48	26%	10%	19%

Summing Up

To sum up, over the last two decades, the telephone service has passed through two periods of rising, and two periods of declining, surpluses. An important consideration is to see what lessons can be learnt from this examination. Some may say that there is nothing to learn since the Post Office, as a part of the general economic system, would be bound to have its share of the periodical booms and slumps which were so characteristic of pre-war industry. Quite clearly, this is not true of the post-war situation because there is no general slump, but it would be not only a superficial but an incorrect view of the pre-war position, because the fall in the surplus occurred during the years when the country was returning to prosperity and while the telephone service was itself growing at a rapid rate.

It is obvious, therefore, that even before the war the factors which produced the changes were outside the scope of the operation of the ordinary Trade Cycle.

What then were the circumstances which account for the pre-war trend? It will be seen that there was a period of low capital expenditure in spite of a large growth in subscribers, and that this was made possible by the existence of an abnormal margin of spares arising out of the fact that the 1929-32 world slump led to the actual growth in subscribers during that period, falling below the anticipated development. This low level of capital expenditure persisted too long and, as a result, it was necessary to raise it very considerably in the two years preceding the war. The curtailment of capital expenditure during the years of very rapid development was no doubt partly in pursuance of the economic thought of the day, particularly in regard to Government activities, especially in so far as it expressed itself in a thrift campaign and a restriction on spending on fixed capital goods by public authorities. Again, no doubt from a national point of view, this policy helped to make possible the 1932 Conversion Loan which, with its effect in producing lower interest rates, ultimately stimulated capital enterprises. However, from the telephone service point of view, the effect was not so fortunate.

Economics of Plant Provision

To understand this, it is necessary to consider the economics of plant provision. It will be obvious that, if for any given item of plant the cost per unit, for example, per mile of subscriber's circuit decreases with an increase in the volume of plant provided in one instalment, then the most economic provision of plant might be that which will meet the maximum foreseeable development. Such a low unit cost will be accompanied, however, by an immediate high aggregate cost. On the other hand, plant provided in small instalments at a high unit cost will result in a low immediate aggregate cost. Both these extremes might entail charges to telephone users which would be prohibitive, in the first case on account of the very heavy burden of spare plant which existing subscribers would have to bear, and in the second because of the high unit cost of production. The difficulty of raising the necessary funds might also operate as a limiting factor in the first case. The practical economic planning period will, in

such circumstances, lie between these two extremes and will be determined by the length of the period over which it is considered to be reasonable to expect the higher aggregate annual charges in the early years, due to the provision of spare plant, to be off-set by the lower aggregate annual charges during the later years on account of the lower capital costs achieved by the provision of plant in large instalments. The appropriate length of this costing period cannot be determined mathematically. Certain factors, however, place a practical limit upon it, for example, (1) forecasts of development become more speculative the farther ahead they are projected; (2) technical advances may make it probable that plant will be obsolescent before it has been fully utilised, and (3) market conditions place a limitation upon the burden of spare plant which present subscribers can be asked to bear. The appraisal of the weight to be given to such factors is a matter for administrative judgment but, the length of the *costing* period having been agreed, mathematical processes enable the *economic planning* periods for different items of plant and also the most economical lay-out of the area as a whole to be determined.

Granted the establishment of appropriate economic planning periods—and a number of engineers have done valuable work in this field—it is clear that, if plant is provided on the basis of development *x* years ahead, the quantity to be provided should not be influenced by the slump or boom of a particular moment. The only possible influence should be the effect of one or the other on the date when the new instalment of plant is required. The slump of 1929-32 would inevitably, by the creation of an abnormal margin of spares, have led to some deferment of additional plant, but the very serious curtailment of capital expenditure which actually occurred tends to show that the economic views, which then prevailed, resulted in a provision of plant below that really necessary on the basis of normal development forecasts and the appropriate economic planning periods. The number of small cables, which to-day need to be recovered and replaced by larger cables to use existing duct space more fully and economically, is proof of this. This curtailment of capital expenditure in itself, while costly in an economic sense, should not necessarily, however, have led to the position in which the telephone service was in danger of running into a deficit. *There is little doubt that this situation was produced by the psychological atmosphere created by a system of Budgets and forecasts of Commercial Accounts limited to a period of one year.* This system did not foster a long view which might have revealed demands which the future would have made on telephone revenue and might have led to a realisation of the temporary nature of the high surpluses over a period of years.

The Need for Long-term Budgets

In the Accountant General's Department, the need for such a longer view was already realised before the war, and some steps were being made in this direction when the war cut short further progress. But, with this object in mind, that Department, soon after the cessation of hostilities, produced the first of a series of Commercial Forecasts indicating an inevitable decline in the surplus as the result, among other things, of legislating for the need to make good the plant deficiencies. To place these forecasts on a firmer foundation, they should be based on a series of budgets covering a period of years with an annual review. Not only are such budgets essential for Post Office purposes, but they are also necessary to provide the Government, through the medium of the Investment Programmes Committee, with a contribution towards a long-term investment programme for the country as a whole. This is why it has been arranged this year to call for a budget for two years instead of one as hitherto.

The "Expense Base" of a Business

Having examined the financial trends of the telephone service during the last 20 years or so and reviewed the lessons to be drawn from this experience, it will be of interest to note what particular influence the expense base of a business has on the financial problems facing the management of a concern, using the telephone and telegraph services in illustration. It will be clear that plant charges are a dominant consideration so far as the telephone service is concerned. The relative importance of the different expense categories is illustrated in figure 7, from which it will be seen that plant charges represent 61 per cent. of the total. In the case of the telegraph service, the dominant category of expense is one which the economists

would define as "Labour", including under this term "Management". This will be apparent from figure 8, general staff costs accounting for 68 per cent. of the total.

CATEGORIES OF EXPENDITURE, 1947-1948

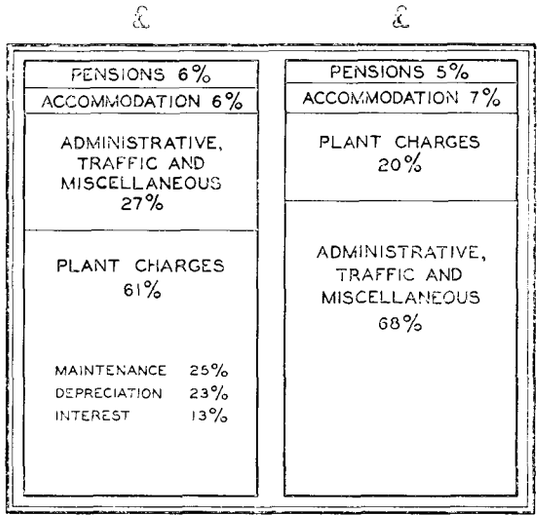


Fig. 7. Telephone Services. The "expense base" of the telephone services is represented by plant charges

Fig. 8. Telegraph Services. The "expense base" of the telegraph services is represented by staff costs

Comparisons of "Expense Base"

In considering the problems which these differences in the expense base of the two services present to the Administration, it should be mentioned that, in both cases, staff and plant have to be provided to carry the peak traffic. Additional traffic outside this peak period can be carried at lower cost. As, however, it is possible, often in some considerable measure, to adjust staff to traffic whereas plant costs cannot be so adjusted, the factor of low cost outside the peak period is of greater importance in the case of the telephone service than the telegraph service. It is, for example, the factor which makes it possible to offer lower trunk rates in the evening.

In the case of the further problem of an increase or decrease in traffic with the same spread over the day as existing traffic, variations in the load will affect staff and plant costs as follows:—

(i) personnel can be adjusted over a period by additional recruitment or by the cessation of recruitment, and reasonably early adjustment of staff to traffic changes is possible;

(ii) as plant is installed, in the main, to provide for development over periods varying with the type of plant, spare capacity generally exists capable of meeting a considerable amount of additional traffic, whether this takes the form of short-term booms or of a more permanent increase. Such additional business can be carried at little additional plant cost though, in the case of a permanent increase, it will bring forward the date when further instalments of plant are necessary and the charges thereon fall due.

It follows that booms are more profitable and slumps are more disastrous on the telephone than the telegraph side.

So far, it has been assumed that an increase or decrease in business activity is not accompanied by a change in price levels, for example, an increase in the rate of salaries and wages or the cost of materials and plant. A rise in costs of this character would affect the telegraph service more adversely because it would receive the full impact of the increase at once on the whole of its dominant expense base, whereas, in the telephone service, the increase in cost would be mitigated for a considerable time by the fact that the vast bulk of the plant will have been bought at lower prices.

It is, indeed, a considerable change in cost levels which accounts for the dramatic increase in the deficit for the telegraph service, an increase due, in part, to a higher level of wages and salaries for equivalent grades, partly to the use of relatively larger staffs than during the war in an attempt, to some extent successful, to restore a pre-war quality of service, and partly to higher costs owing to the gradual employment of youths and adults instead of boys. In the case of the telephone service, on the other hand, the prime cost of the plant in existence at the end of March, 1939, was £212 millions as compared with £330 millions at the end of March, 1948. Although this increase is in the aggregate large, most of it was incurred at much lower price levels than at present ruling, and the effect of annual increments of capital (roughly 10 per cent.) during the next few years will therefore be considerably reduced so far as average costs are concerned by the weight of past capital expenditure. A problem which is,

(continued on page 78)

The Public Telecommunications Services of the Channel Islands

by J. F. A. Dimes, South Western Region

ONE OF THE COMPENSATIONS OF LIFE IN THE South Western Region is the necessity to visit the Channel Islands from time to time and thus to experience some of the excitements of foreign travel without the major inconveniences.

It is not always realised that the Islands do not form part of the United Kingdom and that they are largely self-governing, with their own Parliamentary and Judicial systems. They are often referred to as the oldest overseas British possession, but your true Channel Islander is always ready to debate the question whether the United Kingdom should not, in fact, be regarded as a possession of the Islanders, in view of certain happenings in 1066, and of the fact that the Islands still constitute the Dukedom of Normandy. It can at least be conceded that they are founder members of what has become the British Commonwealth.

In keeping with this historical and constitutional background, the telecommunications services of the Islands present some interesting features, while the story of their development provides a miniature history of telecommunications in general. Telegraph services within and between the Islands and with the world at large are the responsibility of the United Kingdom Post Office, as are the inter-Island and trunk telephone services; but local telephone service is provided by the States Telephone Departments, operating under Licences issued by the Postmaster General, in both Jersey and Guernsey, including with the latter, Alderney and Sark.

Telegraphs

Early records are meagre, but telegraphic contact with the United Kingdom was first established by a cable laid in 1860. At that time, telegraph services were operated by private Telegraph Companies and the Railway Companies, and although an Act of 1868 authorised "His Majesty's Postmaster General to acquire, work and maintain electric telegraphs", its provisions did not apply to the Channel Islands. It was not until two years later that another Act extended its provisions to the "Islands of Jersey, Guernsey, Sark and Alderney and the islands and islets adjacent thereto respectively", and provided for the purchase of the Jersey and Guernsey Telegraph Company Limited. Thereafter, the service was merged with, and developed similarly to, that of the United Kingdom. A second cable was laid in 1884, between landing points which have so remained in use ever since —Compass Cove, Dartmouth to Fort Doyle, Guernsey and St. Martin's Point, Guernsey to Plemont, Jersey, with a land line connection across Guernsey.

In the heyday of telegraphs, the Channel Islands' traffic during the potato and tomato marketing seasons was one of the highlights, recalling to the old telegraph man exhilarating memories of augmented staffs and extra circuits with never an idle moment. Control of markets and other causes now make a return of those peaks unlikely, but, even so, a temporary lifting of controls last Spring and Summer more than doubled transactions for the time being.

At the present time, the service is provided for as follows:—

	Teleprinter Circuits (over Voice Frequency channels) to:		Phonograms
JERSEY (St. Helier)	Bristol	1	6 positions. Telephone – Telegram circuits to 10 sub-offices
	London	2	
	Guernsey	1	
GUERNSEY (St. Peter Port)	Bristol	1	3 positions. Telephone – Telegram circuits to 5 sub-offices
	London	1	
	Jersey	1	

The telephone-telegram circuits are provided for the Post Office by the States Telephone Departments. Traffic to and from Alderney and Sark is handled by telephone from Guernsey, using the local service, while Herm and Jethou depend on boats.

In pre-war days, the Jersey telegraph office was kept open all night. Both offices now close at 9 p.m. when, remarkably, London becomes the Night Appointed Office. As senders pay no more than the day-time charge of 2½d.—the local call fee plus 1d.—they receive, in terms of the length of circuit placed at their disposal, exceptionally good value.

Because of high peaks of season traffic, it has so far been thought inadvisable to include either Jersey or Guernsey in the telegraph manual switching system, but both will be connected with the automatic system.

Local Telephone Services

A local service was started in both Jersey and Guernsey in 1898. In Jersey it was instituted, under Licence from the Postmaster General, by the National Telephone Company, and development followed normal lines. By the end of 1911, when the Company's undertaking in Great Britain was transferred to the Post Office, the Jersey system consisted of the Central Exchange at St. Helier, and 14 minor exchanges serving a total of some 1,300 lines, with magneto working throughout. The States were opposed to the inclusion of the system in the general transfer, fearing higher tariffs, and would have preferred to have acquired it themselves. It was, nevertheless, taken over by the Post Office, no changes in tariffs being made, and negotiations for transfer to the States broke down on the question of price. It was not until 1923 that a bargain was concluded, the system then passing into States ownership for £32,000 with a Licence for a period of 30 years, to 1953. Development proceeded apace and, by 1939, the system served 5,960 stations from 11 exchanges.

