THE POST OFFICE TOWER

LONDON

TWO SHILLINGS AND SIXPENCE

The Post Office Tower is the tallest building in London and its finest vantage point. But London's outstanding landmark is a symbol of the modern Post Office; a science-based industry using the most refined techniques in the telephone, teleprinter, television and computer communication so necessary for modern society.

It is a focal point of communication channels from all quarters of Great Britain and from overseas.

Its height is essential. It must carry aerials high above all obstructions to provide a clear path for hundreds of thousands of simultaneous radio links, carrying telephone conversations, television programmes and computer data between London and the rest of the country. The alternative to using these clear radio paths would have been the disruption and expense of major cable-laying works through the crowded London streets and out into the country beyond.

The Tower itself, which was designed by the Ministry of Public Building and Works, is a triumph of modern architecture and engineering, a unique structure in which more than 13,000 tons of steel, concrete and glass have been shaped to meet the needs of progress. Slender and practical, it symbolises the technical and architectural skills of this modern age.

Such a tall landmark would meet people's natural desire to climb and look about them. So, near the top, there are viewing platforms from which one may see London and beyond laid out almost as a map, with huge office blocks looking like matchbox buildings.

A high-speed lift carries the visitor skywards at a thousand feet a minute. There is a revolving restaurant where the diner can enjoy an ever-changing view.

Why was the Tower built? How was it built and how does it work?

The story is told in words and pictures on the pages that follow.

So that 300,000 people can converse

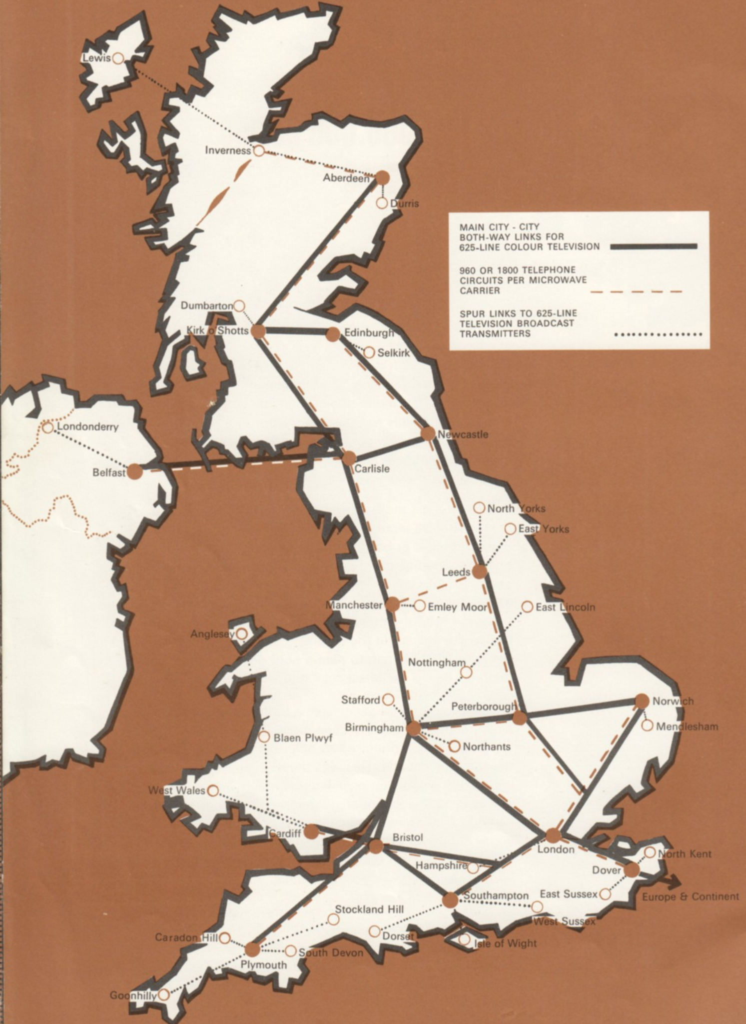
Impressive though the Post Office Tower is as an architectural feature, it was not built primarily as an ornament or amenity for London. There is in fact a much more urgent social purpose: the Tower was constructed mainly to ease the increasing pressure upon the nation's trunk telephone services, and provide the means for expansion for at least a generation ahead; incidentally, also, to meet the approaching need for more television facilities.

For many years the Post Office has been trying to keep pace with the demands of an increasingly telephone-conscious public. The introduction of Subscriber Trunk Dialling has simplified and encouraged long-distance calls. At the current rate of increase of about 17 per cent a year in the number of trunk calls, this traffic alone may double in six years. The need to extend the television services both for entertainment and industry has threatened still further congestion in the channels of communication. A decade ago the Post Office began to plan a bold departure from conventional methods, using the latest scientific ideas.

Those ideas pointed away from a further proliferation of cables. Experiments had already been made with a comparatively new radio technique which promised to open up a new medium for telecommunications. This was the microwave system; transmitting wide-band signals on wavelengths much smaller even than the short waves used in conventional television broadcasting, and capable of carrying 1,800 telephone calls on a single carrier wave. Here was ample scope for expansion. It was decided to create a microwave telecommunication system based on London, linking the whole country via the great industrial cities.

Problems still remained. The microwave beam travels, like light, in a straight line. Obstacles in its path, such as buildings and even trees, cause loss of signal power and produce distortion by reflecting signals. Therefore the aerials for a microwave radio system operating from London must be so placed that they can clear the tallest office blocks and the suburban hills. In London, lying as it does in a hollow, this meant raising the aerials to a height of not less than 355 feet (107 metres).

The Tower rises impressively through the trees of one of London's nearby parks.


MAIN CITY - CITY BOTH-WAY LINKS FOR 625-LINE COLOUR TELEVISION
960 OR 1800 TELEPHONE CIRCUITS PER MICROWAVE CARRIER
SPUR LINKS TO 625-LINE TELEVISION BROADCAST TRANSMITTERS
Lewis
Inverness
Aberdeen
Durris
Dumbarton
Kirk o'Shotts
Edinburgh
Selkirk
Londonderry
Belfast
Newcastle
Carlisle
North Yorks
East Yorks
Leeds
Manchester
Emley Moor
East Lincoln
Anglesey
Nottingham
Stafford
Peterborough
Norwich
Mendlesham
Birmingham
Northants
Blaen Plwyf
West Wales
Cardiff
Bristol
London
North Kent
Hampshire
Dover
Southampton
East Sussex
Europe & Continent
West Sussex
Stockland Hill
Dorset
Caradon Hill
Plymouth
South Devon
Isle of Wight
Goonhilly

Initially, four paths will radiate from the London Tower, one of them toward the great industrial regions of the Midlands and North via this Tower at Birmingham.

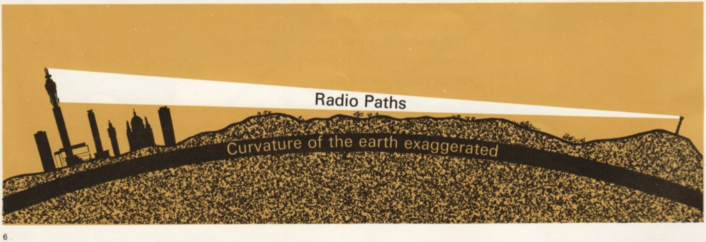
Early plans envisaged the avoidance of central London by building several radio towers on the high ground surrounding the city, transmitting signals to similar structures in the Provinces. This proved impracticable for several reasons. One was the difficulty of finding enough suitable hilltop sites.

Moreover, London already had, in the Museum telephone exchange building, a focus of telephone and television services in and out of the region. These were served by an extensive network of cables and by a steel lattice mast on the roof of the building, which was not, however, tall enough to provide adequate clearance, nor large enough to carry sufficient aerials, to meet future traffic growth. It would have been necessary, therefore, to link the outer London towers to the Museum centre by underground cables, an operation that would have torn up London streets and dislocated traffic beyond all reason. There was only one alternative, to build a tower of the right height and size on land adjoining the Museum exchange and already owned by the Post Office.

The next consideration was the design of the structure. Basically, a stalk surmounted by aerials and carrying the necessary ancillary equipment would have served the technical purpose adequately, and in fact the first conception of the Post Office Tower was as simple as that. But the Tower would be London's most prominent landmark and had to be aesthetically satisfying. Besides, its potentialities as an attraction for the public and for tourists could not be overlooked. Successive plans added observation floors to provide a unique viewing point over London, and a revolving restaurant which is 520 feet above the ground. The building has presented yet further opportunities, for research into constructional problems and for weather forecasting.

