SECRET

W. G. RADLEY

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Vol. 1 of 2.

NOTE

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Issued to Mr……

…….

(Headquarters Town)

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RESEARCH BRANCH SECRET WAR DIARY

August 25th 1939

Occupation of Part of Research Station by Admiralty Insurance Party

We had been informed late on the evening of the 24th that a party from the Admiralty would arrive at Dollis Hill on the following day and would take over part of the accommodation which had been previously ear-marked for them by arrangement with the Telecommunications Department (Telephone Branch, National Defence Measures). Captain W.L. Jackson, D.S.O., Mr. C.M. Dodwell (Principal) and a party including a number of Commander's R.N. and civil staff arrived about midday. The immediate requirements of the party were discussed and the following rooms were handed over

General Research Building - Rooms 1 and 2, 6 and 11, First Floor Rooms 12, 19 and 20, Second Floor

Central Services Building - School Lecture Rooms Nos. 14, 15 and 17 and the Main Lecture Theatre

(Room 2 and the Main Lecture Theatre were subsequently released and other re-adjustments made by the Admiralty so that they remained in possession of substantially this accommodation for a period of over three months).

32 students in the Training School from courses due to terminate on the following day, were sent back to their Headquarters in order to release required accommodation.

August 26th 1939

Occupation of Part of Research Station by Admiralty Insurance Party

Vice-Admiral Sir Charles E. Kennedy-Purvis, C.B., arrived on the Station and took over command of the Admiralty party. It was understood that this party was present as an "Insurance Party" so that in the event of extensive air raid damage being done to Whitehall, a skeleton organisation would exist at Dollis Hill which could temporarily, but immediately, take over the naval control of the war.

In view of the secret nature of the Admiralty occupation, it was thought desirable that students should be excluded entirely from the General Research and Central Services Buildings. In order to make this possible, a further 173 students from nine courses were returned to their Headquarters. The courses selected for treatment in this way were those which had only just started or of which the majority of students came from provincial centres.

RESEARCH BRANCH SECRET WAR DIARY

August 28th 1939 — Occupation of Part of Research Station by Admiralty Insurance Party

When arrangements for occupation of the building were originally discussed it had been agreed that we should line the walls of certain of the rooms with Courtecine (cork carpet) in order that charts and maps might be pasted on these walls. All the available men from the Carpenters Shop had been put on this work during the evening of the 24th. Later the working party was increased to about 16 by the addition of mechanics, motor-drivers and labourers, as these became available from other work. They worked until about 9.30 p.m. on Saturday, 26th August and all day Sunday, 27th August. The Electrical Laboratory (Room 11) was completed late on Saturday evening and Study 15 late on Sunday evening. Vice-Admiral Sir Charles Kennedy-Purvis expressed himself as "amazed at the progress that had been made". (Studies 14 and 17 were completed by midday Tuesday and the Physics Group Office, Room 6, on Wednesday evening, 30th August).

August 30th 1939 — Provision of Music Circuit, Dublin-Birmingham

At the request of the B.B.C., a music circuit was established between Dublin and Birmingham. The request was received via the Defence Group (L. Branch) on 30.8.39 and the work was completed by the 5.9.39. Details are given in Research Report 10862 (Secret).

August 31st 1939 — Occupation of Part of the Research Station by Admiralty Insurance Party

Arrangements for evacuation of a large part of the Station in the event of the many visitors from Whitehall having to be accomodated temporarily at Dollis hill, were worked out in conjunction with Captain Jackson and Mr. Dodwell. Arrangements were made for the present occupants of the rooms required to be prepared to vacate them at very short notice leaving for the temporary Admiralty occupation a clear table, chairs and telephone service.

September 5th 1939 — Installation of Special Equipment for War Office

The War Office (MI.1) asked for concealed microphones and associated equipment to be installed very urgently in some rooms in the Tower. The installation was working, using laboratory amplifiers , in three days. more permanent equipment was installed about a week later. Case No. 10885 refers.

RESEARCH BRANCH SECRET WAR DIARY

September 12th 1939 — Air Raid Warning Equipment

Request has been received from S. Branch for assistance in framing specification for 100 c/s. relays for controlling air raid sirens previously developed under Case No. 10752. The specification was prepared with the collaboration of the manufacturer.

September 13th 1939 — Air ministry RDF Scheme - Provision of Line Terminal Equipment

A request has been received from the Air ministry that we should provide line terminal equipment of the 1 in 1 type for Fighter Command, Alternative Fighter Command, Droitwich Radio Station and 23 RDF stations. Registered Papers 23456/38 refer.

A short account of the work previously done by this Branch in connection with the Air ministry RDF Schemes will be of interest. In September 1937 our assistance was requested by the Superintendent of the Bawdsey Research Station. One four wire speech circuit, four V.F. telegraph circuits and one special synchronizing channel having high phase stability *were* then desired on a four wire cable circuit (cut off 2700 c/s.). The synchronizing channel would form the basis of a time transmission to be used for synchronizing RDF stations. A system was designed having an inverted speech band in the range 1000-2700 c/s. V.F.T. circuits at 420, 540, 660 and 780 c/s. and the special channel at 900 c/s. The precise requirements of the synchronizing channel *were* not known at this stage.

Six experimental systems were made up in the laboratory and installed between Bawdsey and various RDF stations. It was thought that the speech inversion would give a desirable measure of secrecy to the system, but this was not the view of the Commander in Chief, Fighter Command.

No further work was carried out on the system owing to a decision to incorporate the telegraph circuits in the D.T.N, and the objections of the Commander in Chief to speech inversion.

A request for further assistance was received from the Air ministry in January 1939 and a new system was suggested in which the synchronizing tone should be transmitted within the speech band, a small band being eliminated for this purpose.

September 13th (Contd.) A system was designed to fulfil the requirements, a 1500 c/s. synchronous motor being used at the receiving end to smooth out short period phase variations and eliminate the interference due to speech.

September 19th 1939 Electrical Interference from Equipment used for military mining

Lieut.-Colonel C.D.A. Fenwick, Royal Engineer & Signals Board, consulted Dr. Radley as to the possibility of electrical interference being picked up at a distance from electrical mining equipment or cables laid in mining tunnels. Calculations, based on previous work on the distribution of electric currents in earth, were made and the results are given in Secret Research Report No. 10872.

September 22nd 1939 Provision of Special Binaural Circuit

At the outbreak of war a binaural circuit, using distant speaking microphones on an experimental basis, was working from Stanmore to Leighton Buzzard in connection with the distribution of air raid warnings. This has been made permanent and spare equipment provided. See Case No. 10884 papers.

October 4th 1939 Voice Operated Signalling Unit

Work was commenced on the development of a voice operated signalling unit more sensitive than Unit Signalling No. 5. This was required for the Secret Services.

See papers in connection with Cases Nos. 10929 and 10974.

October 6th 1939 Electrical Noise measurements on Power Equipment for D.T.N. Stations

Between 26th September 1939 and 6th October 1939, tests were carried out on the rectifier and smoothing equipment at Debden, Old Sarum and Stanmore D.T.N. stations, these being typical of three standard sizes of equipment.

See Research Reports Nos. 10889, 10890 and 10920.

October 20th 1939 Infra Red Signalling

A memorandum was sent to the Assistant Engineer-in-Chief giving particulars of experiments carried out in connection with the possibility of signalling to aircraft with infra red rays.

October 25th 1939 — Provision of 1 + 2 Duplex Circuits on Wick-Kirkwall Carrier Link

Additional circuits were required between Wick and Kirkwall and these were to be provided over the existing carrier cables (Case No. 10620). Two circuits were provided by October 25th 1939 and one additional circuit will be provided early in 1940.

October 25th 1939 — Invisible Motor Car Headlamp

A demonstration was given using "lash-up" apparatus of a head-lamp system using an infra red beam in conjunction with a simple photoelectric receiver.

November 6th 1939 — Installation of Special Equipment for War Office

The War Office requested that assistance be given in connection with the installation of a considerable number of concealed microphones and associated recording equipment in a building near London.

See Case No. 10885.

~~November 15th 1939~~ — ~~Air Raid Precautions~~

~~Re commencement of training made necessary the provision of additional refuge accommodation. Arrangements were made to accommodate 150 students and members of the Training School staff in the basement of the General Research Building and a practice evacuation was undertaken to this point.~~

November 16th 1939 — Quad Cable for Army Carrier

Work has been in progress for several months on the design of a rubber insulated quad cable to be loaded for use with the Army carrier system. This system is a modification of the P.O. 1 + 4 system intended for use on aerial lines.

Case 10942 refers.

November 22nd 1939 — Illuminated maps and Associated Equipment for R.A.F.

The installation of equipment in the dug-out at Fighter Command was started.

This is a duplicate of the equipment already installed in July at Leighton Buzzard and embodies additions and improvements over the equipment/

November 22nd (Contd.)

equipment which had been earlier still installed in the temporary Fighter Command Headquarters.

The equipment is provided to enable the R.A.F. Officer responsible for disseminating warnings over the country to keep track of the position of each raid and issue the appropriate warnings, viz., Preliminary Caution, Cancel Caution, Action warning, Raiders passed. It also enables all Officers in the Control Room to get a picture of the state of warning in any part of the country.

The later two equipments also provide for passing the information by teleprinter to the Home Office.

The installation comprises a horizontal map on which the Warning Officer plans out the position of each raid and its direction. The map is divided into areas (usually county boundaries) each of which can be separately illuminated from below in orange, red or green. He calls out the Area and colour and assistants then operate switches to pass out the necessary instructions.

A larger vertical map is constructed similarly, and operated in duplicate, and is available for all in the control room.

The switches above mentioned also pass the information in the form of illuminated signals to the local Home Office equipment from which it

November 25th 1939

Electrical Interference from Equipment used for Military Mining

Experiments have been carried out at Heytesbury on Salisbury Plain by the Electrical Group in order to determine whether it would be possible, in the event of electrical interference being picked up from an unknown source, such as an enemy working underground with electrically driven mining equipment, to determine roughly the location of the source of the disturbance. The experiments which are described in detail in Secret Research Report No. 10900 showed that it should be possible to locate with fair accuracy such sources from directional measurements taken at points 200 or 300 yards away.

November 29th 1939

Magnetic Mines

Following a suggestion made by Admiral Sir Charles Kennedy-Purvis, Dr. Radley received an invitation from Mr. C.S. Wright, Director of Scientific/

RESEARCH BRANCH SECRET WAR DIARY

November 29th (Contd.) Scientific Research, Admiralty, to call on him this morning. Mr. Wright disclosed the mechanism of the new German magnetic mine. The possibility of the Research Branch assisting the Admiralty was discussed but it was agreed that at the present stage it would not be profitable to divert any part of our efforts to a problem which was not one coming within our own specialized field of telecommunications. A large stuff at the Admiralty were engaged in the investigation of the practicability of various methods of countering the magnetic mine. A useful contact was established between the two Research organisations.

November 29th 1939 Constant Volume Amplifier for Secret Services

As an extension of the work referred to under 4th October, an A.V.C. audio amplifier was received for test in order that a specification could be prepared for the supply of a number.

November 30th 1939 Army Carrier Cable

The Branch is assisting in the development of a suitable cable for the Army carrier system. 30 miles of a proposed rubber covered cable are to be ordered but the development of a polythene insulated cable which would give an improvement in attenuation equivalent to nearly doubling the range between repeaters of the system, is also being considered.

November 30th 1939 Secrephone

A privacy system 3000 cycles/second carrier and inverted side band (R.R.10550) was demonstrated to a Foreign Office Representative and others.

December 1st 1939 — Line Filter for Army Carrier System

Help has been given to the Signals Experimental Establishment in the design of a modified Line Filter to enable the 0-3 kc/s. frequency band, originally allotted to V.F. telegraphs, to be used for a telephone circuit.

December 2nd 1939 — Provision of a Telegraph Circuit between Scarborough and the Shetland Islands

Equipment has been made up in the laboratory and taken up to locations in the North to assist in the provision of a telegraph circuit between Scarborough and the Shetland Islands. The circuit is routed over the normal 18 channel V.F. system to Kirkwall and thence by submarine cable to the Shetland Islands. In this latter part of the route it is superposed on a D.C. telegraph circuit, frequencies of 680 c/s and 1500 c/s being used respectively for transmission in the two directions. The facility required was a hand-speed telegraph, reception being by telephone.

December 5th 1939 — Design of a Voice-Operated Stabilised Repeater for the Signals Experimental Establishment

Since early in 1938 close contact has been maintained with the S.E.E. in the development of a two-wire voice-operated stabilised repeater suitable for insertion in any type of line. Investigation has been curried out by the S.E.E. with regard to a relay switched repeater and by the Post Office with regard to possible designs utilising non-mechanical switches. Two models of a single stage repeater (Research Report 10159) developed by the Research Branch have been given extended field trial. This repeater has a gain of about 14 db and is only suitable for use at a line terminal. As a result of the trials, a two stage repeater was developed (Research Report 10565) but was re-designed as a three stage repeater (Research Report 10860) to meet Army requirements which involve satisfactory switching on lines of up to 20 miles of D8 cable and use as a

terminal/

terminal or intermediate repeater. Workshop-built models of the new repeater are now to hand.

December 6th 1939 — Design of a Lead-Covered P.O. Cable for Army Use

This Branch, with a representative of Branch Cn., has taken part in discussions at the R.E. & S. Board, relative to the design of 35 pair (10 or 20 lb.) cable to be laid directly in the ground. As a result of tests, in which samples of various types were buried in stoney ground, tough rubber has been the form of protection recommended over the lead. Mechanical joints will be utilised.

Dec. 12th 1939 — Repeaters for military Lines

The R.E. & S. Board has consulted the Branch on the application of 2-wire and 4-wire repeaters for use between G.H.Q. and Army or Corps Headquarters. They will occupy an intermediate position between the 4-wire repeaters which have been mounted in special vans for L. of C. use and the 2-wire stabilised repeater (Research Report 10860; used on forward lines.

Dec. 18th 1939 — Provision of a telegraph circuit between Scarborough and the Shetland Islands

The Executive Engineer in charge and two other members of the Telegraph Group have returned from the North of Scotland after successfully setting up the special telegraph circuit referred to in the entry dated 2 December. The addition of the new circuit necessitated the insertion of filters at Kirkwall, Fair Isle and Sandwick Bay so that existing telegraph circuits should not be interfered with. Some difficulty was experienced in arranging for a passage to Fair Isle owing to the poor harbour facilities there and the absence of an entirely suitable landing ground for aircraft. The Naval authorities, however, put a pilot and aeroplane at our disposal and fortunately the weather was such as to permit an attempt being made. The landing and work on the island were carried out without a hitch but, during the stay, the wind strengthened very considerably and on account of the restricted and awkward nature of the ground the take off on the return flight was hazardous.

A demonstration of the complete circuit was given to Admiralty officers just three weeks after work in the laboratory had commenced, and the equipment is ready for service use as soon as two short overhead lines have been run by the Scottish Region.

Dec. 19th 1939 — Installation of Special Equipment for the War Office

As already recorded, the Branch installed concealed microphones for the War Office (MI.1) in the Tower of London in September. On 6 November a request was received for co-operation in a larger installation at Trent Park, Cockfosters, and this was completed by 13 December although the building had not been ready for wiring until 4 December.

In/

Dec. 16th 1939 (Contd)

In six rooms, to be used for interrogation purposes, the microphone is installed inside the ordinary extension telephone which is fitted. In another eight rooms the microphones had to be so concealed as to be undetectable to the occupants even should they make a careful search. In six of these microphones were installed above perforated guards in ceilings, the whole of each ceiling being papered. After some laboratory experiments a method of mounting a microphone in an ordinary electric light ceiling rose in such a way that the rose could retain its normal function and the microphone remain invisible if the rose were opened was devised. Microphones working binaurally were thus installed in two of the rooms. The equipment for these rooms was provided from Dollis Hill, but that for the remainder of the rooms together with recording, supervising and signalling equipment has been purchased by M.I.1 from R.C.A. Photophone Ltd. All the installation work was undertaken by the Research Branch and occupied eight workmen and an Inspector.

The officer in charge expressed great satisfaction with both the appearance and working of the equipment in the two rooms entirely fitted up by Dollis Hill.

December 29th 1939 — Magnetic Mines

(See also entry under November 29th, 1939)

Admiral Sir Charles Kennedy-Purvis informed me that use was being made of the method of safeguarding a channel by the field from two cables carrying direct current. This method had been suggested in conversation with the Admiral and Mr. Wright in November, but probably also had other sources. The cables do not carry current continuously but are pulsed at intervals.

December 29th 1939 — Telegraph Convertors for Army Lines

An "S + S" system similar to that developed by the Post Office, whereby a teleprinter channel can be obtained on any normal telephone circuit without excessive degradation of speech transmission, was developed by the S.E.E. and tested in co-operation with R. Branch. (Research Report 10661). The equipment has, however, now been redesigned by R. Branch and considerable simplification and improvement has been effected. The number of valves has been reduced from six to four without altering the types and the maximum telegraph distortion has been reduced by 8%.

Details of the final design, given in Research Report 10881, were worked out in conjunction with the S.E.E. who have constructed and tested a model. The construction of a batch of 40 is to be put in hand at once.

December 30th 1939 — Provision of Special Equipment for M.I.5

A request was received through the Personnel Department from M.I.5 for a concealed microphone listening outfit to be installed in a flat in a London suburb. Apparatus similar to that used previously has been fitted, but using only mon-aural listening as it was not possible to find suitable locations for two microphones. It was necessary for all traces of the microphone and wiring to be concealed without apparent disturbance of the existing wall fittings, etc., except in some parts of the building.

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January 15th 1940

Occupation of Part of Research Station by Admiralty Insurance Party

Vice-Admiral Sir Charles Kennedy-Purvis, Rear-Admiral Young, (who replaced Captain Jackson as Chief of Staff to Admiral Kennedy-Purvis in November 1939) and the Naval staff left the Station to-day for their new emergency Headquarters at the Admiralty Chart Factory. Before leaving, Admiral Sir Charles Kennedy-Purvis expressed himself very warmly in appreciation of the way in which the Research staff and, in particular, the Research Services Group, had facilitated the Naval occupation of part of the premises.

Mr. C.M. Dodwell (Principal) and five or six civilian clerical staff are remaining on the Station while there remains the slight possibility of earmarked rooms being required for the temporary accommodation of Admiralty staff from Whitehall. The only rooms now remaining in Admiralty occupation are 12, 19 and 20 on the 1st Floor and 10 on the 2nd Floor of the General Research Building. The emergency telephone switchboard in the basement of the Central Services Building is no longer staffed and this has necessitated making certain alterations with regard to night service.

January 22nd 1940

Trial of P.O. Stabilised Repeaters at 1st Corps H.Q., B.E.F., France

Two models of the voice operated stabilised 2-wire repeater developed by the Research Branch for the Signals Experimental Establishment, as described under entry dated December 5th, 1939, have been taken to 1st Corps H.Q. by Mr. R.E. Jones (E.E.) for trial on lines actually being used by the Army in the field. Comparative tests were made of a mechanically switched repeater developed by the S.E.E. The repeaters were tested in terminal and intermediate positions.

It was evident from the outset that the faster switching time of the P.O. repeater made it possible for two people to carry on a conversation without knowing that a repeater was in circuit, whereas with the S.E.E. model clipping was likely to occur. The P.O. repeater will be described in Research Report 10860.

Summarising the experience gained from the field trials the tests have demonstrated that on long lines, where low incoming speech levels occur, considerable improvement can be obtained by the use of the repeater. In most cases gain control only is necessary and this can be made by a monitoring operator. In certain cases noise will interfere with the proper voice switching of the repeater but the same operator may, by simple adjustments, be able to use the repeater to maximum advantage. Where high noise level occurs it will not be possible to use the repeater at all but calls will, in general, be unintelligible in any case.

As a result of the tests the R.E. & S. Board have asked us to make up a further 12 repeaters for use by the Army.

January 22nd 1940 — Orkney-Shetland Teleprinter Circuit

A Lerwick extension on the Lyness Admiralty teleprinter switchboard has been set up, using a U.S.W. radio link between Kirkwall and Lerwick. The teleprinter circuit uses the inverter channel of the diplex radio link which operates on a wavelength of 5 metres. Under normal conditions the T.E. of the circuit is 3 db, but the extension to Lyness involves a further 25 miles of cable circuit. It was decided, therefore, to convert to D.C. at Kirkwall for transmission to Lyness.

Standard telex equipment is installed at Lerwick and at Kirkwall a specially constructed V.F. - D.C. converter, connected 4-wire to the radio link, is used. The minimum signal-noise ratio was originally 5 db but the insertion of limiters in the speech circuit improved this to 16 db. Under the worst conditions the maximum distortion on the teleprinter circuit was 14% which was considered low enough to permit of the circuit being terminated on the Lyness switchboard.

Satisfactory teleprinter working was obtained over four teleprinter links in tandem, viz., Lerwick-Lyness-Donibristle-Central-London (Admiralty) Further experiments indicate that a four-channel telegraph system could be worked on this circuit.

R. Branch is co-operating with L, Tg., W, E Branches in the provision of 4 and 18 channel further equipment to the Shetlands.

February 2nd 1940 — Articulation on Telephone Circuits used for A.A. Gun Control

The O.C. 1st A.A. Divisional Signals enquired whether the R. Branch could make some tests to determine whether mistakes occurring in the transmission of gun settings from a control centre to gun positions were due to the limitations of the circuit and apparatus or to lack of training of the personnel. In connection with the 'fixed azimuth' method of anti aircraft range finding, these settings are transmitted as a spoken message consisting of a code of figures and letters over a circuit which may be many miles in length. It is essential that the message be received 100 per cent correctly as no repetitions are possible.

A circuit was set up in the laboratory representing the limiting conditions which would arise and using Army telephones. A skilled articulation testing crew has no difficulty in transmitting and receiving a large/

large number of sample messages over this circuit with an accuracy of 99 to 100%. The identification code for the letters was that used by the Army and the few mistakes that did arise were chiefly due to the confusion of two letters. It appears, therefore, that the system should be satisfactory with more training of the personnel.

February 28th 1940 — Work for Army Signals in connection with Line Communication requirements

Following a meeting at the War office on February 12th at which the line communication requirements of the B.E.F. in France were examined and at which a decision was taken to utilize loaded P.C., lead sheathed, cable with 40 lb, conductors and a non-carrier telephone system for linking G.H.Q. to the P.T.T. network, contact has been established with the S.E.E. in connection with two developments.

The design of transportable equipment to provide terminal repeater facilities at G.H.Q. has been agreed with the S.E.E. Transportable racks will provide one bay of 4-wire amplifiers and 4 wire/2 wire terminations, one bay of exchange type 500/20 signalling units for use on 4 wire or 2 wire circuits, and one bay of power supply and testing equipment. The number of units of equipment has been based on the decision to employ 7 quad cables for the extension from the civil system, and the layout agreed upon as giving the greatest amount of flexibility in use. Standard equipment will be used as far as possible. Operation is from a 24-volt battery. Research Case no. 11002 refers.

A suggestion that breaks in the loaded cable might be localized from one end by a simple test has been made by the Research Branch and favourably received by the S.E.E. The method depends on the observation of two frequencies at which the impedance of the cable is a maximum or a minimum, and necessitates only the provision of a variable frequency oscillator to provide the testing current and a rectifier voltmeter to connect across the line. These items are being included as part of the testing equipment associated with the transportable repeaters. Data relating to the accuracy of this method, as applied in the field, will be given. Research Report No. 11059.

February 28th 1940 — Reception of Infra-Red Signals by Enemy Aircraft

See entry under October 20th, 1939.

Further experiments have been carried out to determine the possibility of raiding aircraft being guided by infra-red radiation emitted/

emitted from deliberately erected beacons or, unavoidably, from towns, etc.

The experiments indicate that it would be possible with a 500 watt lamp to obtain definite signals at practically any aeroplane height. A fairly narrow radiating beam would probably be required and this, together with the speed of the aeroplane, would mean that the receiving apparatus would have to operate to a very short signal. Utilisation of the infra-red energy unavoidably radiated from towns is unlikely, if a device based on the resistance bolometer is used as a detector, to be of much use to raiding aircraft, except in the case of the largest towns or of towns containing large structures at high temperatures, such as furnaces. It is just possible that greater sensitivity could be obtained by means of a device based on the recently developed dielectric bolometer, but this is not certain. Secret Research Report No. 10925 refers.