In Guernsey, early events took a more lively course. From the outset, public opinion there was strongly in favour of a States-owned and operated undertaking, but the National Telephone Company claimed that the Island came within the terms of its Licence. The ensuing argument, in which the Home Office and the Treasury, as well as the Post Office were involved, was at times tempestuous. In an effort to apply the closure, the Company, during the night of May 30, 1896, erected a pole in the central part of St. Peter Port from which it ran wires in various directions over the town. The Islanders' reaction next morning was rapid and, fortified more by courage than by the cautious legal advice they had obtained, they cut down the wires within two days. The Court decided against the Company in a subsequent action for damages; and the verdict was later upheld by the Appeal Court and, finally, by the Privy Council. In the upshot, the States secured a Licence from the Postmaster General for a period of 14 years from December 31, 1897. At the end of this period, the Guernsey system comprised six exchanges, serving nearly 2,000 stations. A second Licence, again for a period of 14 years, was followed by the third—and current—Licence which, being for a period of 30 years, will expire in 1955.

In May, 1915, service was extended to Sark, when communication was established over a telegraph cable with a public telephone installed in the Post Office there. An interesting development in 1924—anticipating by seven years a similar service in Great Britain—was the provision of a ship to shore service for mailboats at the Quay in St. Peter Port. A further extension of service took place in 1927, when telephone communication was established with Alderney—again over a single-core telegraph cable. Unfortunately, the cable failed a year later, and the simplex radio link which replaced it could only be used by the telegraph service. By 1939, the system served some 5,900 stations from five exchanges.

The German Occupation

Of the occupation, which lasted from June 30, 1940, to May 8, 1945, much could be written, but space permits of no more than a few notes. Immediately on taking possession, the enemy placed military guards in all exchanges and other telecommunications installations. Initially, loaded machine guns were mounted in some of the exchange switchrooms, and training experts may take it as established that this procedure does not reduce operating irregularities nor consititute the best form of refresher training. The use of public call offices was forbidden, and although no restrictions were otherwise placed on the local services, the stations still remaining in service at the liberation were no more than

about 25 per cent. of the pre-occupation number in Guernsey, and less than 6 per cent. in Jersey, mainly because lack of fuel made power unavailable at outlying exchanges, or because of the diversion of cables by the occupying forces for their own signals services. At the Jersey Central exchange, power was, for a time, maintained by a generator driven by a steam roller installed in the exchange yard. In the same yard, too, crystals for the many clandestine sets on which the B.B.C. was received were manufactured under the noses of the unsuspecting guard—at times from materials requisitioned from the occupying authorities "for maintenance purposes". Those authorities also never discovered the many crystal receivers ingeniously fitted by some subscribers in their telephone line protectors (the little "fuse" boxes which act as lightning arresters), which enabled news from England to be heard by doing nothing more conspicuous than to appear to be making or receiving a local call.

Post-war Recovery

Since liberation, the recovery of the service in both Islands has been very rapid, and it was aided in Guernsey, in the early stages, by carefully ensuring that a squad of German cable jointers should be among the last of the enemy forces to leave, and that they should be occupied meantime in restoring some of the cables they had previously diverted. There are now 9,712 stations and 7,098 exchange lines in Jersey, and 7,678 stations and 6,344 lines in the Guernsey system, the latter including 141 lines on Alderney and 60 lines on Sark. Alderney exchange was opened as recently as May, 1949, when a single-channel radio circuit, provided for the States by the Post Office, made a public telephone service available from Alderney via Guernsey for the first time since the abandonment of the old telegraph cable in 1928. Following the liberation of Alderney, telephone service was provided for administrative purposes by means of a submarine cable laid by the enemy. It developed a fault, however, in March, 1949, and was abandoned. This single-channel radio link has recently been replaced by a 6-channel system.

The following statements show the present composition of the local telephone systems in the Islands:—

STATES OF JERSEY

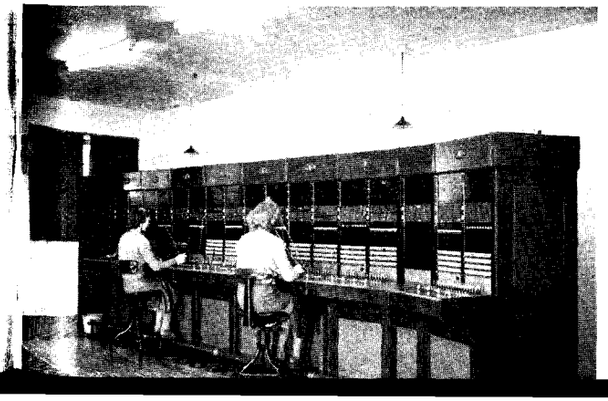
Exchange	Type	No. of lines	No. of stations
Central	Central Battery 10	3,405	5,461
Western	" "	553	626
St. Aubin	" "	794	1,000
Millbrook	" "	640	722
Five Oaks	" "	544	641
Gorey	" "	616	683
Trinity	" "	175	193
Sion	" "	177	185
St. John	Magneto	97	102
St. Lawrence	"	97	99
	Totals	7,098	9,712

STATES OF GUERNSEY

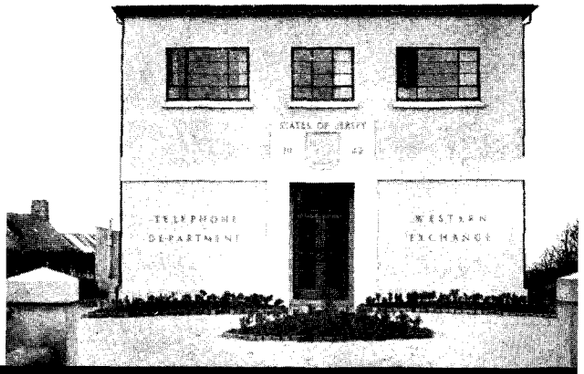
Exchange	Type	No. of lines	No. of stations
Central	Central Battery 10	2,631	3,622
St. Sampsons	" "	1,089	1,237
St. Peters	" "	603	635
St. Martins	Magneto	959	1,024
Catel	"	861	923
Alderney	"	141	167
Sark	"	60	70
	Totals	6,344	7,678

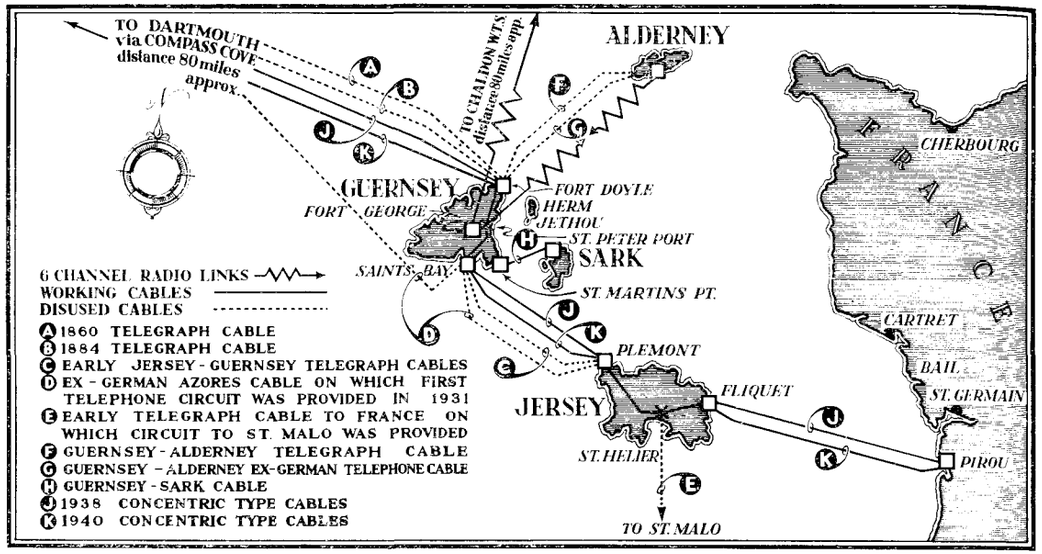
The States of Jersey are, at present, in course of modernising and rationalising their local telephone system. The first step towards this was the opening in July, 1949, of Western C.B. 10 exchange, in a specially designed and most

Part of the switchroom at the Western Exchange, Jersey



Western Exchange, Jersey





CHANNEL ISLANDS CABLES AND RADIO LINKS

attractive building, which can ultimately house automatic equipment. It replaced the magneto exchanges at St. Peter and St. Ouen.

The next stage will be the opening of Northern Exchange planned for the end of 1950, and, by that operation, no magneto exchange will remain. Ultimate proposals provide for a further reduction in the number of exchanges to five or six, and for the conversion of the Central exchange to automatic working. These schemes will involve a large capital outlay, and as the Jersey Licence is due to expire in 1953, the States have recently opened negotiations with the Post Office for a renewal. As a result, it has been agreed that the Licence will be renewed for a period of 20 years on its expiration in 1953, or for a slightly longer period if a new Licence is negotiated earlier.

It is of interest that Guernsey has a common numbering scheme, and, although there are five exchanges in the Island which have separate names for administrative and engineering reasons, to the telephone public they are all known by the one name "Guernsey". The exchanges in the adjacent islands of Alderney and Sark, which are dependent on the main Guernsey exchange, take the name of the Island in which they are situated.

Trunk Service

Thirty-three years elapsed between the establishment of local telephone services in the Islands and the opening of a trunk service to Great Britain on March 26, 1931. The main deterrent had been the very heavy cost of providing and maintaining submarine telephone cables, but the cost of a new cable was avoided when it was found practicable to establish a satisfactory speech circuit over one of the two telegraph cables. This particular cable was a section of a German-owned cable to the Azores, which had been captured during the 1914-18 war and laid by H.M.T.S. *Monarch* from Compass Cove, Dartmouth to Plemont, Jersey. It was intercepted and brought ashore to a cable hut at Saints Bay, Guernsey, whence two local ends were run to Guernsey Central exchange, one for the Guernsey-mainland section and the other for the Guernsey-Jersey section. As there was only one circuit, calls from Jersey to the mainland had to be switched at Guernsey. The mainland terminal of the circuit was London.

Experimental radio work, carried out from 1934 onwards, having proved that ultra short waves could be used over non-optical paths, a commercial circuit was set up between Chaldon,

near Weymouth and Fort George, Guernsey, in July, 1936. Subsequently, two radio links, using high power transmitters, and with carrier equipment associated, were used to provide the cross-channel sections of four telephone circuits from London to Guernsey. The two radio links, one working on about 5 metres and the other on about 8 metres, each carried one inverted audio and one carrier circuit. At the same time, the number of Jersey-Guernsey cable circuits was also increased from one to three.

Meanwhile, the single-core concentric-type submarine cable had been developed, and cables of this type were laid from Compass Cove, Dartmouth to Fort Doyle, Guernsey, from Saints Bay, Guernsey to Plemont, Jersey, and from Fliquet, Jersey to Pirou, France, in 1938. Carrier equipment associated with the terminals provided 12 telephone channels in each section. Fort Doyle, Saints Bay and Guernsey Central exchange were connected to each other by underground cables, as were Plemont, Fliquet and Jersey Central exchange.

Islands was, of course, severed when the Germans moved in in July of that year.

Immediately on liberation, the restoration of communications was taken in hand, and Post Office engineering staff set up a radio link between Fort George, Guernsey and Chaldon, using mobile 6-channel radio equipment. Within a week, teleprinter traffic was passing over the first circuit and, soon afterwards, four London-Guernsey telephone circuits and two teleprinter circuits were working. Meanwhile, the work of re-establishing the concentric submarine cables proceeded apace, despite extensive minefields, and on May 25, 1945, the first cable was proved through from Dartmouth to Fort Doyle. The cables between Jersey and Guernsey had been used by the Germans during the occupation and were found to be in fairly good order, so that on June 21, 1945, telephone circuits to both Guernsey and Jersey were established on the cables.

The growth of trunk traffic to and from the Channel Islands is shown below.

