

EARLY TELEPHONE WORKING IN THE NORTH EAST OF ENGLAND

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1. Introduction

The telephone was invented by A.G.Bell in 1876 and was quickly put into commercial service, both by Bell's Company and by his competitors, chief among whom was Thomas Edison. Commercial telephony using a system of exchanges with subscribers, and also private lines, started in Britain in 1878. Although the service was first offered in London, many provincial towns were quick to try the new system of communication, having exchanges by 1879. The North-East of England was a little slower in this regard, not having a telephone exchange until 1880, when one was opened in Sunderland. However, as this region developed telephony it showed features of great interest which give it a certain importance in telephone history. Some of these special features were :-

(a) From early in 1882, competing telephone services, with their own exchanges, were operated by the Post Office and by the Northern District Telephone Co. in Newcastle-upon-Tyne, and before long in other places in the North-East.

(b) The Post Office telephone exchange was a natural development of a telegraph exchange which had operated in Newcastle since 1864.

(c) Underground cables were extensively used by both the Company and the Post Office; the latter carried out some interesting experiments in telephone transmission on cables in 1882 at Newcastle and Sunderland.

(d) The North-East was regarded as the home of the metallic-loop telephone circuit, whereas in most of the rest of Britain the practice was to use single-wire circuits with earth return.

The operation of a telephone service by the Post Office in competition with a company was not unique to the North-East - it occurred also in South Wales, and one or two other places - but the Post Office operated telephones on only a very small scale until it took over the whole commercial telephone service in 1912. Its operations in the North East were the best-known of its telephone activities.

2. Post Office telephones in the North-East

2.1 Origins (1)

The Post Office telephone system in the North-East had its origins in the system of telegraphy known as the ABC system. This was a direct-reading alphabetic system in which the letter being transmitted was displayed at the receiving instrument by a pointer, stepped round by the appropriate number of pulses, which stopped opposite that letter on a dial. It was a system which could be used by anyone, with no particular training or skill requirement, and thus could be used much as a telephone is now. The Universal Private Telegraph Co. was formed in 1861 to manufacture and supply this system, and in 1864 it set up an exchange in Newcastle to provide intercommunication among the users. In 1870 the telegraph system in Britain was nationalised and transferred to the Post Office, which thus acquired the Newcastle telegraph exchange, which then had eight subscribers, together with a number of private lines passing

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through it. In 1878 a new switchboard for 60 subscribers was fitted; it used the system of two sets of brass bars at right angles; the insertion of plugs at suitable crossing points could provide any required interconnections. Monitoring indicators and instruments were provided for each line which gave calling signals and enabled the end of a communication to be observed.

When the telephone came into use, it was natural to treat it in the same way as the ABC instrument, and to provide exchange service by the same type of switchboard. The Post Office provided its first telephone switchboard at Newcastle in May 1882, with 32 subscribers; the number had grown to over 300 a year or so later. To avoid crosstalk interference on the lines, between the strong telegraph currents and the telephone circuits, the latter were run on the metallic-loop principle, with two wires which had a twist to balance out interference. The switchboard design had to be modified to take account of this, and spring contacts were used; the connecting cord was twin, with a split plug which was compelled to be inserted the correct way up by means of a special spigot and slot arrangement. Monitoring indicators were provided on each line in what was called the A wire of the pair; these provided calling and clearing signals and also indicated whether the subscriber was in his office or out. To keep overall connections balanced in order to minimise interference, the connecting cords crossed the A and B wires so that there was one indicator in each. Combined telephone and telegraph subscribers were accepted; separation of telephone and telegraph traffic between the appropriate switchboards was simple, as the latter used only one of the wires while the telephone used both. How long this system remained in use is not known, but it was probably only a year or two.

