RADIO COMMUNICATION SERVICES

CONTENTS

INTRODUCTION

Radio Communication transmissions can be divided broadly into two categories. The first is Broadcasting, which, as the name suggests, is a service provided for general use without any discrimination in direction, and the second is Point-to-Point communication, in which transmission between two specific points takes place, usually as a means of providing telephone and telegraph routes between this country and abroad.

This pamphlet briefly describes the broadcasting services provided by the British Broadcasting Corporation and Independent Television Authority and gives some idea of the frequencies employed for transmissions and the output powers of the transmitters. Also described are the radio facilities provided by the British Post Office, including Point-to-Point transmissions and several miscellaneous services.

THE B.B.C. BROADCASTING SERVICE

The B.B.C. has a number of transmitting stations located at various points throughout the country, which provide an overall coverage of the British Isles with the Home, Light and Third programs. The main bulk of the programs are for entertainment purposes and are interspersed with regular news bulletins, weather forecasts and educational broadcasts.

The Broadcast service is provided by between 50 and 60 transmitters operating in the medium frequency range, between 647 and 1546 kc/s with output powers ranging from 0.25 to 150 kW. In the low-frequency range one frequency is used, 200 kc/s, and the transmitter power is 400 kW. The locations of B.B.C. stations transmitting in the medium and low-frequency ranges are shown in Fig. 1.

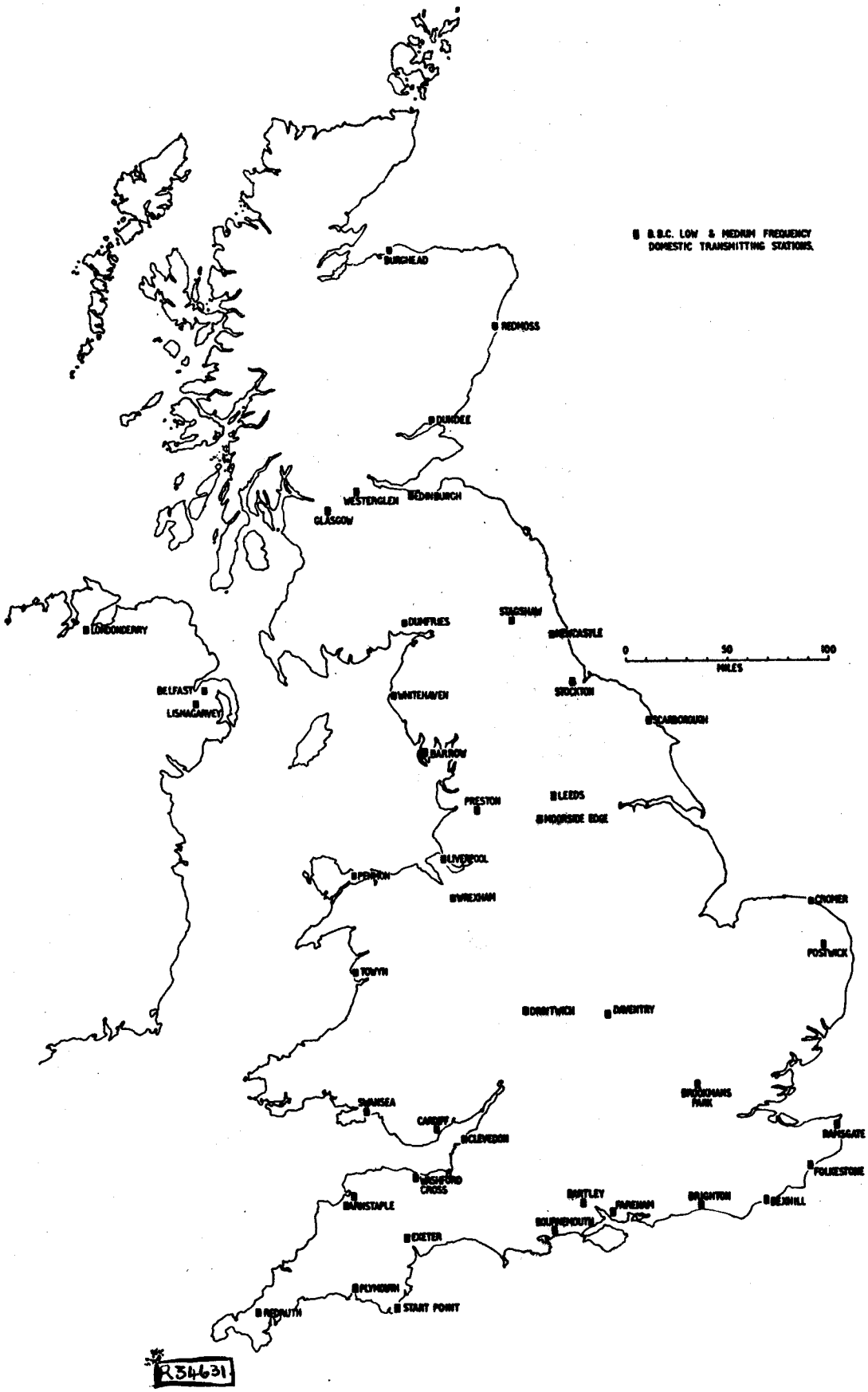

B.B.C. LOW & MEDIUM FREQUENCY DOMESTIC TRANSMITTING STATIONS
BURGHEAD
REDMOSS
DUNDEE
WESTERGLEN
EDINBURGH
GLASGOW
LONDONDERRY
DUMFRIES
STAGSHAW
NEWCASTLE
0
50
100
MILES
BELFAST
LISNAGARVEY
WHITEHAVEN
STOCKTON
SCARBOROUGH
BARROW
PRESTON
LEEDS
HOLME MOOR
LIVERPOOL
BIDSTON
WREXHAM
CROMER
POSTWICK
TOWYN
DROITWICH
DAVENTRY
SWANSEA
CARDIFF
CLEVEDON
BRIDGHAMS PARK
RAMSGATE
FOLKESTONE
CROSS
BARNSTAPLE
BATTLEY
BRIGHTON
BEXHILL
BOURNEMOUTH
EXETER
PLYMOUTH
REDRUTH
START POINT
R34631

Fig. 1

Each transmitting station broadcasts one, two or three programs and usually serves a specific area. An exception is Droitwich which transmits the Light Program on 200 kc/s with a 400 kW transmitter giving a coverage of most of the British Isles. The Midland Home Service is also transmitted from Droitwich on 1088 kc/s at 150 kW and gives a coverage of the Midland Counties.

Other typical examples of the services transmitted by various stations are as follows.

The station at Moorside Edge transmits the Light Program on 1214 kc/s at 50 kW and the Northern Home Service on 692 kc/s at 150 kW. The Third Program is transmitted from Daventry on 647 kc/s at 150 kW with a coverage of an area of radius 100 miles from Daventry. One of the low-powered stations is Cardiff which transmits the Third Program on 1484 kc/s at 1 kW and caters for a small local area only.

The signals transmitted from each station are amplitude-modulated, double-sideband signals and have a bandwidth extending to 20 kc/s. The maximum modulating frequency is 10 kc/s although due to the conflicting design requirements of the average commercial receiver in the radio-frequency stages, the higher of these audio frequencies are seldom reproduced on detection of the modulated signal.

Due to the number of stations transmitting in the medium frequency range, both in the British Isles and abroad, the reception of the B.B.C. programs is not always satisfactory, particularly at night. Changes in the condition of the layers which reflect radio waves in the ionosphere occur and increase the distance over which medium-frequency signals can be transmitted: and because the medium-frequency range is so crowded, interference occurs between British and Continental transmissions on adjacent frequencies.

In order to give an efficient service at all times the B.B.C. are setting up a series of transmitters operating in the v.h.f. range with carrier frequencies between 88.1 and 96.8 Mc/s. The location of these transmitters is shown in Fig. 2.