February 29th 1940 — Illuminated Maps and Associated Equipment for R.A.F. (Fighter Command)

See entry of November 22nd, 1939.

The installations of the area maps and switching arrangements in the fighter command dug-out at Bentley Priory has now been completed well ahead of the date at which the rest of the R.A.F, side of the equipment will be ready. Progress has been hindered by the changes in the R.A.F. arrangements since the original plans were made. The layout of the room used has been altered and the general lighting increased. This has necessitated making some alterations in the map lights but it is considered that the recolouring of the red lamps used will give quite satisfactory results. This will be completed a week before the operations room is officially opened.

3rd March 1940 — Illuminated Maps and Associated Equipment for R.A.F. (Fighter Command)

The equipment was taken over for use on this date, the modifications referred to under 29.2.40 having been completed. It is understood that the new equipment is completely satisfactory.

25th March 1940 — Kirkwall-Lerwick 4-Channel Telegraph System on U.S.W. Radio Link

Further to the diary entry under date 22nd January, 1940 a standard 4-channel telegraph system between Kirkwall and Lerwick has been completed over a second ultra-short wave radio link. Using the converter channel, as before, for the telegraph circuit, it was found that the signal/noise ratio was 21 db. This was worsened to 17 db by inter-channel interference. Better results were obtained on the carrier circuit and the level of telegraph/ telephone crosstalk was considered by W. Branch to be satisfactory. Special voltage limiters were fitted on the telephone circuit.

The question of reducing inter-channel modulation in the radio modulators and demodulators is being pursued with W. Branch.

27th March 1940 — Donibristle-Kyle Teleprinter Circuit

To provide this circuit laboratory trials were made of a scheme operating over a phantom telephone circuit. A satisfactory scheme was developed and details sent to the Tg. Branch.

30th March 1940 — Work for Army Signals in Connection with Line Communication Requirements

The development of transportable equipment to provide terminal repeater facilities at G.H.Q. has now advanced from the design stage to that of layout and detailed specification. The equipment consists of eight 4-wire repeaters with 500/20 17 c/s ringing apparatus mounted on three double-sided bays. All/

30th March 1940 (Contd)

All the components are standard Army or Post Office items and the whole layout has been designed in co-operation with the S.E.E.

30th March 1940

Air ministry R.D.F. Scheme - Provision of Line Terminal Equipment (see entry under September 13th, 1939)

The 26 sets of equipment for transmitting the synchronising frequency from a control and alternative control station to various aircraft locating stations are nearing completion and installation has begun. The apparatus for the outstations and principal control station (Fighter Command) is generally in advance of the provision of necessary associated equipment by the Air Ministry.

In order to re-adjust the phase of the 1500 c/s synchronising frequency received at an outstation after one of the two lines connecting this outstation to the control centres has been interrupted, a phase shifting network and small cathode ray tube are provided at each outstation. The phasing technique is quite simple.

4th April 1940

Provision of Signalling on 6-Channel Radio Systems

The Branch has given assistance in the provision of equipment to give ringing facilities over a portable 6-channel radio system designed for emergency use. The ringing signal is transmitted by 500 c/s over the carrier link and converted from and to 17 c/s current at the terminals. Standard signalling units have been modified so as to be capable of working from the existing power supplies or the A.C. mains and the compact equipment designed.

7th April 1940

[redacted]

RESEARCH BRANCH SECRET WAR DIARY

7th April 1940 (Contd)

[redacted]

RESEARCH BRANCH SECRET WAR DIARY

7th April, 1940 (Contd)

[redacted]

9th April, 1940.

Sabotage by means of Bombs concealed in Bags of Mail carried in Merchant Ships

Dr. Radley attended a meeting at the Ministry of Shipping at which a report prepared by the Research Branch was considered. The conclusions arrived at in this report were :-

(1) There is very little risk of serious damage to a ship being done by an H.E. bomb which could be posted within the limits of weight allowed by the postal regulations. Incendiary bombs are more probably to be anticipated.

(2) Equipment could be developed which would have a reasonable chance of giving an indication when a bag containing any of the more usual types of bomb was passed by it or through it. The equipment would, however, be elaborate and costly and a large number of articles which can be sent legitimately through the post would be liable to give indications similar to those occasioned by bombs.

The above conclusions were agreed and it was decided that for the time being the only necessary action would be to circulate to the mail carrying lines a warning of the possibility of sabotage through mails and advising a regular inspection of mail rooms so that fires could be promptly detected and dealt with

16th April, 1940.

Provision of V.F. Telegraph Channels on existing Orkney-Shetlands Telegraph Cable

The construction and laboratory tests of apparatus to be installed on the Kirkwall-Fair Isle-Lerwick single core telegraph cable were completed and the apparatus was to-day despatched with staff for installation.

It is expected that 6 or 8 duplex channels can be provided. V.F. channels 1 - 8, at standard carrier frequencies, are to work North to South, and channels 11-18 in the reverse direction. Directional filters and audio repeaters will be fitted at Kirkwall, Fair Isle and Lerwick. At Fair Isle the equipment is operated from A.C. mains supply provided by the Admiralty who will maintain it. Spare repeaters, power pads with alarms and change- over switches are provided. These telegraph channels work over the same cable as, and replace, the single teleprinter circuit, the provision of which/

16th April, 1940 (Contd.)

which was referred to in Diary entries dated 2nd and 18th December 1939.

Existing communication with Fair Isle will be maintained by sub- audio circuits working Fair Isle - Lerwick and Fair Isle - Sanday - Stronsay - Kirkwall.

19th April, 1940.

Infra-red Headlight

(See entry under October 25th, 1939).

It having come to our notice through our contacts with the S.E.E. that experiments were being carried out at the Admiralty Research Laboratory at Teddington in connection with infra-red signalling and infra-red vision, the D.S.R. Admiralty was asked if permission could be given for exchange of information. In the absence of the D.S.R., the Deputy Director, Mr. Buckingham, talked this over with Dr. Radley at the Admiralty on April 19th. A representative of the ministry of Supply was present at the interview.

The Admiralty is responsible for infra-red research for all three fighting services. Several methods of infra-red vision have been considered: the use of a fluorescent screen, irradiated with ultraviolet and in which the brightness of the fluorescence is partially quenched (or accentuated with other screen materials) by the superimposed infra-red picture, is known. All other methods though have been dropped in favour of equipment developed by Philips, Eindhoven. This makes use of the principle of the electron microscope. The infra-red picture is focussed on to a photo-electric cathode and the resultant electron discharge on to a fluorescent screen. The receiving equipment is transportable and self-contained as regards power supplies. Its use is being contemplated for various purposes by both the Army and the Navy with illumination to give various ranges of vision.

Both the Admiralty and the ministry of Supply representatives were interested in our work in connection with an infra-red headlight, although it was stressed that the equipment was only in an early experimental stage and that it had not been pressed as an urgent problem by the Research Branch. A demonstration is to be arranged. This will be witnessed by Dr. Hill of the Admiralty Research Laboratory, who/

19th April, 1940 (Contd.) who will disclose his work in connection with the improvement of the electron microscope type of equipment to us, and a representative of the Ministry of Supply.

26th April, 1940. Provision of Carrier Telephone Circuits between Wick and Kirkwall

In June 1939 group modulating equipment was constructed at Dollis Hill to enable two 12-channel carrier systems to be used in opposite directions on the coaxial paragutta cable being laid between Wick and Kirkwall. This provided 12 circuits and 3 more circuits were provided by means of a 1 + 2 duplex system. The equipment is described in Secret Research Report No. 10630. A second cable has now been equipped by the Research Branch with exactly similar carrier apparatus to that used on the first cable (Case No. 10880). A further 12 circuits are now required and will be provided by re-arranging the apparatus so that one cable carries 1+2 duplex system (as at present) and three groups of 12 "go" channels, while the other carries 1 + 2 duplex system and three groups of 12 "return" channels (Case No. 11138). The apparatus on each cable will be made convertible to give 20 circuits in case the other cable fails.

26th April, 1940. Work for Army Signals in connection with Line Communication Requirements

Seven miles of the rubber insulated quad cable made for use with the Army carrier system (W.0.4A) has been erected complete with loading coils near Rochester. The cable itself was very satisfactory both electrically and mechanically but some trouble was experienced with the pin and socket couplings. These were not the 0Z type spring pins which are intended for final use.

Polythene insulated cable with steel braiding and an outer rubber sheath has been designed and 20 miles ordered for field trial. This cable has an external diameter of only 0.39 in. and when loaded with 4.6 mH coils will have an attenuation of 0.8 db per mile at 16 kc/s. The steel braiding wires form an electrostatic screen and at the same time make the cable stronger mechanically than the rubber cable.

30th April/

c.29/5/40

30th April, 1940.

Electrical Interference from Equipment used for Military Mining

(Previous diary entries September 19th and November 25th, 1939).

Portable apparatus has been developed for carrying out the tests described in Research Report No. 10900 and field trials were held at Tilshead on Salisbury Plain during April, 1940. The apparatus performed well and the results obtained agree generally with theory. They show, however, that in the absence of any information whatever as to the location and direction of an enemy cable system, it would be necessary to make measurements at 10 to 12 points before definite conclusions could be drawn as to the position of the source of interference. An advantage of the method is the ability to detect power cables at distances of a quarter of a mile or more even when only a moderate amount of leakage is present. The same apparatus may be used to overhear telephone circuits either working with earth return or having leakage to earth.

Considerable assistance in carrying out the field test was obtained from the use of two Royal Corps of Signals radio transmitting and receiving trucks. By means of these it was possible to maintain communication between the various testing points.

The field tests are described in Research Report 11141 and the portable high-gain amplifier detector used in Research Report 10986.

13th May 1940 — V.F. Telegraph Channels on the Existing Orkney-Shetlands Telegraph Cable (Previous diary entry 16th April 1940).

The equipment was completed on 12th May and put into service on the 13th.

The measured attenuation of the cable between Kirkwall and Pair Isle was approximately as estimated, but the Fair Isle-Lerwick section was 4 db greater than that estimated. Heavy cross-modulation was experienced in the directional filters, although these had been satisfactory in the laboratory test. The cause for this is being investigated, but the trouble was cleared by replacing filter coils wound on carbonyl cores with those on mumetal cores.

Six first-class two-way channels have been provided with a minimum signal/noise ratio of 23 db, and not more than 10% telegraph distortion. Probably two more channels could be obtained, if necessary. Technical details are given in Research Report 11045.

15th May 1940 — Provision of a Telephone Circuit between England and Holland on Lowestoft-Zandvoort Submarine Telegraph Cables

On Monday, 13th May, a request was received to investigate the possibility of providing a telephone circuit to North Holland, very urgently, via the submarine telegraph cables between Lowestoft and Zandvoort. Instructions to proceed were given to the V.F.R. Group at about 4.30 p.m. and work was commenced immediately. The necessary apparatus to be used was tested out and mounted on a rack during Monday night. It was wired the following morning and transported by road to Lowestoft in the afternoon, arriving there about 8 p.m. After some difficulty communication was established via Headquarters Control with M. Visser of the Dutch Administration and arrangements made for testing on selected cable cores. The Dutch Administration, however, expressed the opinion that the scheme was technically impracticable and were not willing or able to give active cooperation from the distant end that night. It was learned at 7 a.m. the following morning, May 14th, that North Holland had surrendered to the German Forces. Work had, however, proceeded at the English end throughout the night and there was good reason to believe that a working circuit could have been obtained. Technical details are given in Secret Research Report 11154.

22nd/

22nd May 1940

Arrangements for use of Research Station in case of severe aerial attack on London including occupation of part of Station by Circuit Laboratory and also by Government Departments

Mr. W.A. Woolverson (Telecommunications Department, National Defence Measures), Major Rawlings (Office of Works) and Capt. Adams, R.N. visited the Station. It was understood that Capt. Adams was concerned with the provision of accommodation for certain sections of the Government should evacuation from Whitehall become necessary owing to enemy air activity. The problem was discussed with the following points in mind

(1) Essential work and work in connection with National Defence would be proceeding in the laboratories and would necessitate the retention of staff and accommodation of approximately the present dimensions.

(2) The Circuit Laboratory would have been compelled to evacuate King Edward Building and would be occupying rooms tentatively reserved for them. These are

Central Service Building - Rooms 12, 13 and 15.

Training School Annexe - Rooms 7, 8 and the Inspectors' Office (possibly Room 9 also).

(3) The Correspondence Courses would have been closed down and the Inspectors acting as tutors dispersed to the Regions as discussed with Mr. Ridd on May 21st. The School courses dealing with Director System (2000 type equipment) P.B.X's and 2 V.F. signalling might be closed down, but other courses more directly connected with the maintenance of the Department's plant and essential services under war conditions would continue as long as possible.

(4) The Admiralty would no longer require the accommodation reserved in 1939 for their possible use. (See diary entries August 25th and 31st 1939).

It appeared that it would be impossible to release appreciable accommodation while training was still proceeding, but it was agreed that should the accommodation be required by the Government Departments represented by Capt. Adams, the intensity of air raiding would have become such that all training would have been stopped in London. It was further agreed that, subject to the Admiralty foregoing any claim on accommodation at Dollis Hill the following would be earmarked for possible occupation by the Government Departments represented by Capt. Adams

General/

22nd May (Contd.) 1940

General Research Building	(Ground Floor)	- Rooms 6, 7 and 11
	(First Floor)	- Conference Room Rooms 12 and 19
" " "	(Roof space)	- All space previously earmarked for Admiralty.
Central Service Building	(Second Floor)	Lecture Theatre and all other rooms except Telephone Exchange.
Auto & Repeater School	(Ground Floor)	- All rooms
" "	(First Floor)	- All rooms except Repeater School Apparatus Room.
Stores and Garage	(First Floor)	- Correspondence Courses and Despatch Rooms

The Library could be released for occasional use (e.g. Conferences) only.

23rd May 1940

Disabling of Telephone Exchange Batteries

Some experimental work has been carried out in the Chemistry Laboratory with the purpose of investigating means of rendering the battery in a telephone exchange useless in the event of the exchange being captured by enemy forces, for example, troops landed by parachute.

It was found that the addition of magnesium, sodium or zinc chloride causes fairly rapid disintegration of the positive plates and the discharge and destruction of the plates is materially assisted by short-circuiting, although a cell with sufficient salt to destroy the plates ultimately and short-circuited for ¾ minute still retained enough charge for isolated cells. The chloride may be conveniently added in the form of blocks of common salt. Complete destruction occurs in a few hours, and in addition, the method has the advantage of producing chlorine gas. (Research Report No. 11153 refers).

31st May 1940

Emergency Provision of Additional Telegraph Circuits and Telephone Circuits to France

Following the loss of the telephone circuits between London and Paris via Abbeville or Amiens, the provision of other circuits, not passing through territory occupied by the German troops, became urgent. Mr. R.E. Jones, of the V.F.R. Group, proceeded to Cuckmere on Tuesday, May 21st, in/

31st May (Contd.) 1940

in order to explore the possibilities of making greater use of two old 4-core telegraph cables between this point and one on the French coast near Le Havre. These two cables originally carried two telegraph circuits which it was hoped to replace by one multi-channel V.F. telegraph circuit and one 4-wire speech circuit. Mr. Lawton of the same Group, with an assistant, proceeded to the French side in order to co-operate, but their work was hampered by enemy air raids and faults on open wire lines between the cable hut on the French coast and Le Havre. Major difficulties were encountered due to the submarine cables each having one faulty core. Their high attenuation resulted in an incoming signal which was far too low in relation to the noise level in the land cables. The solution to this problem was found to be the provision of battery-operated amplifiers on the received pairs in both cable huts. Suitable amplifiers and batteries were quickly obtained on the English side but those required on the French side had to be flown from this country. The establishment of the circuits was delayed by repeated faults on the land sections on both sides, but 11 telegraph channels were working on Monday, May 27th and the telephone by the end of the month.

At both ends of the cable, work was carried out day and night as opportunity offered and involved very heavy strain on the officers concerned who were able to obtain only very short periods of continuous sleep over a period of ten days.

5th June 1940

Provision of Telephone Circuits between England and France (Scheme 81)

Scheme 81 provides for two 12-channel telephone systems working "Go's" over an existing coaxial submarine cable between England and France via the Channel Islands and "Returns" over a similar cable at present being laid. A 1 + 2 duplex system is to be operated over each cable individually.

The share of the Research Branch in this work consists of the construction of all Repeaters, Group Modulators and Demodulators for working of the second group of 12 channels in each direction and emergency equipment for working one group of 12 channels as "Go's" and the other as "Returns" over either cable in case of breakdown of the other.

Up till May 16th work was progressing smoothly to a target date at the end of June, 1940. The invasion of Holland and Belgium and the break through of the German Armies towards the Channel ports, involving the loss of existing circuits to Paris, made the provision of the new circuits via the Channel Islands much more urgent. Work was continuous in the laboratory/

5th June 1940 (Contd.)

laboratory throughout the week-end of 18th-19th May and a 24-hour day has been worked subsequently. The workmen required have been provided by staff transferred from other Groups and progress has only been limited by the physical impossibility of more than a certain number of men getting access to the equipment at any one time and by the difficulty of obtaining components from Contractors. The equipment was ready for shipment from the Research Station by June 5th, which is an improvement of more than three weeks over the date originally anticipated. The work has been supervised throughout the 24-hour period by major staff officers, who have, in fact, individually worked very long hours.

June ..11th.. 1940 — Investigation in connection with the possibility of there being concealed Listening Devices in certain Government Rooms

On May 24th Dr Radley and Mr F. E. Williams (in the absence of Mr Doust) met Col. Butler and Major Denman of the W.D. (M.I. 8) in response to a request passed through the E. in C. We were told that information had been received from two sources that intelligence obtained by means of concealed electrical listening equipment installed in the Cabinet Room at No. 10 Downing St. was being transmitted to Germany. It was suggested by M.I. 8 that as a preliminary measure, a high gain amplifier should be bridged across the power and telephone leads outgoing from the Cabinet Room in order to determine whether these leads were being utilised for a connection to a concealed microphone. Downing St. was visited and the test carried out with a negative result. It was pointed out however to Col. Butler and to Sir Frank Smith (who was also present) that the test did not eliminate the possibility of a carrier frequency feed over the wires which had been tested. Indeed the noise present on the electric light system was such that it would have been impossible to operate any other scheme than one employing carrier frequency current over these leads. It was also pointed out to Col. Butler and to Sir Frank Smith that the room was ideally adapted both acoustically and architecturally for the installation of a concealed microphone.

After discussion it was agreed that such a cursory examination made it impossible to give a "clean bill" to the room and Sir Frank Smith said that he would inform the Prime Minister accordingly.

As the room was required for other purposes it was impossible to conduct a more extended examination of it on May 24th. The telephone instrument (extension on Whitehall 1234) was changed and on examination at Dollis Hill was found to be normal in all respects.

June ...11th..... 1940 — Investigation in connection with the possibility of there being concealed Listening Devices in certain Government Rooms (continued)

On May 25th tests, corresponding to those carried out on the electric light and telephone wiring at No 10 Downing St. were repeated by Mr Doust on the leads into the Foreign Secretary's room at the F.O. and also on the leads into the emergency Cabinet meeting room in the basement of the Office of Works building at Storeys Gate. A negative result was obtained in each case. The Foreign Secretary's room is not acoustically favourable to the use of overhearing equipment. Extensive use of concrete in the construction of the room at the Office of Works building would make the surreptitious installation of equipment difficult. It was pointed out that there should be a switch in the B.B.C. microphone circuit within this room for complete security.

Mr. Doust with Major Denman inspected the Foreign Secretary's suite at the Dorchester Hotel on May 29th and were reasonably assured as to its security.

On May 30th it was learned that the Prime Minister had decided that facilities could not be given to the Office of Works for any extensive investigation of the panelling at No 10 Downing St. but that Professor Lindemann had suggested that, if any concealed microphone were present it should be rendered useless by the induction of an audio frequency masking noise. It was realised by the R. branch that no such method could give a complete safeguard; a memorandum was therefore prepared and discussed between Prof. Lindemann, Maj. Denman and Dr Radley during the morning of May 31st. This memorandum was based on the Branch's experience in the installation of concealed listening devices. The principal points brought out in it formed the basis of subsequent work and are outlined below-

(1) The concealed microphone may be of the high sensitivity type (i.e. a carbon granule transmitter) or of a relatively low sensitivity, high quality (moving coil condenser or piezo-electric) type.

June ... 11th..... Investigation in connection with the possibility of there being
1940 concealed Listening Devices in certain Government Rooms (continued)

(2) If a carbon granule or other microphone giving resistance modulation is used the modulated current may be either D.C. or A.C. in the carrier frequency range.

(3) Connection between the concealed microphone and the listening-point may be surreptitiously installed wiring or use may be made of existing service wires such as electric light or telephone.

The possibilities were simplified by the fact that, if use had been made of existing service wiring, difficulties with power noise or crosstalk would have made the use of carrier frequency current and a carbon microphone essential. The systems to be considered were therefore reduced to:-

(A) Carbon granule transmitter with direct current feed and its own wiring.

(B) High quality microphone (moving coil or piezo-electric) with direct current feed and its own wiring.

(C) Carbon granule transmitter with carrier current feed and making use of its own or existing service wiring. In the opinion of R branch the first of these was the most probable.

(A) Capt. Kinross of M.I.8 had previously suggested that a sensitive microphone giving the same order of modulations of D.C. as the ordinary telephone transmitter might be detected by exciting it acoustically and picking up the magnetic field from the associated wiring by means of a search coil connected to an amplifier with a gain of the order of 100 d.b. Experiments were made in the Laboratory and it was found possible to detect the presence of the microphone with the search coil at a distance of up to 4 ft. After some difficulties had been overcome portable apparatus was constructed and with this Maj. Denman and Messrs Radley, Barnes and Doust explored the complete wall and ceiling area of the Cabinet Room on Sunday June 9th. At the same time many hundred books on the shelves

June .11th..... 1940 Investigation in connection with the possibility of there being concealed Listening Devices in certain Government Rooms (continued)

lining the walls were moved. A whistle producing a note at about 17 c/s was used as the source of sound. This whistle was fixed to the search coil and was blown from a foot-bellows through a length of rubber-tubing. The test unerringly found all the roller-blinds in the room, steels springs of which vibrated slightly to the note used, but no concealed microphone. It was realised that the D.C. feed to the latter might not have been switched on.

(B) With a high quality microphone the speech voltage in the connection between the microphone and the first amplifying valve is only of the order of 0.01 mV. The high impedance of this circuit to earth and its high degree of balance made a fairly strong disturbing field necessary in order to ensure the induction of a sufficiently loud masking noise. After experiments with other types of generator an oscillator giving a distorted output at approximatively 500c/s, further modulated at 50c/s was used as the source of the disturbing current. The output was fed into two coils, a horizontal one located in the picture-rail of the Cabinet Room and a vertical one conforming to the boundaries of one of the walls. The coils were made up from switchboard cable (61 wire/9¼) with the wires previously jointed in sequence and were installed by the senior officers previously mentioned during the night of June 10th. The disturbing field, approximately 10 ampere turns in each coil is controlled by a switch placed near the Prime Minister's seat. This prevents interference with the normal use of the telephone. We were informed by a Private Secretary that the Prime Minister had expressed his pleasure at the arrangement.

(C) A field strength measuring set capable of detecting radiated field between 10 and 200 kc/s was constructed but no opportunity to use it at No 10 Downing St. has yet occurred. The technical details of the apparatus used will be given in Research Report 11173.