2.2 Development

Later on, the Post Office opened telephone exchanges at other places in the North-East; apparently by 1885 there were P.O. exchanges at Sunderland, South Shields, North Shields, Tyne Dock, Hartlepool, Stockton and Middlesborough in addition to that at Newcastle.⁽²⁾ The standard P.O. exchange system developed in the area from about 1889 was unusual in depending on a permanent current in each subscriber's circuit, whether it was in use or not. It had the advantage that faults became immediately apparent. The exchange had for each line an indicator which had both polarised and non-polarised responses. The polarised needle was hung vertically, but was deflected to the right when the line was not in use. To call the exchange, the subscriber lifted the left-hand receiver of his Gower-Bell telephone; this interrupted the current, and the non-polarised relay de-energised and rang the exchange bell, while the polarised needle fell to the vertical position. When the operator answered, the subscriber lifted the other receiver and so closed the local microphone circuit, also restoring the line current but with reversed polarity. The polarised needle thus deflected to the left and so indicated "line engaged". When the subscriber finished, the original polarity was restored.

2.3 Underground cable

The Post Office was a pioneer in the use of cables for telephony. The principles of telephone transmission were not understood in the early 1880's, and results were not very good. The cables were made up of four copper wires of 21½ gauge, each covered with gutta percha, and the four twisted together. Each metallic-loop circuit used a diagonal pair. Groups of four were probably bound together to make a larger cable.

It should be noted in passing that the first lead-covered cable was made in Philadelphia in 1884 with cotton dielectric, and that efforts to reduce the electrostatic capacitance did not result in the paper-insulated cable until about 1889.⁽³⁾ There was no way of measuring the transmission efficiency of

a cable in the 1880's, and W.H.Preece, then Electrician to the Post Office (later Engineer-in-Chief and Sir William), arranged for some experiments to be carried out on the cables already laid in the North-East. These are described below.

2.4 Telephony over underground cable :- Post Office experiments at Newcastle and Sunderland, 1882

A series of experiments was made by Mr.A.Pearson, with help and guidance from Mr.A.W.Heaviside, the Post Office engineer in the Northern District and brother to the great Oliver Heaviside, in June 1882. The object was to examine speech transmission over underground cable, and adequate length of route was obtained by looping the circuit to and fro using several pairs of wires in the same short cable. Such tests were done at both Newcastle and Sunderland, but those at the latter place were the most comprehensive. Pearson's report (4) is a very careful one; he examined the implications of all the steps he took in the light of the knowledge and experience then available to him, and he took care, in the experiments, to eliminate all prejudice and bias on the part of observers. He tested various telephone instruments over various lengths of line (all metallic-loops; no single-wire working), and he tried varying line resistance and capacitance by "bunching" two wires together to make a conductor of lower resistance and higher capacitance. The most interesting conclusions were:-

(1) A modified Hunnings transmitter (granular-carbon type) gave much better results than any other of the several types tested. This was noteworthy in that in later days it was always found that the choice of instrument was unimportant.

(2) Even 2 miles of cable markedly worsened articulation; 4 miles was "so bad that although easy conversation might be carried on, it would be scarcely possible to receive any actual message or unknown words"; 8 miles was quite impossible.

(3) Results were worsened by bunching wires together, although, of course, simple d.c. signals were strengthened.

This last result is puzzling; it must have been due to worsened impedance matching, but one would hardly have expected the effect to be marked. At any rate, it did not seem to puzzle Preece; he concluded from it that :-

"Electrostatic capacity is the cause of the limit to the distance at which conversation by telephone is practicable. Hence fine wires and thick insulating compound are desirable."

— a curious conclusion that he abandoned when he developed his KR law a few years later.

Preece also made a curious conclusion regarding the distance over which speech was possible on a cable :-

"With our present apparatus conversation can be ensured up to 12 miles."

— somewhat at variance with Pearson's finding, (2) above.

2.5 Trunk lines

From 1882 up to 29 November 1884 the Government had prohibited the telephone companies from setting up their own inter-urban lines, or "trunk-lines" as they were then called. (The term "trunk" later became restricted to long-distance lines in distinction to the "junction" lines which connected exchanges in the same local area.) Any such lines that might be required were to be provided by the Post Office; very few were in fact constructed. The rental to be paid by companies having such lines provided for them was £10 per mile per annum.

Among the few trunk lines provided during this period was a trunk system in the North-East linking Newcastle, South Shields and Sunderland, and also Newcastle to North Shields. The Post Office certainly offered this service in 1883,⁽⁵⁾ although, as it is believed that it then still had no exchanges other than that at Newcastle, the terminals at the other places must have been either call offices, or exchanges belonging to the Northern District Telephone Co. (see below). The latter arrangement is unlikely, as it was not until May 1884 that it was announced that the company subscribers had been provided with trunk service.⁽⁶⁾ Post Office trunk lines were all constructed on the metallic-loop principle, and, of course, all trunk lines had to be of open-wire construction, and not of cable, in order to achieve adequate transmission efficiency.