THE GROWTH OF TRUNK TRAFFIC TO AND FROM THE CHANNEL ISLANDS

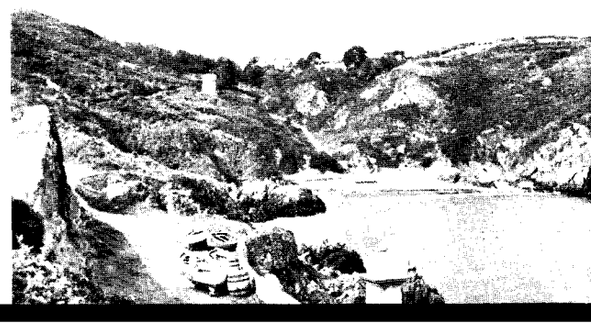
Year	Guernsey to Gt. Britain	Gt. Britain to Guernsey	Jersey to Gt. Britain	Gt. Britain to Jersey	Total
1931 (from March, 26)	3,015	3,563	3,629	4,013	14,220
1932	3,563	4,573	4,699	5,984	18,819
1933	4,907	5,637	7,031	8,589	26,164
1934	5,374	6,191	8,977	11,394	31,936
1935	8,699	10,067	10,506	14,249	43,521
1936	13,963	15,376	17,811	22,534	69,684
1937	18,709	21,797	22,891	28,575	91,952
1938	22,046	24,971	20,471	22,531	90,019
1939	26,792	22,857	18,889	22,173	90,711
1947	84,733	56,031	94,968	91,795	327,527
1948	97,433	63,491	104,223	109,577	374,724

This project was completed and opened for public service on August 1, 1939 with the initial provision of six London-Jersey telephone circuits. The system of concentric cables from Compass Cove, Dartmouth to Pirou, France, via Guernsey and Jersey, was duplicated for strategic purposes during 1940, but communication between Great Britain and the

The substantial increase in the amount of trunk traffic in the post-war years is apparent and, although the concentric cables are fully equipped, and the 6-channel radio link between Guernsey and Chaldon is still in use, the 16 circuits now available between Jersey and London and the 12 between Guernsey and London are inadequate for the peak traffic

Telegraph Bay, St. Martin's, Guernsey, taken from Jerbourg Cable Hut

Saints Bay, Guernsey. The Cable Hut is situated at the foot of the path centre of picture leading down to the bay



encountered during the holiday and produce-marketing seasons. As a temporary step, two additional circuits are being provided by using 1 + 4 carrier equipment on the 4-wire physical circuit formed by the two concentric cables. The need for additional circuits will eventually be met by inserting submarine repeaters in each of the two concentric cables between Dartmouth and Guernsey, so as to increase from 12 to 60 the number of circuits each cable will carry. Five circuits suffice to carry the present traffic between Guernsey and Jersey but, as the inter-island cables also carry the Jersey-London circuits, the number of speech channels in each of the two cables will be increased to 30 without the need for submarine repeaters.

The submarine cables and radio links, with their associated equipment, are provided and maintained by the Post Office, which maintains a permanent staff, under the control of the Telephone Manager, Bournemouth, on both Guernsey and Jersey. The trunk service is, however, operated by the two States Telephone Departments on behalf of the Post Office.

In 1947, it became clear that the three trunk switchboard positions then existing in each island would soon be inadequate for the season trunk traffic, and new trunk switchboards, designed by the South Western Region, were supplied by the Post Office. The new Jersey switchboard, comprising seven equipped positions, was installed by the States of Jersey Telephone Department, while the Guernsey switchboard, of six positions, was installed by Post Office engineering staff from the Bournemouth Telephone Area. These switchboards, incorporating the latest trunk facilities, for example, chargeable time clocks, an outgoing trunk multiple with free line signals, and an ancillaried incoming trunk multiple, were both completed and brought into service in the late Spring of 1949, in time for the Summer season. A rather archaic operating procedure had been in force on the Channel Islands' routes, mainly because the trunk positions in Jersey and Guernsey did not provide facilities either for the accurate timing of calls or for modern operating methods. When the new switchboards were provided, a modification to the operating procedure followed quickly in June, 1949, when the check by London of the timing of calls originated in the Islands was stopped, with a resultant saving of circuit time. Until recently, however, all trunk calls originated in the Islands were re-booked in London. In theory, this practice was used to save holding the cross-channel circuits while the mainland subscriber was being called by the London operator. It was abolished on November 1, 1949, however, since when London operators have connected the called subscriber on receipt of the demand from the Channel Islands' operator. A more efficient use of the circuits has resulted; and the much improved trunk service, which this seemingly minor modification in procedure has given Channel Islands' subscribers, has evoked much appreciation.

Meanwhile, further improvements to the operating procedure are being considered, and a demand service from and to the Islands is anticipated in the not too distant future. Dialling-in to the London Director Area, the destination of about 50 per cent. of the traffic originating in the Islands will, it is hoped, be practicable.

Continental and Overseas Services

Subscribers in the Channel Islands have access to the same continental and overseas services, via the Continental and Overseas exchanges in London, as have subscribers on the Mainland, and they pay the same call charges. In addition, there is a direct service from Jersey and Guernsey (excluding Alderney) to the whole of France (but not beyond) via Rennes exchange. This latter service was first established on March 2, 1939, when two circuits between Jersey and Rennes were provided, via Pirou, in the concentric cable laid in October, 1938. This direct service to France was restored in April, 1949, when a single circuit between Jersey and Rennes was set up. Initially, the restored service was limited to calls originated in Jersey, but it was extended to include Guernsey in June, 1949. The charges for calls from the Channel Islands to France on the direct route are the same as those for calls routed via London.

Acknowledgment

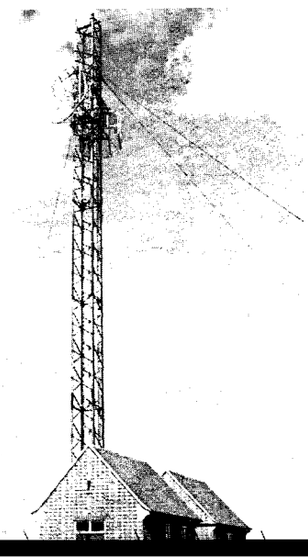
The writer is indebted to Mr. P. K. Luxon, the Engineer-Manager of the Jersey States Telephone Department, and to Mr. E. H. Bennett, the Manager and Engineer of the Guernsey States Telephone Department, for certain of the information contained in this article.

Television Extension to Birmingham

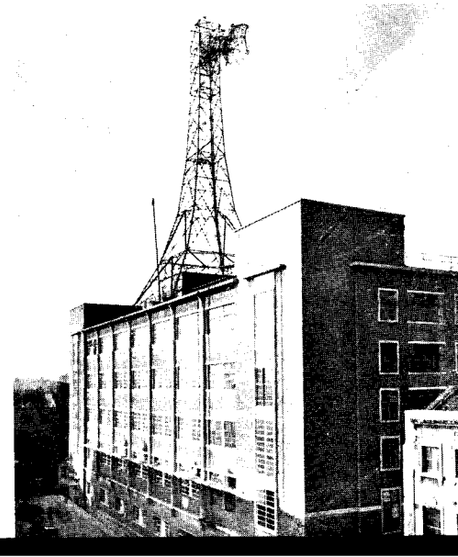
by A. H. Mumford, O.B.E. B.Sc. (Eng.), M.I.E.E., Engineer-in-Chief's Office

SUTTON COLDFIELD, THE SECOND television station in this country, was formally opened by the Postmaster General on December 17, 1949, thereby extending the television service to the densely-populated area of the Midlands. Since the operation of this new station is dependent upon an exchange of television programme material with London, the Post Office was called upon to provide the relaying facilities for this purpose. The provision of facilities for relaying television signals is a much more difficult problem than is the relaying of sound signals. Thus, the bandwidth required for the effective transmission of the standard 405-line signals (the United Kingdom Standard) is some 3,000 kilocycles (3 million cycles) per second, sufficient for the provision of 750 telephone channels, and compares with the 10 kilocycles per second required for the transmission of high-quality sound programmes. One way of relaying the television signals is by means of a chain of low-power highly directional radio stations, working on the very high frequencies, corresponding to wavelengths of 30 centimetres or less. The Post Office issued a specification for the interconnection of London and Birmingham by such a system in November, 1946, one requirement of which called for the system to be so designed that, even if the system were to be extended up to 400 miles, there should be no noticeable impairment of the television signals; the contract was awarded to the General Electric Co. Ltd. in May, 1947. Towards the middle of this year, a special type of coaxial cable systems will become available as an alternative means of transmission, and will enable the performance and economics of both radio and cable system to be directly compared. The programmes are now being relayed to and from Birmingham by means of the radio relay link, and the remainder of this article gives a brief outline of the radio system.

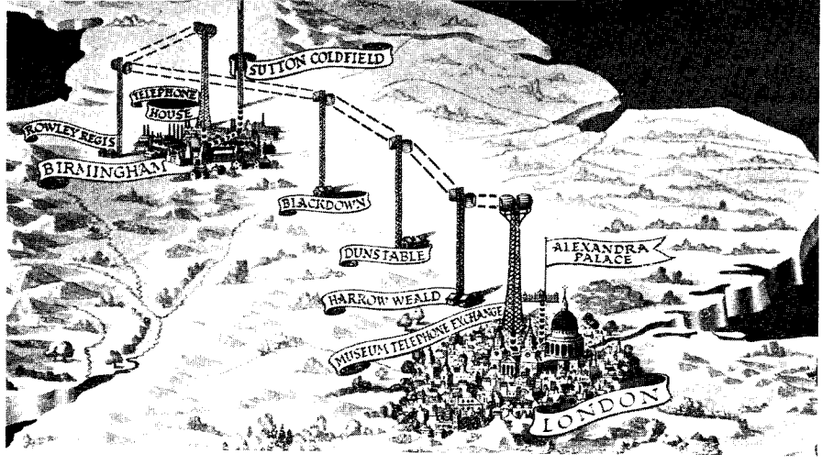
The London Terminal of the radio system is at Museum Telephone Exchange, and the Birmingham Terminal at Telephone House, Birmingham. The connections between the radio link terminals and the respective local B.B.C. studios and transmitters are provided by coaxial cables. The television signals are transmitted over the relay link by frequency modulation of a 900 megacycles per second carrier (corresponding to a wavelength of about 30 centimetres). Because very high frequency waves follow straight line paths, each station in the system has to be in sight of those on either side of it; for this reason, they are usually situated on hill tops, the aerials being mounted at the summit of a tower to obtain additional



Left: **Exterior of Dunstable repeater station** *Photograph by courtesy of the General Electric Co. Ltd.*



Right: **Museum Exchange, tower and aerials.**

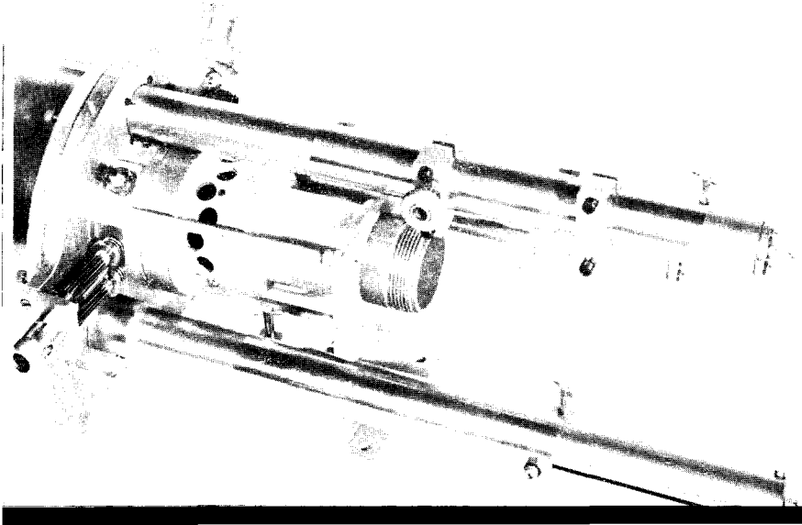


Route of London-Birmingham television radio relay link. *Photograph by courtesy of the General Electric Co. Ltd.*

height. It has, however, only been necessary to use four radio repeater stations between London and Birmingham; one, at Dunstable, is illustrated on the previous page. Each repeater station receives the television signal from the previous station, amplifies it and transmits it to the next one. The sites for the four repeater stations were only chosen after an extensive series of trials and, in the final choice, many factors, other than technical, had also to be taken into consideration, for example, the preservation of amenities. The route chosen is shown above, and it will be seen that extensive use has been made of natural features—the "Elstree" ridge just north of London, the Chiltern Hills, the Cotswolds and the high land to the west of Birmingham. The overall length of the radio link is some 115 miles, and the shortest and longest repeater sections are some 6 miles between Telephone House, Birmingham and Turner's Hill (Rowley Regis), and 39 miles between Turner's Hill (Rowley Regis) and Blackdown respectively.

The use of highly directional aerials, which are mounted at the top of towers, avoids the necessity for relay stations of unduly high power. The highest aerial towers are at London and Birmingham, and are respectively 167 and 196 feet above street level; each tower weighs about 12 tons. The aerials consist of small rods, no more than six inches long, mounted within a paraboloid reflector formed from light alloy tubes. In order to secure a well-defined radio beam, these reflectors, which are 14 feet across, have been constructed to a tolerance limit of half an inch. To prevent their reflecting properties being modified by the formation of ice, electric heating wires have been provided inside the tubes. Coaxial cables are used throughout as feeders for the 900 megacycles per second energy between the aerials and radio equipment.