As the Tower has increased in versatility so it has in height. At 620 feet (189 metres) which includes the 40 foot (12 metre) mast, it overtops by more than 200 feet (61 metres) any other structure in London, and is the tallest building in Britain. It will remain the tallest of the planned chain of towers which is expected by 1970 to serve these islands as far north as Inverness and across to Belfast and Dublin with a microwave system of trunk telephone traffic and

The diagram shows the limitations on a radio path caused by hills, buildings and the earth's curve.



The picture on the left, taken from the Tower, demonstrates that a great height is needed to ensure a clear path for the radio beams. Obstacles in their path would cause loss of signal power and distortion.

television circuits. Initially, four paths will radiate from the London Tower: one towards the greatest industrial regions of the Midlands and the North via Birmingham; a second towards the important ports of Southampton and Bristol and on to the far reaches of Cornwall to link with the ground station at Goonhilly for satellite communication; a third towards Folkestone, Dover and Europe beyond; and a fourth to serve East Anglia and the North-East of England.

These paths will carry both-way city-to-city links for 625-line colour television as well as telephone circuits. The eventual capacity of the system will be 150,000 simultaneous telephone conversations or 100 both-way television channels, if used for either purpose exclusively. A likely combination of services is 100,000 main route telephone circuits and 40 television channels.

Spur routes from the Tower and from some of the regional centres will be able to carry a further 50,000 telephone circuits or 40 both-way television channels. The Tower can also provide microwave transmission for temporary television links and outside broadcasts.

This vast project has proved to be of more than national interest. It ranks among the world's most advanced installations of microwave telephony. Not only in electronics but in other technical spheres too, the Post Office Tower has made outstanding contributions, as later pages will show.

In the foreground is Broadcasting House, headquarters of the British Broadcasting Corporation. Beyond the Post Office Tower is the mast of the Museum telephone exchange.

The alternative to the Post Office Tower and the clear path it provides for hundreds of thousands of simultaneous radio signals carrying telephone conversations, television programmes and computer data between London and the rest of the country, would have been the disruption and expense of major cable-laying works through the crowded London streets.

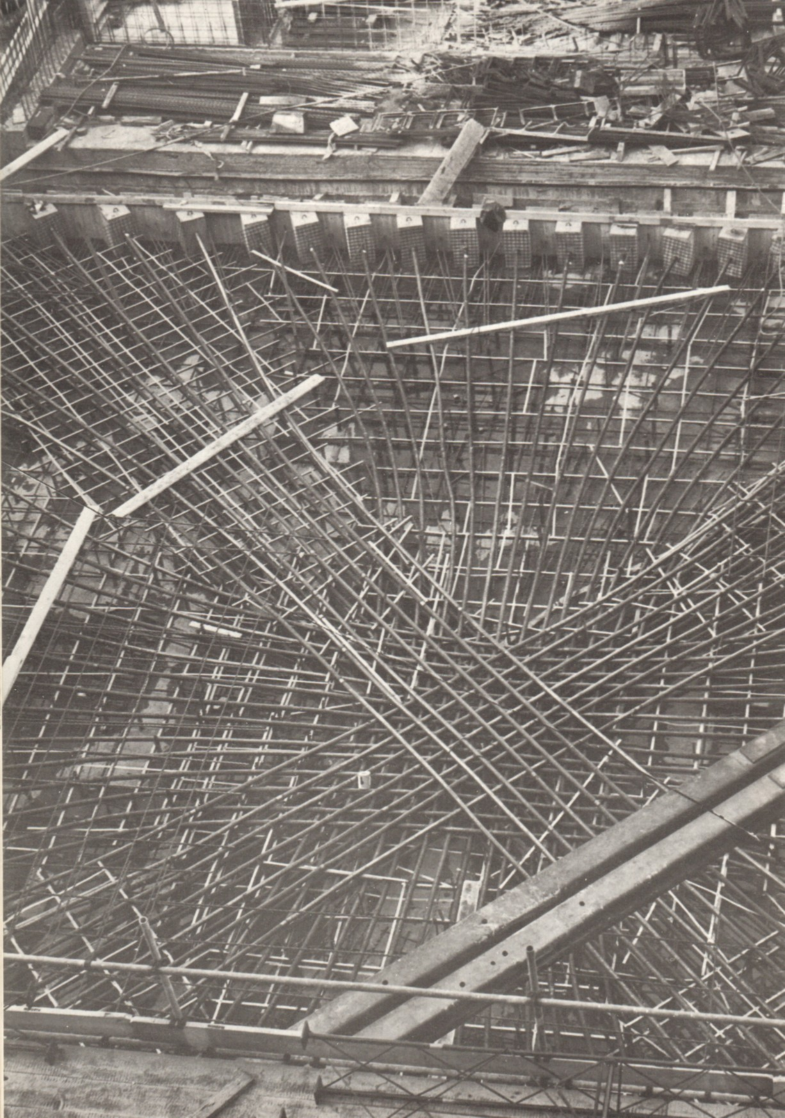
The voice of a caller in this Post Office telephone booth can be beamed via the Tower to anywhere in Britain – or the Continent.

For the technically minded

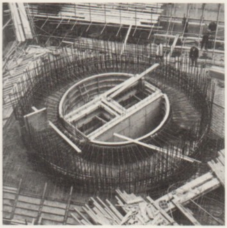
MORE ABOUT MICROWAVES

Microwaves are in the super high frequency range of the radio spectrum. For instance, while one of the BBC's Light Programme channels operates on a 1,500-metre wavelength at a frequency of 200,000 cycles per second, microwaves have wavelengths of a few centimetres and frequencies of several thousand million cycles. In its initial stages the Post Office Tower will use six frequency bands ranging from 1,700 to 11,700 Mc/s.

Since these frequencies are among the nearest to those of visible light, microwaves have some of the characteristics of light, travelling in a straight line and requiring to be beamed between stations in the 'line of sight'. This has imposed two major requirements upon the national microwave buildings and the master Tower in London. First, because of the earth's curvature, and because of the unstable nature of the atmosphere, it has been necessary to provide relay stations at intervals of 25–30 miles (40–48 kilometres) in order to maintain adequate transmission performance. Second, the Post Office Tower has had to be given a degree of rigidity which is very unusual in structures of comparable height-to-width ratio. The bending and twisting movement under wind pressure, and the elliptical movement caused by the sun's heat, must be so small that the radio beam will not deviate more than 20 minutes of arc, or one-third of one degree.



13,000 tons of steel, concrete and glass



The foundations of the Tower were sunk 24 ft (7·3 metres) to rest on the hard blue London clay. A concrete raft, reinforced with pre-stressed post-tensioned cables, supports a concrete truncated pyramid. On this rests the 13,000 ton (13,208,000 kilogram) Tower.

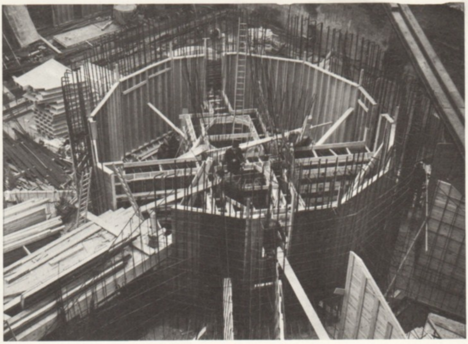
It is common knowledge that tall, slender structures bend under wind pressure. Normally, at the top of a building such as the Post Office Tower, the deviation from the vertical would be many feet. But that degree of flexibility would have defeated the purpose of the Tower. Since aerial alignment with other stations had to be accurate to a third of a degree, more than ordinary rigidity in the building was required.

Wind tunnel tests carried out by the National Physical Laboratory on a model of the Tower confirmed that the structural techniques would give the necessary stiffness with complete security. One of the results is the Tower's most distinctive structural feature, a hollow central shaft of reinforced concrete, from which the successive floors are cantilevered like ribs on a spinal column. For a third of its height it is 35 feet (10·5 metres) in diameter with walls 2 feet (·61 metres) thick, reducing to 20 feet (6·05 metres) diameter and 12 inch (·304 metre) walls. This shaft is anchored to the main building by a 'collar' for additional stability. Because of these measures, a 90 mph (144 kilometres per hour) gust of wind would cause a movement of no more than 15 inches (·4 metre) at the top.