3. Company telephones in the North-East

3.1 Origins⁽²⁾

Assuming that by the North-East of England we mean the region including Northumberland, Durham, and only the northern part of Yorkshire, then the first company telephone activity was the setting up of a telephone exchange at Sunderland by the United Telephone Co. in 1880. (There were earlier telephone exchanges in Yorkshire, in 1879, at Sheffield, Halifax, Bradford and Leeds, with a trunk line between Bradford and Halifax.)

The United Telephone Co., which had been formed in 1880 by the amalgamation of the Bell and Edison telephone interests in Britain, hived off its provincial business to a number of regional subsidiaries under the initial control of a temporary holding company, the Provincial Telephone Co. For the North East, the subsidiary was the Northern District Telephone Co., set up on 13 December 1881, with headquarters at Sunderland.

3.2 Development

Telephone companies could operate only under licence from the Post Office. In regard to the N.D.T.Co., the Post Office were particularly difficult over granting a licence, and in defiance of the P.O., the N.D.T.Co. opened its own exchange in Newcastle in February 1882, without a licence, and within three months had connected 120 subscribers, mainly in the Quayside district. It was, however, compelled to close down from July 1882 until May 1883. When its licence was finally agreed, it began to expand over the area. It set out to link up its several exchanges, and in May 1884 it announced the provision of trunk service between Sunderland and Newcastle for an annual subscription by its exchange subscribers of £6.10s., between Sunderland and South Shields for £6.0s., and between Newcastle and North Shields for £6.0s. The trunk lines were rented from the Post Office, and were presumably additional to those which the Post Office had earlier provided for its own subscribers.

The company also extended southwards to North Yorkshire and opened other exchanges, having 12 in operation by 1887, with a total of 441 subscribers and an average of 4250 calls per day.⁽⁷⁾ These numbers made it the smallest of the several companies originally set up by the Provincial Telephone Co. It had nevertheless made some effort to attract subscribers; a common publicity stunt was to relay theatre performances over its wires. One example was the celebration of the opening of its trunk line from Middlesborough to Hartlepool by the relaying of the Royal English Opera Company from the Theatre Royal at Middlesborough to its subscribers in Hartlepool.⁽⁸⁾

Technically the N.D.T.Co. was advanced, not only in adopting underground cables and metallic-loop circuits, like the Post Office, (with the one exception of its inherited exchange at Sunderland, which for a time remained a single-wire system) but also in converting its Sunderland exchange to operation with a subscribers "multiple" in 1886, being only the third such exchange in Britain.⁽⁹⁾ The "multiple" was a device whereby all subscribers on the exchange

had calling jacks repeated around the exchange, so that every subscriber was directly accessible to every operator, thus avoiding the time-wasting and expensive procedure of involving two operators in nearly every local call.

After the telephone companies became free to provide their own trunk lines from December 1884, the N.D.T.Co. extended its trunk system fairly rapidly.⁽¹⁰⁾ By September 1887 it was as shown in Fig.1.

Competition between the Company and the Post Office was not on a very just basis. Not only did the Company have to pay a royalty of 10% of its earnings to the Post Office in exchange for permission to operate - ie: it had to subsidise its rival - but the Post Office had the power to obstruct the Company in obtaining wayleaves. An instance of this was the refusal of the Post Office in 1886 to allow the Company to run its line from Sunderland to Hartlepool over the North Eastern Railway Co's system, even though the railway company was willing and the line was vital to the Telephone Company.⁽¹¹⁾

3.3 The fate of the Company

Towards the end of the first decade of telephony there was a very serious movement towards union among the various telephone companies. As their territories extended they came into contact at their boundaries, with occasional inter-company trunk lines, and there was obvious advantage in having technical and commercial unity. The Post Office objected, but nevertheless the three main companies - the United, the Lancashire and Cheshire, and the National - succeeded in amalgamating on 1 May 1889 into a single National Telephone Co. with 23,585 subscribers' lines. A year later, the Northern District Telephone Co. was absorbed, but it contributed only 1551 subscribers' lines, being still the smallest of the former Provincial Telephone Co's subsidiaries.