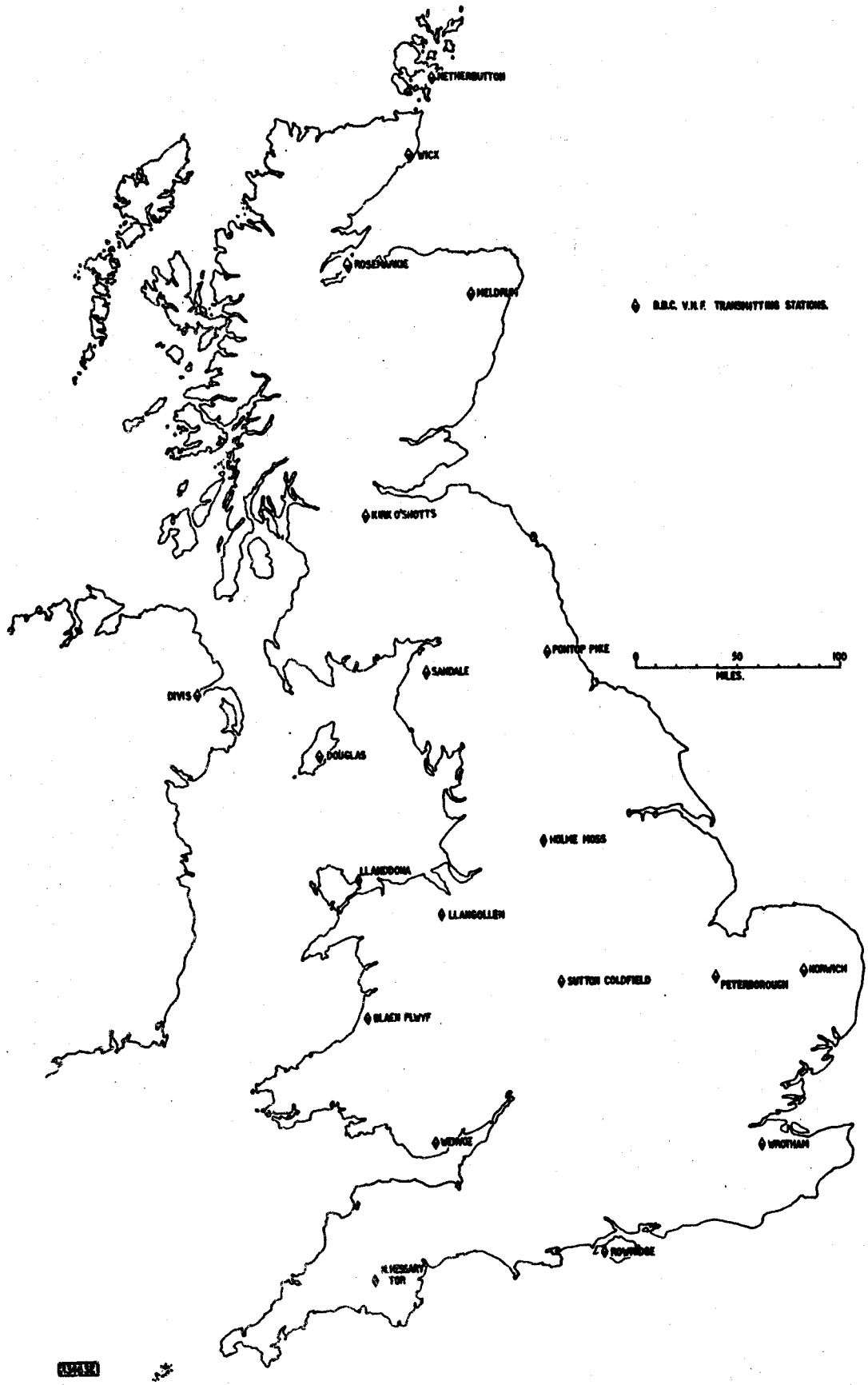

B.B.C. V.H.F. TRANSMITTING STATIONS.
0
50
100
MILES.
DOUGLAS
SUTTON COLDFIELD
PETERBOROUGH
NORWICH
WROTHAM

Fig. 2

These stations transmit the Home, Light and Third Programs on different frequencies and have effective radiated powers ranging from 3 kW to 120 kW. The transmitting stations include Wrotham which transmits the Light Program on 89.1 Mc/s, the Home Service on 93.5 Mc/s and the Third Program on 91.3 Mc/s. The output power of each transmitter at Wrotham is 120 kW. Rosemarkie transmits the Home, Light and Third Programs on frequencies of 94 Mc/s, 89.6 Mc/s and 91.8 Mc/s respectively with a power output of 6 watts for each program. Holme Moss transmits the Home Service on 93.7 Mc/s the Light Program on 89.3 Mc/s, and the Third Program on 91.5 Mc/s each with an output power of 120 kW. Holme Moss and fifteen other stations transmit both v.h.f. and television programs.

Due to the high carrier frequencies used, reception beyond the horizon as seen from the aerial is usually unsatisfactory, and many stations are needed to give complete coverage of the British Isles. The frequencies of geographically adjacent stations are carefully chosen as interaction may occur between them if they are on the same frequency.

However, the method of modulation, known as frequency modulation, ensures interference-free reception in almost all circumstances. The maximum modulating frequency is 10 kc/s and a total bandwidth of 170 kc/s is produced. Commercial v.h.f.-F.M. receivers are designed to accept this bandwidth and the range of audio frequencies re-produced depends upon the frequency response of the output stage rather than the design of the radio-frequency stages.

Coverage of the British Isles at v.h.f. is not yet complete but new transmitters are being brought into service as quickly as possible.

B.B.C. TELEVISION SERVICE

The Television Service is a form of broadcasting which, as with sound radio, is provided by a series of stations placed strategically throughout the British Isles. Their positions are shown in Fig. 3.