Another unusual feature is the position of the microwave equipment. Normally this would be located at ground level and connected to the aerials by hollow waveguides. The waveguides should not be more than about 150 feet (45·7 metres) long, or the loss of transmission power becomes excessive. But in the Post Office Tower the aerial galleries are sited at more than twice that height above the ground, in order to ensure that the microwave beams clear all surrounding obstacles. The equipment has therefore been housed in the body of the Tower, as near as possible to the aerials. Occupying 24,000 square feet (2,235 square metres) of floor space the 16 apparatus floors constitute a large radio station suspended in the air.

That vertical radio station is served by a main building consisting of four floors, mezzanine floor and two-storey basement, comprising altogether 150,000 square feet (13,934 square metres) of floor space. It houses, in addition to the Museum Telephone Exchange, the power supply for the buildings and five diesel alternator sets which start up automatically if the mains fail. It is also the focal point of a vast cable system connecting London trunk exchanges with the Tower.

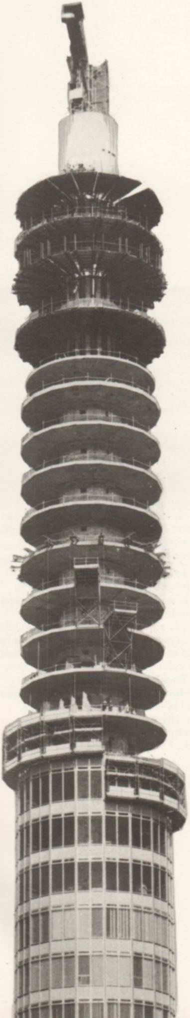
Below ground level, part of the honeycomb of pre-stressed post-tensioned cables which were used in constructing the raft on which the Tower stands.



Growing up. The foundations begin to emerge above ground level.

An internal hollow reinforced concrete shaft provides the main stability of the Tower. It is the backbone of the structure and from it there are cantilevered floors – rather like washers placed on a vertical rod.

The Tower itself takes shape. The first anti-sun glass cladding is in position on the lower floors. Above it is the hollow central shaft – the core of the building – of re-inforced concrete, with the floors cantilevered like ribs on a spinal column.



The location and purposes of the group of buildings and the great height of the Tower presented the designers and builders with uncommon problems. The narrowness of the site demanded split second timing in the delivery and handling of materials. It was impracticable to use scaffolding for reasons of cost and because it might have damaged the special cladding, and materials had therefore to be raised by internal hoists and a climbing-type crane. The crane rose with the construction of the central shaft around which the floors were built, till it was perched nearly 600 feet (182 metres) above London, and the driver had to communicate with his colleagues on the ground by radio telephone. The problem of bringing the crane down so intrigued people that a question was asked about it in Parliament: in fact, it was dismantled and lowered safely in sections by its own winch.

The foundations of the Tower are sunk 24 feet (7·3 metres) to rest on the hard blue London clay. A concrete raft, 90 feet (27·5 metres) square, 3 feet (·9 metre) thick and reinforced with post-tensioned cables, supports a reinforced concrete truncated pyramid, 22 feet (6·5 metres) deep, upon which rests the 13,000 tons (13,208,000 kilograms) weight of the Tower. Eighty feet (24·5 metres) up is the bridge-deck collar linked to the main building, and 30 feet (9 metres) above this starts the first of the floors accommodating the radio equipment, with its batteries, power plant and other associated apparatus, and ventilation, cleaning and refrigeration plant.

To prevent overheating in the apparatus rooms, that section of the Tower is clad in $\frac{3}{8}$ inch (one centimetre) anti-sun glass, which gives the structure its green colour. Solar heat is further reduced by means of double glazing, anodised aluminium ventilators and sunbreakers, and also internal air conditioning and cooling facilities. The topmost apparatus floor has the largest concentration of waveguides, which enter through slots in the ceiling from the aerial galleries. The aerial galleries have been left unenclosed so as to minimise the absorption of the microwave beams.

Above the aerial galleries are three observation platforms, from which the public can enjoy the panoramic view of London. Immediately above are three further public floors housing the restaurant, cocktail

High above the capital city the men who built the Tower work with safety nets below them.

For the technically minded

MORE ABOUT WIND PRESSURE

Achieving aerodynamic stability in tall slim buildings is not simply a matter of protection against high velocity winds. These occur in gusts of short duration and the pressure is easily absorbed. Much more serious is a steady wind of comparatively low intensity causing transverse oscillations, that is, a movement at right angles to the windstream, and thus imposing a cumulative strain on the structure. The effect is a form of resonance, and if continued could damage a building in the same way as the human voice can shatter a glass when the frequency of the note coincides with the natural frequency of the glass.

It was these phenomena that the National Physical Laboratory had to study with a scale model of the Tower in a wind tunnel. The task was complicated by the difficulty of building into a model the characteristics of a full scale structure. From these experiments and calculation it was confirmed that the Tower could withstand some 200 tons (203,220 kilograms) of direct wind pressure, and transmit to the specially reinforced main building structure via the collar a wind force load of 570 tons (579,120 kilograms).

The first of the giant aerials is fitted into position.

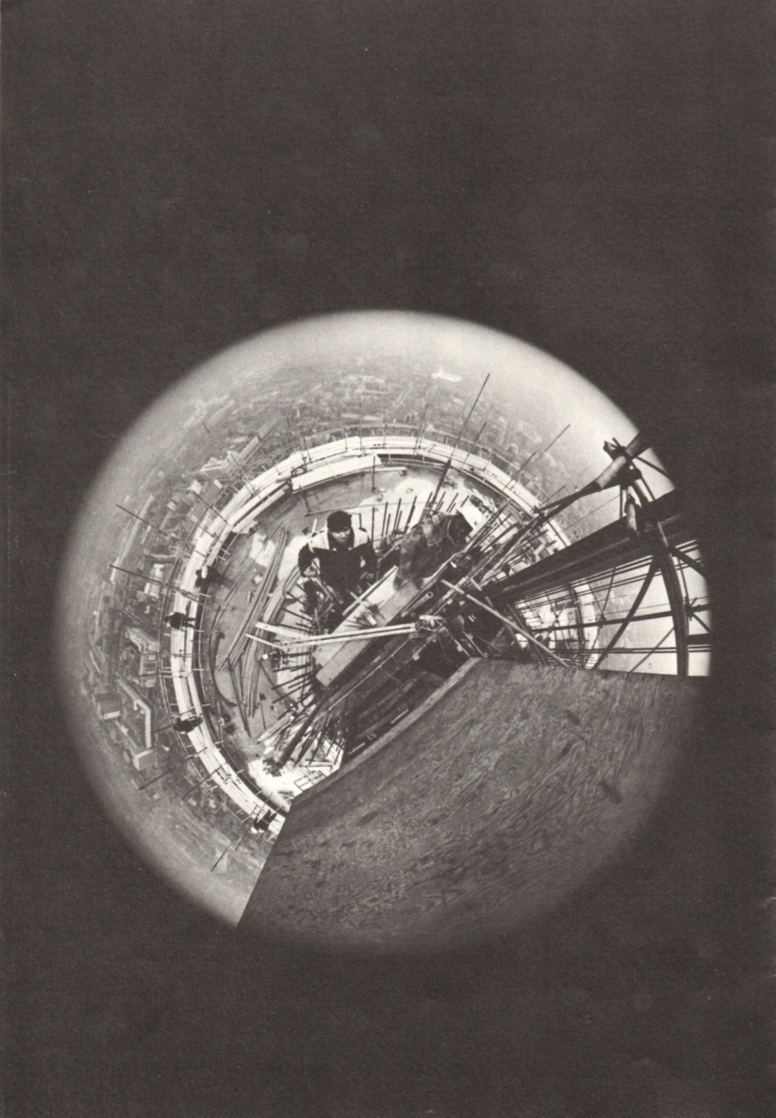
Workman's-eye view of the street hundreds of feet below as construction goes on.

bar and kitchens. The restaurant section which is 65 feet (20 metres) in diameter, constitutes the widest part of the Tower. Its floor, constructed of steel and electrically driven by rack and pinion, revolves two and a half times in the hour and carries the triple glazed observation window with it. Situated 520 feet (158 metres) above the ground, the 23 ton (23,368 kilogram) revolving floor had to be prefabricated and hoisted up in sections, a feat of meticulous construction which fulfilled with precision the required clearance of one-eighth of an inch (3 millimetres) between the moving and the stationary parts of the floor. The motion is imperceptible; a penny can stand on edge while the floor rotates.