June 18th 1940 — Provision of Telephone Circuits between England and France (Scheme 81)

That part of the equipment mentioned in the diary entry of the 5th June intended for the French terminal was shipped from a West Country port on June 7th and landed 2 days later at Nantes. The repeater equipments for Jersey and Guernsey were shipped direct. Messrs. Scowen, Tucker and Triffit (Assistant Engineers) each accompanied by two workmen proceeded respectively to France, Jersey and Guernsey. The equipment intended for installation on the Channel Islands was received safely, the work of lining this up proceeded smoothly and was practically completed by June 15th. Mr. Scowen had arrived at St. Lo on June 7th and 1+4 channel equipment forwarded by L. Branch arrived the same day. This was lined up and was ready for test with Jersey by the time the submarine cable was landed early on June 10th. The tests were carried out on the 11th and the system utilised to provide one circuit between the War Office and Cherbourg from the 12th onwards. A circuit was available for extension through to Paris but could not be completed as the aerial carrier equipment had not yet been installed between St.Lo and Le Mans by the P.T.T. The need for circuits to Paris disappeared on the 13th when the city was evacuated. Attempts were made to extend the available circuit to various military HQ to meet specified requirements, but became useless due to the aerial line between St. Lo and Le Mans being damaged.

During this period nothing had been heard of the equipment consigned to St.Lo via Nantes although it was confirmed that it had been unloaded from the ship there. The military situation had become somewhat confused and communications were difficult. On Sunday, June 16th, Mr. Scowen sent J.E.H. Cosier (Acting S.W.I.) to Nantes to look for the equipment and this officer is to be commended for the energy with which he prosecuted his search. The equipment was finally found to have been side-tracked to the Signal Stores at Nantes. Late on the same day Mr. Scowen learnt from an infantry officer passing through St. Lo that evacuation of the B.E.F. from France was in full progress. He and a U.S.W. went to Cherbourg on the following morning and were among the last to leave for England. The remaining Research Staff came home from Nantes and the Channel Islands by transport, destroyer and airplane. It was possible to recover some of the equipment from Jersey and Guernsey but that in France had to be abandoned.

Valuable experience for the conduct of future work was gained from this expedition. In particular, it was apparent that had the staff been provided with passes which would have carried authority when dealing with the Army and been readily recognisable by the French, much time would have been saved. It is further recommended that in future apparatus should not be allowed to travel unaccompanied under/

under similar conditions. Without exception the officers concerned, both in France and on the Channel Islands, exhibited keenness, energy and self reliance, in circumstances which were made more trying by their lack of knowledge of a changing military situation.

25th June, 1940. Development of Geophones

Arising out of R. Branch contacts with the R.E. & S. Board in connection with the detection of electrical interference from equipment used for military mining (see diary entry 30th April and previously) there came early in the year a suggestion that R. Branch might be able to give useful assistance in the development of a geophone for the detection of sounds transmitted through the earth. The present army geophones are essentially similar to those in use in the 1914-18 campaign and are of non electrical types. Two geophones with a stethoscope are used for determining the direction of the source of the sound heard.

An electrical geophone (to be described in Research Report No. 11039) was developed in the laboratory and tried experimentally in the mine galleries at the School of Military Mining, Chatham, on 25th June. It was found that picking and such like operations could be heard clearly at distances of 180 ft. and 240 ft. Sawing of wood was identified without difficulty at 240 ft. At a distance of 330 ft. knocking on a corrugated iron wall was heard clearly; knocking on the chalk floor came through as dull thuds.

Col. Fenwick (R.E. & S. Board) expressed satisfaction with the apparatus. It was more sensitive than the army acoustic geophones which were tried at the same time. The battery supplied amplifier was satisfactorily portable and could, in fact, be larger if any advantage were to be gained thereby. The P.O. is to be requested to prepare at once a complete design and specification of a remote listening geophone set similar in general to the one demonstrated.

25th June 1940 — Telephony along an Infra Red Beam

A demonstration was given to Dr. Hill, Admiralty, Research Branch, Teddington, Dr. Webster of the Ministry of Supply and Captain Evans of the R.E. & S. Board, of the possibility of telephony over such a link.

The demonstration was given at the request of Dr. Hill.

The equipment used was that of the optical link described in Research Report 9769 but with the addition of infra red filters supplied by Dr. Hill and by R. Branch. The visitors seemed surprised at the quality of the speech and the small reducing effect of the filters except when a very dense one was used. It was left that R. Branch should carry out no more work for the present but should consider the question of possible improvements mainly on the score of size and weight.

On the 12th June Dr. Webster wrote that they were considering the use of relevant equipment and would later advise us as to whether it was desired that we should pursue the matter.

28th June 1940 — Supervisory Alarms on D.T.N. Switchboards

Difficulties have been experienced on these boards due to :

1. False clearing of teleprinter signals.
2. Failure to clear on the normal clearing signal over long physical extensions.
3. False calling.

The causes of these various faders have been investigated and remedies suggested in Research Report 11012. These were found satisfactory.

June 29th 1940 Provision of Overhearing Equipment at a West End Firm

A request was received from MI.5 for the installation of two microphones at the premises of a West End firm who were apparently agents for electrical apparatus of all kinds. The original owners had failed, but one of the members of the firm, was also an agent of MI5 agreed to carry on the business, with the aid of a suitable decoy as a cover for an information collecting centre for enemy agents.

It was originally intended that listening should be carried out only on the premises but it was later decided that, in addition, a direct line should be provided to MI5 Headquarters for this purpose, The occupant of the premises would switch on the amplifier and inform Headquarters by telephone when listening was to take place.

After a preliminary survey the microphones were connected, one in the electric light fittings of the office and one in a living room at the back of the premises where it was anticipated that the most confidential matters might be discussed. About this time, however, the agent himself fell under suspicion and MI5 requested that, instead of the simple amplifier and power unit usually employed, some special arrangement should

June 29th 1940 Provision of overhearing equipment at a West End Firm (Cont'd)

be provided to enable a continuous check to be kept on the agent.

The amplifier and power unit were therefore enclosed in a special case equipped with a three position switch and a red lamp. Two positions of the switch were used to connect either microphone to the amplifier and at the same time light the red signal lamp (to indicate that the microphone was alive). The third position, plainly marked "OFF", connected both microphones to the amplifier but disconnected the local headphones and extinguished the red lamp. Thus, when the apparatus was apparently switched off, both microphones were connected to the lines to MI5 Headquarters. In order to allay suspicion the local headphones were fed by an additional valve the heater of which was controlled by the microphone switch. By this means the familiar effect of the warming up of indirectly heated valves was provided.

The volume control was also arranged so that when it was set to give no sound in the headphones an adequate signal was still sent to line. The

June 29th 1940 — Provision of overhearing equipment at a West End Firm (Cont'd)

apparatus was permanently connected to the mains.

While the apparatus was in course of preparation the suspicions concerning the agent are believed to have become more acute. No definite information is available except that he died, of "natural causes", unfortunately before the apparatus could be installed and tested in practice.

8th July 1940 — Arrangements for use of Research Station in case of severe aerial attack on London including occupation of part of Station by other Branches and other Government Departments

(Previous diary entry 22nd May, 1940)

In order to meet the wishes of those who might become visitors to Dollis Hill should their present, or other possible accommodation, become untenable due to air raids, the rooms previously earmarked for their use have been reviewed. Some re-arrangement has been made so that the accommodation occupied by the visitors might be as compactly sited as possible and, in the case of that occupied by the Offices of the War Cabinet, as far as possible, separate from those parts of the Station where Research activities were still being carried on.

According to the final arrangement the ground and first floors of the General Research Block will remain entirely in possession of Research staff. Other accommodation has been earmarked as follows:-

For the Offices of the War Cabinet

Central Services Building	(First Floor)	All rooms
	(Second Floor)	All rooms except Telephone exchange
Auto and Repeater Schools	(Ground Floor)	All rooms
	(First Floor)	All rooms except Repeater School Apparatus Room (to be used as a store)
Stores and Garage	(First Floor)	Correspondence Course and Despatch Rooms

For the Tp. Branch, Circuit Laboratory

General Research Building	(Second Floor)	Rooms 9 and 10
Training School Annexe		Study Nos. 7, 8 & 9 and Inspectors' Office
Durability and P.E. Laboratories Block		Postal Engineering Laboratory

For the S. Branch, E-in-C's Plant Group

Central Services Building	(Basement)	Old Mechanical Testing and Cable Testing Laboratories

9th July 1940 — Design and Construction of simple Telegraph Printer

R. Branch has been asked to undertake development of a simple telegraph printer, intended primarily for field use, on lines suggested by Capt. G.T. Evans of the R.E. & S. Board. The scheme is a modified form of the Siemens Hell-Schreiber equipment. A rough model of another receiver has been made up by the Research Branch and appears to have advantages over the Evans proposal.

13th/

13th July 1940 — Methods of Spoiling Fuel Oil and Petrol

Various methods for obtaining the required result have been examined. The matter is rendered very difficult owing to the low density and viscosity of the material, particularly in the case of petrol; added materials very readily settling to the bottom of the tanks. Further, owing to the size of the tanks employed, it is desirable that the percentage of adulterant added should be small.

The Shell Mex Company who were approached on the subject stated that, although the matter was under investigation, they had no solution to offer at the moment.

The most promising material so far found has been sulphur chloride. This is an evil smelling liquid which produces decomposition of some of the fuel constituents and results in the formation of a finely divided black powder which appears to remain in suspension.

Petrol treated with ½% of sulphur chloride has been tested in an old 20 H.P. car and was found to clog the carburettor completely after passing about a gallon of fuel. Prior to stoppage, the working of the engine was seriously compromised. Further tests are in hand with different strengths of chloride and also to determine the effects of allowing the adulterated fuel to remain at rest for a period after treatment.

Other methods are also under consideration. The addition of sugar which has frequently been suggested has been proved useless under normal conditions. Research Case No. 11226 refers.

Installation of Listening Equipment at Latchmere House, Ham Common

July 17th 1940

Latchmere House is a large building, about 120 years old, standing in large, well wooded grounds, and was used until about four years ago as a home for officers suffering from nervous disorders as a result of the last war, For this purpose a hospital block had been added consisting of two floors with small rooms and one or two larger wards opening off long straight corridors. It has now been taken by M.I.5 as an examining centre for interned fascists, P.P.U. members and, to a lesser extent enemy or friendly aliens.

It was visited in company with Mr W.C. Crocker (the solicitor who secured Leopold Harris's conviction), Capt. Stevens (M.I.5) and Mr. Chalmers (H.M.O.W.) on July 9th, with a view to the installation of microphones in certain sleeping rooms (S.R.s) and the provision of machine rooms (M.R.s) equipped with recording machines and listening facilities. Messrs. Crocker and Stevens emphasised that the urgency was such as to place this work before any that was in hand for M.I.9, a view which was somewhat modified after discussion with M.I.9 and the Director of Military Intelligence.

S.R.s were chosen in the top floor of the hospital block and it was decided to place the M.R.s in the house itself. The following day, however it was discovered that the rooms were unsuitable from the administrative point of view and too small for two people. Six new S.R.s were therefore chosen on the top floor of the house and the M.R.s were rearranged to suits this. Three interrogation rooms were also chosen. Capt. Stevens stated that the installation was required to be working in four days. Stores were taken down that evening and work commenced on the morning of Thursday 11th. July, under the direction of Mr. D.G. Munro (Insp.)

By Monday 15th, microphones had been installed, wiring completed, and listening could have been carried out. No carpets had yet been laid in the S.R.s or the M.R.s however, and the location of the interrogation rooms had been changed. Also no furniture had appeared for the offices and messrooms so the building could not be put into service. Time was therefore taken to re wire the lighting system of the S.R.s in order to reduce mains interference which was unduly high owing to the use of parallel wires in wooden casing. This wiring was carried out

by R. Bch workmen since it was not possible, for reasons of security, to allow contractor's men to enter the lofts.

Owing to the requirements of M.I.9 it has not been possible yet to install the final recording machines, but two out of the eight listening positions have been equipped with temporary machines. It is expected that the work will be completed early in September.

Extension of Listening and Recording Equipment at Cockfosters Camp July 30 1940

Such good results had been obtained from the original installation at Cockfosters Camp that an increase in the number of rooms fitted with microphones was desired. It was decided that the P.O. method of concealing the microphones should be adopted since it was simpler than the R.C.A. method and less likely to be discovered, (one of the latter had actually been found by a "guest"). It was also decided to use the new recording machines, developed by R. Bch. in conjunction with Messrs. M.S.S. Recording Company, as they were more convenient in use and no more expensive than the

R.C.A. machines and would not require the purchase of dollars to pay for them. The quality of records cut on them was also probably slightly superior to that of the R.C.A. recordings.

Four new rooms were fitted with microphones and the binaural systems in the two existing P.O. Experimental sleeping rooms were replaced by monaural systems. A new machine room was equipped with six listening and recording positions to serve these six sleeping rooms. Care was necessary to ensure that the changes were carried out without causing any interruption of the service from existing rooms. The work was completed satisfactorily on 30 July.

17th July 1940 — Arrangement with Transmission and Lines Branch to assist under Emergency Conditions

Two parties have been organised from the staff of the V.F.R.. Group to give technical assistance to the Transmission and Lines Branch should it be necessary to undertake a large amount of repair work to the trunk network as a result of damage from aerial attack. Each party has been organised as a "flying squad". Portable transmission testing apparatus suitable for operation from A.C. mains, but with provision for falling back on battery supplies, has been earmarked for the use of each party as has also two private cars. The parties will, therefore, be able to travel rapidly to points where their services are needed independently of delays in railway or other public transport.

23rd July 1940 — Signalling Research to be undertaken for the Air Ministry

At a meeting on the 10th July between the Engineer-in-Chief and the Deputy Director, Communications Development, Ministry of Aircraft Production, the former recalled that an offer made by the P.O. to assist the M.A.P. in the solution of problems associated with the development of communications had been accepted. Specific problems were discussed at this meeting and it was agreed that certain of these, which had been investigated on a laboratory scale at the Air Ministry Research Establishment, could well be passed over to the Research Branch for development. Following this the S.E. in charge of the Research Branch and the E.E.'s in charge of the Telegraph and Signalling Apparatus Groups visited the A.M.R.E. on the 23rd July and discussed the problems in detail with members of the A.M.R.E. group concerned with Communications and Operations. Experimental work and development in connection with two problems will be taken over by Dollis Hill immediately. These problems are concerned with the transmission of information from R.D.F, stations to F.C. and A.F.C. and its presentation on display panels. The information concerns the map position, height, number etc. of aircraft which have been located by means of R.D.F, echo equipment and whose range and direction have been translated into map position etc. by means of the associated calculator. At present the information appears on a display panel at the R.D.F. station and is telephoned to A.F.C. Demonstration of transmitting and receiving terminals for the automatic transmission has been/

23rd July 1940 (Contd.)

been promised by the end of August and will involve considerable work by the Signalling Apparatus and Telegraph Groups. It is proposed that the information should be transmitted by means of teleprinter signals. The sending teleprinter will be automatically operated by a series of magnets arranged under the keys, these magnets in turn being actuated through the medium of automatic telephone switches which explore the conditions of the local (R.D.F. station) display panel. An attachment which can be readily fixed to a standard teleprinter and which will actuate five change-over contacts in accordance with the received letter code has been constructed by Messrs. Creed for the receiving end, but the problems of translation and storage of the received information have yet to be investigated in detail.

One other outstanding problem under consideration by the A.M.R.E. seems appropriate to the Circuit Laboratory, but it is impossible to make progress with this problem until the requirements of the staff concerned with operations have been definitely ascertained.

31st July 1940

Occupation of part of Research Station by Admiralty Insurance Party (See entry under August 25th, 1939, etc.)

The last of the Admiralty staff have now vacated the Research Station buildings and a letter has been received from Rear Admiral C.H. Young conveying Admiralty "appreciation for all that has been done during the past 11 months to make our stay comfortable and happy".

1st August 1940

Modification to Air Raid Warning Equipment at Fighter Command and Alternative Fighter Command

(See diary entry November 22nd, 1939)

The air raid warning arrangements have been modified by the introduction of a warning between the (yellow) preliminary warning and (red) the siren warning. The new signal, it is understood, is to give notice for the dimming of light from such places as blast furnaces and goods yards which are normally allowed some easement in the lighting restrictions and which may throw a light to a considerable distance.

To make room for the new signal the green "raiders passed" signal has been abandoned. The new colour chosen was purple, the more suitable blue not being available as it is used for other purposes/

1st August 1940 (Contd.)

purposes. Considerable difficulty was experienced in getting a good purple which would transmit sufficient light, but provisional agreement with the Warning Officer has been obtained, and the necessary changes made. These have involved the replacement of all the escutcheon plates (150) on the switch cases, the replacement of about 150 red lamps on the large map by purple, and about 150 green lamps by red. Corresponding changes on the small map involved about 250 lamps in each case. In addition about 150 red opal caps were changed to purple and the same number of green to red on the Home Office panels. The change-over had to be carried out as far as possible without interfering with the operation of the equipment, and fortunately the time selected happened to occur during a slack raiding period. Nine men were employed on the conversion at Bentley Priory (F.C.) and completed the work, including testing out, between 8.15 a.m. and 11.15 a.m. on July 25th.

Leighton Buzzard (A.F.C.) equipment was similarly modified on August 1st.

23rd August, 1940 Provision of Additional Telephone Circuits to the Shetland Islands (Scheme 84)

During August the equipment provided by the Research Branch for Scheme 84 - 1+2 duplex plus 12 circuits Between Kirkwall and Lerwick - was completed and installed. Terminal equipment to be provided by the contractor for the 12 circuit system and certain equipment at Fair Isle is still awaited but the 1+2 duplex

24th Aug, 1940 Provision of Overhearing Apparatus for the M.I. Branch of the War Office

Following the success of the installation at Cockfosters Prisoners of War Camp recorded in the Diary entry for December 19th, 1939, it was realised that there would be a demand for high quality recording equipment of British manufacture for any further installations which might be required. For this type of work a really high-class record is necessary. Commercial apparatus was investigated and it was ascertained that apart from the American RCA and the German VG machines, of which only a limited number were in this country, there was nothing suitable. However, a firm was found who were making cellulose acetate discs for direct recording and who had some experience in manufacturing studio recording machines for the B.B.C. In co-operation with this firm an entirely new design of portable recorder was evolved of simple and relatively cheap construction. This machine will make high quality records with a playing time of 7½ minutes compared with 4½ minutes on the RCA machines originally installed and has some advantages in the method of operation. A compact, mains-supply, amplifier for operation from the concealed microphone and to feed the listening headphones, also a power amplifier to feed the recorder, were designed in the Research Branch.

While this work was in hand requests were received from the War Office for the provision and installation of equipments as follows :

1. An extension was required at Cockfosters. For this, six tables each accommodating two built-in recorders, a 10-way switchboard with keys and indicator lamps, power amplifier and controls, have been supplied and installed. The two rooms previously fitted by the Research Branch with microphones and four additional rooms have been wired to this equipment. The microphone amplifiers and power supplies are accommodated on a small rack ~~together with a communications frame~~. Four play-back machines with amplifiers were also supplied.

This has been referred to in the Diary entry for July 30th,1940.

2./

24th Aug (Contd.)

2. A request Was received to wire and equip at very short notice a building at Ham for the accommodation of internees. As described in the Diary entry for July 17th, 1940 10 living rooms and 4 interrogation rooms were wired.

Two temporary recording tables (using machines which had been made for experimental purposes during the development) were installed. These will be replaced very shortly by 8 tables each with two recorders. Switchboard amplifiers and some auxiliary equipment were installed, together with two play-back units. About two weeks were taken from the receipt of the request to the opening of the installation for use. The work proceeded at the same time as the necessary building alterations. Owing to the age of the electric light wiring, some trouble from induction was experienced which made it necessary to re-wire part of the lighting circuits.

3. A request was received for the supply of equipment to be despatched to the Middle East for an installation there.
10 tables, 22 recorders, 20 microphones, 22 amplifiers, 4 playback units, switchboards, racks, spares and all the necessary wire, etc. have been despatched. The Branch was asked if it could supply an officer to proceed to the site to supervise the installation but suggested that Capt. D. MacMillan who, before mobilisation, was Executive Engineer in charge of the Acoustic Group should be released from his duties with the Royal Corps of Signals for this purpose. This was arranged and MacMillan has left for a destination in Egypt.

4. A War Office truck has been fitted up as a mobile recording unit. The equipment supplied and installed includes a petrol generator charging a 70 ampere-hour, 50 volt battery and a rectifier unit for charging from mains when available. Two combined recorders and play-back units, equipment for connecting up to microphone rooms, a 2 ft. diameter reflector- type directional microphone for outside use, amplifiers, switchboards and all necessary cable, tools and work bench, are provided on this truck. The Deputy Director of Military Intelligence, Brigadier W.R.C. Penney, D.S.O.,O.B.E.,M.C., inspected this van at Dollis Hill on August 24th and expressed satisfaction. It is anticipated that more similar outfits will be required.

5. The installation of a similar equipment to that at Cockfosters, on a site yet to be selected in the West of England, has been requested but not yet started.

It should be pointed out that these installations not only give longer records and better quality reproduction than the RCA installation at Cockfosters, but the switching facilities are better and the cost is much less; in addition to which the equipment is entirely manufactured in this country. So far most of the work, both of manufacturing and installation, except/

24th Aug. 1940 (contd.) except the making of parts for the recorders and proprietary components, has been carried out by the Dollis Hill staff who have worked very enthusiastically, especially on the actual installation. The M.I. Branch have repeatedly expressed their appreciation of the efforts made to meet their requirements and the good results they are obtaining from the equipments.

30th Aug. 1940 Detection of Buried Delayed Action Bombs

On 23rd August the Research Branch was asked to send a representative to a meeting at Woolwich Arsenal (Research Department) to help in the consideration of the problem of discriminating between enemy bombs containing a delayed action mechanism and those which had merely failed to explode on striking the ground. These bombs had been dropped from aircraft at very great heights and penetrate the ground to depths as great as 30 ft., or more in certain cases. On entering the ground the bomb makes a small hole but after having travelled downwards for some way may be deflected sideways and is often found at horizontal distances of 15 to 20 ft. from the point of entry.

The bomb is fired by the discharge of a condenser through a fuse, delayed action being obtained by means of contacts closed by a clock. This clock, when working, makes a ticking noise no louder than the average wrist watch. An obvious means of discriminating between a delayed action bomb of this type and a "dud" is by listening for the sound of the clock.

Experiments have been carried out at Dollis Hill using watches buried in metal containers. Other work has been done at the N.P.L. As a result of all this it has been concluded that it is impossible to hear the clock work unless the microphone can be pushed within nearer than 3 ft. of the bomb. The difficulty is not lack of sensitivity of available pick-up devices, but the noises present in the ground due to distant traffic and which give an unfavourable signal/noise ratio. An initial problem therefore presents itself: that of locating the bomb with sufficient accuracy for a microphone to be pushed down by means of a probe rod to within 1 to 3 ft. of it. The known electrical methods of geo-physical survey have been tried, but have not the sensitivity necessary for the location of a buried mass of metal of the size of a bomb at distances down to 30 ft. Other means of effecting this location, such as by the use of ultrasonic waves or by short-wave radio, have been considered but technical difficulties stand in the way of the application of each of them. The services of a water diviner have been tried without success!

f.3.10.40

5th September 1940

Methods of Spoiling Fuel Oil and Petrol

The promise shown in the early tests has not been maintained and no solution is at present available. Various adulterants have been tested either for their action in stopping up jets or for their corrosive action on the carburettor or engine. These included rubber, linseed oil, tar, paraffin wax, sugar, chlorosulphonic acid, sulphur chloride, etc. The most efficient adulterant was sulphur chloride but unless the mixture were used within 24 hours of making the harmful effects disappear to a very great extent.

7th September 1940 — Provision of Overhearing equipment for the War Office (XII)

A furnished house in the Provinces had been rented on behalf of some enemy agents who were due to arrive at short notice. The transaction was arranged for them by MI 5 who then requested the Research Branch to equip the house so that the objects of the visit and other information might be overheard.

Concealed microphones were fitted in the two living rooms and in the two main bedrooms. The work was rendered difficult by the necessity of not arousing provincial curiosity and by the extremely shoddy methods adopted by the builder. It was finally accomplished with no more external evidence than the appearance of an extra water pipe in the bath-room cupboard. Amplifiers were fitted in a cupboard in a bedroom of the adjoining house for the use of one or two "lodgers" who were expected shortly.