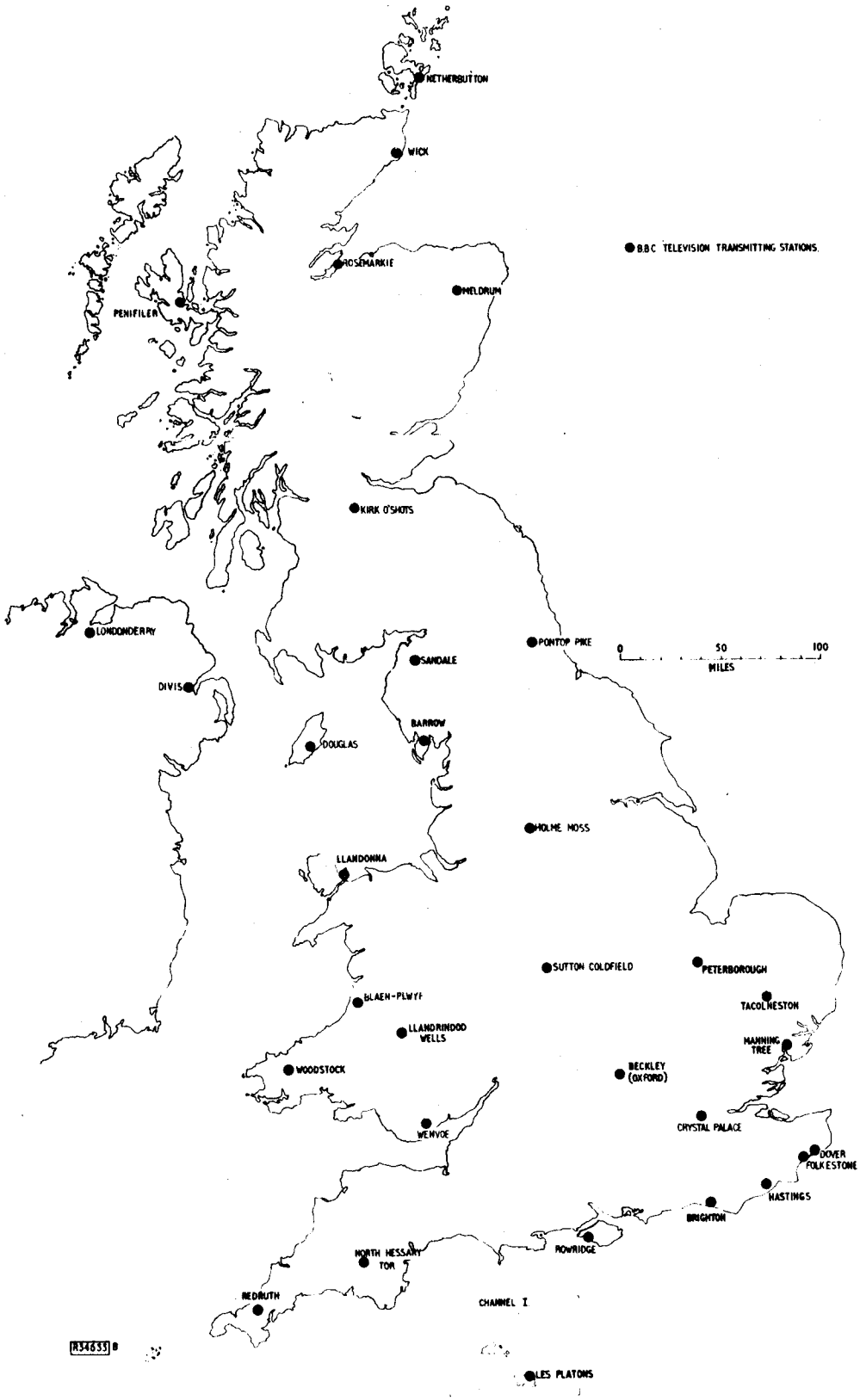

B.B.C TELEVISION TRANSMITTING STATIONS.
NETHERBUTTON
WICK
ROSEMARKIE
MELDRUM
PENIFILER
KIRK O'SHOTS
LONDONDERRY
PONTOP PIKE
SANDALE
DIVIS
BARROW
DOUGLAS
HOLME MOSS
LLANDONNA
SUTTON COLDFIELD
PETERBOROUGH
BLAEN-PLWYF
TACOLNESTON
LLANDRINDOD WELLS
MANNING TREE
WOODSTOCK
BECKLEY (OXFORD)
CRYSTAL PALACE
WENVOE
DOVER
FOLKESTONE
HASTINGS
BRIGHTON
ROWRIDGE
NORTH HESSARY TOR
REDRUTH
CHANNEL I
LES PLATONS
0
50
100
MILES
R34655 B

Fig. 3

The programs are transmitted in the v.h.f. range on five channels. Each channel has a carrier wave for the vision signal and a carrier wave for the sound signal. The five channels used by the B.B.C. are designated Channels 1 to 5 and have the carrier frequencies shown in Table 1.

TABLE 1

Channel	Vision carrier frequency Mc/s	Sound carrier frequency Mc/s
1	45	41.5
2	51.75	48.25
3	56.75	53.25
4	61.75	58.25
5	66.75	63.25

The frequency of each transmitter is carefully chosen so that no interaction takes place between them and the five main high power transmitters are placed many miles apart. They are situated at Crystal Palace in London, Holme Moss in Yorkshire, Kirk O'Shotts in Central Scotland, Sutton Coldfield in the Midlands and Wenvoe in South Wales: these stations transmit on Channels 1 to 5 respectively. The effective radiated power of the Crystal Palace transmitter is 200 kW and that of the other four 100 kW.

The picture transmissions are amplitude modulated, and, in the British Television System, the maximum modulation frequency necessary to give adequate picture quality is 3 Mc/s. This frequency, when used to amplitude modulate a carrier, gives an overall bandwidth of 6 Mc/s. The bandwidth is reduced to about 3 Mc/s before transmission by removing most of the upper sideband, and the remaining signal, which is known as a Vestigial sideband signal, is radiated. The economy in bandwidth obtained allows more transmissions to be accommodated within a given range of frequencies than would be possible if the full 6 Mc/s double-sideband signal were radiated.

The sound transmission is a normal amplitude-modulated double-sideband signal with a carrier frequency 3.5 Mc/s below that of its associated vision carrier.

The programs are carried from the studios by B.P.O. lines and radio links to most of the transmitters, but a few of the transmitters work on the direct pickup system. On this system the signal radiated by an adjacent transmitter is received, amplified and re-radiated at greatly increased power.

INDEPENDENT TELEVISION AUTHORITY TELEVISION SERVICE

This authority controls a series of television transmitters which operate on the same system and with the same standards as the B.B.C. Television Service. The main difference is the range of frequencies used by the I.T.A. transmitters which operate on the seven channels numbered 6 to 12. Channel 6 has a sound carrier frequency of 176.25 Mc/s and vision carrier frequency of 179.75 Mc/s; each subsequent channel is spaced by 5 Mc/s from the previous one up to Channel 12 which has a sound carrier frequency of 206.25 Mc/s and vision carrier frequency of 209.75 Mc/s. The location of each I.T.A. transmitter is shown in Fig. 4.