Window cleaning is a considerable operation in a building which has 50,000 square feet (4,650 square metres) of glass. There are three systems. One, a power operated carriage travelling on rails let into the face of the building, moves up and down and round the apparatus section, cleaning the 18 facets of the surface one at a time. A second one remains stationary, cleaning the restaurant windows as they rotate. The third uses a cradle suspended below the restaurant to clean the windows of the top observation floor.

The central shaft of the Tower houses the two lifts and also the emergency staircase, electricity and telecommunications cables and ventilation ducts, water and sanitary pipes. Water is pumped 560 feet (170 metres) to the tanks. A building embodying so much steel – 95 tons (96,520 kilograms) of high tensile steel to reinforce the base and 685 tons (695,960 kilograms) of mild steel in the Tower proper – has a built-in system of lightning protection.

The Post Office Tower, which has cost a million and a quarter pounds, has made valuable contributions to fields other than that of telecommunications. In addition to facilities for the Building Research Station (Ministry of Technology) and the Ministry of Public Building and Works in connection with the Tower as a building structure, facilities have also been provided to the Meteorological Office (Ministry of Defence) for a storm warning radar installation and other weather instruments; the Warren Spring Laboratory (Ministry of Technology) for atmospheric pollution studies; and University College, London, for climatology research.



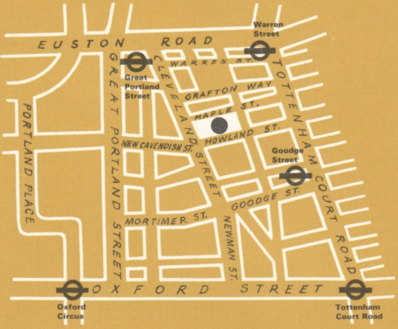
London down below

Before the building of the Post Office Tower, London lacked a viewing point comparable to the Eiffel Tower in Paris. Now, for the first time, one can stand higher than on anything made by man or nature this side of the North Downs and the Chiltern Hills; nearly three times as high as Nelson's Column: more than twice as high as the Monument; half as high again as St Paul's Cross, to look down on the tallest of the modern office blocks. Here one is at the geographical centre of the London conurbation. For 15 miles around stretches Greater London, more than 600 acres of streets and home of eight million people. That is the urban part of the spectacle. Beyond are the hills and woodlands of the Green Belt, and the smaller towns of five counties, Kent, Surrey, Essex, Hertfordshire and Berkshire. On a clear day Windsor Castle can be glimpsed, over 20 miles to the west.

So much is visible because London is mainly flat. It has its own modest eminences: St Paul's Cathedral at the top of Ludgate Hill marks the spot where the early pre-Roman settlers camped above the Thames marshes and named the settlement, according to one theory, Llyd Dyn, the lake fort. There are other heights; Hampstead and its rugged Heath, the Londoner's favourite playground; to the north-west Harrow, with its famous public school on the hilltop; south-west, the old town of Richmond whose hill gives a superb view of the winding Thames; and south-east, Sydenham where the television mast marks the heights where the Crystal Palace, burnt down in 1936, once glittered in the sunlight.

Apart from these natural heights, the dominant points in the view are the towering structures raised since the Second World War. Before that architectural divide, the main landmarks were church steeples and the more imposing public buildings. Today, these are dwarfed by the giants of commerce: Vickers Tower, due south on Millbank; the Hilton Hotel in Park Lane; the massive developments near Victoria Station and at Barbican in the City; and much nearer, diminished only by their proximity to this tallest of London's towers, the latest office blocks in Oxford Street and New Oxford Street.

That is the new London; but successive centuries of old London fill the spaces in between. The Romans have left their legacy in London Wall and the recently unearthed Mithraic Temple; the Normans in the Church of St Bartholomew the Great and the Tower of London; the Tudors in Henry VII Chapel of Westminster Abbey; the First Elizabeth in the timbered houses of Staple Inn; the Stuarts in St Paul's Cathedral and the City churches by Sir Christopher Wren; the eighteenth century in the West End squares and the Nash terraces of Regent's Park; the Victorian era in the elevation of St Pancras Station and in much that is less attractive; and the early decades of the present century mainly in the spreading suburbs.



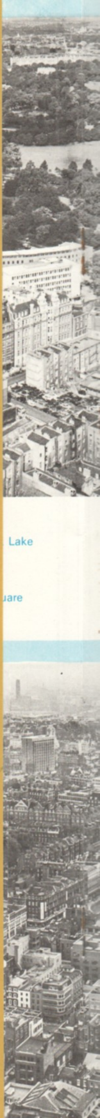
From the varied historical and architectural picture some salient impressions emerge. London presents a more fascinating panorama of roofs and chimneys than most great capitals. It is more thickly sown with trees than one realises from ground level, not only in the parks, which are numerous, but also in the avenues and squares. The squares are a notable feature of the foreground, particularly to the west, north and east: Grosvenor Square; Bedford Square, almost at our feet, an unspoilt gem of eighteenth-century domestic architecture; and the less well-known squares of Islington, fashionable residential centres again after generations of neglect.

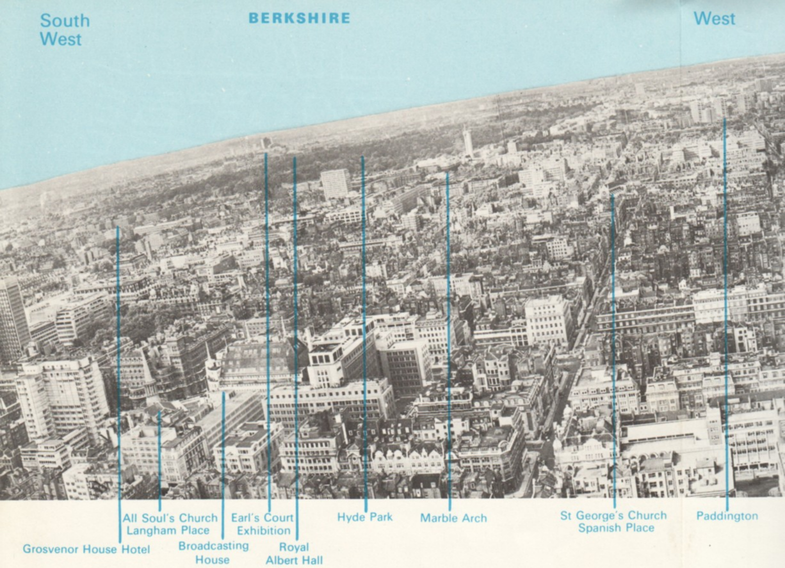
Threaded among the roofs and towers is the River Thames, bisecting London with a wavy silver line, lost to view for long stretches but reappearing to display a vista of bridges, docks and Port of London shipping. For the Thames is a tidal estuary, from the western rim of the view at Teddington, to the Nore, sixty-nine river miles to the east, where the estuary broadens into the sea. It is crossed by 28 road and railway bridges between Richmond and the Tower, and strung with the landmarks of eight centuries.

Richmond Park, a former Royal hunting ground and still the home of a herd of deer, can be seen almost adjoining that other exquisite park and living botanical museum, the Royal Botanic Gardens at Kew. A little downstream is the great bend of the river between Mortlake and Putney where Oxford and Cambridge Universities hold their annual Boat Race. The fluted chimneys of Battersea Power Station provide evidence that industry as well as Church and City can build with distinction. Less than two miles away is the mediaeval Lambeth Palace, traditional residence of the Archbishops of Canterbury; and almost facing it on the opposite bank the Tate Gallery, the nation's greatest collection of modern art.

Due south from our vantage point is Thames-side Westminster, with its Gothic-revival Palace where the two Houses of Parliament sit, the genuine Gothic of Westminster Abbey, burial place of poets and statesmen, and Whitehall, the street of government offices ending at Trafalgar Square. Beyond, and less than a mile from the river embankment are the campanile of the Roman Catholic Westminster Cathedral and the Queen's town house, Buckingham Palace, enclosing a square courtyard. Facing Westminster is the South Bank. On it stands County Hall, seat of the Greater London Council, its neighbour the Royal Festival Hall, one of the great concert halls of Europe, and between them the Shell building and the site for one of London's most ambitious development projects, to create a centre of culture and entertainment.