One of the lodgers has since been instructed in the use of the amplifiers and has taken up residence.

21st September 1940 — Design of a Simple Telegraph Printer

This investigation originated in a suggestion by Major G.T. Evans (R.E. & S. Board) for a simple multi-stylus receiver suitable for use in the field. This gave fairly good results but very much better ones were obtained with a Hell Type helix receiver, constructed on the Station, and with electro chemical recording. These results are as good as those normally obtained with the Standard Siemens Hell ink receiver. Commercial transmissions from Germany have been satisfactorily intercepted. In view of this, it has been agreed to drop the Evans receiver and Major Evans is arranging a demonstration of the Dollis Hill receiver to M.I. staff.

In spite of various objections which have been raised against the Siemens Hell receiver on the score of the critical nature of the adjustments, no difficulty has been experienced in obtaining first class reception on the Siemens Hell type receiver with ink roller constructed comparatively roughly in the laboratory. It would appear therefore that there is less need to make use of the relatively expensive and difficult electro-chemical recording. Tests are however in hand to determine whether a cheaper form of chemical recording paper can be obtained and one which will be less liable to blurring of the signal. A workshop made model of the ink receiver is now under trial.

Disablement of Secondary Batteries

An enquiry has been made by the M.I. Branch of the War Office as to the possibility of disabling the batteries of enemy telephone exchanges. A compound has been found which, when added to the cell, produces intense frothing during the gassing of the cell. If some material, such as zinc or magnesium, is also added the action is sufficiently violent to empty the cell of liquid in a short time. The cell is not damaged but the scheme might have a nuisance value. Methods for damaging the cell are still under investigation.

28th September 1940 — Work of Post Office and Army Signals Co-ordination Committee

The formation of a committee to give increased co-operation between the various parties concerned with the supply of Army Signals equipment is referred to in the Non-Secret Diary entry of August 31st. This committee has since been responsible for the laying of about 50 miles of rubber insulated quad cable and a long length of D.8 over a triangular course mainly in Hertfordshire so that field tests of loading, repeaters, carrier/

28th September 1940 (Cont'd) carrier working, etc. could be made under typical conditions. The full results of these experiments will not be available for some time but it is already evident that:

(1) The quad cable which gave much contact trouble in France is now quite satisfactory with improved flexo couplers loaded and unloaded.

(2) The stabilised repeater works well on quad cable or D.8

(3) The method of locating a complete break in a loaded cable developed for use on lead-covered cables can be applied to the loaded quad and, with less accuracy, to the unloaded quad. Case No. 11224 refers.

29th September 1940 Further Modification to Air Raid Warning Equipment at Fighter Command and Alternative Fighter Command

The Branch was requested as a matter of urgency to alter the boundaries of certain air raid warning areas on both large and small maps at Fighter Command and Alternative Fighter Command. The changes required were principally in the London area although others were required elsewhere in the country. The original central London area had to be sub-divided into three with an alteration and splitting of some of the adjacent areas in the Home Counties. A time was quoted for the completion of the work at Fighter Command which was well within that required by the Telecommunications Department for making arrangements for distribution of warnings to the new areas. The changes required were such that it was not found possible to alter the front of the large illuminated map and an entirely new one had to be constructed and fitted after altering the various cell areas. Corresponding alterations were also made simultaneously in the Home Office panels. The work was rendered difficult by the fact that the alterations had to be made with as little interference as possible with the normal use of the maps and warning system. The very congested space available to work in added to the difficulties. Dismantling of the large illuminated map at Fighter Command was commenced at 6 a.m. on September 27th. The new front was fixed and the map made ready for use by 7.15 p.m. when the changeover to the new warning areas took place. The small map was altered subsequently on the 28th and 29th.

Alterations/

29th September 1940 (Cont'd) Alterations to the two maps at Alternative Fighter Command are in hand.

30th September 1940 Provision of Matrix for Sound Recording Discs

In connection with the development for the War Office of overhearing and sound recording equipments, some difficulties have been experienced in getting suitable matrix-covered aluminium discs for making records. The discs which previously gave satisfactory records were made in France. The Research Branch has been asked to suggest suitable materials and treatment and discs very similar to the French ones have been produced.

2nd October 1940 Location of Buried Delay Action Bombs

Since the last diary entry (30th August, 1940) there have been several discussions between representatives of the Research Branch and other organisations investigating the problem. At a meeting to-day under the chairmanship of Dr. Paris, progress in connection with one side of the problem ((a) below) was completely reviewed. There were present at this meeting Professor W.L. Bragg, Professor Andrade and representatives of the N.P.L., E.R.A., the Research Department, Woolwich Arsenal, the B.T.H. Co., the Anglo Iranian Oil Co., as well as those of the Department.

The problem has two clearly defined sides:-

(a) The first is concerned with the accurate location of the bomb so that it may be rapidly excavated or in some cases detonated in position. Experience accumulated within the past few weeks indicates that 80% of the bombs will be found within a semi-circle of radius 10' about the point of entry. The depth varies greatly with the size of the bomb and the nature of the ground. Electrical methods of location, operated solely from the surface, have probably been investigated by the Post Office more extensively than by other bodies. The methods may be classified as depending upon:

(1) Canalization of earth currents

(2) Change in self impedance of a coil

(3) Change of mutual impedance between two coils.

The first two compare unfavourably with the 3rd. The third demands the measurement of impedance changes which are of the order of one part in 100,000 of the mutual impedance between the two coils tightly/

2nd October 1940 (Cont'd)

tightly coupled and difficulties are experienced due to the extreme mechanical stability which is required of the coil system and to the occurrence of drift. With coils 3' in diameter satisfactory indications have been obtained from an object at 6' and it has been concluded that, with an input of 2.5 K.V.A. to the primary coil, location of bombs would be possible down to depths of 15'. This is not impossible where equipment can be transported by lorry but for greater depths the power values become astronomical as the observed effect decreases with the 6th power of the distance. This agrees closely with the experience and conclusions of the N.P.L. who have been working along similar lines.

Surface methods are now regarded as the subject for long term investigation. There are prospects of methods being more quickly developed for location by means of apparatus which may be lowered down probe holes. Three methods exist.

(i) The first developed by Professor Bragg depends on the magnetisation of the bomb which is accomplished by a permanent magnet lowered down the bore hole. Search coils are rigidly fixed to the top and bottom of the magnet and discharged through a small galvanometer when the flux linking with them is changed by the assemblage passing the bomb. The range of the equipment is not more than 2' 6".

(ii) In the second method, developed by the E.R.A., the course of the tunnel made by the bomb is explored by means of an electrode driven from the surface. If this enters the tunnel made by the bomb its resistance to earth is increased.

If it touches the bomb its resistance to earth becomes small.

(iii) The third depends on the measurement of the mutual impedance between two coils which can be lowered down the hole. The method compares disadvantageously with (i) in that it is not directional. It is understood that equipment is available for boring 4" diameter holes to a depth of 20' within one and a half minutes.

(b) The second side of the problem is concerned with the provision of equipment for listening to the clockwork delay action mechanism in the bomb. Experimental work which has been carried out since the last diary entry has made it clear that with conventional types of circuit reliance/

2nd October 1940 (Cont'd) reliance cannot be placed upon ability to hear this mechanism unless the microphone casing can be brought into contact with the bomb. A contact microphone and 2-stage amplifier have been developed at Dollis Hill and submitted to the Research Department, Woolwich, as a Mark II device. The whole, with battery supplies, is very easily portable.

3rd October 1940 Occupation of Part of the Research Station by other Government Departments

A meeting of the War Cabinet took place this morning in the special basement under the new Stores Building. After the meeting Ministers were served with lunch in the Refreshment Club (1st floor dining room). All the arrangements were made by Capt. B.P. Adams, R.N. and the normal life of the Station was not interfered with.

c.5/11/40.

October 18th 1940

Signalling Research undertaken for the Air Ministry

The diary entry of 23rd July, 1940 describes the Air Ministry requirements in connection with the transmission of display information from RDF stations to Fighter Command and Alternative Fighter Command. During October the final model of the equipment proposed for RDF stations was designed and constructed at Dollis Hill and finally transported to the Air Ministry Research Establishment at Worth Matravers and there demonstrated to Air Ministry officials. This apparatus is associated with the panel on which is displayed the results of the radio measurements fed into the calculator. It consists essentially of a Siemens type high-speed uni-selector used to find marked wires from the lamp display and eventually to operate a teleprinter so that characters corresponding to the display are sent out to line.

New equipment, of particular interest, is the modified Teleprinter No.7, the key levers of which are arranged to be operated by electro-magnets made up from standard 3000 type relay parts.

The "make-up" of the message to be transmitted has already been altered since the experimental work was started by the Research Branch on behalf of the A.M.R.E, in August. Certain additional facilities now seem likely to be required and the development of these and the design of a verbal announcement system operated at Fighter Command or Alternative Fighter Command, from the received teleprinter message, are being proceeded with.

October 20th 1940

Provision of Special Equipment for the War Office (M. 1.5)

Evidence been obtained that the mission of a semi-official representative of a neutral government was not being confined to the objects disclosed to the Foreign Office.

[redacted]

[redacted] He was therefore supplied, by the British Council with a radio receiver and a special line from the B.B.C. so that he could receive directly the short-wave broadcasts to his country and so avoid reception difficulties. A microphone was mounted in the set [redacted] no response on the performance of the equipment has yet been received.

October 24th 1940 — Provision of Portable Recording Equipment for the War Office

A record has been made from time to time of work carried out for the Military Intelligence Branch of the War Office. Such work has usually involved the installation of concealed microphones in rooms used by prisoners of war or suspected persons, together with an associated listening or recording equipment located elsewhere. This work has resulted in the discovery of much information of value for war purposes but has accentuated the desire on the part of various M.I. branches for a self-contained listening and recording set sufficiently small to be secreted on the person or concealed within a common object, such as a gas-mask container or an attaché case. A friendly agent could then carry the equipment into such places as restaurants, with the possibility of bringing away a record of important conversations. The construction of listening and recording equipments has not yet developed to such a stage that it is possible to make one as small as this but another method of achieving the desired result is being explored experimentally, in conjunction with the Radio Branch. This involves the use of a microphone feeding into a midget radio transmitter with a range of 100 yards or so. The radiated message would be picked up by a radio receiver, amplified and either fed into a recorder or listened to on headphones. The radio receiver and associated recorder would be suitably located, for example, in the agent's parked motor car, within the sending range of the midget transmitter. Many constructional difficulties will have to be overcome before the latter, complete with microphone and battery supplies, can be reduced to a size so that it can be easily concealed, but it is thought that there may be a very fair chance of success.

October 26th 1940 — Work of P.O. and Army Signals Co-ordination Committee

The tests of audio and carrier equipment on the field quad cable laid in Hertfordshire have been continued and discussed by the Committee. It is now possible to state the conclusions of this work, which were indicated in diary entry of 28th September, 1940, more definitely.

1. Field quad cable may be used for local and long-distance Army communications.

2. Two-wire repeaters are suitable for local communications but long-distance Army communications require four-wire repeaters so that an equivalent of 4 or 5 db can be obtained.

3./

October 26th 1940 (Cont'd)

3. A single channel carrier system can be worked on a two-wire basis without intermediate repeaters for short distances and on a four-wire basis (using the same repeaters as the audio circuit) over long distances. When the cable is loaded, one carrier circuit can be worked on one of the earth phantoms.

It is interesting to record that the 21 type of repeater (balancing line against line) which seemed promising on account of its simplicity, was thoroughly tested but found unsatisfactory compared with the ordinary 22 type in which there is a line balance on each side.

October 31st 1940

Use of American Teleprinters in England

Owing to the difficulty in obtaining adequate supplies of English teleprinters, the Air Ministry were anxious to see if American machines could be satisfactorily worked with English ones. A demonstration showing that the American 15B machines could be operated satisfactorily with the English 7B type was given to Air Ministry officials. The objections to such an arrangement, i.e., different baud speeds, different motor voltages, different touch, necessity for relays and maintenance difficulties, are considered by the Air Ministry to be outweighed by prime consideration of the fact that quantities of 15B machines can be obtained without difficulty.

October 31st 1940

Provision of Matrix for Sound Recording Discs

Further to the diary entry of 30th September, considerable success has been obtained with the manufacture of sound recording discs in the laboratory and the question of larger scale production is now being investigated.

20th November 1940

The Location of Unexploded Bombs

A comprehensive Research Report (No. 11263) is being written describing the experimental work which has been done by the Research Branch. Although no method of location having a greater range than those developed by other investigating bodies has been found, the complete investigation of various possible methods which has been carried out may prevent attempted development elsewhere of methods which are fundamentally limited as regards their range.

The methods investigated at Dollis Hill may be summarised as follows:-

A. Methods based on the use of Sound Waves

(1) Ultrasonic Methods

Abandoned owing to excessive attenuation of the earth path, i.e. 20 to 30 db per inch.

(2) Acoustic Methods

The depth of a hole can be accurately measured by resonating it as an organ pipe but the test is not one which could easily be carried out by unskilled personnel. Work is still proceeding on methods depending on the reflection by the bomb of a sound wave caused by a blow or small explosion but this is not thought likely to lead to any practicable method.

B. Radio Reflection Methods

These have been dropped, after theoretical consideration only, on account of the difficulties involved due to the very short reflection times.

C. Electrical Methods

(1) Methods depending on the Canalization of Earth Currents Unless impracticably large layouts are used the sensitivity is quite inadequate.

(2) Methods based on the change of Self Impedance of a Coil Laboratory tests have indicated that 2'6" is about the maximum distance at which the bomb could be detected. Location in the field would be very difficult owing to the refinement required in the test and the need for extreme stability of the oscillating circuit. Earth capacitance effects increase the difficulties.

(3) Methods based on the change of Mutual Impedance between two Coils With coils on the surface of the ground the power input required becomes impracticably large for location at depths greater than about 15 ft. Erroneous results are also obtained due to the presence of buried/

20th November 1940. (Contd)

of buried pipes, etc. near the surface. Attention was therefore directed to the development of coils which could be lowered down 4" diameter bore holes. A range of about 2' to 3' was obtained easily in the laboratory but with difficulty in the field owing to the masking effects of eddy currents in the earth. Extreme mechanical stability of the coil system is necessary.

23rd November 1940

Army Carrier Telephone System

The two types of quad cable intended for use with the Army (1+4) carrier system are undergoing a field trial at Salisbury. About 20 miles of rubber cored cable made by the B.I. Co. and about 8 miles of a later type of Polythene cored cable made by the T.C.M. Co. have been laid between common points. Both cables have proved satisfactory apart from certain constructional details and an order is being placed for several 100 miles of the Polythene cable. It is smaller and mechanically stronger than the rubber cored cable and the attenuation is 0.8 db per mile at 16 kc/s as against 1 db per mile for the rubber cable.

23rd November 1940

Work of P.O. and Army Signals Co-ordination Committee

Good progress has been made with the trials of repeaters and single channel carrier equipment on the special field quad cable run between Tatmore Place, Albury and Hertford. The first model of the carrier system (S.O.C.2) designed by the S.T. & C. has also been supplied and is under test. A suitable type of repeater usable as 2-wire or 4-wire has been specified and schemes worked out for the application of repeaters and carrier equipment to field quad and other types of Army lines under various conditions.

23rd November 1940

Stabilized Repeaters for Army Telephone Lines

Some of these repeaters are being given field trials in actual service at 2nd and 4th Corps headquarters. The repeater at 4th Corps headquarters is working satisfactorily on P.O. lines and two repeaters are also working on 30 miles of D.8 cable specially laid between Newmarket and Brandon.

27th November 1940

Design of Simple Telegraph Printer

The simple telegraph printer referred to in the diary entry of 21st September, 1940 has been demonstrated to Major G.T. Evans (Ministry/

27th November 1940 (Contd) (Ministry of Supply) and considerable satisfaction was expressed. He is arranging for representatives of other Service Departments to receive a demonstration.

The main features are :

(1) Light weight, about 12 lbs. for the complete instrument.

(2) Sensitivity. Line current of mA is ample and 2 mA quite good.

(3) Low power consumption, total about 9 watts.

(4) Start-stop operation.

28th November 1940 Assistance to the M.I. Branch of the War Office

On two occasions a temporary installation of a concealed microphone has been made in a West End hotel. In each case the installation was made, used and recovered during the course of one day. The standard apparatus is easily transportable in suitcases and includes amplifiers and duplicate recorders. In these two cases the actual recording of the interviews was carried out by members of the Research Branch.

Enquiries have been made by MI Branches concerning the possible construction of a completely self-contained and portable unit comprising hidden microphone and recording equipment. There seems to be a real need for such a unit, which could be carried out by an agent, but it would have to be small enough to go within a despatch case or gas mask container etc.

Despite recent developments in technique this is still impossible but the assistance of W Branch has been sought in connection with the alternative development of a microphone associated with a miniature short range radio transmitter. The latter would work for a receiving set and recording equipment located not more than 200/300 yards away, for instance in a parked motor car.

28th November 1940 Signalling Research for the Air Ministry

Continuing the story given in previous diary entries (23rd July and 18th October) the equipment constructed in the laboratory at Dollis Hill for meeting the Air Ministry requirements, known as Problem 1, was taken to the Telecommunications Research Establishment at Worth Matravers (lately known as A.M.R.E.) and successfully demonstrated there to Air Ministry officials. It will be recollected that this equipment is wired to the calculator at the R.D.F, station and by relay operation of a teleprinter sends out in the form of teleprinter signals to line the information (raid position, number of aircraft, height, etc.) given locally on a display panel associated with the calculator.

The Air Ministry scientific staff have not yet decided between various possible methods of presenting the received information at Fighter Command

(Problem 2)/

28th November 1940

(Problem 2). In addition to the difficulties involved in translating the received teleprinter signals into displayed or spoken information, consideration has to be given to the requirements of the Operations Staff who have not yet accepted automatic teleplotting. The following methods, each supplementing reception of the complete message on teleprinter tape are being examined at Dollis Hill.

(1) Reproduction on a lamp display of all the information given by the lamp display panel at the transmitting end.

(2) Verbal announcement (by means of photoelectric talking apparatus) of all, or part, of the information received over the line. In the latter case the raid position would be spoken and other raid details read from the teleprinter tape or lamp display.

(3) Announcement to plotters of the raid position by means of morse signals, the remaining information being obtained from the teleprinter tape or a lamp display.

(4) Complete automatic plotting of the raid position by movement of a projected spot of light on the map.

30th November 1940

Provision of Telephone Circuits to the Orkney and Shetland Islands

Several members of the Carrier Group of this Branch have recently spent long periods in the Orkney and Shetland Islands in connection with the installation and line-up of carrier telephone equipment constructed in the laboratory at Dollis Hill. The position with regard to different schemes for providing additional circuits is as shown below :

Scheme 84

A total of 15 circuits between Kirkwall and Lerwick have been completed and put into service. These include 3 circuits which can be switched at Fair Isle (1+2 circuit duplex system, completion reported last month) and a 12 circuit grouped system, all operating over a single concentric submarine cable.

Scheme 87

A further group of 12 circuits has been completed and made available for traffic between Wick and Kirkwall. The 12 channel groups between these terminals have been re-arranged so that the three "Go" groups are transmitted over one cable and the three "Return" groups over the second cable. The 1+2 circuit duplex groups are unchanged. Further 12 circuit groups can now be added if required.

When/

30th November 1940 (Contd.)

When one cable is faulty, 19 circuits are available.

At the time of this installation the Wick terminal was transferred from the temporary to the permanent repeater station.

1st December 1940

Air Raid Damage to Special Equipment

During the night of November 29-30 a well built country house used by the M.I. Branch of the War Office was hit by a bomb. This house had previously been equipped by the Research Branch with concealed microphones in eight rooms, listening positions, recording equipment and play-back units (see diary entry dated July 17th, 1940) The bomb hit solid masonry and exploded in a bedroom on the second floor, killing the occupant. In the next room were two racks of amplifiers associated with the overhearing equipment, and in adjoining rooms listening positions, recording and play-back units. In order that the existence of this equipment should not become generally known, it was necessary to recover all the apparatus before the demolition squad started work on the building. Members of the Research Branch were therefore hastily collected and worked throughout Sunday, December 1st, in somewhat precarious positions, recovering all the equipment including the microphones. The amplifiers, power units, recording and play-back units, were buried under masses of brick-work and rubble; and dust had penetrated the covers. Except, however, for two broken valves, all the amplifiers were found to be in working order after the equipment had been brought back to Dollis Hill.

Opportunity will be taken of this mishap to put on record the information gained as to the effect of explosions on valves and a short Research Report (R.R. No. 11326) issued on the subject.

f.4.1.41.

9th December 1940 Air Raid Damage to Special Equipment

Further to the diary entry of December 1st, it has been suggested by the M.I. Branch of the War Office that it would be possible to install temporary equipment in any part of the buildings still available to replace that rendered unusable as a result of bombing on the night November 29th/30th. Four rooms have now been wired and recording tables and equipment installed. In connection with the installation of the concealed microphones, it has also been necessary for Research staff to re-wire the lighting equipment.

Further accommodation is now being provided by extending some of the undamaged buildings. As soon as this is ready, a further 11 or 15 rooms will be equipped and corresponding recording apparatus installed. Most of the apparatus will be that originally used.

11th December 1940 Simple Telegraph Printer for Army Use

A laboratory model of this equipment referred to in the diary entry of the 27th November 1940 has been demonstrated to Brig. Tillard, Col. Elsdale and Major Evans (all of the Ministry of Supply), Major Meiklejohn (War Office) and Capt. Fulton (Canadian Military Headquarters). The officers considered the equipment very promising and a request has since been received for four models to be made up for field trial. Some of the main features of this equipment have been referred to previously. They are:-

(1) It is a start-stop, tape instrument with an electro chemical reproduction and a signalling speed of 150 lines per minute.

(2) The dimensions are 13" x 10" x 6" high. The weight is about 12 lbs.

(3) The power consumption of the motor is 0.66 A. at 12 V.

(4) A line current of 5 mA is ample. On short lines a 12 V. battery will be sufficient.

(5) The printer is adaptable for V.F. or D.C. line or radio circuit operation.

(6) The tolerances are such that manufacture by non-specialist firms is possible.

13th December 1940 Special Work for the War Office (M.I. Branch)

Considerable interest was provided by a small task undertaken yesterday for the War Office. An enemy agent had been apprehended but allowed to live, under the guardianship of plain clothes officers of M.I.5., in a house in an outer London suburb and to transmit "edited"

13th December 1940 (Cont'd)

news to Germany. Contact with this agent was made by another German spy and the War Office desired that the two should meet and talk freely, but at the same time wished to overhear the conversation. A concealed microphone was fitted in the book case in the sitting-room and the microphone amplifier secreted in a cupboard. The provision of a listening position presented a difficulty as it was not desirable that the suspicions of either agent should be excited. [redacted]

A General Staff Officer from M.I.5 listened to a 2-hour conversation in the late evening and 18 gramophone records were cut of the most important parts. The signal/noise ratio at the listening point was not as good as expected and, should similar expedients be necessary in future, some improvements may be possible in the small, battery supplied, microphone amplifier. Apart from a few whispered passages, however, the conversation was intelligible and a formal letter of appreciation from Brigadier [redacted] stated, "the results obtained by your co-operation were exactly what we wanted and it will enable us to get a great deal of information which we otherwise might not have obtained."

23rd December 1940 — Modification to Air Raid Warning Equipment

It will be recollected that all air raid warnings are now sent out initially from Fighter Command or Alternative Fighter Command.

The equipment which was installed at these places by the Research Branch was described in the diary entry of November 22nd, 1939. Briefly this consists of switching and display equipment and two maps each of which can be illuminated according to the state of warning in the various warning areas. One of these maps is for the use of the warning officer who plots out the position and direction of each raid on its horizontal surface and the other for the general information of the Officer Commanding and the operations staff.