The power transmitted from each repeater station is about 10 watts and the received power over the 40-mile paths is just over a microwatt, so that the repeater station may have to increase

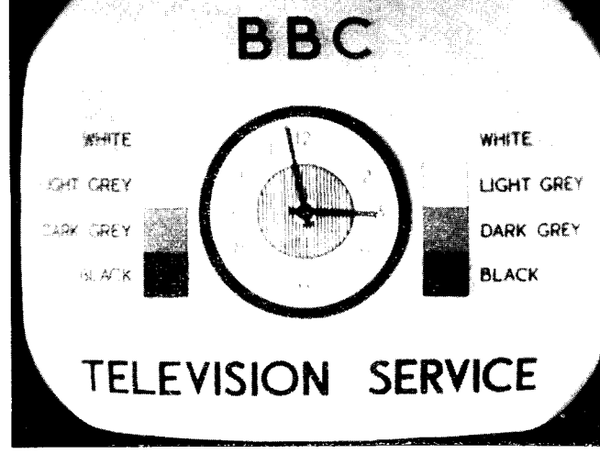


Typical radio frequency circuit equipment. *Photograph by courtesy of the General Electric Co. Ltd.*

the power of the received signals by some 10,000,000 times. Since the system operates on a frequency of 900 megacycles per second, a range of advanced techniques in valve and circuit design has had to be used. For instance, the circuits are markedly different from circuits performing similar functions at lower frequencies. The new circuit components, a typical sample of which is shown on the opposite page, derive their characteristic form from the fact that they are produced on lathes and not by an assembly of coils, condensers and resistances. Each tuned circuit is essentially a length of coaxial transmission line, and a particular feature of the circuits used in the link is that they have been designed for reliable and stable operation over long periods by elimination of all sliding contacts and by robust constructions.

Reliability of service is essential, and considerable attention has been paid to this requirement in design of the equipment and provision of spare facilities. Duplicate signal channel equipment and power units with changeover switching are provided to maintain the operation of the link in the event of a failure of the working equipment. The equipment which is not in use is kept warmed-up in a standby condition so that it is ready for immediate operation. From the control points located in Museum Exchange and Telephone House, it is possible to switch the equipment at all the stations, on and off, and to make a changeover between working and standby units. These operations may be performed for all the stations at once or for each station individually. If the supervisory system should fail, the stations will continue to work on pre-set time switching. Comprehensive test equipment has been supplied for checking the overall vision—frequency response of the system from terminal to terminal.

Ultimately, the radio link will provide for the simultaneous transmission in both directions of the 405-line signals between Museum Exchange and Telephone House, Birmingham. However, it was foreseen at the time of placing the contract that it might not be possible to provide the full two-way installation in time for the opening of the public service, and arrangements were made for one of the channels to be completed before commencing the installation of the other, and for the direction of transmission to be reversed at will; this can be effected in less than ten seconds. This reversible service has been



Television tuning signal

provided, complete with all its essential standby equipment, with just over 60 per cent. of the complete radio equipment. In parallel with the provision of the radio equipment, the Post Office had to arrange with the Ministry of Works for site acquisitions and the provision of buildings. In addition, main and emergency power supplies, and, last but not least, the training of personnel for the operation of the system, had to be provided for. In all this, the Midland, Home Counties and London Telecommunications Regions played their part.

Readers, particularly those who are viewers in the London area, will be interested in the photographs on this page, which show signals actually received at Sutton Coldfield after transmission from Alexandra Palace over the complete radio relay link and its associated coaxial tails during some of the early tests. In the illustration above, the clarity of the detail in the centre of the clock face will doubtless come as a surprise to many.

Announcer Sylvia Peters at Alexandra Palace

Incident

★ ★ ★

World War II brought risk and adventure to our Cable and Wireless colleagues in remote parts of the world. In far-off Cocos Islands, a repetition of the famous Emden raid of 1914 brought peril and almost disaster. Resource and courage kept the line of communication open.

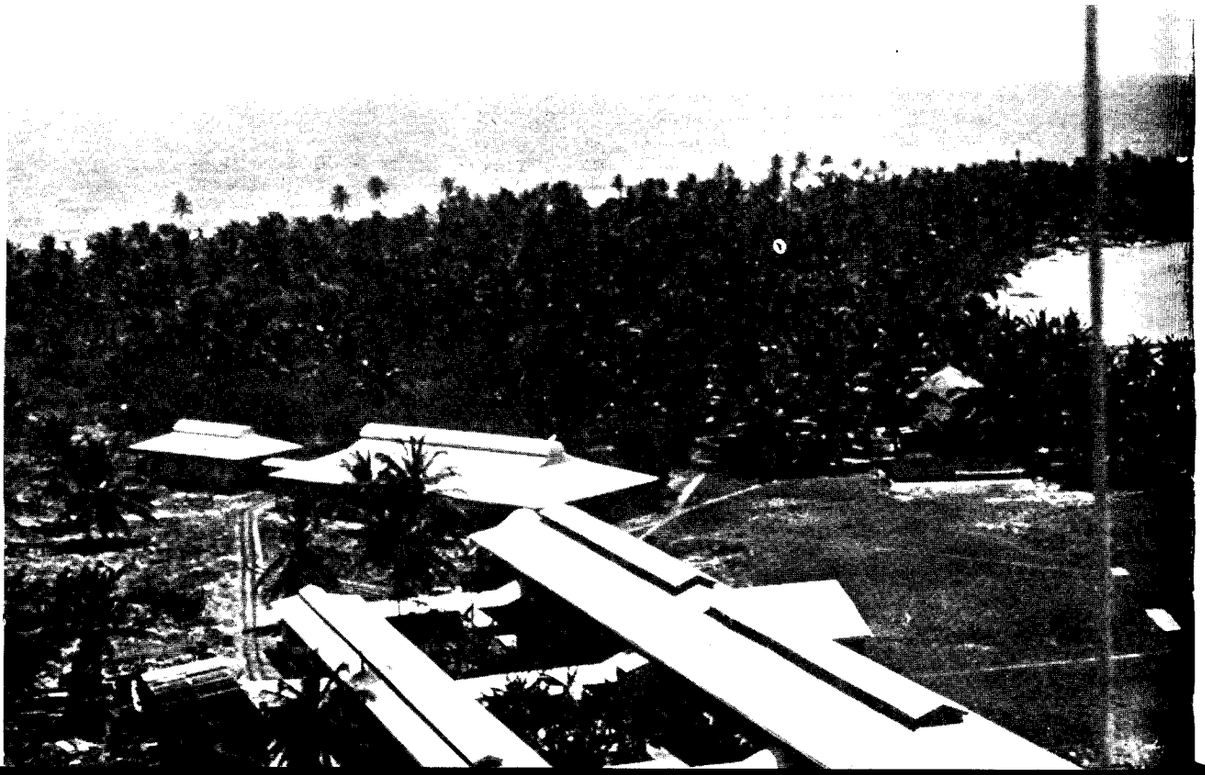
★ ★ ★

THE COCOS ISLANDS, SET IN THE midst of the Indian Ocean between Ceylon and Western Australia, are tropic isles enclosing, with stretches of reef between, a lagoon six miles across. At the northern end of the lagoon, there is an opening deep enough for a small ship to enter. Close by lies Cocos Island where there is the Cable and Wireless station which has grown up from the wooden building set up in 1900, when cables were laid across the ocean to connect South Africa with Australia. This island is a mile in length and 500 yards at its greater width.

One of the best bluffs of the whole war was pulled by the Company immediately after the fall of Singapore—so unexpected in view of Air Marshal Brooke-Popham's announcement about its impregnability. The Japanese were advancing rapidly down Java, six hundred miles south of which were the Cocos Islands, vital link in the Empire communications with Australia. If the Cocos Islands' station had been captured or the cable put permanently out of action, it would have been necessary to transmit all messages to Australia on the already overloaded route via the Pacific.

Sure enough, a Japanese warship shelled the tiny base on March 3, 1942. Signals abruptly

Cocos Station from the air



stopped, but a few hours later, cable communication was resumed with the announcement that the staff were safe although the cable office had received a direct hit. The Company realised that no air or sea protection could be given and so, with the consent of the Admiralty, the Head Office sent a radio message to Batavia in plain English (knowing that it would be intercepted) to the effect that the staff at Batavia were to destroy their instruments because Cocos had been permanently put out of action. This stratagem was a complete success, and throughout the rest of the war the vital cable between London and Canberra was maintained. Needless to say, the staff were warned by cable, which could not be tapped, not to send radio messages which would at once give the game away. Cocos itself was never mentioned by name until long after the Rheims Surrender. Instead it was nick-named "Brown", "Jones", "Robinson", or some other common name whenever some reference had to be made to it. Even then, these names were altered at irregular intervals.

It was not until May 22, 1945, that the Head Office learned what really happened when the Japanese warship attacked the Island. It now appears that the first warning that the Company's men had of the approach of the Japanese was their failure to contact Christmas Island on the 9 a.m. schedule, although it had been in communication with Cocos Islands one hour previously. Plans were at once made to prepare for raids but, as Cocos was only ten feet above low-water mark, the slit trenches filled to the brim at high tide, even though they emptied gradually when the tide dropped. The armament of the atoll, for that is all it is, consisted of two six-inch guns on the neighbouring island of Horsborough, manned by the Ceylon Coastal Artillery, while Cocos itself had as its protection only a company of the Ceylon Light Infantry, armed with brens and Vickers machine guns.

A number of Japanese reconnaissance aircraft had been reported in the neighbourhood, but familiarity bred contempt and when, on March 3, yet another Japanese plane was sighted, the staff was not unduly alarmed. Everything went on normally, men coming in from tennis or sailing and discussing the merits of Australian beer, the afternoon lawn tennis, and the possibility of fine weather next morning. Later, when one enthusiastic fisherman hurriedly turned to grab his steel helmet, he remembered that it was down on the beach imprisoning a number of hermit crabs which he was keeping for bait. Certainly no one was discussing the prospects of a raid.

There was a fitful moon with heavy clouds and poor visibility when, at 8 p.m., the staff were brought to their feet by a sharp report, obviously from a gun of heavy calibre. "Horsborough having a practice," hopefully suggested one cableman; but as another shell tore across the roof and brought down thirty coconut trees, he disappeared towards the trench, concluding his remark with, "But he's bloody erratic."

By this time, shells were coming over in rapid succession, and there was no longer any doubt that the Island was being raided. The two cablemen on evening watch had a hot time. While under shellfire, they had to advise all communicating stations of the raid, short their instruments and turn off the engines. In the meantime, the coolie lines, kitchen and quarters went up in flames, setting light, in turn, to a number of coconut trees nearby. Most of the Island was brilliantly illuminated. The special cairns built for destroying secret documents were operating, these fires, in turn, showing up another section of the quarters. Considering the well-lit targets available, the Japanese shooting was wild and ineffective. British gunners given such an opportunity would have destroyed every building on the Island.

Four of the cablemen were just leaving the office when there was a sudden blinding flash and the whole place seemed to disintegrate. The whole quartette were blasted 30 feet along the verandah, but the main force of the explosion was centred on the right-hand side of the office and, though less than 10 feet from where the shell hit the iron girder, the four men only received minor shrapnel wounds. The rest, three of whom had been wounded, had jumped into the waterlogged slit trenches where they remained for nearly an hour, when the shelling ceased abruptly and the Japanese warship disappeared at high speed.

Why the commander did not occupy the Island remained a mystery but, brief as his attack had been, considerable damage had been done to the office. Blast had hurled almost every instrument to the floor; the Batavia and Singapore forks and magnifiers (where one of the cablemen

had been busy two minutes before the explosion) had completely disappeared. The roof was in a bad way, and sheets of corrugated iron had fallen on the already-mangled instruments. But within five minutes, every man, except for the wounded, was hard at work cleaning up the office as a preliminary to re-establishing communication. The cables were luckily undamaged and, before midnight, the staff had managed to raise Cottesloe and Durban by hand on the test set. At 1 a.m., most of the cleaning had been finished and it was left to the man on night duty to speak to distant stations every half hour, as well as exchange urgent Service messages with Head Office and the naval authorities.

By noon next day, conditions were nearly back to normal and, ironically enough, the staff had once again begun channel working five minutes before a news broadcast in English from Tokio radio announced the following news flash: "Last night our naval forces operating in the Indian Ocean attacked the Islands of Cocos. We caused heavy damage, starting fires still visible twenty miles at sea. We destroyed cable and wireless communications and split the island in two."

This exaggerated claim might have been justified if the Japanese had hit a certain iron shack filled with bombs. Presumably the Japanese commander really believed that he had completely destroyed all communications, and may have been quite satisfied to leave the occupation of the Island to other forces. He would certainly have had grounds for this, because reports from Horsborough and another island showed that there was such an inferno of flames on Cocos that it really looked as if the station had been completely destroyed. Actually, the shell that hit the office was a freak. Its trajectory was traced next morning. Apparently it had cut off a coconut tree, passed through the wooden bumping board of the tennis court, pierced the Chinese rice store, and then scored a direct hit on an iron girder on the seaward side of the office. Had it missed this girder, it would have probably exploded harmlessly out in the lagoon like many of the other shells which passed completely over the Island. It is a fact that damage would have been much greater if the warship had not shelled the Island at point-blank range.

The incident was not without its touches of humour. The mess servants had prepared oil drums, just big enough to hold one man, as their foxholes in the coral, but they did not stay long. Five minutes after the last shot was fired, they left *en masse*, except Gold Tooth, the outside engineer, for the neighbouring Island. He appeared wet through and shivering at the office door next morning, announcing that he was "very brave man" and that he had come back to die with the tuans. The "tuans" later discovered that he had missed the last boat to Selma.