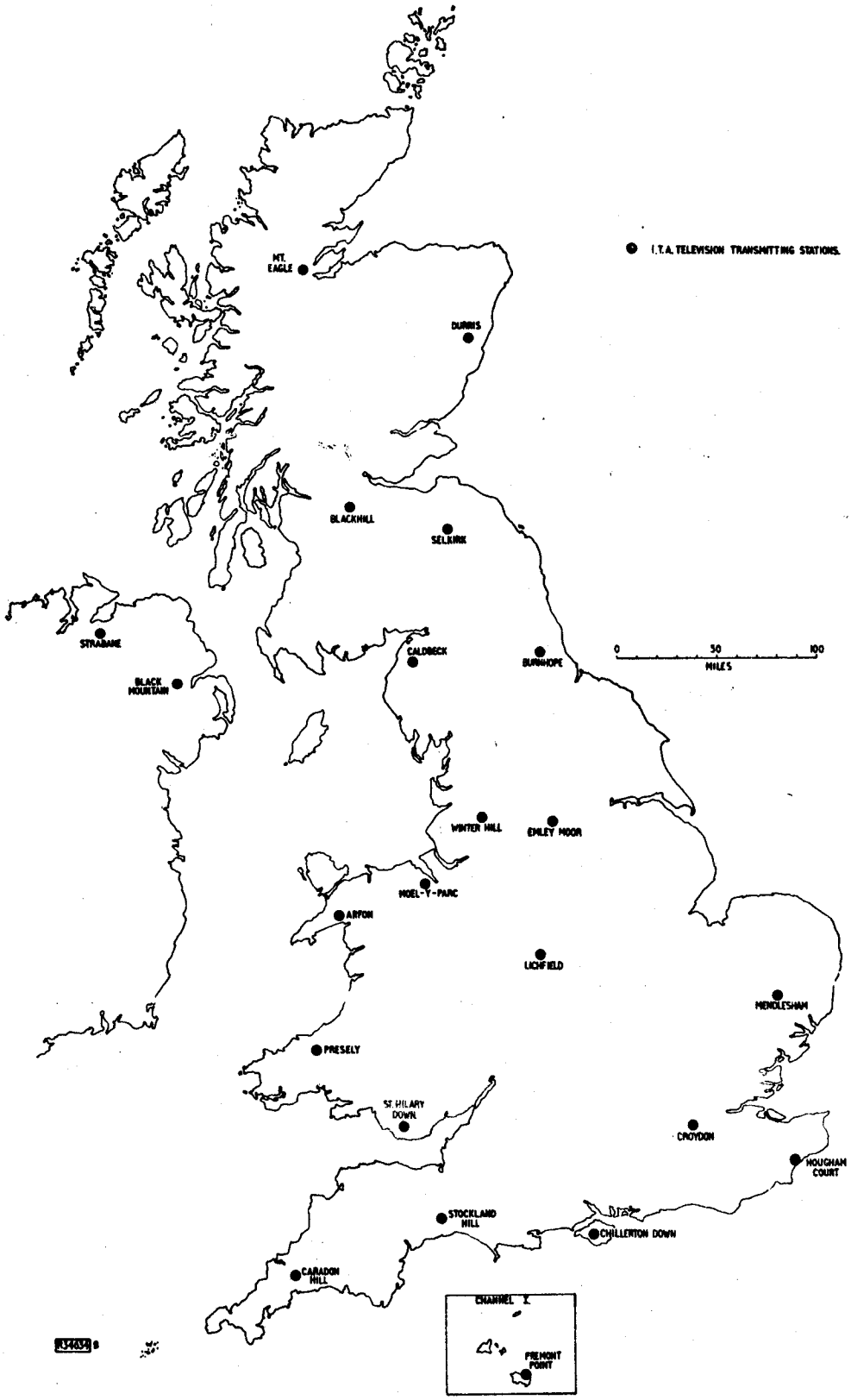

I.T.A. TELEVISION TRANSMITTING STATIONS
MT. EAGLE
DUNRIS
BLACKHILL
SELKIRK
STRABANE
CALDBECK
BURNHOPE
0 50 100
MILES
BLACK MOUNTAIN
WINTER HILL
EMLEY MOOR
MOEL-Y-PARC
ARFON
LICHFIELD
MENDLESHAM
PRESELY
ST HILARY DOWN
CROYDON
HOUGHAM COURT
STOCKLAND HILL
CHILLERTON DOWN
CARADON HILL
CHANNEL I.
FREMONT POINT

Fig. 4

POST OFFICE RADIO SERVICES

When a telephone or telegraph call is extended overseas the long-distance B.P.O. Radio Service is employed if cable circuits are not available. Point-to-point working is used and the transmitter signal is 'beamed' to a particular receiving station in the distant country. As the transmission is in one direction only a return path must be provided by a transmitter located in the same country as the receiving station, and the return signal is picked up at a B.P.O. receiving station.

The transmitting and receiving stations in each country are situated some distance apart and different frequencies are used for transmission and reception. These precautions minimise the possibility of interference between the transmitted and received signals.

Point-to-point working and a wide range of other services are provided by a number of B.P.O. transmitting and receiving stations situated throughout the British Isles.

These stations provide radio circuits which operate regularly between Great Britain and such countries as Australia, New Zealand, North and South America, the Continent and the Middle East to mention but a few.

The regular services include such facilities as the transmission of still pictures (facsimile), press broadcasts and standard-frequency transmissions. In addition bothway telephone and telegraph transmissions can be provided with suitably equipped ships at sea.

The locations of the main B.P.O. transmitting and receiving stations (except Portishead and Burnham) are shown in Fig. 5.

In addition to their conventional radio communication commitments the B.P.O. is now engaged in research into the problems of setting up a world-wide communication system via artificial earth satellites. An experimental microwave transmitting and receiving station has been established at Goonhilly Down in Cornwall for this purpose.

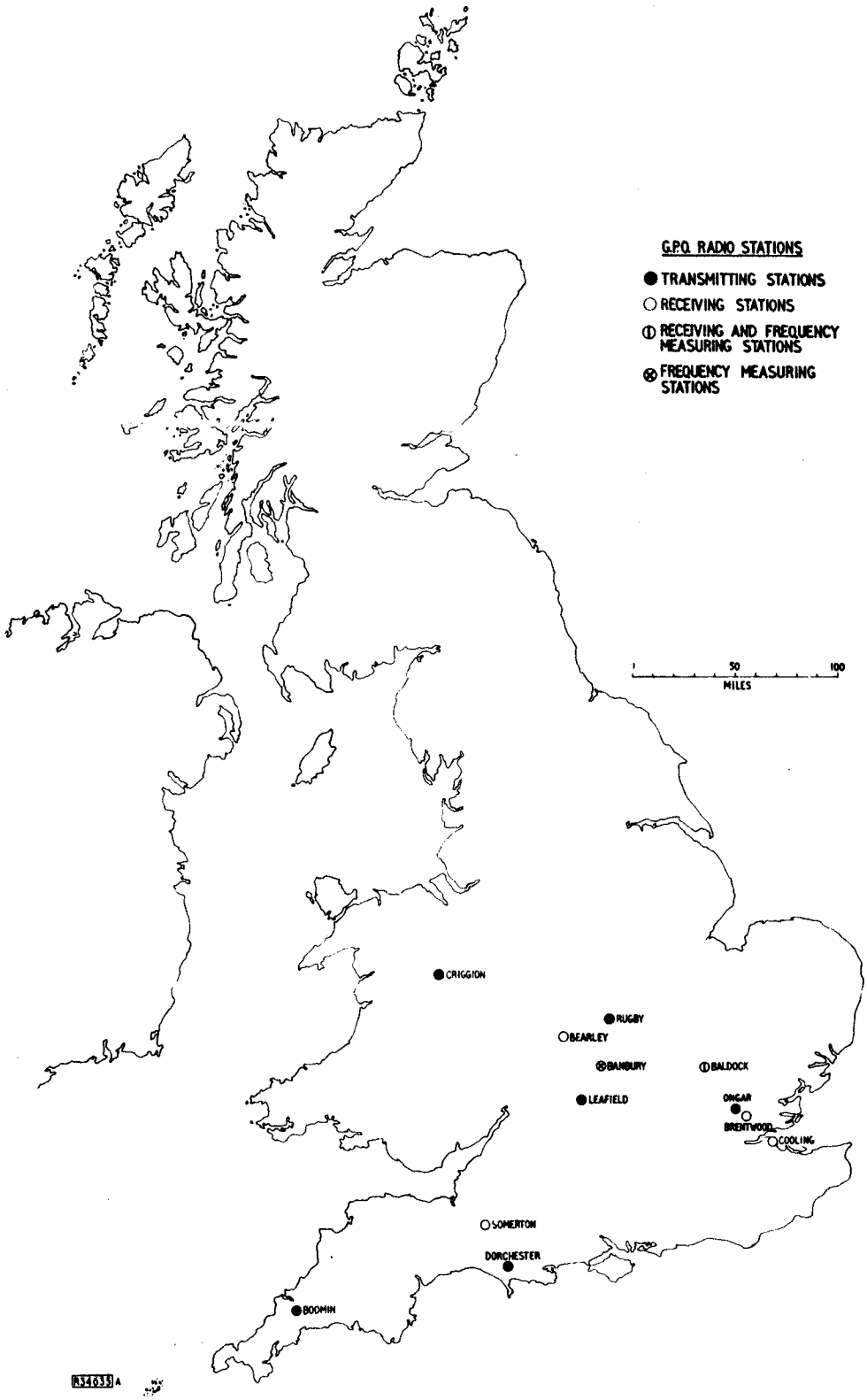

G.P.O. RADIO STATIONS
TRANSMITTING STATIONS
RECEIVING STATIONS
RECEIVING AND FREQUENCY MEASURING STATIONS
FREQUENCY MEASURING STATIONS
50
100
MILES
CRIGGION
RUGBY
BEARLEY
BANBURY
BALDOCK
LEAFIELD
ONGAR
BRENTWOOD
COOLING
SOMERTON
DORCHESTER
BODMIN
R34635 A

Fig. 5

A list of B.P.O. transmitting and receiving stations is given in Table 2 together with the services provided.