It has now been decided that the distribution of warnings shall be partly decentralised by the establishment of two grouped centres serving roughly South-West and North-West England and February 1st, 1941 has been fixed as the target date for this. Should these prove successful, four other grouped centres may eventually be set up. The Research Branch has been asked to construct the necessary maps, switching and display equipments for the two new centres and to make the necessary alterations to the maps and equipment at Fighter Command and Alternative Fighter Command. This will involve the entire re-construction of the illuminated maps at the latter points as well as construction of illuminated maps for the two new centres as, in addition to the change of method, a great many of the existing warning areas are being sub-divided. In view of the very extensive alterations required and the short time available, it will be necessary, and has been agreed both with the Fighter Command and the Home Office, that new equipment should be supplied, built to a simplified design. It will be possible to use only parts of the existing equipment at Fighter Command and Alternative Fighter Command and also some parts of the original experimental equipment. Completion of the work by the due date will involve considerable pressure on the Signalling and Research Services Groups and assistance in the form of the loan of wiremen is being sought from outside.

24th December 1940 — Electrically controlled teleprinter keyboard

In connection with the work on the transmission of information relating to the movement of aircraft, enquiries have been made for a remote/

24th December 1940 (Cont'd) remote controlled teleprinter. Two models have been designed and partially made up, one using 3000 type relays mounted below the keyboard and operating the keys via a link work and the other using special small magnets mounted above the keybar extensions.

28th December 1940 Stabilised Repeaters for Army Telephone Lines

The repeaters which were handed over to the Signal Officer- in-Chief, Home Forces, for field trial are still working satisfactorily at various Corps headquarters. A small cordless board arrangement has been made to facilitate operating as a cord circuit repeater. Several selected N.C.O's have been instructed in the use of the repeater at Dollis Hill.

Modifications had to be made in order that the repeater might be suitable for civil as well as for Army lines for which it was designed, and two important improvements were made possible by this work. Firstly the battery drain has been halved by use of the new valve (VT 149) and secondly the low-end frequency response has been improved.

31st December 1940 Post Office and Army Signals Co-ordination Committee

The experimental work at Tatmore Place and Albury is now complete except for some line maintenance problems. The 2-wire/4-wire repeater and the S.T. & C. carrier system have both been approved and the Army has ordered large numbers of both. Carrier quad cable of the polythene type has also been ordered in quantities.

18th January, 1941 — PROVISION OF ADDITIONAL TELEPHONE CIRCUITS TO IRELAND

As many circuits as possible are to be added on the route between this country and Northern Ireland going via Blackpool, Isle of Man and Ballyhornan. These will provide alternative service in case of breakdown of the main channels of communication carried by the submarine cables from Stranraer, Preliminary measurements have been made on the four-core balata cables between the Isle of Man and Ballyhornan to determine the maximum number of additional carrier circuits which can be worked with the aid of compandors. Three audio and three carrier circuits are now working on each cable and, by working up to the limits set by crosstalk and resistance noise, it appears likely that about 20 more can be added using one cable for "Go's" and the other for "Return's". Fortunately when these two cables were laid in 1929, the usual anti-toredo brass tape was omitted giving a substantial improvement in attenuation at carrier frequencies. Between England and the Isle of Man the Blackpool cable, an old telegraph cable from St. Bee's Head and radio links can probably be made to carry the same number of additional circuits. Research Case 11365 refers.

25th January, 1941 — POST OFFICE AND ARMY SIGNALS CO-ORDINATION COMMITTEE

A specification for the Polythene quad cable for use with the Army 1+4 Carrier System has been agreed with the Ministry of Supply and this cable is now being manufactured in large quantities. The sheath is of Mipolam (polyvinyl chloride) instead of rubber and is unaffected by sunlight, heat or oil. Research Case 11342 refers.

A sling for use with Army field quad cable has been designed and satisfactory samples made. Research Case 11340 refers.

For use with the Army 1+4 Carrier System the Post Office Repeater No, 36A has been redesigned so that the total heater and anode power consumption is reduced by more than 50%. This has been done by changing the valves. The performance is very little affected and the modified repeater is proving useful in carrier circuits provided for other services.

25th January, 1941 — AERIAL SWITCHING

At the request of the R.A.E., Farnborough, a series of aerial switching schemes, using automatic telephone equipment, have been designed. These are for use at the direction finding stations round the coast, in association with the calculator and teleplotting apparatus. Apparatus meeting the most complex requirements has been constructed and is about to be shipped to the station at Nether Button. In this scheme there are four directions in which the beam may/

25th January, 1941 (Contd.) may "look", two alternative aerials for transmission in each direction and four wavelengths. The set will automatically "look" in each direction in turn for 12 to 18 seconds but can be stopped on any one at will. Wavelength and aerial changes can be made by manual control. The transmitter and receiving gear is interlocked as is also a duplicate set which may be in use at the same time but must not use the same wavelength. The transmitting aerials are switched by remote contactors which must be operated in a definite sequence to prevent damage to the transmitters.

At other stations the requirements are simpler. Prototypes of more simple sets, which will meet the requirements at the stations forming the east and west coast chains and for reserve buried stations, are being constructed.

31st January 1941 SIGNALLING RESEARCH FOR THE AIR MINISTRY ("TELEPLOTTING")

See Diary entries 23rd July, 18th October and 28th November, 1940.

The Telecommunications Research Station wish to retain permanently the experimental teleplotting equipment which was designed and supplied by Dollis Hill in November last. Some additions and modifications to the order of the message which is sent are required, together with the addition of a semi-automatic method of identification of the raid. The scheme is to be proceeded with for general use.

31st January 1941 PROVISION OF MILITARY GUARD AT DOLLIS HILL

A meeting was held this morning in the War Cabinet dug-out at Dollis Hill to discuss the retention of military guards, in view of the unlikelihood of the War Cabinet occupying the underground accommodation on the Station or at the flats, Neville's Court. The meeting was attended by Vice- Admiral Sir Geoffrey Blake, Rear-Admiral Young, Brigadier Price (Headquarters, North London Sub-area), Major Martin (Vulnerable Points Advisor), officers from GHQ, Home Forces, the War Office; and Capt. Adams, R.N. and Lt.Col. Ives of the Offices of the War Cabinet. Capt. Timmis and Mr. Aldridge represented the Research Station.

It was agreed that the present military guards at the "Dug-Out" and at Neville's Court should be reduced forthwith and eventually replaced respectively by service police and a guard provided by the Admiralty. Retention of a military guard for the protection of the Station was agreed to be a question directly between the Post Office and the military authorities. A verbal request for such retention was made at the meeting and this was agreed.

31st January, 1941

ASSISTANCE TO THE M.I. BRANCH OF THE WAR OFFICE

Apparatus for Middle East

A request was received from M.I.9 to provide additional apparatus for the Middle East, consisting of six listening and recording positions, 12 special microphones and amplifiers, together with a complete set of spares. Cable and small stores were provided to enable fitting to be carried out without any local purchases. This apparatus was packed for shipment and has been delivered in two separate consignments at the docks. Case No. 11333 refers.

"Dropper Eaves, Mark I"

Contact with M.I.6 was obtained through M.I.5. M.I.6 required two special microphones, one to be capable of being concealed in a room, lowered outside an open window, etc., the other to be suitable for placing against the crack under a door or on a partition, etc. Midget amplifiers which could be operated economically from types of battery likely to be on sale at radio dealers were also required. These have been supplied and are now undergoing field tests abroad. Case No. 11352 refers.

Equipment for Prisoner of War Centres

M.I.9 requested a supply of listening equipment for installation by their staff at certain more advanced Prisoner of War centres. Recording was not required. Two types of apparatus have been made up:- (i) a battery-operated amplifier with batteries and headphones concealed in a box of military appearance and marked with a red cross, this is intended for use with permanent fittings of the usual type; (ii) a midget amplifier with batteries, associated with a microphone concealed in a service respirator case. The latter equipment is carried, when not in use, in a suitcase and covered by a tray on which clothing or papers, etc. can be arranged. Case No. 11353 refers.

Installation of Microphones in a Private House

At the request of M.I.5 eight rooms of a moderately large private house have been fitted with microphones and connected by a cable concealed underground/

31st January, 1941 (Contd.)

ground to amplifying gear in the house next door. The house was unfurnished and it was necessary that the prospective occupant should be able to inspect it before redecoration was commenced. Since he might wish to fit his own electric light fittings, etc., great care was necessary in the concealment of wiring and a new type of microphone fitting was employed. Case No. 11377 refers.

Listening Equipment at M.I.5 Headquarters

A request has been received from M.I.5 to equip a room at their new Headquarters with listening and recording equipment. An ultimate capacity of 10 positions is envisaged. Two listening and recording positions have already been fitted as a temporary measure in the protected building at Shepherds Bush. Case No. 11379 refers.

February 10th 1941 — Location of Unexploded Bombs

The comprehensive experimental investigation of various electrical methods of locating the exact position of an unexploded bomb in the earth, which was carried out last Autumn, has been made the subject of a Research Report, No. 11263. This Report has been sent to the Ministry of Supply and represents a very thorough exploration "of the possibilities of solving what must be regarded as an extremely difficult problem with many technical and practical difficulties to be overcome". None of the methods investigated showed much promise of success as a means of detection by apparatus entirely at ground surface but, using apparatus inserted in 4" diameter test holes, a mutual impedance method has a sure range of detection of about 2 feet. As other methods of bomb location, such as that developed by the E.R.A, and Professor Bragg's probe method are now available, the Branch is not being asked to undertake any further work on location at present but has been thanked for its active and useful co-operation.

February 10th 1941 — Kyle-Stornoway Circuits

Two additional carrier circuits have been set up on an existing cable between Kyle of Lochalsh and Stornoway making three circuits in all. In order to work these additional circuits it has been necessary to carry out extensive transposition of ten miles of open wire line on the Isle of Lewis and to install a repeater in the cable hut at Staffin Bay. This repeater is driven from a 12 volt car battery. The circuits are satisfactory and were ready for traffic to-day. Careful maintenance will, however, be necessary.

February 12th 1941 — Modifications to Air Raid Warning Equipment

The change-over to local control of warnings at Groups 9 and 10 was satisfactorily made on this date. In addition to the new equipment at the two Group Centres substantial alterations were necessary at Fighter Command and these had to be carried out with the minimum interference with the normal functioning. The corresponding alterations at Alternative Fighter Command will be completed in two or three weeks' time. The preparation of equipment is in hand for the further decentralization which is anticipated and which may be required at comparatively short notice or delayed until the summer.

February 18th 1941

Detection of Clockwork Mechanisms in Unexploded Bombs

A meeting was held with the Ministry of Supply to-day on the question of means for the detection of working clockwork in delayed action bombs. The Research Branch has been asked to investigate the problem in two steps :

(a) To test equipment already in production as to its suitability to stand up to tropical conditions and, if necessary, suggest suitable modifications.

(b) To investigate the possibilities of producing an equipment superior to that now under construction.

The present, Mark I, equipment uses a Rochelle Salt Piezo-Electric Crystal Microphone and considerable doubt is felt as to its capabilities of standing up to severe tropical conditions. Ministry of Supply officials were given a demonstration of a Post Office equipment employing a magnetic type microphone not subject to the disadvantages of the Piezo- Electric instrument.

February 22nd 1941

Assistance to the War Office (M.I. Branches)

1. Two optical systems are now being constructed for M.I.5 which, while their existence cannot be readily detected from the interior of a room, will enable that interior to be kept under observation from a point outside. The aperture in front of the lens used is only 3/16 inch diameter and is given additional concealment by the treatment applied to the wall or ceiling.

2. Arising from an enquiry by M.I.8, suggestions have been made for putting telephone exchange batteries in enemy-occupied countries out of action. It has been found that the addition of relatively small quantities of magnesium in conjunction with a "foaming" mixture will cause such violent frothing as to empty a cell. About two ounces of magnesium per gallon of acid are required. The proposal is to make up capsules of magnesium with the foam powder so arranged that action on the magnesium is delayed until the powder has dissolved. Details have been given to M.I.8 who will pursue the matter themselves.

3. M.I.9 approached the Research Branch for assistance in methods of detecting articles hidden in clothing, games parcels, toilet requisites, etc. The matter has been discussed with the officer concerned who has expressed appreciation for the loan of X-ray equipment. Other methods/

February 22nd 1941 (contd.)

methods are being examined.

4. The M.S.M. Co. have in hand the construction of a semi-automatic machine based on a design suggested by Research Branch for coating recording discs in a single spraying operation instead of three. It is hoped to be able to use unskilled labour. Experiments are in hand as to the possibilities of using pyrex glass cutters in place of steel, suitable qualities of which have been difficult to obtain.

February 28th 1941

Tests in Mobile V.F. Telegraph Equipment

Acceptance tests and special noise and interference tests have been made at Dollis Hill on a mobile D.T.N. telegraph equipment. The apparatus was found to be quite satisfactory.

February 28th 1941

Use of Remotely-Controlled Teleprinter

Messrs. Creed have been asked by the War Office to produce a remotely-controlled type 'X' teleprinter. They had seen the models developed in connection with the automatic teleplotting equipment. In one of these models the keys are operated from magnets mounted over the key bars and Messrs. Creed asked to be allowed to use this idea, pointing out that it would be a waste of time to attempt to develop a new scheme when that designed at Dollis Hill appeared satisfactory. They were given permission. No arrangement was made as to payment.

March 3rd 1941

Work for the M.A.P. (Telecommunications Research Establishment)

The experimental work which Dollis Hill took over from the Tele-communications Research Establishment at Worth Matravers (see Diary entries 23rd July and later) having reached a stage at which review appeared to be desirable, discussions have taken place with Mr. E.J.C. Dixon, M.A.P. (Directorate of Communications Development). To some extent the experimental development at Dollis Hill of equipment for the receiving end of the projected automatic teleplotting system may have given rise to wasted effort due to Research Branch engineers being unaware of the conditions existing in filter rooms. It has, however, been agreed that, in future, general information on R.A.F. operating procedure and apparatus should be made available to nominated members of the Research Branch and that detailed information should be provided on aspects connected with specific problems undertaken by the Post Office. In addition, the Research Branch is/

March 3rd 1941 (contd.) is to have direct contact with the Group maintained at Fighter Command whose function it is to study and analyse operational requirements. The Executive Engineers in charge of the S.A.S. and Telegraph Groups are to visit Fighter Command and also Groups and Sectors, if thought desirable. Mr. E.J. Barnes (A.S.E.) has been nominated as the Senior Officer to whom the staff at Worth Matravers might freely disclose the general operational requirements and operating conditions behind any new development and who might decide with T.R.E. what work could usefully be done by the Research Branch and at what stage it should be taken over.

As a further precaution against the Branch undertaking work in connection with a development likely to be unacceptable to staff responsible for operations, or incapable of being worked into the general scheme for the provision of communication facilities, Research Branch will inform the War Group before experimental work is commenced in connection with any investigation. Form R.202 has been drawn up for this purpose.

8th March 1941 — Synchronization of Air Ministry R.D.F. Stations (1-in-1 System)

Shortly after the outbreak of war, the Research Branch was asked to construct line terminal equipment for Fighter Command, Alternative Fighter Command and 26 Air Ministry R.D.F. Stations, whereby the R.D.F. Stations could be synchronized by locking signals transmitted over the operational lines. These systems were completed early in 1940 and installation has been carried out by the Research Branch as soon as the various accommodations were available. In addition to the Central Station equipments, 21 R.D.F. Stations have, so far, been equipped; the remaining five terminal equipments are still held, awaiting installation instructions.

Several R.D.F. Stations have been operated experimentally with line lock and it has been necessary to recommend certain modifications to the existing time base and cathode ray tube circuits of the Air Ministry radio receiver. Tests have been carried out in close co-operation with 60 Group and T.R.E.

10th March 1941 — Cabinet Meeting

A Meeting of the Cabinet was held in their emergency accommodation in the new Stores Building this morning, Mr. Atlee, Lord Privy Seal, presiding. After the Meeting, Ministers and the Cabinet Secretariat were served with lunch in the Refreshment Club.

Investigation of power interference on 12 Channel Carrier Cables laid in the tunnels of London Tube railways

In connection with the scheme for laying important cables in the tunnels of the tube railways belonging to the L.P.T.B., measurements have been made in some typical cases. They showed that the disturbance from the traction circuits is generally negligible in the carrier frequency range and would not interfere with the working of 12 channel systems.

15th March 1941 — Experimental work in connection with Army cables

The 1 + 4 carrier system is intended to form the main long distance communications of an expeditionary force. Three different types of cable are being manufactured. These are :-

(1) A rubber quad cable with rubber sheath

(2) A polythene cored cable with mipolam (polyvinyl chloride) sheath

(3) A cable with core consisting partly of polythene and partly of mipolam with mipolam sheath.

At present it appears that mipolam is likely to be widely used for Army field/

15th March 1941 (Cont'd)

field cables (D3 and D8).

Work has also been carried out in connection with the jointing of 14 pair paper core cables used by the Army. It has been demonstrated that joints can be made using copper sleeves over the wires and crimping them with tool jointing No. 1A and then completing the joints with mechanical joint No. 15, designed in the Research Branch. Two such joints have been installed with an Army cable and the idea has been welcomed as it avoids all soldering.

RESEARCH BRANCH SECRET WAR DIARY

18th March 1941	Results obtained from Overhearing Equipment installed for the War Office
	The War Office, M.I. Branch, in strict confidence has disclosed that the work done recently by R. Branch led recently to the sinking of three German submarines in one day. A captured submarine officer had been confined in one of the rooms equipped with concealed overhearing and recording apparatus and had let fall remarks referring to, and giving the location of, a secret German submarine rendezvous. The Admiralty acted on the information and warships sent to the spot in question made a "triple kill". This success was announced by the Prime Minister during his speech of welcome to Mr. Winant at the Pilgrims' Club 15 Mar.
	26th/

26th March 1941

Work for the M.A.P. Telecommunications Research Establishment

Following a meeting held on March 3rd (referred to in previous entry), a visit was paid to the Telecommunications Research Establishment and full details of four problems, for which solutions were desired, were discussed. Further information was imparted to the Research Branch by S.R.S. (Stanmore Research Section) at a visit there on the 26th.

The filter room end of the automatic teleplotting project was discussed and T.R.E, will arrange for the Post Office to be asked to make a model of the Research Branch's proposal of an "autoteller" on the lines of the talking clock. This scheme has the advantage of retaining headphone reception of the message, leaving the plotter's hands and eyes free for plotting. It only requires a teleprinter channel between the R.D.F. Station and Fighter Command with the attendant advantage of easier re-routing in emergencies.

It will be recollected that automatic teleplotting includes the transmission of information displayed at the R.D.F. Station as teleprinter signals and that the Research Branch has already developed and made the equipment required at the R.D.F. Station. This equipment is being taken into use as an automatic message recorder giving a printed record of successive displays. Some work remains to be done, including silencing of the teleprinter in the receiving room and the provision of automatic paper take-ups and this is being undertaken by R. Branch. Arrangements for the supply of further equipment have been made with the Circuit Laboratory and these equipments will be constructed to the designs agreed by R. Branch and the T.R.E.

The T.R.E. is to arrange for the Post Office to be asked to work out a coding scheme for teleprinter signals where a radio link is included in the transmission path between the R.D.F. Station and Fighter Command.

Work in connection with the 4th problem (remote automatic squadron indicators), it was agreed, should be continued by the T.R.E, who had already made considerable progress. R. Branch, however, were to be kept fully informed.

29th/

29th March 1941 — Assistance to the War Office (M.I. Branches)

Further assistance has been given to the M.S.M. Co. in connection with the manufacture of recording discs and cutters and a new type of spraying machine has been developed and is ready for production at Wraysbury. Work on the possibility of using softer disc material and of avoiding the use of imported plasticisers and solvents is proceeding, but so far satisfactory results have not been obtained. A supply of steel for cutters has now been obtained and the attempt to use cutters of pyrex glass has been abandoned. It is hoped to get a cutter life of six discs per cutter.

At the request of M.I.5, a concealed microphone was fitted in the sitting room of a small flat in a large block. Listening facilities for two people were provided in the kitchenette. It has since been gathered that a committee meeting held there was a great success.

31st March 1941 — Detector for clocks in delayed-action bombs

At the request of the Ministry of Supply, tests have been carried out on a piezo electric pick-up proposed for incorporation in an electrical stethoscope to be used for ascertaining whether unexploded bombs contain working clockwork. It has been found that these pick-ups lose practically all sensitivity at temperatures above 50°C and that prolonged heating at this temperature permanently destroys them. They are therefore unsuitable for use in such theatres of war as the Middle East and during a steam sterilization of the bomb. The Research Branch has suggested to the Ministry of Supply the use of an alternative form of pick-up built up with a modified "Weda" (Weston Electric Deaf Aid type of receiver). This is unaffected by temperature. The design of a suitable and less costly form of pick-up on similar lines as the "Weda" is also in an advanced stage.

1st April 1941 — Address to Regional Security Officers in connection with Work for the War Office

Mr. Doust had accepted an invitation to address Regional Security Officers at their meeting which was held at Blenheim Palace to-day. He was asked to give a talk on the use of concealed microphones. The requirements in regard to rooms, furnishing, accommodation of listening gear, etc. were mentioned but the main emphasis was laid on "security". It was pointed out that all work must be carefully planned beforehand in order to provide adequate "cover" for the officers carrying out the installation/

1st April 1941 (Cont'd)

installation. Attention was also drawn to the difficulty of running leads between buildings and between rooms in public buildings, such as hotels.

The questions and discussion which followed showed that the officers were very interested in the subject and it is thought that the statement of the limitations to which this technique is subject will be extremely useful to them when they are considering the origination of work of this kind.

4th April 1941 — Work for the M.A.P. Telecommunications Research Establishment

The Air Ministry has decided to equip all R.D.F. Stations with the automatic message recorder which was designed by the Research Branch in co-operation with the T.R.E, and was last referred to in the Diary entry of 26th March. The Air Ministry has requested 44 of these equipments to be supplied by the Department for use abroad in addition to 120 required for this country.

9th April 1941 — Aerial Switching

A Diary entry under 25th January 1941 outlined the work to be done by the Research Branch for the R.A.E., Farnborough, in connection with a series of aerial switching schemes using automatic telephone apparatus. The aerial switching equipment for the first and most complicated of the stations, that at Nether Button, has been installed and was left working to-day.

19th April 1941 — Work of P.O. and Army Signals Co-ordination Committee

Samples of rubber core cables suggested for field use by the American Army Signals were sent over by the purchasing commission for consideration. They seem generally inferior to our cables and cannot be recommended unless serious difficulties of supply arise over here.

23rd April 1941 — Equalisation of delay on radio telegraph transmitter control circuits

In order that radio telegraph transmissions shall not afford navigational aid to enemy aircraft, it is desired to operate simultaneously two, or possible three, transmitters working on nominally the same carrier frequency. It is therefore necessary for the transmission times on the control line circuits to be practically equal.

Experiments have been made on two circuits from the Admiralty Wireless Control Room, Whitehall, to Leafield and Cleethorpes, where initially the difference in transmission times was, on the average 67 mS. A suitable delay network has been constructed and inserted in the D.C. section of the Leafield circuit, and tests made at Dollis Hill to-day showed that the difference is now less than 3 mS, which is negligible. Further listening tests by the Admiralty and W. Branch, and the design of delay networks for general use in similar cases, are

Supplies of Carbonyl Iron

Early in this month a technical Sub-Committee was formed by the Ministry of Supply to follow the development of dust production and to/

23rd April 1941 (Cont'd) to advise with regard to the allocation of stocks of Carbonyl to the most urgent requirements. Mr. C.E. Richards, Senior Chemist, together with an officer of the Stores Department, was appointed to this Committee to represent the Post Office.

Formation of this Sub-Committee followed general realisation of the seriousness of the position likely to arise due to the inroads now being made on the stocks of Carbonyl powder held in the country. These stocks had been obtained from Germany by various firms for their own work prior to the outbreak of war and about 6½ tons remain available. On the advice of the Ministries of Supply and Aircraft Production, the Iron and Steel Control has commandeered this and proposed to control its use, to the national interest, through the normal licensing system. It is evident that proposed uses of this powder will have to be restricted severely as such proposals would have required about 10 tons during the present year.

Use of carbonyl dust appears essential for certain cores forming part of radio transmitters, principally for aircraft work.