Where the Thames flows between the City of London, financial and institutional heart of the nation, and the ancient borough of Southwark, site of the Globe Theatre where Shakespeare staged his plays, more




South West
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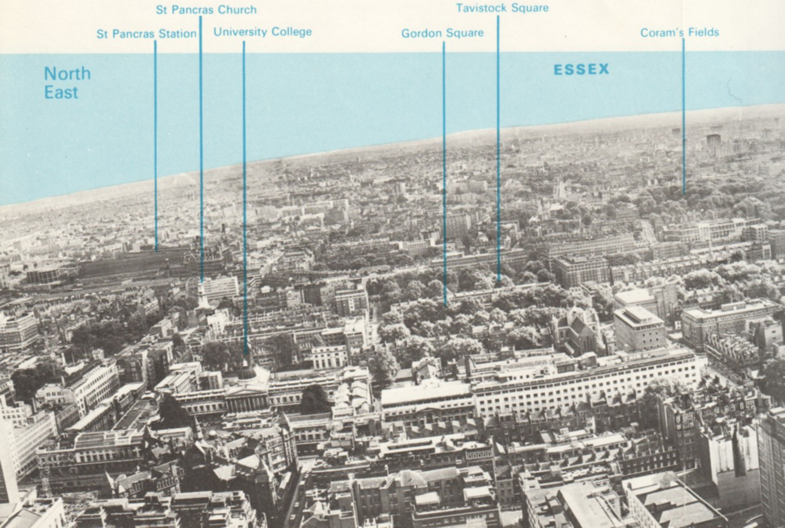
Hyde Park
Marble Arch
St George's Church Spanish Place
Paddington
Grosvenor House Hotel
Broadcasting House
Royal Albert Hall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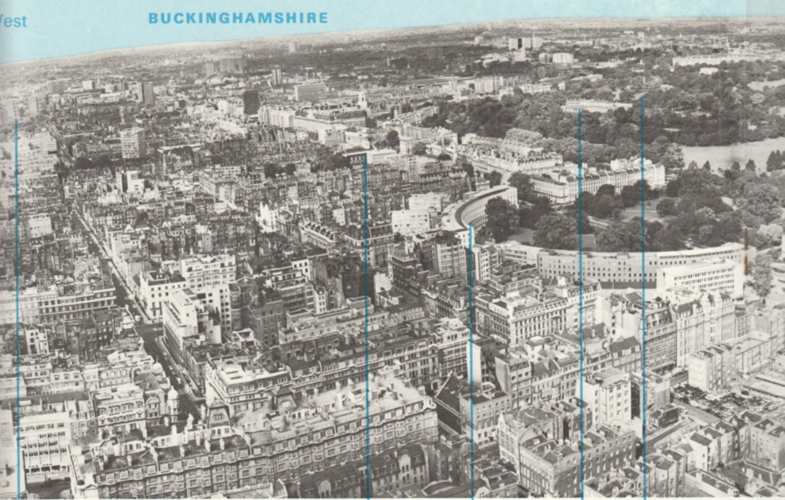
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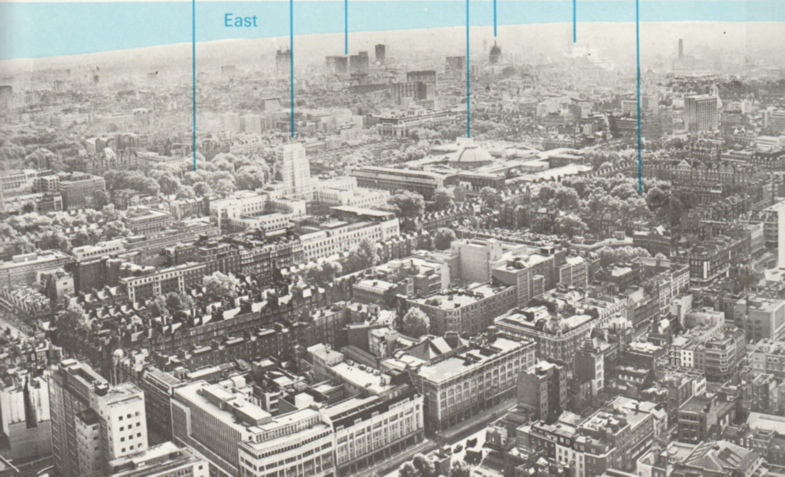
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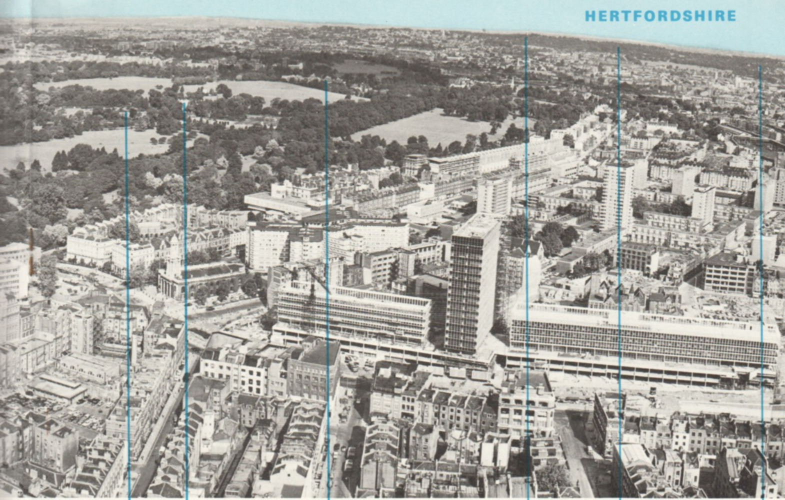
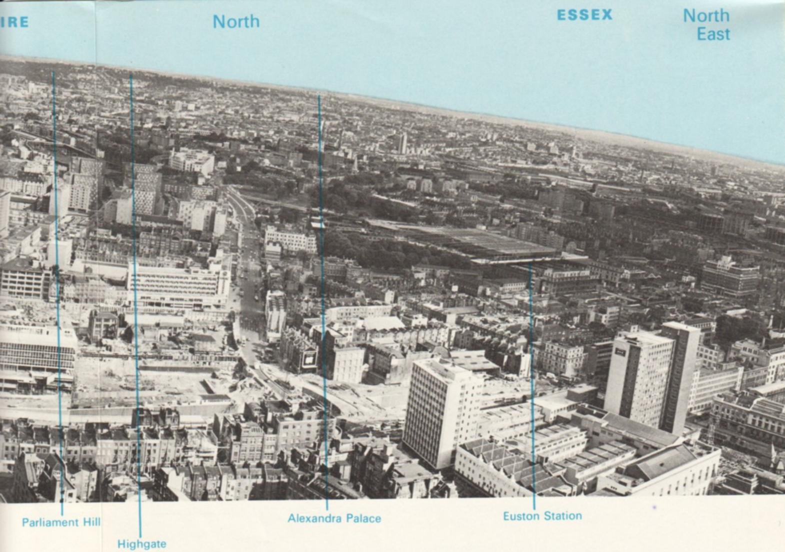

HERTFORDSHIRE
Queen Mary's Gardens
St John's Lodge
London Zoo
Hampstead Heath
Ken Wood
Parliament


Royal Festival Hall
Charlotte Street
Soho Square
County Hall
Nelson's Column
Victoria Tower
Houses of Parliament
Big Ben
Westminster Abbey
Piccadilly Cir
KENT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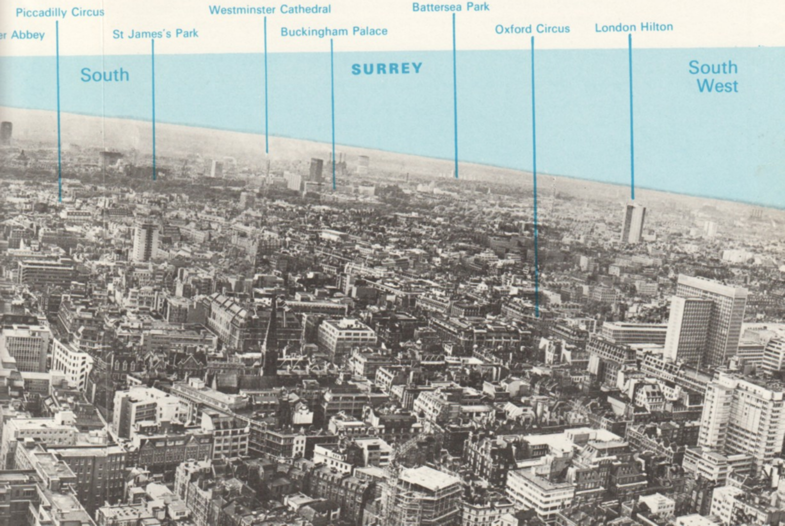
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Westminster Cathedral
Buckingham Palace
Battersea Park
Oxford Circus
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South
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historic monuments come into view. St Paul's is now encircled with modern office blocks, replacing the ancient narrow streets wiped out during the 1940 Battle of Britain by bombs which left the Cathedral miraculously intact amid the flames and rubble. Less than a mile away rises the column of the Monument, memorial of the earlier Great Fire of London in 1666, which started in Pudding Lane near by and burnt itself out at Pie Corner in Holborn, leaving only a few relics of the mediaeval city surviving to our day. Across London Bridge is Southwark Cathedral, a gem of Norman and Early English architecture.