The whole of the telephone trunk line network in Britain was taken over by the Post Office in 1896 in order to enable uniform and high technical standards to be achieved and to ensure that an adequate country-wide network was provided;⁽¹²⁾ in spite of the fact that both the companies and the Post Office had been building trunk lines in competition in most parts of the country, Britain's trunk network was inadequate and compared unfavourably with those of other countries. The North-East had fared well enough in respect of trunk calls within its region, for the Post Office had provided a rival network between Newcastle and Middlesborough in 1889,⁽¹³⁾ and it had a connection to the rest of the country at least as early as 1891, when a line to the Midlands and London was opened.⁽¹⁴⁾ But after 1896 the telephone company operated only its local exchange network.

The whole telephone service of the country was taken over by the Post Office, except for a couple of municipal systems, on 1 January 1912, and thereafter the North-East had a single unified system.

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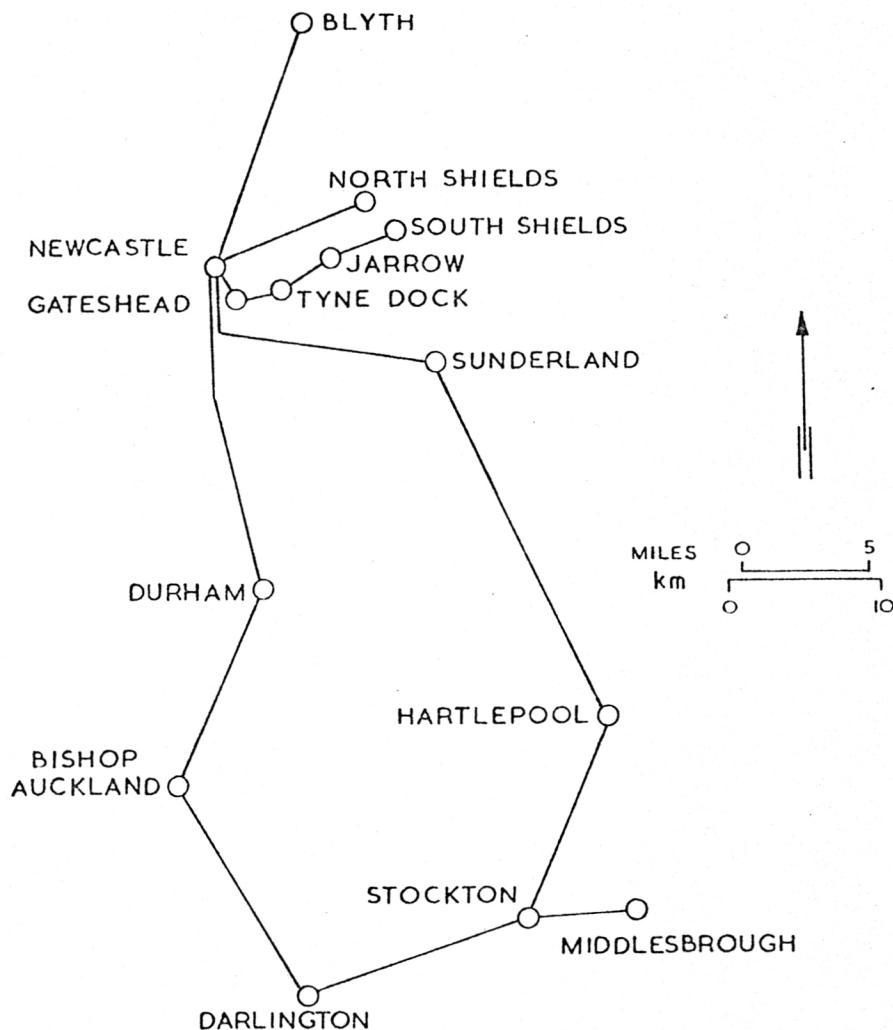


FIG. 1 THE NORTHERN DISTRICT TELEPHONE COMPANY'S TRUNK SYSTEM IN 1887