As far as Post Office requirements are concerned, permalloy dust will provide a sufficiently low hysterisis material to be satisfactory for such uses as channel filters; a very small percentage of radio cores only may still necessitate the use of carbonyl dust.

The question of finding other suitable alternatives to Carbonyl is being actively pursued by the Committee and visits have already been made to the G.E.C. magnetic dust plants at Salford and Heywood. The S.T. & C. plant will be visited shortly.

26th April 1941 Modifications to Air Raid Warning Equipment

Further decentralization of warnings (in this case to No. 12 Group, East Coast Area) has been decided upon and the necessary work is proceeding. This includes the provision of new display and plotting maps at Fighter Command and Alternative Fighter Command, as well as a plotting map at No. 12 Group. It also involves the provision of switchcases at No. 12 Group and modification to the existing switch cases at Fighter Command and Alternative Fighter Command.

7th May 1941 — Recording of Telephone Conversations

In connexion with the installation of recording gear for certain telephone conversations, the Research Branch were asked by the Telecommunications Department to -

(a) Get out specifications for, and make models of, amplifiers to operate the recorders to replace and be interchangeable with those supplied from abroad with the recorders

(b) To develop and make an amplifier to tap across the line and to supply a constant volume at its output for levels of input ranging over 40 db.

(c) To develop and construct a sensitive voice-operated switch which would start the recorder.

The experimental work was completed and designed and a small number of models supplied in less than two months at the end of 1939. The equipments have since been obtained in considerable numbers from contractors. Secret Research Reports Nos. 10929, 10969 and 10974 describe the apparatus and have been filed. Certain of the information in these reports may prove useful in connexion with the development of apparatus for other purposes.

10th May 1941 — Work of P.O. and Army Signals Co-ordination Committee

Six of the stabilised repeaters developed and constructed by the Research Branch are being put to the test of field use at the headquarters of various commands and corps in this country. These field tests are to be extended in order that operating procedure (apart from the working of the repeater) may be cleared up. Conditions in this country, with Post Office switchboards at some places and Army switchboards at others, are rather different from those envisaged with an expeditionary force.

19th May 1941 — Improvement of Great Britain-Iceland Telegraph Circuit

The speed of transmission on the telegraph circuit connecting Great Britain and Iceland via Aberdeen, Wick, Lerwick, Thorshaven (Faroe Islands) and Seydesfjord (Iceland), has been hitherto only 40-50 w.p.m. and, in order to dispense of the traffic, the circuit has been worked in two sections with re-transmission at Lerwick. The Thorshaven-Aberdeen section has therefore been modernized chiefly by the installation of a simplex repeater at Lerwick. The original Wick-Aberdeen link has been abandoned in favour of the multichannel V.F. circuit. Under these conditions a speed of 80 w.p.m. is readily obtainable in either direction between Aberdeen and Seydesfjord, but the receiving reperforator at the latter station was found to be incapable of this speed for long periods. It has therefore been reduced to 70 w.p.m. for normal working. A reserve circuit (multi-channel V.F.) between/

19th May 1941 (Cont'd)

between Lerwick and Aberdeen was also set up.

The circuits were handed over to traffic to-day. It is of interest to record that as the aircraft conveying the Research Branch officer was approaching Sumburgh Aerodrome (Shetlands) anti-aircraft fire was opened on it luckily without scoring a hit.

Installation of Overhearing Equipment in house to be occupied by "Italian Generals"

Work for the War Office XXXVIII was carried out in connexion with the provision of equipment in a house which it was announced would be occupied by "Italian Generals". This work is described on pages 91 and 92.

Work/

19th May 1941	Work for the War Office XXXVIII

On Friday, 16th May, a request was received from the War Group to inspect a large private house, about forty miles from London, which was being prepared for the reception of a distinguished guest who had paid a flying visit to Scotland. If possible, four rooms, a bedroom and a private sitting room upstairs and a dining room and a very large sitting room downstairs were to be fitted with concealed microphones.

The house was visited on Friday afternoon and it was found that the work had to be carried out between 2.30 p.m. on Saturday and 2.30 p.m. on Monday, during which time the house would be free of workmen etc.

A request of this kind had been anticipated and a certain amount of equipment had already been collected. This was taken down on Saturday and work was commenced at 2.30 p.m. By using ceiling fittings upstairs and a new design of floor fitting upstairs, the number of floors which had to be disturbed was reduced but was still considerable owing to the size of the house. Installation was, however, completed just after midnight on Sunday and the house was handed over at 9.0a.m. on Monday morning.

For security reasons listening staff could not be accomodated in the house itself. Amplifiers were therefore installed in a locked cupboard on the ground

floor and a concealed cable connected them to four telephone pairs. Listening and recording gear was installed in duplicate in the telephone exchange and was ready to function when the guest arrived on Tuesday evening. It is understood that the recording equipment will shortly be transferred to private premises in the neighbourhood.

23rd May 1941

Equipment of Mobile Units for Intelligence Work

The second mobile unit equipped at Dollis Hill for War Office intelligence work was inspected to-day by Brigadier Stawell (D.D.M.I.), Col. Crockatt and Col. Kendrick (C.S.D.I.C.) and other officers of M.I. 8 and 9. The unit has been designed to give facilities similar to those provided at Cock Fosters prison camp, i.e., overhearing, recording and transcribing facilities. At the same time it is completely self- contained from the point of view of operation, power supply and mobility. The design of the unit was assisted by experience gained from a mobile unit equipped by the Research Branch in 1940 and referred to as Item 4 in the Diary entry of 24th August of that year. In this original unit, power supplies and recording gear were mounted in a single vehicle and no living accommodation was provided. Each new unit embodies two converted Green Line, or similar, coaches known as Vehicles A and B respectively. Vehicle A contains the necessary power equipment to make the unit self- contained, the prime mover being a 1½ KW petrol generator-battery charging set, while at the same time, facilities are provided for obtaining power from the local A.C. mains. The latter is a more convenient arrangement if mains are available. Vehicle A also contains living accommodation for six other ranks. Vehicle B contains the recording room where 2-4 officers may work and the transcribing room wherein is living accommodation for four officers. The recording tables are arranged so that they may be moved from the vehicle and used elsewhere, if required, and special multipling and monitoring facilities, giving a very good degree of flexibility, are provided.

From the time of the delivery of the first two coaches to the coachbuilder to the time when the first unit had been completed in every detail a period of eight weeks elapsed during the last fortnight of which the wiring, fitting and testing at Dollis Hill were done. The first unit was despatched to the military authorities for transport to the Middle East on May 2nd and since that date the second has been completed and a third started. Five units in all will be equipped.

The D.D.M.I. expressed himself as extremely pleased with the arrangements.

24th May 1941

Teleprinter Secrecy

The desire has been expressed by the Admiralty for some device whereby teleprinter signals cannot be received by officers monitoring on special lines. Enciphering is not desired as the message may already be in code.

24th May 1941 (Cont'd)

A scheme has been worked out in principle whereby the signals are distorted at the sending end and the distortion removed at the receiving end. These operations will be performed by compact apparatus which can be switched in and out of circuit at the will of the user. A monitoring machine would not be able to receive any intelligible signals in the absence of the device for removing the distortion.

26th May 1941

Acquisition of a Factory at Wraysbury by the Post Office

A meeting was held to-day with Mr. T.H. Boyd, Assistant Director General, in the Chair, to discuss means whereby the Post Office might take over the factory and personnel of the M.S.S. Recording Co. Ltd. at Wraysbury. The circumstances giving rise to this discussion were as follows:-

The Company is a family concern of which Mr. C.E. Watts is the Managing Director and his wife and father-in-law the remaining active directors. The Company began as an unofficial research laboratory for the B.B.C. to exploit a mechanism for sound recording which had been developed as a hobby by Mr. Watts. When the potentialities of the apparatus were established and appreciated, small scale production commenced. The B.B.C, acquired a few machines and later became a large scale buyer of the lacquer-quoted discs used for direct recording. The firm is at present supplying the B.B.C. with 10,000 discs per month in connexion with the re-broadcast of programmes, etc.

The Research Branch first came into contact with the M.S.S. Recording Co. Ltd. at the beginning of 1940 when, at the suggestion of the B.B.C., the Company was approached about the design of recording machines required for use in connexion with the overhearing equipment provided for the War Office. Mr. Watts did a great deal of work at high pressure and eventually, as a result of co-operative effort between him and the Research Branch, a very satisfactory machine was produced and it was arranged that he should make three dozen of such. This was then rather a large order for the firm. Since then some 270 machines have been supplied or will shortly be supplied by the Company to the Research Branch for war purposes.

In September 1940 it became evident that there was a chance of the factory, which was then at Kew, being damaged through enemy action and the matter was taken up with the War Office who suggested that it should be transferred to a safer area. This was arranged and the move to Wraysbury took/

26th May 1941 (Cont'd)

took place, building and constructional work being given suitable priority.

At the commencement of May 1941 the demands for production from the Research Branch (for the War Office), the B.B.C. and the Air Ministry, which had also ordered a small number of machines, were such that they could just be met by the existing factory capacity but were beyond the financial resources of the Company. This was discussed with the Contracts Department and in order that Mr. Watts might have the funds available to purchase increasing numbers of component parts, etc., a payment of £1,800 was made to him on account of Post Office contracts in course of completion.

The importance attached to the continued and guaranteed supply of machines and discs was further stressed in a letter from the War Office to the Research Branch dated 1st May, which stated: "It is essential that the equipment to be provided by you should be maintained in continuous operation when completed, and that steps should be taken to ensure an uninterrupted supply of discs, cutters and machines for satisfactory maintenance. Would you therefore be so good as to arrange for reserves of discs, cutters and machines and reserve plant and materials for producing them under your control to be available on a scale sufficient to meet any contingencies that may arise".

Throughout the career of the M.S.S. Recording Co. Ltd. Mr. Watts, bent for technical progress, had completely overshadowed any regard for financial management and it was quite apparent that the firm would be unable to establish and equip reserve premises. Furthermore, it was felt that the situation, wherein equipment of acknowledged importance was made by one small firm only and depended for its successful production upon the personal participation of one man (Mr. Watts), could be much improved from the security standpoint by the intervention of the Post Office.

Two courses were discussed at the meeting held to-day:-

The purchase of the business and the assimilation of its staff within the Post Office, the terms of sale providing for the re-purchase of the business by Mr. Watts after the termination of hostilities.

That the Post Office should lease the business from the Company for the duration of the war.

The latter course was preferred partially on account of the difficulties which would have arisen in connexion with the transfer of the staff to the Post Office. It was agreed that the Post Office should put in an office manager and an assistant works manager. The former of these would be provided by the A.G.D. (or other Department) and would take over from Mr. Watts entire financial management of the business, the ordering of stores, etc. The latter would be an Assistant Engineer seconded from the Research/

26th May 1941 (Cont'd) Research Branch and would act as an understudy to Mr. Watts as regards technical supervision of the work.

30th May 1941 Work for the M.A.P. Telecommunication Research Establishment

A meeting was held to-day at Dollis Hill at which the development of equipment for automatic teleplotting was discussed with Dr. Walmsley, D.D.C.D. (M.A.P.) and representatives of the T.R.E. The D.D.C.D. stated that before the staff responsible for operations could be interested in the proposal it was necessary to give a demonstration with equipment. The M.A.P., however, were convinced that the advantages to be gained in the way of line economy from the transmission of plots as teleprinter signals were such as to justify fully work by the Research Branch and the development of equipment needed at the receiving end (Fighter Command) of the lines from the R.D.F. stations. Several ways of dealing with the information at Fighter Command had previously been considered. It could be made to: -

Operate a display

Appear as a printed message and be read by the plotter

(c) Appear as a printed message and be read by a teller over a local circuit to the plotter, or

(d) Be automatically spoken by a machine of the talking clock type to the plotter.

It was decided that the advantages of (d) were such as to warrant the construction of a model for demonstration to the Air Staff responsible for operations. This apparatus is now in course of design. Various components of the messages which may be sent are recorded in the form of photographic tracks on glass discs and reproduced by means of a light beam, photo-cell and amplifier. Some 45 tracks, each with its reproducing equipment, are required. A very neat arrangement of photo cell amplifier has been evolved. The various words which might be required will be spoken continuously on to bus bars and the message made up by selecting those actually required by switch mechanisms operated by the incoming teleprinter signals.

31st May 1941 Work in connexion with the provision of Telephone Carrier Circuits in Scotland and Ireland

The battle of the Atlantic leading to the establishment of aerodromes and anti-submarine bases off the west coast of Scotland has called for many additional telephone circuits in these areas. The/

31st May 1941

The Carrier Group of the Research Branch has taken an active part in the provision of these circuits. Nearly every route has called for special treatment. In some cases it has been possible only to add one or two carrier circuits over an old submarine cable. In other cases, where modern concentric cables have been available or laid, it has been possible to add 12 channel groups, "go" and "return" channels often working over the same cable by means of group modulation. The equipment required has been assembled in the laboratories at Dollis Hill and because of its nonstandard character installed by officers of the Research Branch. At the present time five Assistant Engineers from the Carrier Group with junior staff to help are engaged on this work in Scotland. Some of them are located at very remote spots and in these cases their living and provisioning requirements have had to be met by the exercise of considerable ingenuity. It may be well to summarise the progress of the various schemes.

1. Belfast-Stranraer, Groups 4 and 5

Installation is well advanced and circuits should be available for service in two weeks.

2. Inverness-Wick, 2 Groups on Coaxial Cables

Equipment installed early in May but delay caused by cable faults and modifications. Circuits now being lined up and available for service in one week.

3. Kyle-Benbecula

The temporary scheme (123A) will provide five circuits, using Carrier System No. 4 on a single paragutta cable. The terminal equipment from R. Branch is ready for shipment but the Benbecula temporary hut and power plant are not yet available.

The final scheme (123B) will provide 12 circuits (group modulated), with an intermediate repeater station at Broadford. The equipment is well advanced.

4. Mull-Tiree

The preliminary scheme (127A) is being carried out in two stages. The first stage provides three circuits with units of Carrier System No. 4, on a single submarine cable pair and will be ready for shipment in about one week. The second stage is a duplication of the first except that two submarine cable pairs are used; this is in hand.

The final scheme will provide nine Oban-Tiree circuits (five by radio/

31st May 1941 (Cont'd)

radio Oban-Tobermory), one Tiree-Tobermory, two Tobermory-Craignure and two Craignure-Oban. This scheme has not yet been started.

5. Northern Ireland Switching Centre

Arrangements are being made at Dundonald (near Belfast) to terminate Groups 4 and 5 on the Stranraer route, as an alternative to Belfast.

6. Kirkwall No. 2 Station (Scheme 51C)

Equipment for the permanent station is well in hand and should be ready before the completion of the building. The Wick and Lerwick circuits will normally work to the new station but equipment is being left in the temporary station to provide circuits as follows :-

Wick cable	1+2 circuit duplex and primary 12 circuit group - 12 circuits in all.
Lerwick cable	complete duplication giving 15 circuits.

Training of R.A.F. personnel in connexion with "Starfish" scheme

Short courses are being run in the Training School to familiarize R.A.F. personnel with the switching apparatus used to control the flares and imitation factory fires installed near target areas for the purpose of deceiving enemy bombers. Some 250 men have already been trained. During the course of instruction certain difficulties in the procedure have come to light and have been dealt with in cooperation with the Tp. Branch and the R.A.F.

3rd June 1941

Detection of Working Clock Mechanisms in Delayed-Action Bombs

Further to the Diary entry of 31st March, a simple form of magnetic microphone for use as a pick-up has been developed. This is constructed by adaption of the standard Post Office 2P telephone receiver. It was demonstrated before officers of the Ministry of Supply (D.S.R.) at Dollis Hill early in May and was found to compare very favourably with the piezo electric pick-up adopted by the Ministry as its Mark I type. The improvement was especially noticeable in respect of the signal noise ratio. A further demonstration was given to-day in Richmond Park before the Ministry of Supply and Army authorities and was very successful.

14th June 1941 — Records of Aeroplane Noise

A number of records of aeroplane noise under various conditions have been made for the R.A.F. These will be used in the training of personnel, chiefly radio operators, who will eventually have to operate in the noisy conditions simulated by the records. The records were made by means of a microphone and radio transmitter in the aircraft working to a radio receiver and recording equipment on the ground.

21st June 1941 — Belfast Stranraer Cables, Carrier Groups 4 and 5

Two additional groups of 12 circuits (Groups 4 and 5) between Belfast and Stranraer have been completed and made available for service. The circuits operate over two concentric paragutta cables with balanced pair land sections. The new groups occupy the frequency ranges 156-204 and 204-252 kc/s and it will be possible to add four more groups at a later date. In all, the cables now carry 65 circuits.

The new installation has involved the equipment of the Portpatrick Repeater Station and this has been fitted with a new type of line amplifier having a frequency range 12-500 kc/s, i.e. suitable for the full number of groups (9).

Group carrier frequency generating equipment has been fitted at Belfast and Stranraer to provide all the frequencies ultimately required from the master 4 kc/s oscillators at the two ends. These are synchronized by means of a 60 kc/s transmitted tone. In the absence of a standard 1000 c/s supply at either terminal, the 4 kc/s oscillator at Stranraer has been locked to a 120 kc/s crystal oscillator recovered from the earlier installation. Research Report No.

24th June 1941 — Decentralisation of Air Raid Warnings

The cutover to number 12 group (Watnall) with the corresponding modifications at Fighter Command, Bentley, was successfully carried out on this date.

Equipment is now being installed at Newcastle and Inverness for the coming cutover to No. 13 and No.14 groups respectively. Alternative Fighter Command at Leighton Buzzard is also being modified. All these changes are due to occur on July 4th.

28th/

28th June 1941

12-Circuit Carrier Groups, Aberdeen-Wick

Two 12-circuit carrier groups have been provided between Aberdeen and Wick. These operate over normal 12-channel cables between Aberdeen and Inverness but between Inverness and Wick they are transmitted in the frequency bands 64-112 and 112-160 kc/s over coaxial cable pairs. The coaxial pairs were equipped by W. Branch and the group terminal equipment was provided by R. Branch. One 12-circuit group is extended to Kirkwall and the other terminates at Wick. The channel equipment at Aberdeen, for the Wick group only, has not yet been provided by the Contractor. Research Report No. 11417 refers.

RESEARCH BRANCH SECRET WAR DIARY

1st July 1941 — Work for the War Office XLV

Two German officer prisoners were to be entertained on parole and later questioned at the private house of a member of the Admiralty. In order that the conversation might be overheard and suitable notes prepared, two listening systems were installed in the lounge. One was a standard system using lines which were obtained by disconnecting certain portions of the electric power system which in this house was fortunately run in lead- covered cable. The other system was a radio one and utilised the new short 80.9 Mc/s transmitter which has been developed by the Radio Branch. For the purpose of this work it was concealed with its microphone in a suit case which was left standing in the company of a golf bag and a well-worn cloth cap near the settee which would be used. Reception was carried out in the chauffeur's flat which occupied part of the basement. While reception was not as good as on the line system, the method showed promise and with the introduction of a superhetodyne receiver in the place of the super-regenerative one at present in use, it should prove valuable in cases where the concealment of lines presents great difficulty.

8th July 1941 — Discussion with Representatives of M.I.5 at St. James' Street Headquarters

The various types of microphone installation were discussed in detail. The circumstances in which each could be used were laid down, the advantages and shortcomings of each tabulated and a memorandum prepared for the use of Regional Security Officers and Officers at Headquarters who may wish to avail themselves of such facilities. In order to keep a strict control on the use of these facilities, a definite scheme was laid down by which officers requiring them would pass their proposals through the appropriate directorate at M.I.5. It is anticipated that as a result of this meeting, demands for equipment may increase somewhat but the position in regard to security will be much improved.

9th July 1941 — Locating a complete break on Army 14 pr/40 Loaded Cable

The impedance frequency method, the only effective one for a break due to shells or bombs, (which may be wet or dry) has been demonstrated to Signals and accepted. Two heterodyne oscillators, modified some time ago with this in view, are being sent to Middle East for use on the Cairo- Palestine cable.

10th/

10th July 1941 — Provision of Additional Circuits between Blackpool and Port Erin (Isle of Man)

The continuously loaded submarine cable (4 quads + 1 centre wire) between Blackpool and Port Erin is theoretically capable of providing 16 audio circuits including all possible derived circuits. Crosstalk is, however, very bad and only 13 audio circuits have hitherto been operated. By equipping all derived circuits with compandors the three additional circuits have now been made available for service, although in some cases circuits are still subject to crosstalk in excess of that normally tolerated. Case No. 11418 refers.

11th July 1941 — Work for the War Office VII

At a meeting at M.I.9 Headquarters on the 30th June it was learned that the number of prisoners from submarines promised to be greater than could be conveniently handled at the Intelligence Centre already fitted with listening facilities and it was decided to make use of at least one of the mobile units which would be stationed at the Newmarket P/W cage. Four rooms had already been fitted with concealed microphones for the use of the resident Intelligence Officers during interrogations. These rooms were to be used as sleeping rooms and the microphones connected to the mobile unit which was concealed in a large covered stable room. The purpose of the unit has proved very satisfactory from the technical point of view and it is understood that the Intelligence Officers are well satisfied with the standard of comfort and convenience that they provide. This method of dealing with extra batches of prisoners may be used at other centres.

19th July 1941 — Stabilized Repeater for Army Use

(See diary entry for 28th December 1940).

The six repeaters which have been on field trial with the Home Forces for some months have been the subject of interim reports from the Signal Units concerned. These reports have been favourable to the repeater which in all cases has been working "terminal" in some cases in a cord circuit, in others permanently connected to the line.

The Post Office and Signals Co-ordination Committee has therefore decided to order about 100 to the present specification except that the provision for working in an "intermediate" position will be cut out/

19th July 1941 (Cont'd) out and a change-over key for manual control of the direction of transmission added.

22nd July 1941 Work for the War Office XVI

Owing partly to inexpert handling and to deterioration of the building due to gunfire and near bombing and partly to fair wear and tear, the recording machines at Cockfosters Camp were becoming difficult to maintain. A modified machine which is somewhat more stable in operation has been produced by M.S.S. Recording Co. and on the nights of July 14th and 22nd, all 12 machines were changed. No further complaints of the operation of the machines other than those which can be ascribed to careless handling have been received.

25th July 1941 Provision of Five Circuits between Kyle of Lochalsh and Benbecula (Scheme 123A)

Five circuits have been provided between Kyle and Benbecula on a single pair by means of terminals of Carrier System No. 4 and group modulating equipment. This is a temporary provision until cables are completed across Skye and Benbecula, when 12 circuits will be provided by means of a Carrier System No. 7 and group modulating equipment.

A new paragutta submarine cable has been laid between Loch Slapin (Skye) and Benbecula and the present system utilizes this in conjunction with open wire line across Skye and Benbecula. It has been necessary to solder all open wire line joints in order to ensure reasonable freedom from noise.

The audio channel of the Carrier System No. 4 is operated on a duplex basis and return channels are provided for the four carrier channels by group modulation into the frequency band 20-33 kc/s. Case No. 11385 refers.

25th July 1941 Work for the War Office XL

Information was received that a house in Surrey in a commanding position was being purchased at an excessive price by one individual of doubtful intentions and it was required to place a microphone in the house which would not be discovered during the process of redecorating and moving in. As an experiment a moving coil microphone was fitted behind the skirting board and well concealed wiring taken to the telephone protector. The two overhead wires were replaced by two concentric cables, one being the normal telephone pair and the other connecting to a very small amplifier concealed in/

25th July 1941 (Cont'd) in a Dis. case fixed to the pole. The amplifier is operated by a battery supply from the exchange. From the ground the leading wires look perfectly normal and this appears to be a means of dealing with cases where it is impossible to find other suitable accommodation for an amplifier.

Special repeater for Admiralty P.W. circuits

A demonstration of this teleprinter secrecy device, previously referred to in this diary, was given to representatives of the Naval Intelligence and Coding and Ciphering Departments to-day. In this device no attempt is made to produce an unbreakable code or cipher, but it was shown that with a standard monitoring unit a message is reproduced in almost random gibberish, and even if special efforts are made to receive it correctly no maladjustment of the teleprinter will enable more than 30% of the letters to be received correctly. The Admiralty representatives were satisfied that the apparatus would meet their requirements on the three special circuits concerned.