Of the others, about a dozen lost their personal

(Continued on page 81)

War damage to the native colony on one of the Islands

Local Line Plant Provision

The Modern Method of the United Kingdom Post Office

by A. Morris, A.R.C.Sc., M.I.E.E., Engineer-in-Chief's Office

★ ★ ★

This article deals with the provision of underground local line systems, planned, designed and constructed in accordance with the latest method of the United Kingdom Post Office. The principal innovation is the Cabinet and Pillar system of* full flexibility, *embodying the cross-connection method of wire-changing, which is thereby reduced to the simplest kind of operation.

★ ★ ★

GENERAL PURPOSES AND AIMS

IT IS TO THE PRODUCTION OF A VERY effective practical design of Cabinet and Pillar, that, for the first time in the development of methods of plant provision, the realisation of the whole of the benefits of full flexibility are to be ascribed. Unit-type cable is used in the networks, which are effectively sub-divided each into three separate sections by means of the flexibility plant. Such a system, with its facilities for counteracting quite large departures from forecast, ensures a real simplification of engineering function, design and construction, with an accompanying lowering of costs. The outstanding cost savings, however, accrue from that deliberate feature of the system which permits the main cables to be provided by short-term instalments, and enables them to be used in such a manner that a very large proportion of the pairs can be taken into service before augmentation becomes necessary. The operation of the system in this manner, with the smallest practicable proportion of unusable pairs at all times throughout the life of the plant but without the creation of a pair shortage adversely affecting the rate of joining-up subscribers, enables large financial savings to be achieved.

A further saving effected by the British method in suitable cases, arises from an appreciable cheapening of track and cable costs, by the use of small gauge wires, consequent upon the use of telephones of the latest type and the adoption of modern transmission performance standards.

NEED FOR REVIEW OF OLD METHODS

The fixing of telephone exchange area boundaries, the actual siting of the exchanges and the subsequent lay-out and provision of the line plant, are of the greatest significance in the economics of local telephone systems. This article deals only with the line aspect of this important subject and is restricted to the plant extending between the exchange and subscribers' distribution points, known as local line plant. The provision of the line plant connecting subscribers' premises with distribution points, however, needs to be considered in conjunction with the local line design, since the means and cost of its installation have an important bearing upon the overall economy of the provision of service.

The total cost of the building, line plant and apparatus of a modern automatic exchange will range between one-third and three-quarters of a million sterling, according to size and locality. The need for the economic planning of expenditure of such magnitude is obvious.

Often under the conditions of pre-war design and practice, the demand upon the network for circuits could not readily be met without frequent plant extensions, with the result that there was a continual and insistent demand throughout the country, for a change in line plant provision practice. The matter was fully investigated as a post-war reconstruction task and a Departmental Report (Harvey Smith 1945) contains the recommendations upon which the present-day technique of the United

Kingdom Post Office is based. The following paragraphs aim mainly at describing the principles underlying the design of modern line plant systems, with particular regard to the cost aspect. In attaining this objective, detailed reference is made to matters which are common to all systems of line provision. This is necessary for a clear explanation of the shortcomings of the old system and the advantages of the new.

GENERAL ASPECTS OF DESIGN TECHNIQUE

Economic Basis of Provision. The capital cost of an engineering project, such as a local line network, is not a direct measure of the overall expenditure which will be incurred during the life of the plant. In the first place, because the plant is usually provided in instalments, capital is expended at intervals. Furthermore, the different types of plant have differing lives; also their respective maintenance costs are not necessarily of comparable magnitude. In consequence, for cost comparison purposes, it is necessary to take a comprehensive view, and employ the method which is based upon an assessment of the present value of the relevant annual charges over a period of years. These annual charges arise out of financial liabilities in regard to interest upon the loan of capital, maintenance or upkeep of the plant and its ultimate replacement, necessitated by its depreciation.

The annual bulk augmentation of line plant throughout the country is controlled financially by the Inland Telecommunications Department. The economic principles applied to its engineering design and to its planned provision, have the approval of the Accountant General's Department and are laid down in instructions issued by the Engineering Department. These instructions are applied by Regional and Area Staffs, upon whom full responsibility rests for the development of their local line networks.

During the past few years of pressing post-war reconstruction needs, in the face of greatly inflated costs of stores and labour, and of Capital Investment restrictions, renewed effort has been energetically directed in the Post Office to improved engineering design, so as to secure the full economic benefits which can accrue from the planned provision of local line plant.

Provision by Instalments. As the number of subscribers to the telephone service increases, more and more circuits are needed. The local line plant necessary to meet this demand is, of course, not provided as and when each individual telephone circuit is required, since obviously this would be too costly a procedure. On the other hand if, for any particular exchange area, plant were installed at the outset to meet the requirements of the full period of forecasted growth, there would be a considerable margin of spare plant during a large part of the period for which such provision was made, with consequent over-expenditure. In order to avoid waste, cables, other than distribution, are provided in instalments, which cater for growth during certain periods of time, known as economic planning periods. The durations of such periods are determined by means of financial studies taken over a full costing period appropriate to each case. The rate at which cable pairs are required to meet the demand in the different parts of the system, has a direct bearing upon such durations; generally, a low rate necessitates long planning periods; a high rate warrants short planning periods. There is, however, a definite lower limit, due to mounting construction costs per cable pair, for small additions to the plant. Large economies result from short-term provision in suitable circumstances.

Forecasts.—The bulk figures of growth for a complete exchange area can be forecast with considerable exactness, by experienced staff employing modern statistical methods. This is true both for the various planning periods and for the full forecasting period. Detailed forecast figures of growth for sub-divisions of an area, such as main cable areas and particularly distribution areas, are, however, not so reliable in respect of total growth, rate of growth or locality. In view of this, augmentation or rearrangement of the line plant often becomes necessary before the conclusion of the period for which the original provision was made. It will be explained later how the serious consequences of this matter under pre-war provision conditions are, to a large extent, averted in modern practice.

Re-arrangements.—When drawing upon the balance of plant previously provided, or when providing additional plant to meet current or future demands for circuits, re-arrangements of the existing plant are almost always necessary. Re-arrangements, as usually understood, consist of the opening of cable joints at various places in the network and the changing-over of wires, previously un-connected or connected in some other manner. This work involves the plumbing of cable sheaths and the identification and splicing and stumping of cable conductors. It is always a lengthy, costly and uneconomical operation; for example, compared with the cost of simple jointing, the cost of re-arranging an equal number of cable pairs is from five to ten times as great.

Spare Plant.—Because block area forecasts are unreliable, it is often desirable, in the absence of a satisfactory flexibility system, to lay additional cables at an earlier stage than would be otherwise necessary, in order to obviate a succession of costly re-arrangements. The alternative, in such circumstances, is to provide the initial plant on a long-term basis, but at the cost of a large spare-wire margin. Actually, this expedient merely does away with the need for early and frequent relief. It is often a wasteful procedure because, not only is the proportion of spare wire high at the outset, but it will seldom fall to a low value, because numbers of pairs cannot be used unless extensive rearrangements are ultimately put in hand. It will be seen later how modern flexibility plant, with its virtual elimination of costly re-arrangements, enables the amount of spare plant to be kept economically at a low value.

Flexibility.—Endeavours have continually been made to reduce the amount of work involved in plant re-arrangements, with the object of facilitating and cheapening "wires-changed-over" operations. Ideally, exchange pairs ought to be available at any distribution point in the exchange area, inexpensively and without the need continually to carry large numbers of spares. Such a facility is referred to as flexibility. In practice, if any terminated main cable pair is readily available at any distribution point proper to be served by that same main cable or cables, there is said to be full flexibility. Various devices have been developed from time to time, such as cable-distribution heads, auxiliary joints and teeing including multiple-teeing (that is, the simultaneous appearance of individual cable pairs at several terminals).

Fig. 1. Flexibility cabinet shewing details of assemblies and associated cabling work

Except for the cable-distribution heads, which however, gave much maintenance trouble, these devices provided only partial flexibility. The modern flexibility plant items of the United Kingdom Post Office are colloquially known as Cabinets and Pillars. They employ the cross-connection principle, as embodied in assemblies, to the screw terminals of which the cables are connected. These assemblies are fitted into various types of container, huts, cabinets, pillars and so on erected unobtrusively at convenient locations on the network.

Figure 1 illustrates a cabinet with its assemblies

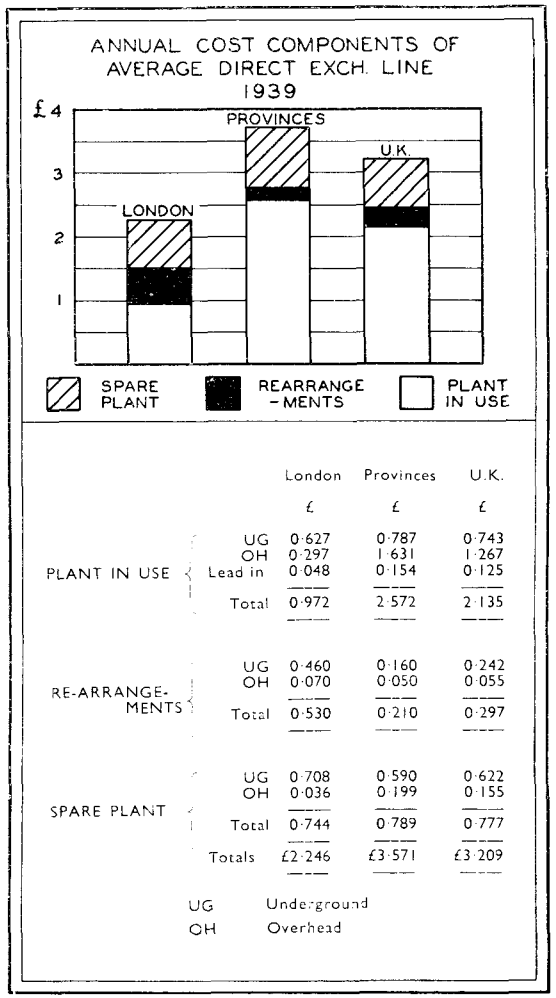
Fig. 2. Flexibility cabinet installed near the subway at Mansion House Station, London, and sited not to cause obstruction

and associated cabling. Figure 2 shows a cabinet of the largest type. It is installed near the subway at Mansion House Station, London, and sited not to cause obstruction.

In the development of flexibility plant, the continual aim has been to reduce, as much as possible, the amount and complexity of the work incidental to its functioning. Thus the extensive re-arrangement work necessary with the early systems of flexibility has given way to mere jumpering at the terminals of cabinets and pillars; the cost of such plant is more than off-set by re-arrangement savings.

In addition to what may be termed the convenience of its circuit provision function and the financial savings which it effects in respect of re-arrangements, modern flexibility plant provides other advantages and gives rise to other savings, which will be referred to later.

Fig. 3.



		London	Provinces	U.K.
		£	£	£
PLANT IN USE	UG	0·627	0·787	0·743
	OH	0·297	1·631	1·267
	Lead in	0·048	0·154	0·125
	Total	0·972	2·572	2·135
RE-ARRANGE-MENTS	UG	0·460	0·160	0·242
	OH	0·070	0·050	0·055
	Total	0·530	0·210	0·297
SPARE PLANT	UG	0·708	0·590	0·622
	OH	0·036	0·199	0·155
	Total	0·744	0·789	0·777
	Totals	£2·246	£3·571	£3·209

UG Underground
OH Overhead

PRE-WAR DESIGN AND PRACTICE

Often under pre-war conditions of design and practice, the demand upon the network for circuits could not readily be met. Re-arrangements were frequent and costly and, despite large spare-wire margins in various sections of the network, the desired rate of joining-up new subscribers could not be maintained. This resulted mainly from the practice of through-connecting as many pairs as possible from the exchange to distribution points in accordance with the initial forecast. When, in the course of time, numbers of such pairs were actually required to serve other distribution points, the diversions had either to be carried out at ordinary cable joints or at somewhat inefficient flexibility joints. The annual cost components of an average direct exchange line for the year 1939, which illustrate certain aspects of the foregoing, are given in figure 3.

Pre-war systems were based upon partial flexibility, whereby each distribution site was connected to the exchange, partly by pairs directly routed and partly by pairs routed via flexibility joints. The mechanical design and construction of these joints was such that the re-arrangement work to be carried out in making use of them during the full period of their life often proved to be extensive.

Because of these expensive re-arrangements on each occasion of relief, it was usually economical, under the conditions of partial flexibility, to provide larger main cables catering for longer planning periods, in order to reduce their number, frequency and extent. The degree of pair utilisation in such circumstances was always low. On the other hand, it is clear that short-term provision would have resulted in the plant being in a continual state of re-design and re-arrangement, with consequent detriment to the service and deterioration at cable joints, owing to frequent handling.

Auxiliary Joint Flexibility.—The Post Office has, for many years, employed the "Auxiliary Joint System" of partial flexibility. It comprises, at each flexibility position, a main cable

joint enclosing all pairs contained in the cables situated on either side of the joint. Pairs, between which it is desired to provide flexibility of interconnection, are led from the main to an auxiliary cable joint. The auxiliary joint is of either the plumbed or mechanical type; the main joint is plumbed.