At the eastern riverside edge of the City is the Tower of London, built by William the Conqueror with the dual purpose of keeping the arrogant citizens submissive and protecting the wealth of the capital against marauders. It is a fascinating and sinister monument, wonderfully preserved. Used for centuries as state prison, torture chamber, place of execution, it is now an unsurpassed tourist attraction. Tower Bridge, a curious combination of Victorian mediaevalism and engineering virtuosity, is another of the favourite sights of London, particularly when it raises its two bascules to admit ships to the Upper Pool.

Dockland begins immediately past the Tower, and stretches in unbroken sequence along ten miles of river, whose loops enfold such picturesquely named spots as the Isle of Dogs, Bugsby's Reach and Galleons Reach. Linked to the Isle of Dogs by a tunnel under the river is the old town of Greenwich.

There are two ways of viewing the scene from a height of 500 feet; to follow the east to west river line as we have tried to do and the trunk roads radiating from the centre, or to see London in concentric circles, starting at Tottenham Court Road below and rippling outwards to the boundaries of vision. Since the Post Office Tower is in the heart of London, the panoramic circle is particularly revealing, and richest in detail within the first couple of miles radius. London down below includes the City and the West End, with its parishes of Mayfair, Soho, Bloomsbury, Bayswater, Belgravia and St James's; the best known parks, and streets with names that are familiar to millions who have never seen them.

Two highways intersecting at Oxford Circus divide the area into its four segments, Portland Place–Regent Street roughly north and south, and the straight road that hugs the northern edges of Kensington Gardens and Hyde Park, continuing as Oxford Street and Holborn, and cutting across the City and East End.

Northwards on the far side of Regent's Park are the Zoological Gardens. Westwards is the early nineteenth-century elegance of the Bayswater squares and avenues, enclosed between the parks and the new giant office blocks of St Marylebone and Paddington. South-west, past the oval BBC building and its neighbouring All Souls Church, are Mayfair's sumptuous houses, town residences of the wealthy a century ago and cherished by their commercial tenants today. Due south, and only the width of Regent Street from Mayfair, the scene changes abruptly to the narrow streets of Soho, their clutter accentuated by a sprinkling of tall modern blocks. Here is the foreign quarter of London with exotic food shops and restaurants; here also is theatreland. The district ends at Piccadilly and the Strand, marked by the Nelson Column, the cupolas of the National Gallery, and the spire of St Martin-in-the-Fields.

West and south-west is London's Latin Quarter, Bloomsbury. Its leading features are all in the foreground, London University and the Senate House Tower in the centre, flanked by University College on the left and the British Museum, holding the largest collection of antiquities in the world, on the right. The dome in the centre of the Museum surmounts the circular Reading Room of a library whose $5\frac{1}{2}$ million volumes make it one of the two or three largest collections in the world.

To the south-east lies the City, that proud and still independent centre of wealth and tradition. And the Law Courts and that legal precinct, the Temple, with its ancient round church shaped like the tents of the Knights Templars from whom the institution took its name. Here also are St Paul's Cathedral and many churches built by Sir Christopher Wren, notably St Bride's in Fleet Street, the journalists church and recognisable by its five-tiered spire.

The Central Criminal Court, the Old Bailey, whose dome is topped by the figure of Justice holding sword and scales, reminds us that only by looking down from a great height does one realise how many domes still survive in Central London among the spires and towers. And the view of the Bank of England helps to emphasize the increasing rarity of the squat four-square style of building in a city where space is so costly and sought after that only by building upwards can the vast working population that surges twice daily into and out of it hope to be accommodated.

This then is London, or rather the many Londons that the centuries have superimposed one on the other and extended on all sides. There are two cities, London and Westminster, the inner suburbs, some of which still preserve their parochial charm, and the outer circle of towns that London has swallowed but never completely digested. It is not a coherent picture, but it is full of oddities and unexpected beauties.

The inside story of the Tower

The Post Office Tower is the central feature in a process of developing the trunk telephone services in Britain. It provides an effective alternative to the coaxial cable as a means of linking Central London into the national trunk network, and offers scope for expansion which might otherwise have presented difficulties.

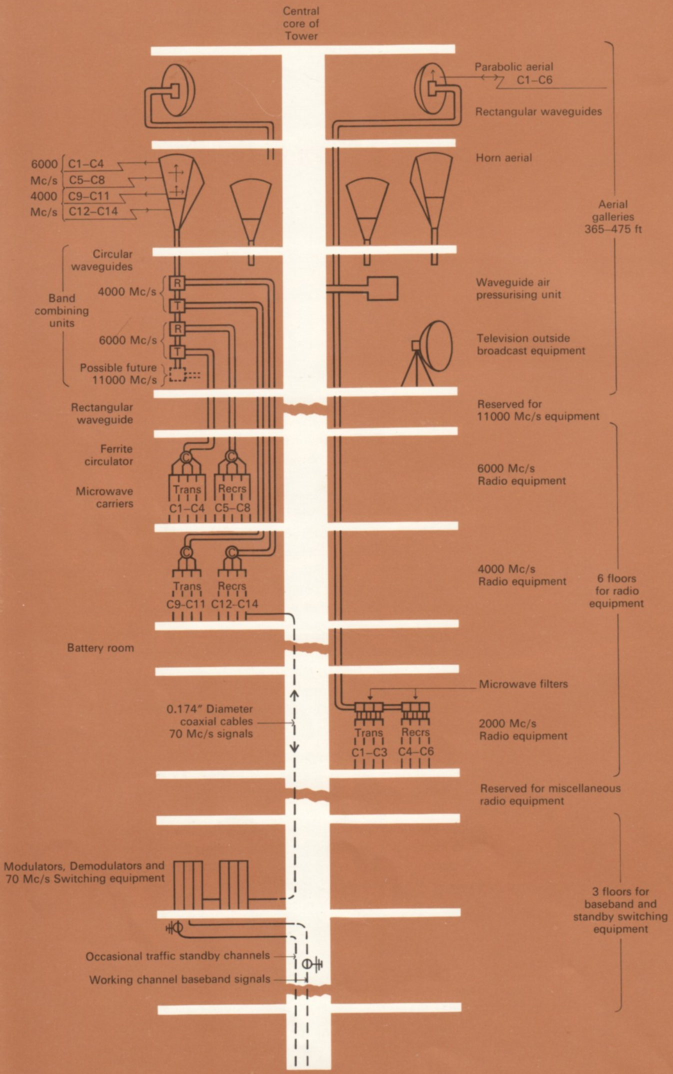
Radio, using lower frequencies, was used in the telephone service before the Tower was planned. So was microwave transmission for linking television studios to transmitting stations; in fact, some of its developments had been pioneered in Britain. That the two services can be combined in the same system operating from a common transmitting and receiving centre represents one of the special features of the microwave network, of which the Post Office Tower forms part.

Before the Tower came into operation, a trunk call from London to, say, Birmingham, would have been routed all the way by underground cable. Now it has an alternative route, into the Museum Exchange building, up the Post Office Tower and by microwave transmission via a succession of relay stations to a tower in Birmingham.

The benefit to the public service is not only the increased capacity, which could have been achieved – at a cost – by means of additional underground cables. The chief gain is in the ultimate economy. To use the microwave system up to the limit of its capacity merely involves installing further transmitters and receivers at vastly lower cost in money and trouble than laying cables. Since microwaves are beamed from point to point across comparatively small distances instead of being reflected from the ionosphere like radio waves on lower frequencies, they are not subject to interference from magnetic storms and vagaries of weather, and give the same clarity of reception as transmission by underground cable.

Conversion of incoming and outgoing signals to microwaves is effected in the equipment housed in the upper six floors of the apparatus sections of the Post Office Tower. Transmitters 'up-convert' outgoing signals to microwave frequencies for radio transmission to the provincial telephone subscriber, and receivers 'down-convert' incoming microwave signals for communication to subscribers in

Cables entering the main cable chamber from the underground duct system to the right of the picture.