It was agreed that equipment for five circuits, three for Admiralty and two for the Air Ministry, would be made up and installed by R. Branch staff.

A similar demonstration was given later to the Air Ministry. It was agreed that the use of this apparatus should not be allowed to become widespread, but that there was a definite need for it on several circuits.

27th July 1941 Teleprinter Links between CH Stations and Filter Rooms

At a meeting held in Swanage to-day, at which representatives of D.C.D., T.R.E., No. 10 Group (Ops.1) and the Post Office were present, a memorandum prepared by W. and R. Branches was discussed. The original proposal by T.R.E. was to use teleprinter radio links for communications in an emergency between CH stations and filter rooms, but this was shown to be impracticable. Various other schemes, based mainly on short distance V.H.F. links which could bridge parts of the line network where there were no alternative routes, were suggested, but from an operational point of view, it seemed desirable to provide a single link covering the whole distance independently of land lines. Under these conditions only hand-speed morse is likely to prove satisfactory. To ease the inevitable staffing difficulties, it/

27th July 1941 (Cont'd) it was suggested that an automatic morse transmitter, operated from the calculator could be used, and subject to the agreement of the Headquarters Operations side, the Post Office was asked to undertake the design of such an instrument. This was agreed.

Various details of the auto-teller were also discussed.

Provision of Six Circuits between Tobermory (Mull) and Tiree (Scheme 127A)

Six circuits have been provided between Mull and Tiree by means of units of Carrier System No. 4. Three circuits are provided on each of two submarine cables, the audio circuits being duplex and the carrier circuits arranged to provide two U-D and two D-U channels on each cable. One submarine cable was already in existence and this is used in conjunction with open-wire lines for one half of the scheme. A new submarine cable is used in conjunction with temporary interruption cable for the other half of the scheme. Owing to excessive noise from dry line joints, the carrier circuits on the open lines are not yet workable, but the joints will all be soldered as soon as possible.

The interruption cable will be replaced by permanent cable in the near future and the present scheme will be extended later on this year. Case No. 11409 refers.

31st July 1941 Iron Dust Cores

The position as regards these cores is being cleared. Lists of standard cores have been prepared and estimates of requirements for 12 months got out. It is understood the Mond Nickel Co. have been instructed to build plant to turn out 100 tons of carbonyl iron per annum. Work, with very promising results, has been carried out by the Research Branch on the recovery of carbonyl iron in dust form from made inductors taken from crashed German aircraft and also from scrapped British cores.

7th August 1941 — Work for the M.A.P. Telecommunication Research Establishment

Models of the special teleprinter mechanism and the silencing arrangements required in connexion with the auto message recorder have been approved by the M.A.P. and working drawings are being prepared for the manufacture in considerable numbers of these equipments.

9th August 1941 — Aerial Switching at R.D.F. Stations

(Previous Diary entries 25th January and 9th April).

The installation at West Prawle was completed to-day. Owing to changes made by the M.A.P. in the requirements, the majority of the circuits have had to be re-designed and in some cases completed equipments have had to be re-constructed or modified.

11th August 1941 — Application of 3-channel Carrier to Aerial Lines

There are two aerial lines between Belfast and Dublin, an old, twisted-square, road line, and a still older telegraph line on the railway with alternate long and short 2-wire arms. More circuits are required between these points and measurements have been made to explore the possibilities of adding additional 3-channel carrier systems. The road line presents no unusual difficulties but the railway line will require very much cleaning up and transposition. This seems possibly to be a case where profitable use might be made of compandors.

18th August 1941 — Work for the War Office XLIX

M.I.5 requested the installation of listening facilities in a club library which was used for a weekly luncheon party. The installation of a microphone and wiring to a listening position was not possible. A self-contained radio transmitter and microphone were placed on a bookcase before the meeting by an agent of M.I.5 and reception was carried out successfully in a private car parked 30 or 40 yards away.

24th August 1941 — Detection of Working Clock Mechanisms in Delayed-Action Bombs

A number of samples of the simple form of magnetic microphone ("Pongaphone") referred to in the Diary entry of June 3rd, have been sent to the Ministry of Supply for field tests. So far the general opinion is that they form much the best type of pick-up yet devised. Since/

24th August 1941 (Cont'd)

Since the original application for pick-ups was made, it has been learned that the bombs may be subjected to heavy magnetic fields used for stopping the clock forming part of the delayed-action mechanism ~~during operations~~ and this, it was thought, might prejudice the use of the magnetic pongaphones. Tests have indicated some temporary loss of sensitivity and the effect of magnetic screens to reduce this is now being investigated.

Records of Aeroplane Noise

A disc record of aeroplane noise has been sent to the R.A.E. who have expressed great appreciation of it, so much so that considerable numbers are likely to be required. The question of quantity production will be discussed shortly.

Arrangements are being made to obtain a portable photographic recorder so that records of noise may be taken direct in the larger aeroplanes and so avoid the noise difficulties due to the use of a radio link necessary in the case of small aircraft.

30th August 1941

Iron Dust Cores

The preparation of a revised list of standard dust cores has been completed and is now available to Government Departments. It is hoped an abridged list may be made available to trade designers.

The investigation into the possibility of the recovery of the carbonyl iron from captured German dust cores has been completed. The cores are powdered and the bakelite binder largely removed by treatment with caustic soda and sodium bichromate. The last remaining impurity can be removed by treatment with strong nitric acid with or without chromic acid. The latter treatment requires care to avoid damaging the iron but results in practically pure iron.

2nd September 1941

Advisory Committee on Army Telephone Instruments

A Committee was formed at the end of July with the object of advising the Ministry of Supply (E.S.2.(T)) concerning the most suitable types of microphone and receiver for use by the Army. The Staff Engineer in charge of the Research Branch is Chairman of this Committee which includes representatives from the Telephone Contractors, the Directorate of Tank Design, Signals Experimental Establishment and the Ministry of Supply. Such laboratory tests as are required in connexion with the work of the Committee will be carried out by the Research Branch at Dollis Hill.

After three meetings the Committee is prepared to make recommendations concerning the most suitable microphone for light field wireless sets and the most suitable receiver for field line equipment. With regard to the first of these, the Army requires a sensitive microphone for use with small forward area wireless sets. This requirement is only met by carbon granule type instruments. After consideration of much work carried out by the Post Office in co-operation with telephone manufacturers and directed towards the development of an improved two-electrode transmitter, the Committee has formed the opinion that it could not with confidence recommend any of the designs at present in the laboratory stage as an improvement on the Army inset corresponding to the P.O. No.13. The present handset receivers used by the Army are of the P.O. type 1L and the headset receivers used with line equipment are of approximately the same type. Considerable quantities of types corresponding to P.O., 2P have, however, been ordered both by the Army and by the other Fighting Services. This receiver has a more uniform frequency characteristic than the 1L type and gives a small, but useful, improvement in transmission. There appears no reason why its use should not be made general especially as a number of manufacturers are organised for its production in large quantities.

The position as regards transmitters and receivers connected to radio and intercommunication equipment in an armoured vehicle is more difficult. The acoustic noise level is very high, approximately 30 db above the standard reference level in one of the latest types of infantry tank, and the interference on radio transmissions often severe/

2nd September 1941 (Cont'd) severe. Moving coil microphones and receivers have been standardised in conjunction with a radio set now going into quantity production, the No. 19 set, but it is by no means certain that this will be an ultimate solution. In order to assist the Committee, the Research Branch has made records of the noise in a tank travelling at full speed and, with the aid of these records, is setting up conditions in a laboratory corresponding to those within the tank. Some difficulty has been experienced in reproducing all the low frequency noise as the acoustic power required is considerable. Articulation tests will be carried out within this "noisy" laboratory in order that some measure may be available as to the difference between the various instruments. Transmission will be over a radio frequency link where appropriate and to this will be introduced a standard amount of interference.

Special Photographic Work for the War Office

The War Office (M.I.) had reason to believe that microphotography was being used for secret correspondence and assistance was requested to determine the possibilities. It has been found that by using special collodion plates a message of several hundred words could be inserted into a space no larger than a full stop.

M.I. desired to send an agent of military age on a mission and to avoid any question as to why he was not in uniform wished to give him a low medical category card. For some reason not explained it was not desired to approach the medical officer for a fake certificate and the M.O.'s signature was required to be forged. This was done photographically so successfully as to deceive M.I.

Arrangements were made for the secret photographing of individuals during interview in a room in Piccadilly.

20th September 1941 — Provision of two Telephone Circuits to Scillonia

Two telephone circuits have been provided on the single core telegraph cable between Porthcurno and Scilly Isles. These are a 2-wire audio circuit and a 4-wire carrier circuit and, owing to telegraph interference from the transatlantic cables, it has been necessary to fit compandors to both circuits. The audio circuit is available for public service between Penzance and Scillonia; the carrier circuit is terminated at Redruth and extended to Portreath as an Air Ministry private wire. Both circuits are 5 db overall.

26th September 1941 — Work in connexion with the provision of a Multi-Channel V.F. Telegraph System over long wave Transatlantic Telephone Circuits

To cover a possible failure of the transatlantic telegraph cables, it is proposed to instal a multi-channel V.F. telegraph system to operate on the long-wave telephone circuit. The actual number of channels will depend, apart from traffic demands, on the ability of the V.F. receivers to receive signals without excessive distortion under noisy conditions; since the greater the number of channels the lower must be the power per channel from a given radio transmitter. Tests have, therefore, been made, in co-operation with W. Branch, on various types of V.F. receiver, including a special two-tone receiver (one frequency for marking and another frequency for spacing) recently designed in R. Branch. So far this receiver has shown an improvement of 9 db as compared with a standard single-tone receiver under exactly the same conditions, which would enable at least four times as many channels to be worked with the same degree of reliability, or alternatively, would provide a considerable improvement in reliability if the amount of traffic does not warrant that number of channels. The latter advantage is likely to be the more important; as W. Branch has estimated that a standard 6-channel system would be unworkable for about one third of the year, and an improvement of 10 db would make it satisfactory for all but four or five hours per day in the worst month.

It is not thought that this represents the maximum advantage obtainable by the two-tone method of transmission, and further experiments are in progress.

26th/

26th September 1941 (Cont'd)

Acquisition of a Factory at Wraysbury by the Post Office

In the Diary entry for the 26th May, 1941 the reasons making it desirable for the Post Office to take over control of the M.S.S. Recording Company's factory at Wraysbury were discussed. Various means of exercising this control have since been explored. Arising from the decisions of the meeting on 26th May, the Solicitor prepared drafts of a Control Order and of a Legal Agreement between the M.S.S. Recording Co. and the Postmaster General. These drafts with certain amendments and the procedure implicit in them were generally acceptable to the Telecommunications, Contracts and Engineering Departments but later became subject to fundamental criticism by the Accountant General on the grounds that the Treasury policy as regards finance had been to induce the banks to lend money where Government work was involved. A further meeting was held on the 25th July, 1941 at which the position was reviewed and it was decided that it would be simplest to appoint a Controller and make an agreement later, if necessary. The Controller should negotiate with the bank as to an overdraft and so reduce the advance payment which would have to be made by the Department. It, however, appeared later during discussion with the Ministry of Supply that the Control Order was not favoured where the firm in question was ready to co-operate to the best of its ability. Informal discussions took place between members of the Research Branch and the firm and as a result of these it was proposed that the arrangement with the firm should be allowed to rest on correspondence without formal agreement and without a Control Order. Sir Raymond Birchall therefore wrote to the Company in August 1941 formulating proposals by which the output of the factory could be increased and Mr. Watts assisted in the commercial and technical management of the business. The points mentioned in this letter are included below for future reference.

1./

26th September 1941 (Cont'd)

"1. Output

The Postmaster General will take the total output of the M.S.S. Recording Company's factory either for his own use or for subsequent transfer to other users on terms which will be fixed by the Post Office Director of Contracts after investigation by him of costs of production, allowance being made for profit at a rate which is reasonable by comparison with the rate of profit allowed to comparable undertakings engaged on war work for the State.

2. The remuneration to be drawn each year by the officers of the Company shall not exceed such sums as may be agreed from time to time with the Postmaster General.

3. Advance Payments

The Postmaster General will make advance payments on account of future production of such amounts as are required to provide for the necessary expenditure by the Company in respect of all contracts.

4. Additional Equipment

In the event of the Postmaster General requiring to be installed in the factory additional equipment which the Company agrees to be requisite for its peacetime production, the Company will provide and pay for such equipment.

5. Equipment in excess of Company's Peacetime requirements

In the event of the Postmaster General requiring the installation of equipment which the Company deems to be in excess of its peacetime requirements the Postmaster General will make such payments as are required to provide and enable such equipment to be installed and such equipment shall be and remain and be marked as the property of the Postmaster General subject to the option of purchase hereinafter contained.

6. Co-operation of Company

The Company and its officers and servants will co-operate fully with the Postmaster General in the manufacture of its products and will give such assistance and advice in a consultative or technical capacity or otherwise as the Postmaster General may require in operating the factory at Wraysbury as it is now and in connection with the installation of additional equipment in the factory and in operating the factory as it may be when extended and in equipping and operating any reserve factory which may be provided by the Postmaster General.

7. Control of Company

The Postmaster General will nominate an officer of the Research Branch of the Engineering Department of the Post Office to determine the types and quantities of articles to be manufactured and to assist the Company in the business management and technical direction of the factory and the Company will give him all facilities for so doing.

8. Accounts

The Postmaster General will nominate an officer of the Department who will keep the accounts of the Company in a form to be determined by the Postmaster General and who will assist in the pricing of the Company's goods in accordance with Clause 1 above.

9. Option to purchase Equipment

The Company shall have the first option of purchasing from the Postmaster General any equipment installed in the factory or reserve factory which is the property of the Postmaster General and which the Postmaster General does not require to retain at a price to be agreed

or/

26th September 1941 (Cont'd)

or failing agreement to be settled by arbitration such option shall be exercised within 6 months from the date on which the Postmaster General notifies the Company in writing that he no longer requires the whole of the output of the factory.

The Postmaster General undertakes that he will not sell equipment belonging to him en bloc to a competitor of the Company.

10. Duration of Agreement

This Agreement shall continue in force until the date upon which the Postmaster General notifies the Company in writing that he no longer requires the whole of the output of the factory.

11. Arbitration

Any dispute or difference which may arise between the Company and the Postmaster General in respect of any of the matters herein contained shall be referred to the arbitration of a single arbitrator pursuant to the Arbitration Acts 1889 to 1934."

These terms proved acceptable to the Company and the happy working arrangement appears to have been reached.

An Assistant Engineer from the Research Branch (R.S. Group) and a Chartered Accountant from the Contracts Department have been attached to the Company and are permanently stationed at the factory although it is the intention later to replace the Chartered Accountant by an Executive Officer. The Assistant Engineer has acquired first-hand knowledge of the processes involved by undertaking the work himself in the shops. He will in future act as a deputy to Mr. Watts and will be capable of keeping production going should anything happen to the latter. The Chartered Accountant is undertaking all work in connexion with cost investigation and will assist the firm in the preparation of accounts in accordance with Clause 8 in the informal Agreement.

14th October 1941 — Distribution of Air Raid Warnings

Alterations to the maps and other equipment to divide the Norwich area into two, Norwich and Gt. Yarmouth, were carried out and completed to-day. Fighter Command and No. 12 Group equipments were involved.

The yellow warnings were abolished on the 28th October. The change to the map and Home Office equipment was made by removing the lamps.

17th October 1941 — Advisory Committee on Army Telephone Instruments

Committee Report No. 2 has been issued, giving the conclusions to date of the Committee, based on tests of various microphones and receivers suggested for use in Armoured Fighting Vehicles in conjunction with the No. 19 radio set. A moving coil microphone of alternative manufacture (S.T. & C.) was tested which gave a better performance than the moving coil unit (Goodman's) at present being used. It is also likely to stand up better to prolonged use in service. Manufacturing possibilities have been discussed with Messrs. Standard Telephones & Cables, Ltd., the present position being that, although the Goodman microphone gives a satisfactory performance electrically, lends itself to easy manufacture and is being produced in very large numbers, some of the materials used are open to criticism if the units are to withstand long usage especially under damp atmospheric conditions.

Work for the War Office LIX

A microphone was fitted in a room in the Midland Hotel, Manchester, in which a luncheon was to be held. The speeches made, rather than the general conversation, were of interest to M.I.5. The room presented no means of concealing the microphone which was placed on a ledge at the head of a pillar and camouflaged to harmonize with its surroundings. Concealed wiring inside the room was completed in less than two hours.

24th October 1941 — Detection of Working Clock Mechanisms in Delayed-Action Bombs (Previous diary entry 24th August)

The work done in connection with the provision of devices for listening to the clock mechanism incorporated in German delayed-action bombs has been reviewed in correspondence with the Controller of Research of the Ministry of Supply.

The/

24th October 1941 (Cont'd)

The Ministry were originally faced with the problem of producing with the utmost speed a stethoscope for use by Bomb Disposal units. The stethoscope produced was made by Messrs. Cinema Television, Ltd. and comprised a suitable amplifier with a piezo electric pick-up. This instrument proved itself to be very valuable but suffered, however, from two disadvantages, the first of these being quickly apparent, i.e., the rather poor signal/noise ratio and the second, which became apparent when demands were made for the instrument to be sent out East, being the deleterious effects of heat and moisture on the pick-up unit. The Research Branch investigated these deleterious effects and as a result of tests has been able to specify the conditions under which the piezo electric pick-up will give satisfactory results. It has further made suggestions which will enable this pick-up to be used at the end of a longer length of lead than heretofore and with improved signal/noise ratio. In addition to this it developed the magnetic pick-up (Pongaphone) referred to in the diary entry of June 3rd. This Pongaphone has been further developed by enclosing it in a steel case which renders it immune to the effects of K.I.M., i.e. the field use for stopping the clock.

The position now is that, although the Ministry may make use of some of the Research Branch suggestions, they will continue to use the existing equipment to a large extent in order not to interfere with manufacture on the grounds that, although it is admitted that this equipment is not ideal and can be improved upon, it does appear to do the job.

25th October 1941

Work for the War Office XXVI

The number of carrier telephones installed is expected to increase in the near future and the premises at 57, St. James' Street have been redesigned to accommodate 20 listening positions instead of ten as at present. A larger switchboard of a new type, giving the listening positions access to about 40 lines, has been installed. It is anticipated that the building works involved will be completed during January, 1942, when the additional ten listening positions will be fitted as opportunity arises.

At/

25th October 1941 (Cont'd)

At present seven carrier telephones are in use, four or five having been recovered. Two or three ordinary microphone circuits also terminate at St. James' Street.

26th October 1941

Privacy Units for Teleprinter Working

The installation and testing of privacy units on the first Bletchley Park-Admiralty intelligence teleprinter circuits to be so equipped, were successfully completed, and the circuits handed over for service, today. This work has been seriously delayed, partly on account of difficulty in obtaining the necessary stores, but mainly due to a change of accommodation at the Admiralty Office. A strike of carpenters employed in preparing the new accommodation was largely responsible for this delay.

Privacy units are to be fitted on three more circuits - one Bletchley Park-Admiralty and two Bletchley Park-Air Ministry - in the next few days.

31st October 1941

Work for the War Office (M.I.9)

Large new camps are being constructed at Wilton Park and Latimer for the interrogation of officer prisoners of war, chiefly flying and submarine officers and generally on technical points. In each case a large country house has been taken over to provide mess and sleeping accommodation, offices, etc. for the staff of the Director of Military Intelligence and for the Camp Commandant. Adjacent to these special buildings have been erected for the accommodation of prisoners. These include sleeping rooms generally for two officers and interrogation rooms. Forty-four sleeping and interrogation rooms have been fitted with concealed microphones, wired to a special room with listening and recording facilities sufficient for 24 officers to work simultaneously.

The installation of amplifiers and recording tables and all cabling in the listening rooms at Wilton Park was completed on October 23rd. Installation of microphones will be commenced as soon as the decorators have left that part of the building.

Difficulties have arisen in connection with the camp at Latimer. The Air Ministry will shortly be completing an aerodrome at Bovingdon which is 2¼ miles from the camp and it is anticipated that considerable interference will be caused by aircraft noise, as has occasionally

been/

31st October 1941 (Cont'd)

been the case at Cockfosters. Attempts have been made to persuade the Air Ministry to abandon the site but as some £300,000 have already been spent, this appears unlikely. The Ministry of Works have been asked to express their views on the possibility of finding two new sites equivalent to Latimer and Wilton Park elsewhere. It is not anticipated that these camps will in fact be abandoned or that the Air Ministry will abandon the aerodrome. It appears probable, therefore, that steps will have to be taken both in regard to the construction of the buildings and the characteristics of the apparatus to reduce the interference as far as possible. It has been suggested by the Research Branch that the Air Ministry be asked to co-operate in a programme of practical tests.

Work for the War Office XVIII

The installation of microphones in some 26 cells and the equipping of three listening rooms with amplifier and recording gear at Ham Common (M.I.5) has been completed. This equipment is housed in a new block which has recently been built. It was originally intended as a reserve in case of further damage to the main building, but owing to increases in the number of prisoners held, it has been brought into use as a working installation.

24th November 1941 Iron Dust Cores

(Previous diary entry 30th August, 1941)

Several materials, including a sample of an American carbonyl and a sample of British-made carbonyl iron have been examined with respect to their suitability for the manufacture of dust cores for which German carbonyl was originally used. It has been found that the American is much the same as the German supply but that the British, though satisfactory for most purposes, is a little inferior. A small hydraulic press is on order so that cores can be made up by the Research Branch in order to facilitate a programme of experimental work. Owing to the supply position, delivery of this press is not, however, expected for some months.

Work for the M.A.P. Telecommunication Research Establishment

(Previous diary entry 7th August, 1941)

Production of the model auto teller, e.g. equipment whereby calculator communication sent over a line as teleprinter signals is automatically spoken to the plotter by a machine of the talking clock type, has reached a stage where it can be stated that a satisfactory result can be achieved. Various difficulties due to pick-up of noise have had to be overcome and a few such difficulties still remain to be cleared.

25th November 1941 Advisory Committee on Army Telephone Instruments

Committee Report No. 2, referred to in the diary entry of 17th October, 1941, has been re-drafted, experimental work carried out at Dollis Hill now having reached a stage when it is possible to convert the provisional recommendations given in the earlier report into more definite ones. Articulation tests have shown conclusively that in the presence of very loud noise the best results are obtained with moving-coil microphones and receivers. These tests were carried out in a laboratory in which the noise corresponded very closely, both as regards level and composition, to that existing in the infantry tank Mk. IV. Speech over an intercommunication set and over a radio frequency path between two wireless sets No. 19 was used. In the latter case the conditions were so bad that with average radio frequency interference, in addition to the room noise, the syllable articulation was only of the order of 10 to 15% (corresponding to 38 to 55% intelligibility). The data accumulated/

25th November 1941 (Cont'd) accumulated during the tests under these conditions point to the importance of a relatively uniform response throughout the speech range the complete transmission system, including microphone and telephone receivers. Within the infantry tank Mk. 4 the margin between the noise level and that at which a sensation of pain is experienced is small and a "peaky" system gives rise to painful overloading of the ear at those frequencies at which the response of the system is a maximum. It follows that if the received signal level is reduced to avoid such overloading, the signal/noise ratio at the other frequencies is deteriorated. The very high noise level existing in this type of Armoured Fighting Vehicle, therefore, imposes severe restrictions on the design of the communication system. In their present state of development the comparatively simple and robust types of moving iron microphone and receiver give a substantially poorer speech efficiency than the corresponding moving-coil units when speaking and listening have to take place in very noisy locations. The tests have also shown the impracticability of using carbon microphones in locations where the noise level is high. This is on account of the effects of crossmodulation which become very distinctly audible.

The Committee has recommended to the Ministry of Supply certain modifications in the construction of the moving coil microphones and receivers at present being used. These alterations can be made without interfering with production and will be without effect on the speech efficiency of the units. Judging by laboratory tests which have been made and from the experience of the Post Office over a number of years, they will increase the useful life of the units very considerably.