Extensive experience of cable networks based upon the auxiliary joint system of flexibility had accumulated in London by 1943, and late in that year, in connection with proposals for post-war reconstruction, it was made clear that line plant re-arrangements, involving plumbing work and cable splicing for purposes of changing-over wires, were inherently costly and that, in addition, there was need for greater flexibility than that provided by auxiliary joint practice.

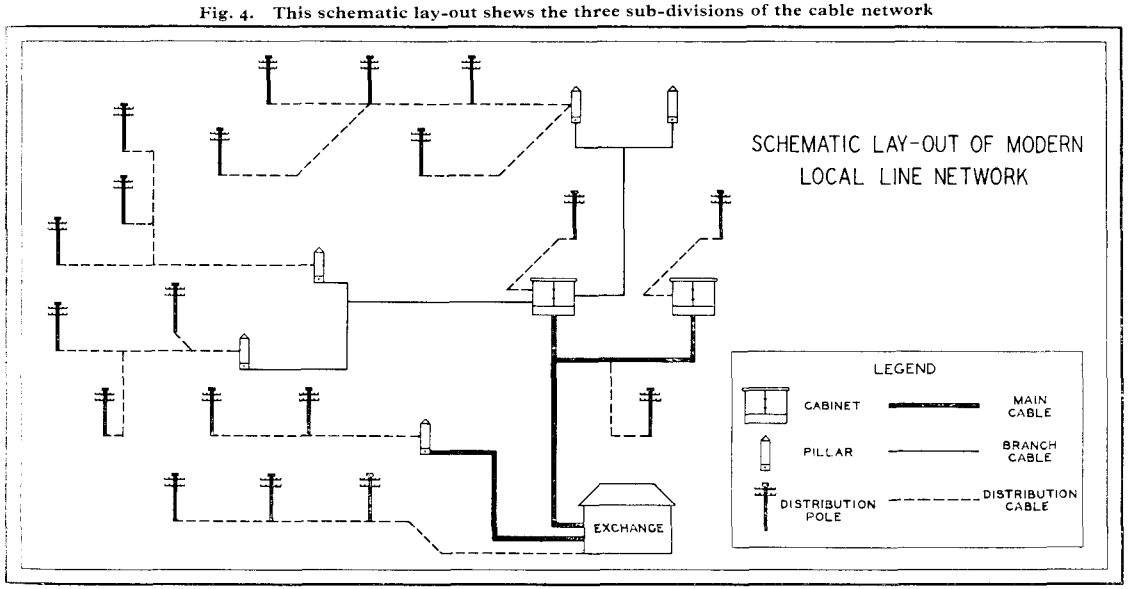
A principal short-coming of auxiliary joint systems arises from the fact that they afford only partial flexibility. As has been previously mentioned, augmentation of the cables becomes essential at a relatively low degree of utilisation of the pairs. Frequent re-arrangements are necessary, despite the large spare-wire margin. In addition, in those cases where the ratio of cessations to gross new lines is high—in London, pre-war, this ratio was 2 : 3—an increasing proportion of spare pairs appear as through-connected pairs, and are thus not available in auxiliary joints. Furthermore, relief arrangements in such systems necessitate the wholesale re-distribution of pairs, generally involving large multiple, plumbed joints; such arrangements are costly to design and carry out.

MODERN DESIGN AND PRACTICE

Main, Branch and Distribution Cables.—It has already been explained, that the modern local line networks of the United Kingdom Post Office are based upon the full flexibility of cabinet and pillar systems. At a conference held in the London Region in 1943, full flexibility (based upon the use of plant embodying the cross-connection principle as distinct from teeing, which was rejected as a sole method of flexibility) was recommended. On the same occasion, a prototype cabinet with terminals and cable tails was demonstrated, and designs for various flexibility units of more than 4,000 pairs were exhibited.

All modern local line cable networks, considered from the design and construction points of view, are virtually sub-divided into three cable sections, as a result of the interposition of the special flexibility plant (see figure 4). Thus, main cables extend from exchange main distribution frames to cabinets, branch cables from cabinets to pillars and distribution cables from pillars to subscribers' distribution points. Each

Fig. 4. This schematic lay-out shews the three sub-divisions of the cable network



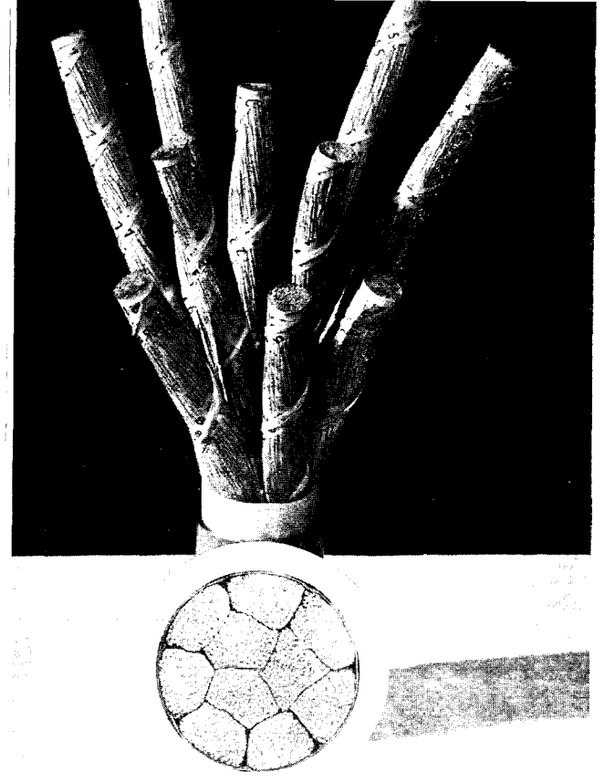
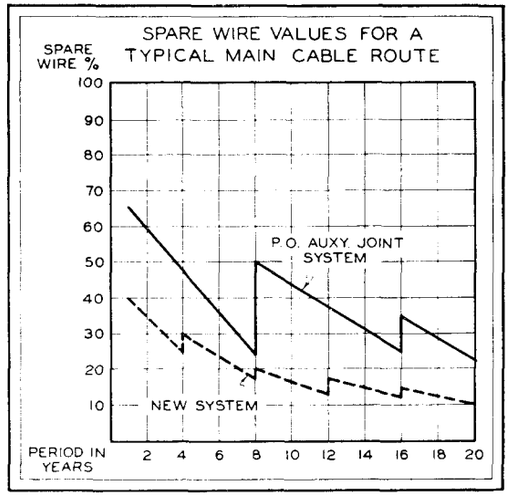


Fig. 5. Unit-type cable, with cross-section, as used by the United Kingdom Post Office

cable category is terminated independently of the others at both ends and is thus physically segregated. Although there is interdependence respecting the number of pairs, augmentation of one section can be carried out without any interference with the other sections. There is full flexibility of inter-connection between the pairs of successive cable categories. Unit-type cable, in which the core is bunched into separately identified groups of pairs in place of the conventional layer arrangement, is particularly advantageous for large-size cabinet work and is used, whenever suitable, in up-to-date lay-outs. Figure 5 shows the make-up and a cross-section of this type of cable. The practical advantage of this sectionalisation of the network lies in the ease of the constructional and maintenance work operations, in the freedom from complication of the records of pairs in each cable section as well as their reliability and ease of check, and in the essential elimination of the causes of lost pairs. It needs emphasising that such a general simplification of the engineering features of modern schemes results inevitably in an appreciable lowering of costs throughout the whole life of the plant.

The provision of plant within each cable category is based upon studies for the determination of the most economic series of instalments requisite to meet anticipated growth. In this way, the full advantage of deferred provision in each sub-division of the network is secured. At the same time there is a considerably increased utilisation of plant, free from cabling and splicing re-arrangements. Added to increased utilisation, are the savings due to the reduced spare-wire burden, (see figure 6), and other lesser savings in respect of the reduced number of main frame verticals, fittings and wiring and, to some extent, exchange space. Moreover, the re-arrangement work is basically of minor character in cable networks provided with cabinets and pillars, as it consists merely of the unbolting and bolting of the containing cases, and changing-over of wires at the screw terminals of the assemblies. Main cables into exchanges serve many subscribers, are of large size, and the rate of take-up of their pairs is usually considerable. In comparison with cables of other category, main cables are provided in instalments at more frequent intervals. The provision periods for main, branch and

Fig. 6. The interval between the curves shews the extent to which the spare-wire burden is shed as a result of modern design methods



distribution cables are of the order of 5, 10 and 20 years respectively.

Short-Term Cable Provision. — Further advantages of the short-term provision of main cables in modern systems, are that the incidence of certain of the ultimate annual charges is thereby deferred. The present value of such charges is accordingly small and savings are, in this manner, effected. Full flexibility, by reducing the cost of re-arrangements to a minimum, permits the whole of the financial benefits of short-term provision to be realised. In addition to the savings accruing directly from planned deferment, short-term provision also permits of savings when the forecast proves faulty. Thus, if the forecast is too generous, over-provision can be avoided; if too low, under-provision is obviated.

The aggregated savings for an exchange area due to short-term provision amount to a considerable sum and are an extremely important feature of modern line plant economics.

The Use of Cabinets and Pillars of Full Size. Full-sized cabinets and pillars are installed in local networks when they can be justified on economic grounds. The financial savings arising from the possible shorter-term cable provision, with increased cable pair utilisation, must at least cover the cost of the flexibility plant. Where the initial short-term instalment of main cable is small compared with the total number of pairs in the branch cables to which it is jointed, full flexibility must be provided to achieve maximum use and overall availability of the pairs. Almost invariably the fitting of a cabinet, large enough to give such full flexibility, is the most economical course. Some slight savings may be effected in suitable cases by the deferment of the full complement of assemblies.

Flexibility by Teeing Between Cabinets.—The full flexibility, so far referred to, relates to flexibility within units consisting of the pairs serving individual cabinets and or pillars. Flexibility between cabinet areas, and also between pillar areas, can be afforded by means of multiple-teeing, and this enables an even greater degree of utilisation of cable pairs to be attained. Much time has been given to the study of this development of flexibility methods. The practical field results will be closely watched,

Fig. 7. Flexibility pillar in use in the United Kingdom Post Office system

especially from the viewpoint of possible accompanying disadvantages. It may be noted that the achievement of flexibility, solely by means of multiple-teeing (that is, without the use of associated cabinets), is attended by certain disadvantages, such as (i) increased cost of the plant by reason of the more complicated lay-out, involving large cables and more difficult jointing; and (ii) transmission difficulties, possibly involving a larger gauge of conductor.

Use of Light-Weight Conductors.—The behaviour of a telephone connection in respect of the transmission and reproduction of speech has, since 1946, been assessed in the United Kingdom Post Office on a Transmission Performance basis, in replacement of the previously-employed Volume Efficiency basis. The new basis involves an appreciation of intelligibility as well as loudness and, in contrast with the older basis, leads to a more realistic measure of the effectiveness of a connection.

The limiting resistance-values for light-weight circuits are greater than heretofore, because of the improved side-tone characteristics of modern telephones. They are also greater than for heavy-weight circuits, because side-tone is adversely affected by the electric capacity of the line. The maximum permissible lengths of small-gauge cable will, of course, always be shorter than those of larger gauge.

There is a limit to the size of light-weight conductor cable—about 200 pairs—below which little or no financial advantage is obtainable. An extensive field of worth-while use of light-weight conductor cables exists in the larger towns, in which telephone density is high in the neighbourhood of the exchange. The use in appropriate cases of very large size 4-lb. conductor cables, say up to 2,000 pairs, with extruded insulation, will enable considerable savings to be realised on account of long or indefinite deferment of duct provision. In such cases the network cabinets can also be used to control the extension of the light-weight conductors. Cable and track costs have been greatly reduced in a recent scheme where 4-lb. cable has been extensively employed. Arrangements are in hand for future Post Office cable allotments to contain a proportion of the 4-lb. type.

CONCLUSION

The keystone of the modern technique of local line provision as applied by the United Kingdom Post Office is *full flexibility*, achieved by means of cabinets and pillars specially designed to free the system from heavy re-arrangement and maintenance charges. The various economic considerations which, in practice, can be assessed in monetary terms and advanced in justification of the system have been explained in the course of this article. In conclusion, however, those other advantages of the system, which cannot at present be expressed in specific monetary values for the purpose of computing their off-set of the normal annual charges, ought perhaps to be stressed, for example:—

(i) the considerable engineering simplification which results from the improved lay-out of the plant in the field, particularly the virtual segregation of the cable elements of the network. Records are much less complicated, lost pairs eliminated, there are better facilities for the more direct routing of miscellaneous circuits, improved facilities for fault location and testing, and cabinets can be employed to function additionally for the controlled extension of light-weight cable circuits;

(ii) the longer life of the plant due to the greatly reduced re-arrangements;

(iii) the shortening of the time required to design, provide and record relief measures. This is an important and far-reaching feature;

(iv) the reduced main frame requirements and exchange accomodation.

The financial effect of such features will vary in different cases. Nevertheless, although these advantages are not, in the light of the data at present available, capable of exact assessment, they do represent very real savings. In time, when experience of the new technique has been obtained and cost data compiled, the additional information will doubtless enable the whole of the improvements in the service and cost aspects of the local line system to be precisely stated.