Central core of Tower
Parabolic aerial C1–C6
Rectangular waveguides
Horn aerial
6000 Mc/s C1–C4 C5–C8
4000 Mc/s C9–C11 C12–C14
Aerial galleries 365–475 ft
Circular waveguides
Band combining units
4000 Mc/s
6000 Mc/s
R
T
Possible future 11000 Mc/s
Waveguide air pressurising unit
Television outside broadcast equipment
Rectangular waveguide
Reserved for 11000 Mc/s equipment
Ferrite circulator
Microwave carriers
Trans C1–C4
Recrs C5–C8
6000 Mc/s Radio equipment
Trans C9–C11
Recrs C12–C14
4000 Mc/s Radio equipment
6 floors for radio equipment
Battery room
Microwave filters
0.174" Diameter coaxial cables 70 Mc/s signals
Trans C1–C3
Recrs C4–C6
2000 Mc/s Radio equipment
Reserved for miscellaneous radio equipment
Modulators, Demodulators and 70 Mc/s Switching equipment
3 floors for baseband and standby switching equipment
Occasional traffic standby channels
Working channel baseband signals

Inspection of a channel panel. One of these plug-in units is needed for each of the thousands of telephone trunk circuits brought into the Post Office Tower.

The charging rate for telephone calls is selected by means of switches which provide for cheap or full rate metering pulses according to a prearranged programme.

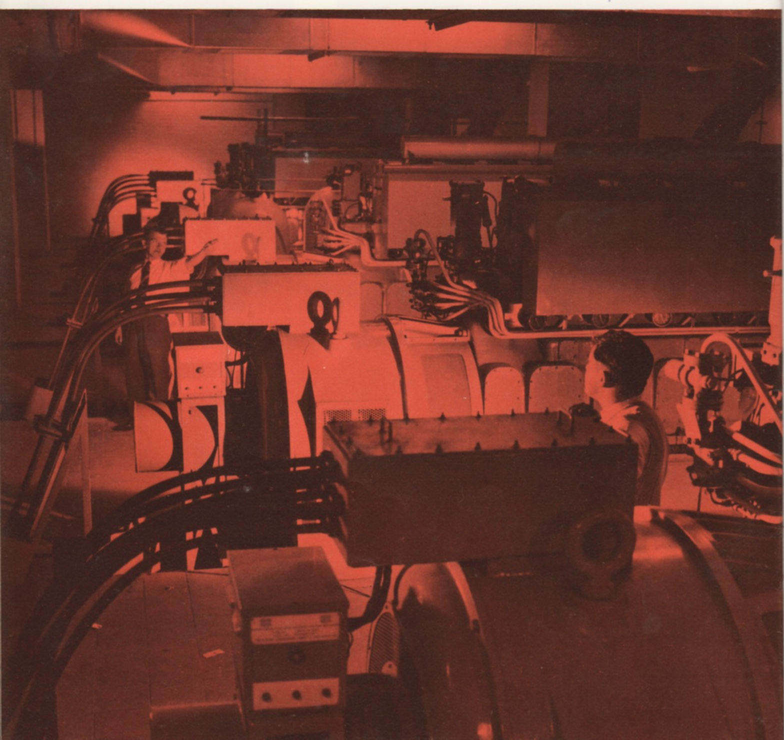
London or outlying exchanges. Frequencies are allocated to the equipment on each floor in descending order, the highest frequencies being represented on the floor nearest the aerials.

Microwaves travel between the radio equipment and the aerials along waveguides. These are hollow brass tubes of very precise construction. There are two types of waveguide, circular and rectangular in section. The circular waveguides absorb little power with length, but cannot be bent. Waveguides of rectangular cross section are used where right angle bends are required, but these introduce a greater loss of power. It is for this reason that radio equipment and aerials must be close together in the Tower. The rectangular tubes differ in cross section area for each frequency band; the higher the frequency the smaller the tube.

The aerial cluster, occupying a little over 100 feet (30·48 metres) of the height of the Tower, is the key element in this microwave system. The galleries which accommodate the aerials are circular because of the need to transmit the radio beam in many different directions.

Testing operations in the Television Network Switching Centre. All circuits are terminated in this control room. Engineers are seated at the Test Consoles, where suitable test gear can be connected to any circuit. The switch key being operated in the foreground connects the circuit under test to one of the picture monitors seen in the suite beyond, enabling the engineer to assess the performance of the circuit.

Standby power plant: a view of the five 500 kW standby diesel alternator sets housed in the sub-basement of the main building. In the event of mains failure these sets start automatically to provide continuity of power supply to all essential equipment both in the building and in the Tower.

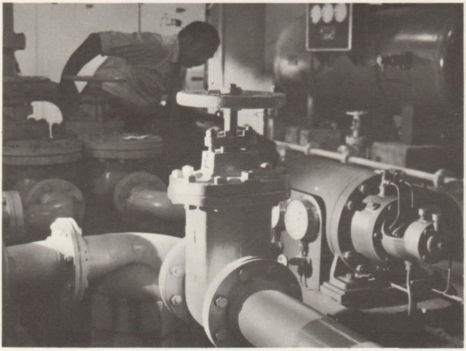


Inspecting the batteries: a maintenance man reads a hydrometer, an instrument for testing the specific gravity of the acid, in one of the very large cells. Batteries of these cells form an integral part of the power plant serving the telephone switching equipment.

Magnetic drum register-translator: one of the magnetic drums which determine the routes to be taken by calls from London over the network of circuits to all parts of Britain.

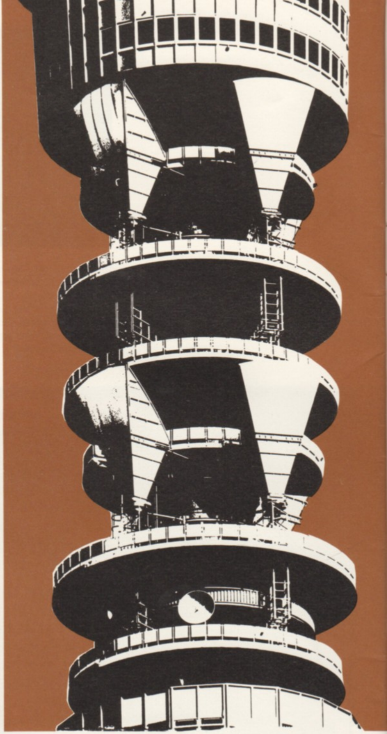
Visually, the aerials provide the Tower with its most striking feature, since they are the only exposed item of the microwave equipment. They are mounted on the outer edges of four circular galleries, 50 feet (15·24 metres) in diameter, cantilevered from the central shaft and open to the air. Two of the galleries are 36 feet (10·8 metres) high, alternating with two 18 feet (5·4 metres) high, to accommodate horn and dish aerials respectively. Rectangular waveguides are used to feed the dish type aerials, and also to feed the band branching units, which in turn connect with the horn aerials via circular section waveguides.

Both types of aerial are paraboloid reflectors, the horn paraboloids being more directional than the dish types and carrying larger numbers of circuits. The horn aerials, consisting of a parabolic reflector, fed by a pyramidal horn, are made of aluminium alloy sheet to resist corrosion. They are arranged in pairs which are spaced to avoid interference. There are two sizes of horn aerial, the larger being 27 feet (8·25 metres) high, 14 feet (4·25 metres) wide and a ton (1,016 kilograms) in weight. The horn aerials and all the waveguides



These fire booster pumps serving the Tower are installed in the new extension building.

One of the horn aerials being fixed in position.



The aerial cluster, occupying a little over 100 feet (30·48 metres) of the height of the Tower, is the key element in the microwave system. The galleries which accommodate them are circular because of the need to transmit the radio beam in many different directions. Both sets of aerials, horn and dish types, are in effect mirrors transmitting and receiving highly concentrated and precisely directed radio beams.

Underground cables are pressurised with dry air to prevent moisture entering through leaks which may develop in the sheaths. Loss of air pressure is indicated by these gauges which set off an alarm at a selected low pressure measurement.

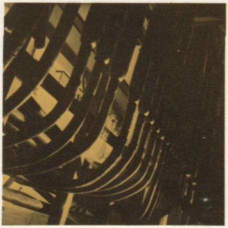
Dry air is circulated in waveguide feeders to keep out moisture which would degrade transmission performance. Flexible hoses connect the waveguides to the air supply pipes.

are filled with dry air circulating under pressure in order to exclude moisture and prevent corrosion which would cause loss of power.