TABLE 2

Transmitting Stations	Services
Leafield	Multi-destination press broadcasts. Point-to-point telegraphy.
Griggion	Multi-destination press broadcasts. Point-to-point telephony and telegraphy.
Rugby	Point-to-point telephony and telegraphy. Standard-frequency transmissions. Time signals. Multi-destination press broadcasts.
Dorchester	Point-to-point telegraphy and facsimile.
Ongar	Point-to-point telegraphy and facsimile.
Bodmin	Point-to-point telegraphy and facsimile.
Portishead	Shore-to-ship telegraphy.
Receiving Stations	
Somerton	Point-to-point telegraphy and facsimile.
Bearley	Point-to-point telegraphy and telephony. Facsimile.
Baldock	Point-to-point telegraphy and telephony. Ship-to-shore telephony. Frequency measuring station.
Brentwood	Point-to-point telegraphy and facsimile.
Cooling	Point-to-point telephony including New York telephony service.
Burnham	Ship-to-shore telegraphy.
Banbury	Frequency measuring station.
Experimental Stations	
Goonhilly Down	Experimental work on communication via artificial earth satellites.

Two centres in London have technical control of all overseas telephone and telegraph calls. The radio telephone calls are controlled at Brent Building in North West London and radio telegraph calls at Electra House on the Thames Embankment

A map showing points connected to London by the B.P.O. long distance radio telephone and telegraph services is shown in Fig. 6.

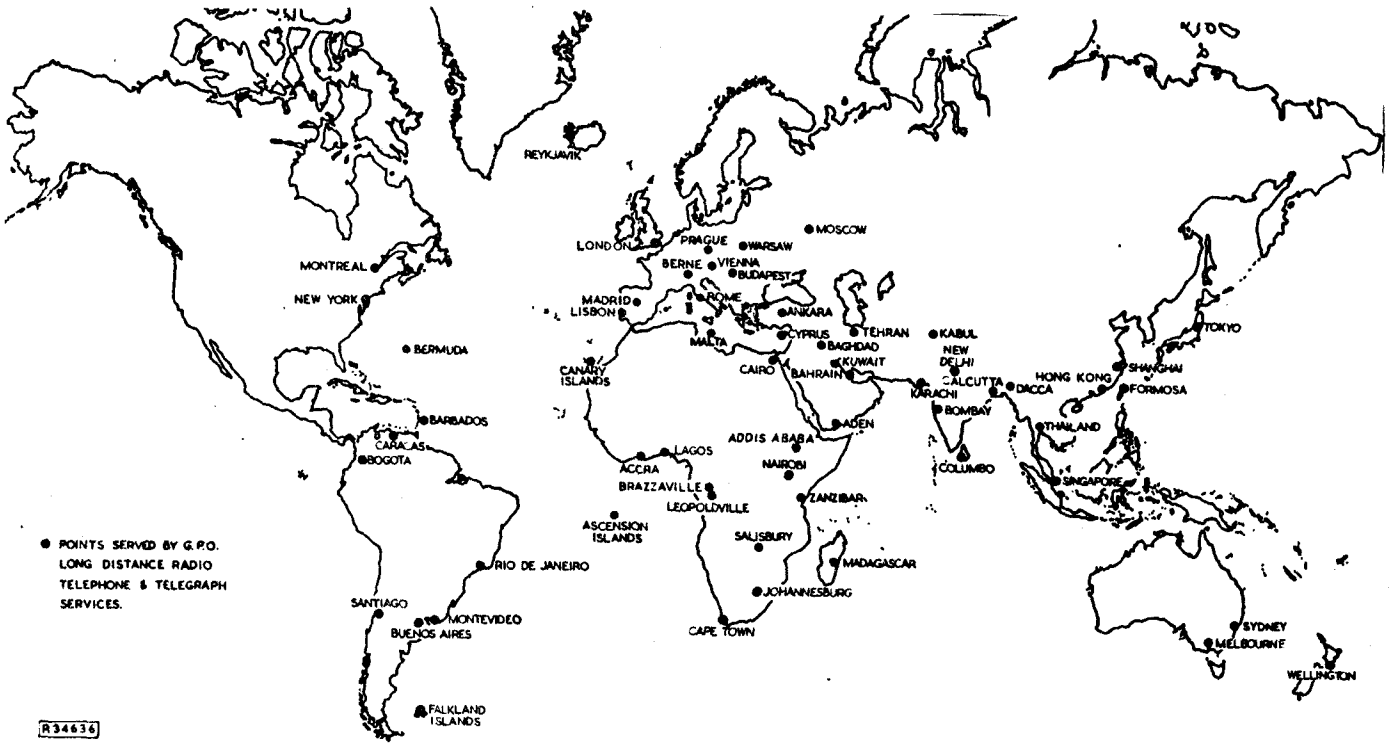


Fig. 6

POINT-TO-POINT RADIO-TELEPHONE SERVICE

When a telephone subscriber wishes to speak with someone overseas the call may be effected by the point-to-point radio services provided by the B.P.O.

The call from the subscriber is routed from the local exchange to the International Exchange (in Wood Street, London) where the call is controlled and timed. Details of the call are taken and then passed to Brent Building where supervision of the call by technical staff takes place. The call is connected by land line to the correct transmitting station and its associated receiving station. The 'go' and 'return' circuits are combined at International Exchange and are connected to the National telephone network.

A block schematic diagram showing the connexions of an overseas call is shown in Fig. 7.

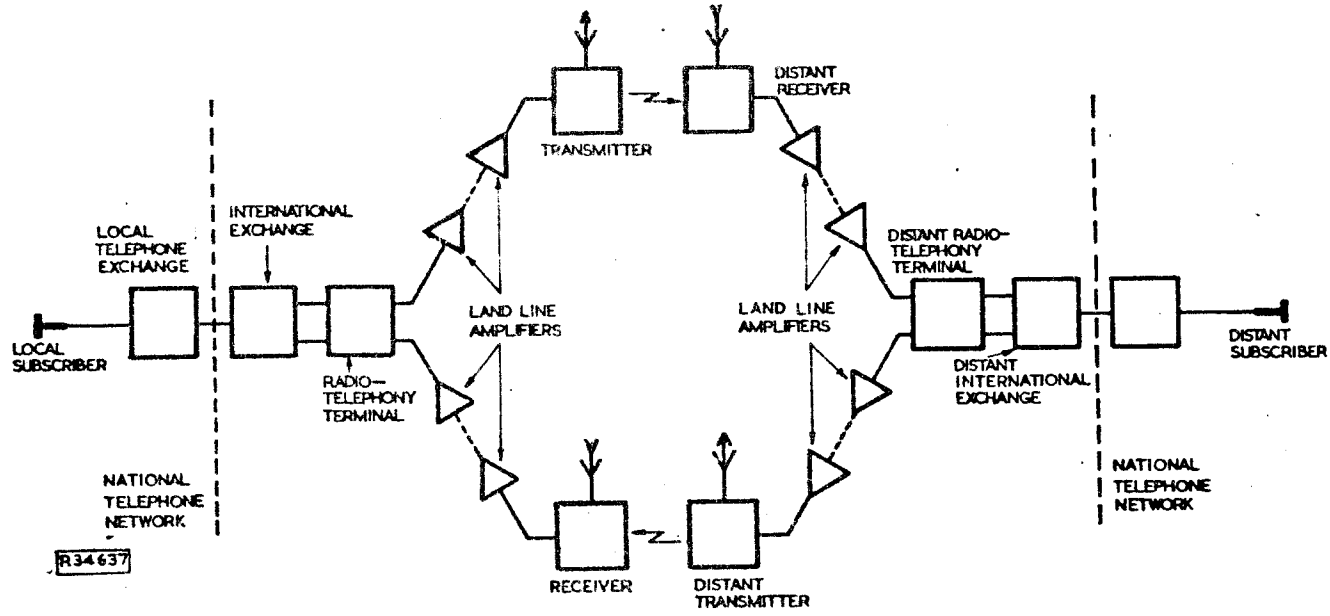


Fig. 7

Equipment is situated at Brent Building which gives privacy over the radio section of the route. This apparatus splits the speech band from the subscriber into five sections and transposes them so that the messages are unintelligible to any unauthorised person receiving them. The transposed sections of the frequency band are then used to modulate a transmitter. Equipment is installed at the distant receiving station which restores the signal to normal before transmission over land lines to the called subscriber, and similar equipment is installed on the return path to ensure privacy in the return direction.