TELECOMMUNICATIONS FROM THE FINANCIAL POINT OF VIEW *(continued from page 58)*

however, looming largely before all managements is the question of what provision, if any, should be made in advance for the future cost of renewing plant which has been provided at substantially lower price levels than will obtain in the future. On this problem, the accounting world has not yet come to any agreed opinion. So far as the Post Office is concerned, it is making provision in the Depreciation Account for current excess costs of renewal, and a small advance contribution to future costs.

Need for Team-working at All Levels

This picture of the financial problems, which the Administration has inherited from the last two decades, and of the still more difficult problems with which it is confronted so far as concerns the future, has already indicated that every functional unit of the telecommunications services is involved, and that co-ordination of their various activities (engineering, supplies, sales and finance) is essential if administrative policy is to be soundly based. Such co-ordination requires the existence of a team spirit and, for working purposes, some machinery through which this co-ordination can be effected.

Gainsborough —A Break With Tradition

by A. Scarborough, Lincoln Telephone Area

★ ★ ★

"Great oaks from little acorns grow"—and the germ of an idea develops into a new switchboard with new colour schemes.

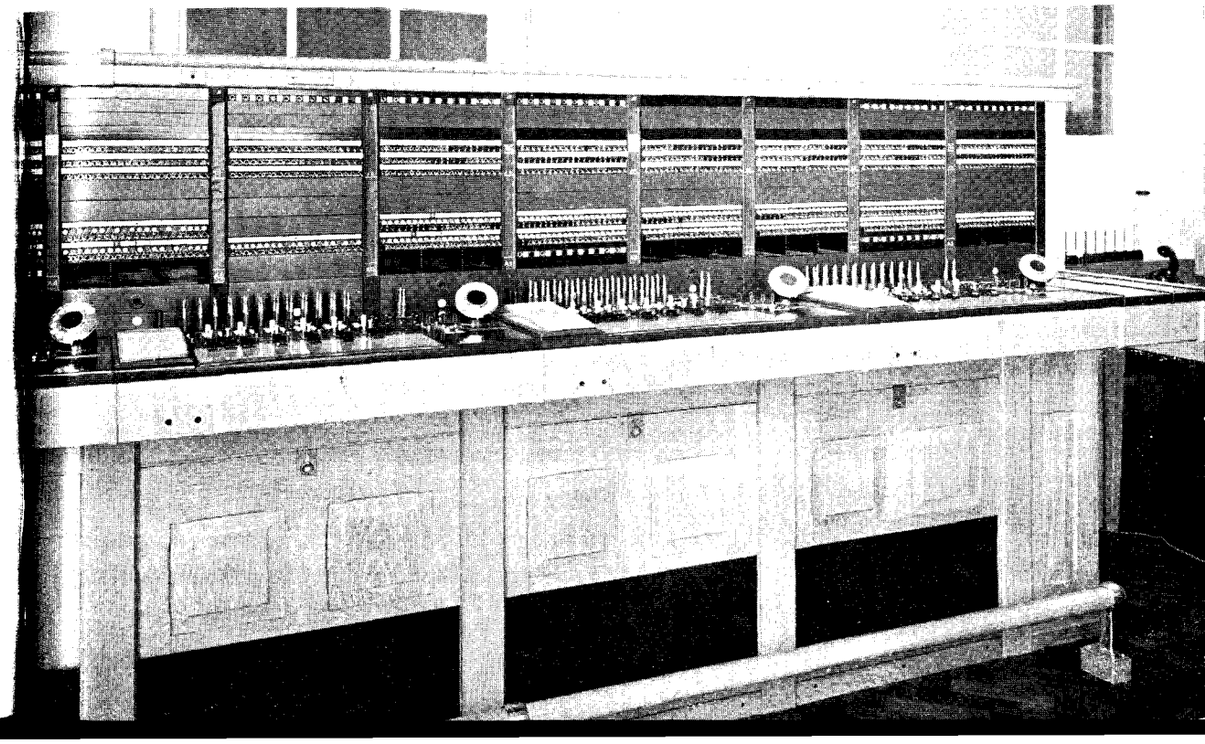
★ ★ ★

SWITCHBOARDS IN LIMED OAK—A complete break with tradition—have been installed at Gainsborough. The new exchange was opened for service by Captain the Rt. Hon. H. F. C. Crookshank, P.C., M.P., on November 24, 1949.

When Postmaster General, Captain Crookshank made some comments on the appearance of Post Office switchrooms. Since that date, a considerable amount of research on this subject has been undertaken. The Gainsborough auto-manual exchange is one of the first fruits of this research. Limed oak has enjoyed something of a vogue in domestic furniture in the last decade or so. The finish is produced by treating the prepared wood with a paste compounded of clear beeswax, whitening and turpentine (or white spirit). The surplus is cleaned off and a clear cellulose lacquer then applied. The general effect is cheerful and attractive. Polishing is unnecessary. The only maintenance recommended is frequent dusting with a soft cloth and occasional cleaning with white spirit.

As soon as it was decided to employ oak, it was

A close view of the new switchboard



Part of the new switchroom at Gainsborough

realised that red fibre for the key shelf might not be appropriate. Indeed, apart altogether from these aesthetic considerations, it is probably undesirable to use red as a dominant colour in offices or workrooms for anything but fire appliances. In this connection a modern trade journal has this to say on experiment with colour: "Scientific tests have shown that the painting of a machine in successive colours can vary the operator's speed over a considerable range: a time study . . . showed that for a typical operation, all other factors being constant, the time taken varied between 3.5 and 6.0 seconds. . . ."

Soft greens for backgrounds with buff for working parts, are now frequently advocated. Green was accordingly chosen for the key shelf and there is no doubt that, had suitable dyes been available, a pale shade (such as eau-de-nil) would have been selected. However, the manufacturers were hampered by restrictions then in force (1946), and the colour finally accepted was similar to that used for standard steel furniture. Provided it does not darken in use, the green colour adopted should be quite satisfactory.

Other smaller "matching" problems remained to be solved. The colour scheme finally adopted for furniture and equipment was as follows. The switchboard woodwork, the supervisor's desk, tables, sorting trays, key case, ticket boxes, duty chart frames, book rack, headset rack, hat stand, directory trolley, clock cases and doors were produced in limed oak. The items in green were key shelves, plug covers, spacing strips, marker stands, visible index file frames (frames, notice No. 25A), and stile-strip labels. Standard items which have been utilised without modification were the steel press, operators' chairs and the steel chairs for supervisors and clerical staff. The fire appliances had, of course, to remain red but they are arranged in groups, and these splashes of warm colour harmonise quite well and actually accentuate the general effect.

The floor presented something of a problem. This had been laid in 1939 when the building was erected and the blocks were of jarrah wood, which is dull red in colour. It was at first suggested that it should be covered with green ruberoid; but there was a technical objection to this and consequently the normal finish has been retained. The walls were originally cream; the ceiling white. It was felt that the effect of this was too cold and, in any case, the colour scheme, bearing in mind the warm tones of the floor, could scarcely be said to be properly integrated. The solution was to repaint the walls and overhead beams in "french beige" and the ceiling panels in pale buff. The walls have a matt finish but relief is given by gloss cream on the radiators and window frames.

The broad idea of the new switchroom is, of course, to achieve a brighter and more cheerful atmosphere, coupled with a modern style of furnishing. This has meant that many standard items had to be discarded. Not only were their colours and materials found unsuitable, but even the shape of some items appeared incongruous. A good example was the bracket electric light fittings originally supplied for illuminating the backs of the switchboards. They have been replaced by modern fittings which are flush with the wall.

Gainsborough exchange is a very convenient size for an experiment of this nature. Some details as to its capacity may not be out of place. The automatic plant has an initial multiple of 1,000 and a straightforward four-digit numbering scheme. There is nothing abnormal about the apparatus room. The automanual suite is of ten 4 ft. 8½ in. positions including the enquiry position *en suite*. There are 650 exchange lines (some 1,220 stations) on

Gainsborough itself and 850 exchange lines on the ten dependent Unit Automatic Exchanges, which are all of the interdialling type. There are no dependent manual exchanges. The exchange replaced a Central Battery Signalling 2 installation (two suites of six and three positions respectively in separate rooms) which was originally scheduled for replacement in 1939. Latterly, it was badly overloaded and had become expensive to staff and maintain.

Naturally the Staff Associations, namely the Controlling Officers' Association, Union of Post Office Workers, Post Office Engineering Union and the National Guild of Telephonists, had an interest in the scheme and were consulted in the early stages. On completion of the installation, a "pre-view" was arranged for them before the actual opening. Comments on the new switchroom by these observers were generally favourable, and criticisms were confined almost exclusively to that part of the equipment which has necessarily had to remain standard, for example, jacks and labelling. It is, of course, impossible to provide an entirely new labelling scheme, otherwise the standard operating instructions would be vitiated, but simple changes have been made. Examples of this are the stile-strip labels, which have been produced in green by a photographic process, and the bulletin notices which are cards in a pastel shade of green. Experiments are also being made with tinted labels for the outgoing junction multiple. A further experiment is being made with anti-glare screens. As the windows are large and those behind the switchboards face south-west, it has been necessary to consider the glare problem. A batch of screens in dark green perspex has been produced and, if these prove successful, the whole suite will probably be equipped with them.

The eighty guests, invited to witness the opening ceremony, inspected both the new and the old exchanges and, without exception, expressed their preference for the new lay-out. This clean, light and refreshing departure from the old concepts has certainly justified the careful thought and planning which everyone connected with the scheme has given to it. It is probable that when the effects of the new colour schemes, both for the equipment and its setting, can be assessed they may have a considerable influence on the exterior design of switchboards in exchanges equipped with the cordless-type switchboard. No one can yet say for certain how the new items will stand up to everyday use; but any scheme which tends to brighten the appearance of switchrooms seems bound to have good results. The Gainsborough experiment, therefore, cannot fail to have an important bearing on the trend of exchange design and telephone practice.

The General Electric Company installed the equipment and their workshops were also responsible for the woodwork of both the main suite and the supervisor's desk.

Other similar experiments are in hand. Cardiff is to have beech for its woodwork, Vigilant (London) is being constructed in natural oak, while "bleached" mahogany has been chosen for Wembley.

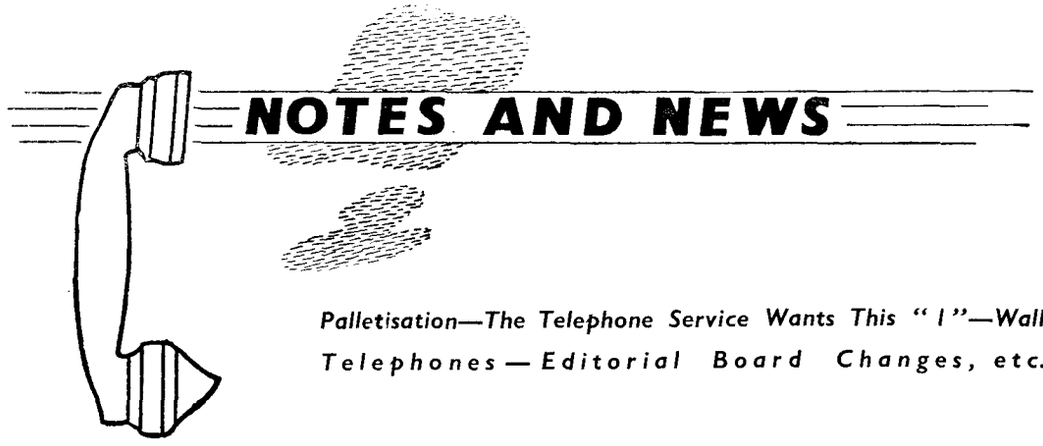
INCIDENT

(continued from page 70)

belongings in the fire. Each, when interviewed for compensation claims, announced that he had lost as least one gold watch and chain, two dozen best silk pyjamas and two dozen best black silk trousers. No claim was for less than $600, and many went to the thousand mark . . . All, except four, left on the following relief ship for Colombo, claiming that their intention was to return home by devious routes and then kill plenty of Japanese.

Thus ended the Cocos incident. History has a peculiar habit of repeating itself for, in many ways, the raid of the *Emden* in 1914 and that of the unknown Japanese ship twenty-eight years later, had much in common. The unfortunate part of the second raid was that there was no H.M.A.S. *Sydney* at hand to give the same treatment as was dealt out to the *Emden*.

But no praise can be too high for the cablemen who had the unenviable job of closing the office under heavy shellfire, a job they carried out in the finest traditions of the cable service.



NOTES AND NEWS

Palletisation—The Telephone Service Wants This "1"—Wall Telephones—Editorial Board Changes, etc.

Palletisation.—Our attention has been drawn by Mr. W. A. Smith, author of "Materials Handling and Palletisation" in the August issue of the Journal, to the erroneous impression given by the illustrations on pages 17 and 20 accompanying the article "Not a Penny Wasted" in the November, 1949 issue. He states that these photographs would indicate methods of handling which have since been superseded by the modern devices and procedures described in his article. The photographs used were, unfortunately, taken some time ago before the introduction of the new devices described by Mr. Smith, and we are glad to make this clear to our readers.