The aerials are designed as precision instruments of communication. They are in effect mirrors transmitting and receiving highly concentrated and precisely directed radio beams. The beams are vehicles for tens of thousands of simultaneous telephone conversations, for television programmes from the BBC, the Independent Television Authority and Eurovision, for outdoor and closed circuit television operations and for signals via the Goonhilly satellite link.

In order to ensure that these important services shall not be interrupted, standby facilities have been installed in the Tower which will come automatically into operation in the event of failure in the working equipment.

Off-duty moments: a corner of the lounge attached to the canteen in the main building.



Power feeders: a section of the conductors in the power room which *carry direct-current to the telephone* switching equipment on the upper floors. These 'bus-bars' made of aluminium, are of very large size to carry the heavy electrical currents required.

The main cable chamber in the basement of the building: underground cables rising up to the main distribution frame on the ground floor.

Trunk test desk: throughout the day and night technicians man testing positions from which a fault on any circuit can be rapidly identified and located.

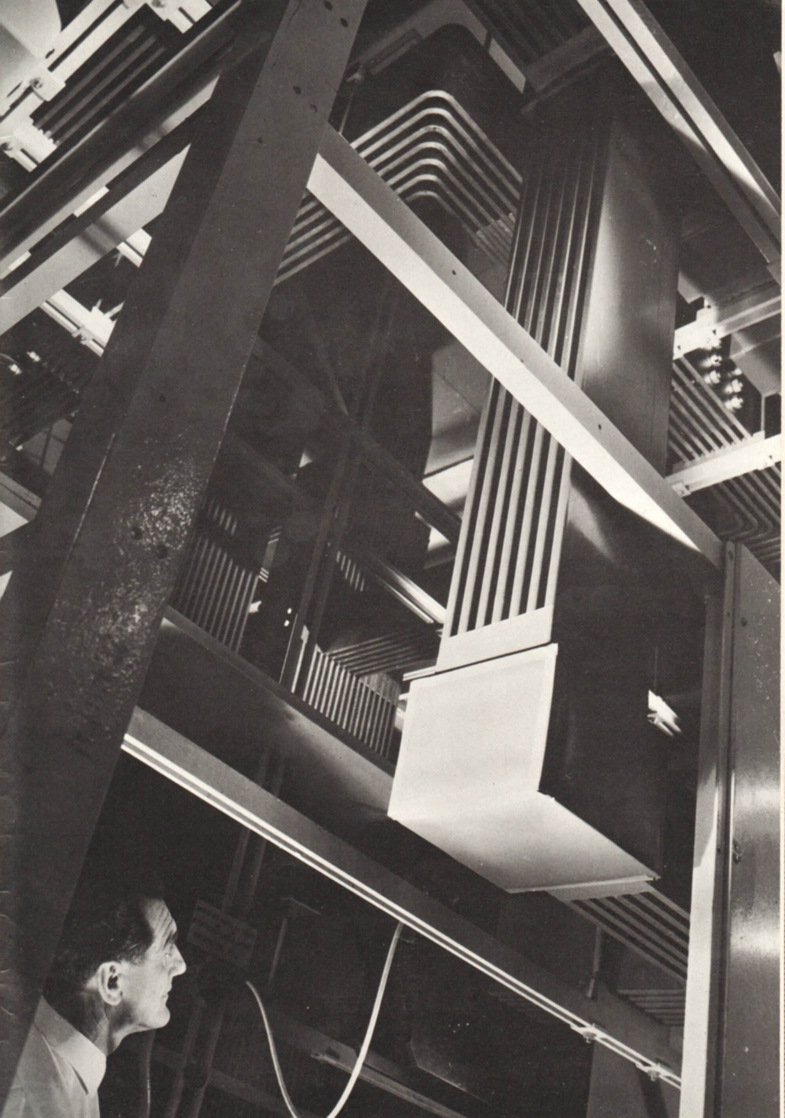
For the technically minded

MORE ABOUT THE AERIALS

Since the horn aerial both transmits and receives carrier waves, the circular waveguide connected to it contains a two-way traffic, but the mutual interference is reduced to infinitesimal proportions by the facts that the transmit and receive waves are polarised at right angles to each other in the tube, and that they are separated by wide frequency differences. The horn shape of the aerial is adopted to ensure that the energy is largely confined in the desired direction, and the dimensional accuracy is such that the microwave signals lose no more than one per cent of power in their passage from the waveguide to the air.

The concentrated beam produced by the aerial has a power density 40,000 times as great as that of an omni-directional aerial, and an angular width of about one degree. It is because the energy level falls so steeply beyond this width that the same carrier frequencies can be used simultaneously in several directions without mutual interference.

Vision Circuit Amplifiers. The engineers are examining the response of a video amplifier by means of trolley-mounted test equipment in the television repeater station. The instrument behind the picture monitor is an oscilloscope used for checking waveform response in greater detail.



Up to the top at 1,000 feet a minute

The restaurant revolves $2\frac{1}{2}$ times every hour, giving diners an ever-changing panorama of London through its glass walls.

The Post Office realised that this landmark could be a great magnet for visitors – and has catered for them.

At ground level is an imposing vestibule where a display of diagrams and photographs on the walls provide all the information about the 'works' that the most inquisitive visitor is likely to want. And there he will find a shop where, among other things, he can buy a postcard view of the Tower and post it to obtain a special postmark to record his visit.

From this vestibule the visitor steps into one of two high-speed lifts for a miniature journey into space. The lift carries him smoothly upward, through the very heart of the Tower, to a vast window on the whole of London.

Travelling upward at 1,000 feet a minute, he soars through the centre of the five floors which house the main ventilation and refrigeration plant, the batteries and the power units; past eleven apparatus floors and the four circular galleries where the aerials are mounted – until he steps out at one of the half dozen floors which have been designed to cater especially for the visitor.

The visitor has the choice of three observation platforms, from one of which, with the aid of binoculars and large photographic panoramas, he can look down upon and identify all the landmarks of London laid out before him – a view described and pinpointed for him in the panorama in the centre of this book.

Immediately above the highest of the three observation platforms there is a memorable restaurant. Driven electrically, with silent motors, it rotates slowly about the central core of the Tower. Revolving about $2\frac{1}{2}$ times every hour, it provides 120 diners with an ever-changing view through its glass wall. And above the restaurant is quite the highest cocktail lounge in London.

An artist's impression of the revolving restaurant which seats some 120 diners.

In the Vestibule a smartly uniformed Post Office attendant explains the Tower to a young visitor.

For the technically minded

THE GIANT WASHER

The revolving floor of the restaurant is in effect a large washer which carries the cladding of that portion of the Tower and so the windows themselves also rotate. Nylon-tyred wheels running on inner and outer circular rails support the whole rotating structure, which weighs almost 30 tons. A weather seal at both top and bottom of the rotating cladding is provided by means of polythene formed into a U cross-section rubbing on a coated steel plate.

Inside one of the two high-speed lifts which carry visitors up to the viewing platforms at 1,000 ft a minute.

An eye on the weather

Perched on the very top of the Tower is a lattice mast designed to carry still higher aerials in the future. Meanwhile it carries a storm warning radar scanner. This is the key-piece of equipment in the Meteorological Office's 'weather bureau in the sky'. With it rain or snow storms can be tracked down over a radius of up to 200 miles, the course, and speed, of the storm plotted, and warnings issued. It provides a service which enables, for instance, those involved in the staging of outdoor events, to find out where the storms are and if – and when – they are likely to hit or miss them. Other instruments, such as an anemometer (wind speed and direction recorder), sunshine recorder, thermometers and humidity recorders, are also installed; and some are connected to the London Weather Centre in High Holborn.

The aerial and turning gear of the Weather Radar being hoisted in position 620 feet above London. The radar will enable forecasters at the Holborn Weather Centre to see on display screens the position and extent of rain areas.

The Tower was designed by the Ministry of Public Building and Works to meet the technical requirements specified by the Post Office.
Chief Architect: E. Bedford, CB, CVO, ARIBA
Senior Architect in Charge: G. R. Yeats, LRIBA
Senior Structural Engineer-in-Charge: S. G. Silhan, M I Struct E
Senior Mechanical and Electrical Engineer-in-Charge:
J. J. Taylor, AMIEE
Resident Engineer: N. Lampitt, OBE, AMICE
The Main Contractors were Peter Lind & Co Ltd
(Site Agent: E. P. Cronin, AM I Struct E)

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