Other apparatus compensates for differences in speech level in the system and ensures that, within limits, a reasonable depth of modulation is maintained throughout the conversation.

The majority of transmitters operate in the high-frequency range between 3 and 30 Mc/s and employ single-sideband or independent-sideband transmissions. In the independent-sideband system each sideband carries different information and the carrier wave is transmitted at a relatively low level. The bandwidth of each sideband is approximately 6 kc/s and can carry two conversations each of which have a bandwidth of 3 kc/s. This means that four conversations or 'channels' can be transmitted simultaneously from each transmitter with an overall bandwidth of 12 kc/s.

Directional aerials are used which beam the transmission in the required direction.

Rhombic aerials are used at most B.P.O. transmitting stations because these aerials combine highly directional properties with the ability to work efficiently over a fairly wide range of frequencies. The latter property is desirable as changes in propagation conditions make it necessary to use several different frequencies on one transmission path during different parts of the day.

POINT-TO-POINT TELEGRAPHY

Telegraphy services are available to all parts of the world and as with the telephone service the National telegraph network can be extended and messages transmitted by radio. The telegraphy signals from the renters are routed through Electra House where they are converted into a suitable form for radio transmission. Several different types of signalling systems are used to operate distant teleprinters or other devices, but wherever possible, automatic error detecting signals are being brought into use so that errors due to fading or distortion over the radio path are automatically corrected as the message proceeds.

PRESS BROADCAST SERVICE

The Press Broadcast Service is provided for press agencies who wish to broadcast news to their agents abroad.

The B.P.O. have transmitters for this purpose operating in the h.f. range, each of which uses an aerial having a broad beam. The transmissions are thus 'beamed' to large areas such as North America, South America, Europe and others. This service gives almost world wide coverage.

Difficulties arise on this type of long-distance transmission due to changes in propagation conditions over the various paths. The service is one way only and the receiver operators are not necessarily highly skilled so changes in frequency cannot take place at short notice as can be done in point-to-point operation.

To overcome this it is necessary to arrange a schedule of frequencies for each direction of transmission. Forecasts are made by the B.P.O. showing which frequencies will give the best service at any particular time for several months ahead. These are sent to the transmitting and receiving stations and the necessary frequency changes are made by both at the appropriate times.

Morse code and Hellschreiber transmissions are at present used for the majority of the Press broadcasts but teleprinter operation is now becoming more popular.

TRANSMISSION AND RECEPTION OF PICTURES

The transmission and reception of still pictures or documents is known as facsimile telegraphy and as with telephony and telegraphy transmission this may take place over normal telephone cables or over a radio path between two countries.

The parties interested in this facility are press agencies who require a picture taken in, say, New York for publication in a newspaper in this country a few hours later, or business firms who require accurate copies of documents from an overseas branch.

The picture to be transmitted is scanned by a point of light and the light reflected from the picture is directed on to a photo-electric cell. The electrical output from the photo-electric cell varies according to the light and dark parts of the picture. The output is amplified and is used to amplitude or frequency-modulate a low-frequency carrier wave. This may be sent over a line circuit to a transmitter where it is used to modulate a high-frequency carrier wave. At the receiving end the reverse process takes place and the signal is used to vary the intensity of a lamp focussed upon sensitized paper. The paper is scanned by the lamp in synchronism with the light spot scanning the original picture. The paper is then developed and after development a copy of the original is produced.

The copy is either delivered by hand or re-transmitted over line circuits to the press agencies or firm requiring it. Further details of facsimile telegraphy are given in E.P. Draft Series Telegraphy 6/1.

SERVICES TO SHIPS

Facilities which enable communication to take place between ships at sea and the shore are provided by a series of radio stations operated by the B.P.O., these are under the control of the Wireless Telegraph Section of the Radio Services Dept.

Services to ships in home waters are provided by a series of coast radio stations and long-distance services by certain of the inland transmitting and receiving stations.

Transmission from the coast stations is in the medium-frequency range and all British territorial waters are covered by these transmitters. In addition to normal bothway telephone and telegraph services the coast stations broadcast weather forecasts and gale warnings and provide medical and distress services.

Bothway telephony services in the v.h.f. band are now being provided at each coast station for communication between ships and harbour authorities.

The locations of the coast radio stations are shown in Fig. 8. (overleaf.)

For long-distance services six frequency bands in the high-frequency range are used near 4, 6, 8, 13, 17 and 22 Mc/s. The main high-frequency telegraph transmitters are situated at Portishead and the receiving station at Burnham. The radio operator at Burnham has control of the remote transmitter he is using at Portishead.

Long distance h.f. telephony traffic is received at Baldock, the associated transmitters being situated at Rugby and Criggion.

High-frequency transmissions have an inner limit within which satisfactory reception is not possible, The range of the medium-frequency coastal transmitters is not great enough to cover this area so low-frequency transmission in the range 110 to 160 kc/s are provided.

The low-frequency transmitters, which are remotely controlled from Burnham, are sitauted at Portishead.

Ship Distress Signals

Two frequencies, 500 kc/s and 2182 kc/s are allocated for ship distress signals. These frequencies are monitored by all coastal stations and should a ship call on a distress frequency it is answered immediately, and, after taking