★ ★ ★

Shared Service.—A film strip on the subject of shared service has been prepared for exhibition to Post Office staff. It is accompanied by notes for lecturers. The aim is to give those working on a particular aspect of shared service, such as operating or accounting, a broad picture of all aspects of this type of telephone service.

The small difference between shared and exclusive service is not always appreciated. Having seen the film strip, however, Post Office staff should be in a position to answer correctly any questions about what shared service is, and how it helps the Post Office to meet the present demand for telephone service.

★ ★ ★

Forest Fires.—Both the Forestry Commission and the Post Office are fully agreed upon the necessity for telephones at forest wardens' lodges and lookout points, so that assistance may speedily be summoned to combat forest fires and thus prevent loss of valuable timber. Lines to such places often involve very long overhead routes, and are expensive both in labour and materials. In order to assist the Post Office, the Forestry Commission has agreed to provide some of the labour for erecting the poles.

★ ★ ★

The Telephone Service Wants This "1".—In the early stages of development of the automatic telephone system, experiments showed that there could be distinct danger of calls being misrouted to wrong numbers by an inadvertent double movement of a switch-arm when a receiver is lifted at the commencement of a call, because the electrical impulse which this action sends to the exchange is the same as that given by dialling the figure "1". It was foreseen that subscribers whose numbers commenced with the digit "1" might frequently be called in error; for instance, the number 1346 might be called in error for numbers commencing 346. (In London and other towns, where dialled telephone numbers have to be prefixed by letters of the exchange name, the difficulty would occur if an exchange had an initial letter corresponding with the figure "1" on the dial.) To prevent this trouble, it was decided that no telephone number (or exchange name where this has to be dialled) should commence with the operation of the first hole on the dial and that, should the initial impulse received at an exchange correspond to the digit "1", the equipment should ignore it. (It is for this reason that on the lettered dial used in the largest towns, the letters A B C on the dial are associated with the figure "2" instead of "1".) It will be appreciated that this rule reduced the available telephone numbers by at least one-tenth, and this has, at times, become a considerable handicap on a growing exchange.

The question has now been raised whether the modern design of the subscriber's telephone instrument has reduced the liability of false impulses from this cause to such a point that the number of wrong connections could be tolerated, provided, for instance, that all such misrouted calls went to "Service" points.

Observations to determine the extent of the present trouble are now proceeding.

★ ★ ★

"Efficient and Pleasant Service".—Four Kent doctors have written a very warm letter of appreciation to the General Post Office on the work of their local telephone exchange. In the course of the letter they say:—"It is necessary for us to transfer calls on many occasions and to make many enquiries, and at all times we receive most efficient and pleasant service. In these times, when courtesy is at a premium, we feel that we would like you to convey to the supervisors our sincere thanks for their help which so greatly assists the smooth running of our practice".

A letter of thanks has been sent to the doctors for their kind appreciation.

★ ★ ★

Recruitment of Telephonists.—Representatives of the Copenhagen Telephone Company, on a visit to this country, were interested to see how the United Kingdom Post Office selects and trains telephonists. They saw candidates being interviewed and visited Telephone Training Centres in London.

★ ★ ★

Wall Telephones.—There is a fairly constant demand for the installation of wall telephones; telephone instruments which can be attached to a wall and do not require a table or bracket on which to stand. Such telephones are the natural type for stores, warehouses, narrow passages, or the halls in houses where space is limited.

The Post Office is not satisfied with the present design of wall instrument and is considering the introduction of an improved pattern in keeping with modern artistic developments. Industrial design experts have now been asked to put forward proposals for a new design of instrument which will be both technically suitable and of artistic merit.

Meantime, a modified design has been produced to meet the urgent need for a wall telephone which can be used on shared service lines. This design provides for the press-button facilities which are required with shared service on certain types of automatic exchanges.

★ ★ ★

Malin Head and Valentia Radio Stations.—On January 1, 1950, the Post Office short-range coastal radio stations at Malin Head and Valentia, which provide wireless services with ships at sea, were transferred to the control of the Administration of the Irish Republic. Since the formation of the Irish Free State Government, these two stations had been operated by the Irish Post Office on behalf of the United Kingdom Post Office on an agency basis.

★ ★ ★

Telephone Kiosks.—During the nine months ended September 30, 1949, the Post Office installed 2,087 new kiosks and replaced 552 obsolete ones. Of the new kiosks, 795 were placed in rural areas. This latter figure includes the first kiosks provided under the scheme, referred to in the August issue of the Journal, which provides for a certain number of kiosks to be earmarked annually for rural areas, and for allocation to be arranged, so far as England and Wales are concerned, in co-operation with the Rural District Councils' Association.

★ ★ ★

Editorial Board Changes.—We welcome to the membership of the Editorial Board Col. A. H. Read, O.B.E., T.D., D.L., who has succeeded Mr. H. Townshend, C.B., as Director of Overseas Telecommunications, and Mr. A. F. James, who has succeeded Mr. C. J. Miles, C.B.E., as Assistant Secretary in the Training and Welfare Branch, Personnel Department.

Mr. E. A. Bracken has succeeded Mr. F. Richardson as Regional Representative, Welsh and Border Counties Region.

Our readers will join with us in good wishes to Mr. Townshend for success in his new post as Assistant Secretary General of the International Telecommunication Union in Geneva.

Letters to the Editor

Delayed Traffic Problems

From S. D. Mellor, B.Eng., A.M.I.E.E., Area Engineer, Newcastle-on-Tyne Telephone Area.

A study of Mr. Longley's article on "Delayed Traffic Problems" in the February issue of "The Post Office Telecommunications Journal" reveals two apparent errors which invalidate the author's results in so far as they differ from the widely accepted formulæ of Erlang, Crommelin and Pollaczek.

Variable holding times.—When the holding times are distributed exponentially the author agrees with Erlang with regard to the proportion of calls delayed, but obtains only half the value of the Erlang expression for the average delay on delayed calls. The error appears to arise in the use of the variable b_s. In the second and third of the three basic sets of equations on pages 38 and 39, b_s is used to represent that proportion of the total number of intervals between successive cessations in which exactly s calls arrive, i.e., it has a purely numerical significance and is not affected by the duration of the intervals. In the first set of equations, however, it is clear that both the number and the duration of the intervals are involved. If a consistent meaning is to be attached to b_s, these equations should be re-written as follows:

$$p_{s=0} = \frac{a_0 x}{h}(b_0 t_0 + \tfrac{1}{2} b_1 t_1 + \tfrac{1}{3} b_2 t_2 + \tfrac{1}{4} b_3 t_3 + \ldots\ldots)$$

$$p_{s=1} = \frac{a_0 x}{h}(\tfrac{1}{2} b_1 t_1 + \tfrac{1}{3} b_2 t_2 + \tfrac{1}{4} b_3 t_3 + \ldots\ldots\ldots)$$

$$+ \frac{a_1 x}{h}(b_0 t_0 + \tfrac{1}{2} b_1 t_1 + \tfrac{1}{3} b_2 t_2 + \ldots\ldots\ldots)$$

etc.

where t_s represents the average duration of those intervals between cessations in which exactly s calls arrive.

$$\sum_{n}^{\infty} b_s t_s = \frac{h}{x}$$

If the holding times are variable it is evident that the intervals between successive cessations will also vary. The longer intervals will tend to contain more arrivals than shorter intervals and vice versa. For exponentially distributed holding times it can readily be shown that:

$$t_s = \frac{h\,(s+1)}{A+x}$$

and

$$b_s = \frac{x}{A+x}\left(\frac{A}{A+x}\right)^s$$

Substitution of these values results in the normal Erlang relation:

$$p_{s=1} = \left(\frac{A}{x}\right)^s p_0$$

and the average delay on delayed calls $= \dfrac{h}{x-A}$

Constant holding times—Even if the call holding times are constant the intervals between consecutive cessations may vary (except for the single channel case). The variation will be within the range o to h, with an average of $\frac{h}{x}$.

The correction to the basic equations necessary for the variable holding time case (i.e., inclusion of the factor t_s) is therefore equally necessary when the holding times are constant. In this case however, the derivation of expressions for t_s and b_s presents considerable difficulties. In the special case of $x = 1$, t_s is fixed ($= h$), and the result achieved by the author for the average delay is correct.

In deriving the equations for the proportion of calls delayed the author states "No assumption is necessary about the incidence of cessations, and the solution applies whether holding times are constant or variable". This simplification of the problem is unfortunately not permissible; it is an implied assumption in deriving the basic equations of Fig. 1 that the rate at which cessations occur when n channels are occupied is independent of the proportion of time for which this condition exists. This in turn implies random incidence of cessations and whilst this can be shown to be correct if holding times are distributed exponentially, it cannot be demonstrated for the constant holding time case. The correct basic equations are those derived by Fry, and used by Crommelin.

There is little doubt that if a solution to the constant holding time problem could be reached along the lines adopted by Mr. Longley (subject to the corrections indicated) the results would be the same as those obtained by Crommelin and Pollaczek. Such a solution would be of considerable theoretical interest in view of the mathematical difficulties of existing methods of solution.

Mr. H. A. Longley writes: I appreciate the opportunity, afforded me by the Editor, to examine Mr. Mellor's communication before publication, and I am happy to accept it as a most interesting correction of my treatment of the problem.

Mechanisation or Service?

From Lt.-Col. W. A. Stripp, Traffic Superintendent, Brighton Telephone Area.

In Mr. Bradburn's article "Mechanisation or Service", he refers to our failure to provide sites and buildings of adequate size. A prime cause of this failure is that our development forecasts are too low. We are planning our new exchanges, repeater stations and so on, on development forecasts obtained by much the same means as those of pre-war days.

A comparison of the figures of "Telephones per 100 population" for towns in Great Britain shown in the November Journal, with those for other countries quoted in the May issue, shows that we lag behind badly in many comparable instances, and in many cases, this ratio, even when based on post-war surveys when they are available, shows that our long-term forecasts do not even produce the telephone density that has already been reached elsewhere. Surely we will not always lag behind.

Added to this is the probability that the high rate of present-day technical development will enable telephone service to be given at a lower cost, and the fact that we are living in an age of steadily-increasing standards of amenities.

I suggest, therefore, that some of our ideas on development should be revised, and that our long-term development forecasts need to be pitched at an appreciably higher figure than our present methods will normally produce.

From S. C. Tedder, Male Telephonist, Bishops Stortford.

Will you please accept the thanks of an ordinary male telephonist for the fine articles written by the experts in the field of telephony. Although some of the subject matter is "over my head", I do feel that these very informative articles are widening the mental horizon of our job.

The article by Mr. Bradburn was of particular interest to me. Indeed, much of what he has so lucidly described has, I feel, made my work more efficient, and consequently more satisfying both to the subscriber and the operator.

Further to his fears of an over-complicated system of tandem dialling through exchanges by code followed by a 3, 4 or even 5-digit number, the following possible experience may arise. (Whilst it is true that these calls are at present infrequent, on the strength of Mr. Bradburn's revelations, we must expect many more to come into operation.)

A minor exchange has asked for, let us say, TL A 21367246711. I have dialled this file of digits—result—*nothing*. Holding the junction I have dialled it again—*still nothing*. In the interim, a Xmas tree array of lights has appeared on the incoming position. To the accompaniment of teeth-sucking and tut-tuts, I have, in desperation, dialled TL A 2130 and left it at that. The net result is a waste of time, speed of incoming answer gone to pot and everybody very unhappy.

What will be an irate subscriber's reactions when he is empowered to dial these exchanges and numbers for himself? If we *must* have crocodile-length codes, can the automatic apparatus be tuned to concert pitch with the utmost care, so that selectors and switches gladly give the operators (or subscribers) that which is asked of them.

In conclusion, my deepest thanks for the magnificent publication, so finely produced.

From E. Henry, Head Postmaster, Cardiff.

I have read the article "Mechanisation or Service?" with considerable interest. I am, of course, not qualified to enter into a technical argument, but my own feeling is that the mechanisation can be overdone. In addition to the question of subscribers' reactions, it seems to me that one unknown factor in the problem is the ultimate number of telephone subscribers. This, in turn, is obviously dependent on the national standard of living. Who can say, for example, how the country will stand economically in five years time?

If John Citizen is on the rocks he will not be able to afford a telephone. On the other hand, if there is a long run of prosperity, telephones may eventually become as commonplace as radio receivers. I am very happy not to be one of those who have to forecast how the pendulum will swing.

"Progress" is a very strange thing. I well remember two experts discussing development some time ago. One ventured the opinion that if there had never been such a thing as magneto ringing and it was now invented, the inventor would be hailed as a genius.

From S. J. Giffen, Assistant Telecommunications Controller, Northern Ireland Region.

I read with much interest Mr. Bradburn's article on "Mechanisation or Service" in the

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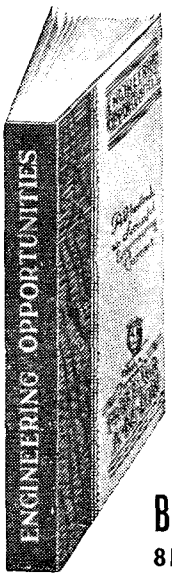

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