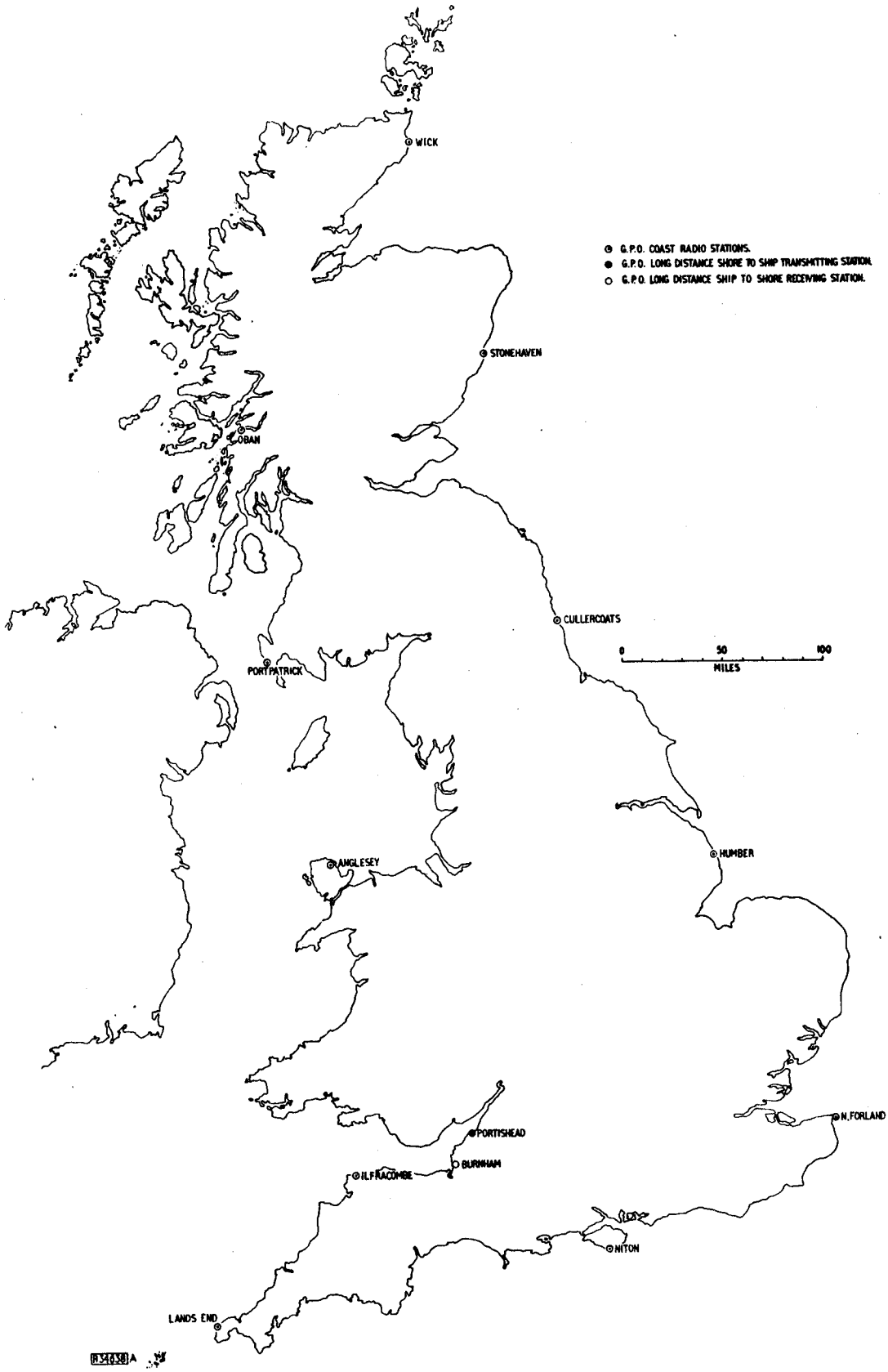

G.P.O. COAST RADIO STATIONS.
G.P.O. LONG DISTANCE SHORE TO SHIP TRANSMITTING STATION.
G.P.O. LONG DISTANCE SHIP TO SHORE RECEIVING STATION.
WICK
STONEHAVEN
OBAN
CULLERCOATS
0
50
100
MILES
PORTPATRICK
HUMBER
ANGLESEY
N.FORLAND
PORTISHEAD
BURNHAM
ILFRACOMBE
NITON
LANDS END

Fig. 8.

particulars, the rescue services are informed at once. Direction finding equipment is available should it be necessary to determine the position of the ship.

Medical Service

This service which is known as "Medico", enables medical advice to be obtained should there be an accident or case of sudden illness at sea. The master of a ship may call a coast station and be connected with a local hospital ashore. The master then passes as much information as possible about the patient and receives advice from a doctor as to the correct way to deal with the case.

The Thames Radio Service

The Thames Radio Service is provided to give telephone service to small ships which operate in the Thames and its estuary. The service provided enables a telephone subscriber to talk to any ship and for a ship to call a telephone subscriber.

A fixed shore station is situated at Shooters Hill on the south side of the Thames. This station is equipped with a 50 watt transmitter and a receiver, together with standby equipment, and is operated by the B.P.O. Land lines connect Shooters Hill to the International Exchange and it is there that calls are received from ships and telephone subscribers.

The mobile equipment fitted to each ship consists of a transmitter with an output power of about 10 watts and a receiver. This equipment is not provided by the B.P.O. but is supplied commercially. It must not cause interference to other radio users and must have adequate range.

Carrier frequencies used are in the v.h.f. range and are of the order of 160 Mc/s. Amplitude modulation is used.

A river service with similar facilities to the Thames Radio Service is provided for the river Clyde.

Radiophone Service

A pilot scheme for this service was installed in South Lancashire in 1959. The system provides communication between mobile radio telephones installed in motor vehicles and the public telephone network. Two base stations are used, one situated at Winter Hill near Bolton, and the other at Liverpool. The service area of this scheme is bounded by Lancaster on the north, Oldham on the east, and Chester on the south and serves all the west coastal areas in this range.

Calling is by voice over one of two channels on two common frequencies for both base stations. One channel is used for originating calls from all mobile stations, the other being used for originating calls from the telephone network. When contact between the mobile and base station has been established, the telephone conversation is carried out on either a simplex or duplex basis over one of two traffic channels which are available, the calling channel being freed for further use.

Frequency modulation is used in the v.h.f. range of 160 Mc/s.

The effective radiated power (e.r.p.) of each base station transmitter is approximately 35 watts, and the mobile transmitter output power is limited to 25 watts. The mobile equipment is provided by commercial companies but must be licensed by the Post Office.

This service is only in its pilot form and future developments which may include selective calling and privacy are envisaged.

STANDARD-FREQUENCY TRANSMISSIONS

The B.P.O. transmit four carriers which may be used as frequency standards wherever they can be received. These standards are transmitted from Rugby Radio Station at frequencies of 60 kc/s, 2.5 Mc/s, 5 Mc/s and 10 Mc/s. The 60 kc/s signal is transmitted for only a short period each day but the high-frequency carriers are transmitted throughout the 24 hours. The carriers are modulated with a 1 kc/s signal, a one second time signal and are cut off completely at predetermined times each hour in the following sequence:-

Minutes past the hour				Type of modulation
0-5		30-35	45-50	1 kc/s tone
5-10	20-25	35-40	50-55	1 second pulses
10-14	25-29	40-44	55-59	No modulation
14-15	29-30	44-45	59-60	Morse and speech announcement
Carrier is not transmitted between 15 and 20 minutes past the hour.				

This sequence enables the carriers to be identified and used as a time standard i required.

The carriers are derived from one of three high stability 100 kc/s oscillators which are continuously compared with each other so that any instability can be detected immediately. Suitable frequency multiplying and dividing circuits convert the 100 kc/s to the frequencies required.

The standard frequencies are continuously monitored by the National Physical Laboratory who inform the B.P.O. if the radiated frequencies vary by more than the tolerance allowed of ± 2 parts in 100,000,000.

The frequency of the 16 kc/s transmitter at Rugby is also derived from the high-stability oscillators and has a stability high enough for it to be regarded as a standard frequency.

The service is used by laboratories who require a frequency standard for experimental work, commercial firms who require a frequency standard to calibrate instruments, amateur radio enthusiasts, Service Departments and observatories.

FREQUENCY-MEASURING STATIONS

The frequency-measuring stations operated by the B.P.O. continuously monitor radio transmissions in the range 10 kc/s to 30 Mc/s. Frequency-measuring stations are situated at Banbury and Baldock.

Banbury is particularly concerned with gathering the information required for the International study of frequency allocations. The information obtained at Baldock is used in connexion with the day to day operation of the B.P.O. radio services.

All types of transmission are monitored and the information obtained for each transmission includes its identity, frequency, bandwidth, field strength, direction, and degree and nature of fading and interference. From the observations taken, it can be ascertained whether stations are observing Internationally agreed frequency allocations, have the frequency stability required and do not occupy excessive

bandwidth. Propagation conditions over various paths and at different frequencies can also be observed. This information is useful when the frequencies for long-distance radio routes are allocated.

Signals to be measured are received on commercial and B.P.O. receivers which are used in conjunction with special equipment which measures transmission bandwidths and scans a range of frequencies. Signals received are registered automatically. The frequency of any particular transmission can be measured, with frequency-measuring equipment, to a greater accuracy than is required to conform to International standards. Measurements of this type enable a record to be obtained of stations infringing internationally agreed standards for frequency and bandwidth.

A frequency standard is provided which has high stability and is derived from 100 kc/s crystal-controlled oscillators. Suitable frequency-multiplying and dividing circuits provide the necessary frequencies for operation of the frequency-measuring equipment and other apparatus. The frequency standard is checked against the standard frequencies transmitted from Rugby Radio Station.

RADIO LINKS

It is often necessary to provide communication between two points where it is impracticable or uneconomical to lay cable. Under these circumstances a radio link is used.

A radio link consists of a series of combined transmitting and receiving station in sight of each other at intervals of between 20 and 50 miles along a route. The signal to be transmitted is fed into the transmitter at the beginning of the route and modulates a carrier wave which is beamed to the first receiving station. After reception it is amplified and re-transmitted at a slightly different frequency to the next receiver in the chain. It is again received, amplified and passed on until it reaches its destination. At its destination the carrier is demodulated and the original signal recovered. A block diagram of a radio link is shown in Fig. 9.

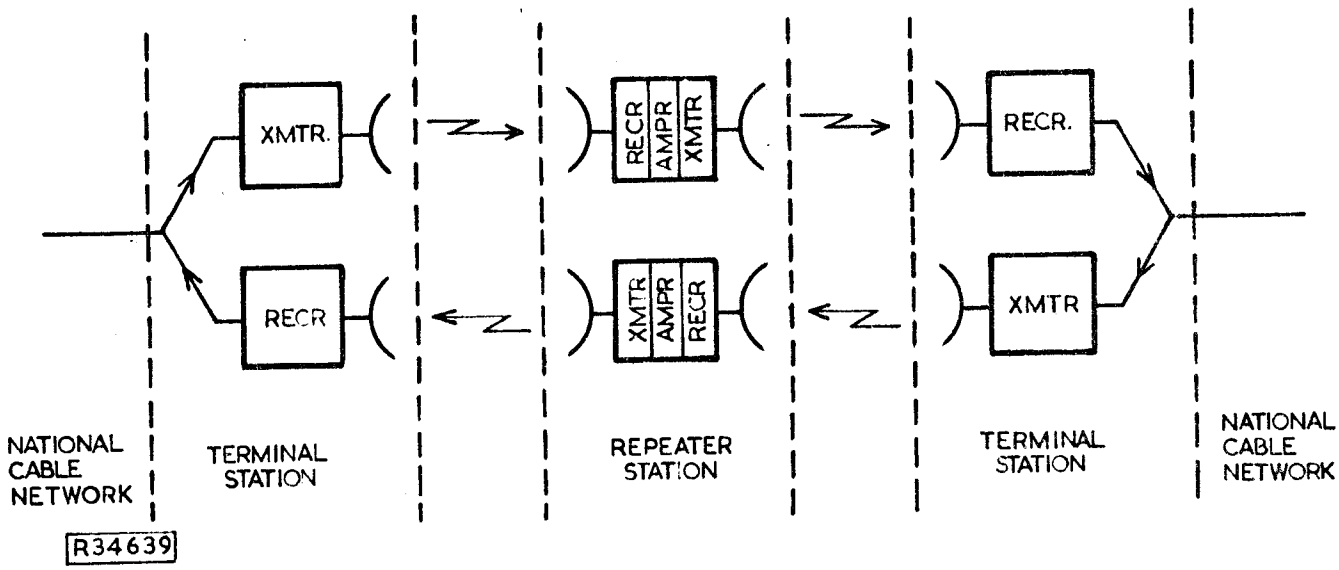


Fig. 9

A radio link may have only one hop with a transmitter at one end and a receiver at the other, or alternatively, a number of intermediate repeater stations forming a route several hundreds of miles long.

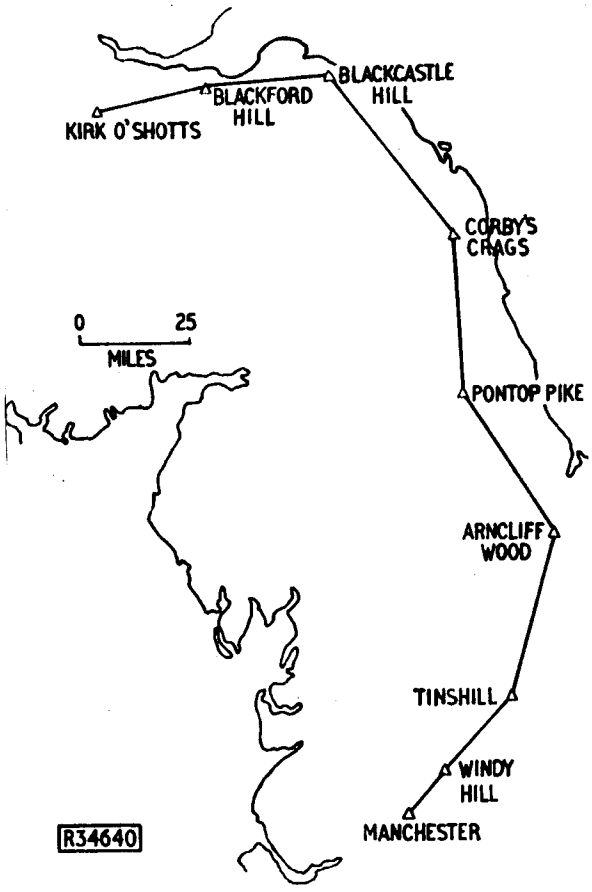
The carrier frequencies used on radio links are between 50 and 4000 Mc/s.

The carrier frequencies used on the latest B.P.O. equipment are in the range 2000 to 6000 Mc/s and frequency modulation is used.

At frequencies of 900 Mc/s and above, parabolic aerials are mainly used on both transmitters and receivers. The signal may thus be accurately directed from one station to the next with powers of 10 watts or less.

Transmission over the route is usually in both directions and each intermediate or repeater station is equipped with a transmitter and receiver for each direction together with standby equipment for use in the event of a breakdown. Radio links may be an integral part of the National telephone and telegraph network as an alternative to conventional cables, and as such may be equipped to carry as many as 1800 telephone conversations simultaneously. They may also be used to carry television signals and are used in conjunction with the coaxial cable network to carry vision signals from television studios to transmitters.

A typical system is shown in Fig. 10. B.B.C. television signals are sent from London via a coaxial cable to Manchester and from there by a radio link of eight hops to the B.B.C. television transmitter at Kirk O'Shotts.



Radio links are provided between the mainland and off-shore islands where a telephone service is required and a suitable location for the radio equipment can be found. These links operate in the v.h.f. range; a typical system is designed to carry twenty-four simultaneous conversations. Links are also provided to give telephone service to remote villages or isolated subscribers. These operate on a lower frequency and only single-channel systems are provided.

Fig. 10

OTHER SERVICES

The main radio-communication systems operated by the B.P.O., B.B.C. and I.T.A. have been described in this pamphlet and these give a general overall picture of the types of radio service operating in this country. Many other services are also in operation and these include ground-to-air communication by the airlines, Armed Services stations, Diplomatic Wireless Service stations and mobile police, fire and ambulance networks.

END

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E.P. - Draft Series TELEGRAPHY 6/1.

APPENDIX

Nomenclature of Radio Frequencies

Frequency		Classification	Abbreviation
10 - 30	kc/s	very-low frequencies	v.l.f.
30 - 300	kc/s	low frequencies	l.f.
300 - 3000	kc/s	medium frequencies	m.f.
3 - 30	Mc/s	high frequencies	h.f.
30 - 300	Mc/s	very-high frequencies	v.h.f.
300 - 3000	Mc/s	ultra-high frequencies	u.h.f.
3000 - 30000	Mc/s	super-high frequencies	s.h.f.
30000 - 300000	Mc/s	extra-high frequencies	e.h.f.