27th November 1941 Work for the War Office (M.I. Branch)

Mr. Gibbs (M.I.5 and Censorship Department) visited the Station two days ago and Lord Rothchild (M.I.5) visited the Station to-day to discuss with us various aspects of the photographic work which is being done at Dollis Hill to assist these departments. The photographic staff at Dollis Hill has made a useful contribution to the ease of conveying messages by means of "duffs" and our technique in this respect, judging by specimens of his which have been examined, is possibly superior to that of the enemy. The improved method of photographing/

27th November 1941 photographing intercepted letters has been recommended, also various intercepted cinema films have been examined and processed.

14th December 1941 — Work for the War Office LXVIII

Major D. McMillan, who was at one time in charge of the Acoustic Group at Dollis Hill, was transferred from a Signal Unit to special technical work in the Middle East in connection with intelligence about a year ago. There he has been supplied by the Research Branch with overhearing and recording equipments of which Intelligence has made considerable use. Major McMillan has just returned by air to the Middle East after a short visit to this country for technical discussions. He was able to report that, on the whole, the performance of the apparatus supplied had been excellent and that it had played a very useful part up to the present. It was hoped that considerable experience in connection with new applications will be gained during the present Libyan campaign.

It appears that with adequate training of personnel a mobile listening and recording unit could be used with safety much nearer the battle area than had been visualised by the War Office. With such use in view, appropriate training will probably be given to the personnel of the four mobile units remaining in this country as soon as it can be arranged.

Both the Indian (including Iran and Iraq) and Far East Commands have asked for C.S.D.I.C. facilities. Five mobile units, each with four listening and recording positions, and two fixed centres, each with ten positions, have been requested and equipment is being prepared with all possible speed. Experience has shown that for use in difficult country, where vehicle maintenance is likely to be a major consideration, it is not satisfactory to build the equipment into specially constructed trucks. The equipment for the five new mobile units is, therefore, being arranged so that it can be mounted in standard 3-ton trucks. Petrol generators, rotary converters, batteries and all amplifier equipment are being arranged in units provided with special plugs and sockets so that the whole installation, or any part thereof, can be dismantled and re-assembled in new trucks in the shortest possible time. Such changes could be made without endangering security by exposing the nature of the special apparatus.

The switching system provided for the two fixed installations will be simpler than that in use in this country. The slight reduction in flexibility will not be serious in view of the small size of the installations and will be compensated by the reduction in fitting/

14th December 1941 (Cont'd) fitting time and greater ease of maintenance under bad climatic conditions.

With the provision of C.S.D.I.C. facilities in the Indian and Far East Commands, the War Office (M.I.9) has asked the Research Branch if it could assist with regard to the selection of suitable technical officers to supervise the installation and maintenance, not only of this equipment, but also for the maintenance of the equipments in this country at Latimer and Beaconsfield and to be responsible for the training and development of mobile units. In all, five officers are necessary. Two officers, now serving in the Army who were before the outbreak of hostilities Inspectors at Dollis Hill, have been nominated as men with suitable experience for this work. The War Office is arranging for their transfer from their present units. Three members of the staff at Dollis Hill (one A.E. who had received prior permission to enlist for flying duties and two Inspectors) have been promised to the War Office. The War Office will arrange for them to be commissioned as Captains and transferred to the reserve of officers. All five men will be given a special period of training at Dollis Hill in the equipment with which they will be concerned. They will then proceed to the various centres as and when the apparatus becomes available. Major McMillan will remain with the Middle East Command but will, in addition, act as Technical Advisor to the Indian and Far East Commands.

17th December 1941 Work for the War Office LXXIII

In view of developments in the Far East, four sets of listening and recording equipment, which had been in course of preparation for West Africa, were despatched to Malaya. As far as possible all the apparatus was made suitable for use in tropical conditions.

19th December 1941 Aerial Switching (Previous diary entry 9th August, 1941)

Between November 23rd and December 7th the equipment previously installed at Nether Button was changed. The new equipment gives greater facilities and higher speed of switching and uses all relays in place of uniselectors. The original equipment worked satisfactorily since February 1941.

The equipment at Whale Head was installed between 7th and 19th December.

22nd/

22nd December 1941 — Work for the M.A.P. Telecommunication Research Establishment

(Previous diary entry 24th November, 1941)

Following a discussion on the 11th December at Dollis Hill with representatives of the M.A.P., a request was received to-day from the M.A.P. (D.C.D.) for the operational tests and demonstrations to take place at Dollis Hill instead of at T.R.E, as previously arranged. It has been agreed that the work will be undertaken and the nature of the demonstration to be given will be decided by a Sub-Committee comprising representatives of the Research Branch, R.D.C.6 and Operational Research Sections of M.A.P. As the introduction of auto-teleplotting may have repercussions on the provision of private wires by the Post Office, the Telecommunications Department War Group has been informed of the position and invited to add a member to the Sub-Committee. There is the further possibility that auto-teleplotting might be adapted to Observer Corps reports with consequent economy in line provision.

One serious difficulty is to be met in connection with the introduction of auto-teleplotting. The plotting circuit now carries a great deal of additional conversation, consisting mainly of queries and requests for the check of information. Visits have been made to Operational Stations in order that a better first-hand idea of the conditions might be obtained and records have been made of the miscellaneous telephone enquiries passing over the lines during periods of considerable air activity. If the facility of requesting and passing information in a non-standardised form is regarded as essential, it may seriously interfere with the introduction of auto-teleplotting, and this is being watched in order that the matter may be raised with the M.A.P. (D.C.D.) before unnecessary experimental work is undertaken. At the moment the records which have been taken are being subjected to a detailed analysis.

31st December 1941 — Four-channel Voice-Frequency Telegraph Equipment for Egypt

A 4-channel voice-frequency telegraph system is being sent to Egypt for Air Ministry use. This equipment is A.C. mains operated, and some concern has been felt on account of the copper-oxide rectifiers which might be adversely affected by the high temperatures experienced in that locality. A maximum ambient temperature of 120° F. is expected.

After/

31st December 1941 (Contd)

After examination of the conditions of service, it is thought that the anode and filament power rectifiers are likely to fail after a few months' use. Hence, although the standard equipment is being installed as soon as possible, it will be necessary to provide new power rectifiers using selenium elements for installation as soon as the hot weather arrives.

No experience has been had of static relays working at abnormal temperatures, and therefore tests are being made to see whether deterioration, if any, is likely to be serious. At 145° F. the rectifier elements deteriorated appreciably in a few days, but after two months' test at 126° F. there has been practically no change in their characteristics.

9th January 1942 — S + D Equipment

Tests have been made on the War Office S + D equipment with a view to its use in the D.T. Network. This equipment provides a two-way telegraph channel and a speech channel, which can be used simultaneously on one telephone circuit. The performance of the equipment was found to be highly satisfactory, enabling the telegraph channels to be used either as a switchboard or a point-to-point circuit. The apparatus is unfortunately very elaborate, largely because it is designed to meet conditions much more severe than are to be expected in the Post Office system, and it is therefore not suitable for normal Post Office maintenance. It was decided therefore that the widespread use of the present equipment could not be agreed to, though it is considered that suitable apparatus, meeting all the Post Office requirements in regard to both facilities and maintenance, could be designed, if required. Research Report No. 11610 refers.

10th January 1942 — Work of Post Office and Army Signals Co-Ordination Committee

It was learned from the Ministry of Supply (E.S.2 (T)) that the War Office was proposing to place through the Post Office an order for 1,256 stabilised repeaters of the type referred to in the Diary entry of 19th July, 1941. The matter was discussed with Mr. Chamney and subsequently Mr. Chamney and Dr. Radley put forward their reasons why such a large order should not be proceeded with in a personal discussion with Sir Stanley Angwin. The repeater in question gives the best possible performance which can be anticipated from such a device in the present state of the art. Line noise and room noise at the local end are, however, both inherently likely to interfere with the operation of the repeater, so that it can only be used on a proportion of calls for which amplification is desirable. If used with discrimination it can fulfil a useful function in the military line network, but it is felt that the number of cases in which appropriate conditions are likely and where skilled personnel are likely to be available for its maintenance are both so limited that the possession of such a large number of repeaters would only lead to their use under wrong conditions. This view was put forward to Major General Rawson (D.D.S.) by Sir Stanley Angwin in a telephone conversation and subsequently a Research Report was prepared (R.R. 11684) giving a brief outline of the repeater/

10th January 1942 (Cont'd) repeater and indicating its performance and uses.

The attention of the Committee has recently been turned to the reconsideration of the design of carrier quad and field cables in view of the fact that no more polythene can be used for the former and no rubber for the latter. Mechanical tests on cables made up with substitute materials have been planned and a start has been made on them.

17th January 1942 Monitoring Equipment for A.M.E. Stations

At the request of M.A.P. the Department has undertaken to test and install radio monitoring equipment at all A.M.E. Stations. This work is being carried out by the Research Branch in collaboration with the Radio Branch. The equipment has been designed and ordered by the B.B.C. and the first units are being tested at the B.B.C. Research Station. Installation work has commenced and one unit has been tested on site. This work ties up with the Research Branch's previous work in connection with the provision and installation at A.M.E. Stations of synchronising equipment controlled over the "one- in-one" system from a central station. Case No. 11659 refers.

23rd January 1942 Simplex Repeater for Teleprinter Circuits

Research Branch has been asked by the Ministry of Supply, via Telegraph Branch, to design and draw up a specification for a simplex telegraph repeater. The equipment is required for general use on O/H. routes and to meet urgent requirements in the Near East. Research Branch has agreed to supply the first six units. The design of the repeater is being based on that recently installed at Lerwick on the Aberdeen-Iceland telegraph circuit. Research Report No. 11685 refers.

26th January 1942 Detection of Working Clock Mechanisms in Delayed-Action Bombs (Previous Diary entry 24th October, 1942)

The Ministry of Supply has written to state that the Research Branch has supplied them with all the information required about the performance of the Ministry's stethoscope. This instrument is referred to in the previous diary entry. No further work is, therefore, required. The Admiralty have, however, become interested in the alternative pick-up device developed by the Research Branch and have asked for a sample for their own investigation. This pick-up device (the pongophone) is also described in the previous Diary entry.

28th January/

28th January 1942 — Work for the War Office (M.I.14)

During the recent battles in Libya, a number of documents were captured from General Rommell's Headquarters. These documents are understood to have given important details regarding the composition of German forces. They were photographed on 16 mm. film and flown to this country. The film was handed over to the Research Branch for enlargement at Dollis Hill in preference to processing by the normal equipment used for airgraph matter.

31st January 1942 — Noise in Armoured Fighting Vehicles

Measurements have been made at Farnborough and Sandhurst of the noise existing in some of the Armoured Fighting Vehicles at present in use. Figures are given for the two most important positions (viz. near the driver's head and in the turret) for the various conditions of road speed, ground, gearing, etc. most likely to occur in practice, and an analysis has been made to determine the chief sources of the noise. Relevant constructional data is included to aid in the interpretation of the results.

The measurements were carried out at the request of the Military Personnel Research Committee but have a direct bearing on the work being done by the Research Branch in connection with the Technical Committee considering Army requirements for microphones and telephone receivers. Research Report 11681 refers.

February 7th 1942 — Aerial Switching - Previous Diary entry 19th December, 1941

Aerial switching equipments have now been installed by this Branch at Noos Hill and Skaw in the Shetlands. The former has four lines of shoot with two different aerial arrays for two transmitters. The latter has two lines of shoot, but four aerial arrays for two transmitters. With the exception of Kilkenneth, Tiree, which will not be ready for the equipment for some months, this completes the installations to be equipped by the post Office.

February 21st 1942 — Improvements in Recording Methods

The Physical-Chemical Group is working in close co-operation with the M.S.S, factory at Wraysbury towards the improvement of direct recording discs. These discs are used for recording conversations picked up by listening equipments installed for the War Office. Similar discs are also supplied to the B.B.C. for re-broadcasts. The immediate past work has been directed towards obtaining better performance at low temperatures. Cutters have also been improved to cut at least 50% more discs than the original cutters.

Search Coil for Finding Buried Cables

G.H.Q. Cairo has asked for advice on the finding of 14/40 armoured L.C. cable in the desert when markers, etc. have been covered by drifting sand. Experiments on cables of this type near Windsor proved that a fullerphone used as a buzzer (with an extra battery) and connected to the sheath, not the armouring, could be heard on a search coil of 200 turns on a 2½ ft. square frame without an amplifier up to a couple of yards from the cable. With a 40 db amplifier, the cable can be detected at 50 yds. three or four miles from the buzzer. Recommendations have been made to the War Office.

February 28th 1942 — Work for the War Office XXVI

Listening and recording rooms at M.I.5 Headquarters have now been considerably extended and improved. The original installation consisted of one listening and recording room containing ten positions and one small room which served for transcribing of discs, typing, filing of discs, etc. and also for a certain amount of transcription of telephone check cylinders.

The installation now consists of two well furnished listening and recording rooms, each capable of holding ten positions, one room being fully/

February 28th 1942 (Cont'd)

fully and one partially equipped. Another room has been provided solely for transcription of discs and has 15 booths, each large enough to contain a small table and playback unit. This room has been fitted with carpets and building board partitions so that its acoustic properties are as good as those of the listening rooms.

A separate office has been provided for noisy work, such as typing and to house the disc filing cabinets.

Switching facilities have been provided so that the officer- in-charge can allocate incoming lines to any desired listening position. By this means it is anticipated that the 20 positions, when fully equipped, will be able to handle traffic from approximately 40 sources.

During the last few months, it has been evident that the employment of special staff solely for this work has proved a wise policy. With suitable training and continual practice, the efficiency of the staff has shown a steady improvement and it is understood that very satisfactory results have been obtained under signal/noise conditions which six months ago would have been regarded as impossible.

The lines incoming to this installation consist of approximately half a dozen from special microphone installations in premises definitely under the control of M.I.5 and approximately a dozen from carrier telephone equipment installed in various subscribers' premises. These numbers fluctuate from time to time, but a steady increase is taking place and it is anticipated that by the end of this year the new installation will be fully loaded.

March 7th 1942

Special Work for Combined Services Organisation

On February 24th I visited an establishment at B.P. This visit was the result of one to the same place some days earlier by Sir Stanley Angwin at the direct request of the head of the establishment. Commander Travis explained to me a problem which involved the use of equipment to list a very large number of possible circuit arrangements

March 7th 1942 (Cont'd)

in succession. He stated that to satisfy new conditions of working, the testing time had to be reduced to less than one millisec for each arrangement. Equipment previously used at a slower speed had been designed by a firm specialising in Calculating Machines and incorporated a crude type of relay unsuitable for fast operation. The aid of the Telecommunications Research Establishment (M.A.P.) had already been sought and Dr. Wynn-Williams detached to give assistance. Contact was made with him during my visit to B.P. and his proposals for a possible solution using gas filled relays discussed.

The problem seemed to be one where the assistance of the Post Office should have been called in earlier. The help which we could give was discussed with Commander Travis and Dr. Wynn-Williams, and I stressed the point that, if assistance from Dollis Hill were to be effective, it would be necessary to disclose the whole problem to an expert in the telephone switching field. Commander Travis obtained permission for this to be done and the next day I took Mr. T.H. Flowers to B.P.

Subsequently plans were discussed for a combined attack on the problem at the Telecommunications Research Establishment, Swanage and at the Research Station, Dollis Hill. The more fundamental aspects of the general problem will be investigated by a small "cell" working under Dr. Wynn-Williams at

Swanage but, once the general method of attempted solution has been settled the building up of automatic telephone equipment to test it will take place at Dollis Hill. In order to keep Dollis Hill fully informed of what Swanage is doing and to assist Dollis Hill to appreciate the requirements, an Inspector, reporting to Mr. Flowers, has been detached to work temporarily within the "cell" at Swanage.

It is considered that progress might be facilitated if a larger proportion of the work were transferred from Swanage to Dollis Hill, This has been raised with Mr. A.P. Rowe, Superintendent, T.R.E. through Mr. Flowers during a visit paid by the latter to Swanage.

Mr. Rowe has agreed to the suggestion. It is proposed that a laboratory should be set aside where the work can be segregated at Dollis Hill and a small team of workers got together similar to the "cell" at Swanage.

W.G. Radley.

21st March 1942 — Advisory Committee on Army Telephone Instruments

Committee Report No. 3 was sent to the Ministry of Supply to-day. This report deals with the replacement of existing Army types of telephone receiver used on field lines. Two possible types are considered -

1.The P.O. type 2P (an equalized receiver with volume efficiency about equal to the normal 1L type)

2. The balanced armature type

It is concluded that both types are better than the present Army receivers and their introduction is recommended. They will give better transmission on all lines and the type (2), which in addition to having a relatively flat frequency response, is 8 db louder than the present type, will enable longer lines to be used. Three firms are now making type (1) and two firms type (2) in large quantities.

The Committee has also been giving attention to the redesign of headgear equipment both for use in Armoured Fighting Vehicles and for other Army telephones. Essential features about the new designs is that the assembly should be capable of being worn with a steel helmet and a gas mask. The suggested designs differ from existing types in that the pressure of the receivers on the ears is maintained by a steel spring passing round the back of the neck. The receivers are held in position by a webbing strap passing over the head.

Experimental work is being actively pursued in connection with the development of laryngaphones (throat microphones) both for use in Armoured Fighting Vehicles and also as a solution to the problem of providing microphones for use with a gas mask.

28th March 1942 — Communications to Tiree

To provide service to R.A.F. establishments in Tiree, the following circuits have been set up:-

Tobermory (Mull) - Scarnish (Tiree): 5, 2-wire audio circuits + 6, 4-wire carrier circuits

Oban - Scarnish: 4, 4-wire carrier circuits

Oban - Tobermory: 2, 2-wire audio circuits

Oban - Craignure (Mull): 1, 2-wire audio circuit

Craignure - Tobermory: 1, 2-wire audio circuit

All the main circuits have been provided by means of units of Carrier System No. 4, re-arranged so that the audio circuit operates on a duplex basis while the four carrier channels are operated as two U-D channels and two D-U/

28th March 1942 (Cont'd) D-U channels.

The route between Tobermory and Scarnish consists of an old single core telegraph cable via Coll, with open lines on Mull, Coll and Tiree, together with a new direct 8-core cable and a 38 pr/40 lbs. cable across Mull. The circuits on the telegraph cable remain as under the temporary provision (Case No. 11409); a 1 + 2 circuit carrier system is operated on each pair of the 8-core cable. The four Oban-Scarnish carrier circuits together with the two Oban-Tobermory audio circuits are routed on two open wire pairs from Tobermory to Achnacraig and thence via an old 4-core submarine cable to Oban. A duplex telegraph circuit, Oban-Tobermory, is operated over the phantom of this submarine cable. The Oban-Craignure circuit is on an open wire pair and the old single core telegraph cable; the Craignure-Tobermory circuit is overhead throughout.

31st March 1942 Microgram Service

A demonstration of the equipment has been given at the War Office, to the Assistant Secretary of State and to officers of the Army Pay Corps Casualties Service. Certain apparatus has already been despatched to Cairo. Pending the establishment of the microgram service for official and secret correspondence, enlarged prints from a number of films captured in the Middle East have been made at Dollis Hill.

20th April 1942 — Simplex Repeater for Telegraph Circuits

The first of the simplex telegraph repeaters to be supplied to the War Office for use in the Middle East (see previous diary entry of 23rd January) was delivered from Holloway Factory to-day. On laboratory test it proved to be completely satisfactory, and the remaining equipments will be made to this model.

Research Report No. 11685 refers.

25th April 1942 — Use of Telephones with C.D. Respirator

An interim report was sent to the Ministry of Home Security on the speech transmission qualities of an attachment to the C.D. type respirator for use when telephoning or when giving orders to squads in the open air. The device effects a considerable improvement in the speech transmitted, is cheap and can be fitted easily to C.D. type respirators.

27th April 1942 — Records of Aeroplane Noise - Previous Diary entry 24th August, 1941

A glass disc reproduction from the film records of noise has been prepared and accepted by the R.A.E. as satisfactory. Ilfords will now prepare 200 copies.

A similar record is now required for machine-gun noise for air gunnery training.

29th April 1942 — Demonstration of Auto-Teller

Under the heading of "Work for the M.A.P. Telecommunications Research Establishment", a diary entry of 22nd December 1941, and earlier entries, described the development of auto-teleplotting equipment at Dollis Hill. A working demonstration of this equipment was given to-day to Air Commodore De Burgh and other officers of the Air Ministry, Air Commodore Cunningham and other officers of Fighter Command, Air Commodore Warrington Morris, Commandant Royal Observer Corps and representatives of the D.C.D., Ministry of Aircraft Production and of the Telecommunications Department, G.P.O. The demonstration consisted of three manually-operated teleprinter channels working into the auto-teller which converted the incoming teleprinter characters into speech at a speed of approximately five plots per minute and distributed these to three positions equipped with earphones at the plotting table. Experimental equipment had been designed for the transmission of plots from R.D.F. stations (the plots being automatically transmitted from the calculator) so that the whole range of characters utilised in .the normal coding of plots from Royal Observer Centres was

not/

29th April 1942 (Cont'd)

not available. It was explained, however, that the equipment could easily be modified to give such facilities and also to enable a higher speed of plotting.

During the subsequent discussion it was taken for granted that the line position would in future necessitate much information being transmitted on telegraph channels and endeavours were made to assess the merits and drawbacks of the auto-teller for retelling plots received in teleprinter code as compared with the use of unskilled R.A.F. operators for this purpose. The advantages of the autoteller were seen to lie in the considerable saving of staff and accommodation which would be achieved, the elimination of human error especially when operators were fatigued, the higher quality of received speech and the saving in time (estimated to be between five and ten seconds) as compared with the normal re-telling methods. On the other hand, there are the disadvantages that a certain loss of flexibility must result from the use of the mechanical device, additional maintenance problems would be introduced and the mechanical reliability of the equipment was at present an unknown quantity. With the auto-teller no record is received of the incoming plots and plots cannot be queried, but there is a difference of opinion in the R.A.F, as to whether this is a disadvantage or not.

It was finally agreed that the Air Ministry in collaboration with Fighter Command and the G.P.O. should prepare a balance sheet showing the pros and cons of the device. It was agreed that in preparing this balance sheet cognisance should be taken as far as possible of the modifications to aircraft reporting systems which would shortly be required as a result of the introduction of Inland Filter Rooms at Fighter Groups. It was also agreed that concurrently with the preparation of this balance sheet, the Post Office should give facilities to Fighter Command to carry out any trials necessary to test the reliability and accuracy of the device in the Post Office Laboratories at Dollis Hill. The Research Branch in agreeing to these proposals stated that it should borne in mind that production of the final equipment would necessarily occupy a period of many months and stressed the desirability of obtaining an early decision if a large number of equipments were ultimately to be brought into use. On the other hand, in/

29th April 1942 (Cont'd) in view of the large programme of work for the Fighting Services to which the Branch was committed, if development of the device was not to be proceeded with, an early decision was again of considerable importance.

30th April 1942 Work for the War Office

Various discussions have been continued regarding procedure and equipment for microgram services terminated at Cairo and Jerusalem. Five Graflex cameras have been obtained and tested and a number of Army staff trained in the use of the equipment.

Methods have been discussed with M.I.5 for obtaining small photographic records of plans and drawings which might be destroyed in the event of invasion. Special films have been prepared for the use of foreign agents. These require special processing and are designed to fog completely if the normal processing

1st May 1942 Special Work for Combined Services Organisation - Case No. 11714 refers

It will be recollected from the diary entry of March 7th that the solution to a problem confronting a certain Combined Services Organisation can only be found by testing a very large number indeed of alternative circuit combinations. Equipments for the preliminary testing of circuit combinations of this type are already in use and are being further developed by the firm which originally designed them so that the speed of testing will be considerably increased. Work in connection with speeding up the preliminary testing is also being undertaken at the Telecommunications Research Establishment, where the scheme using gas filled relays is being experimentally developed. Not all the results obtained during the preliminary testing are of interest: those which are can be discriminated and the particular circuit combination giving rise to them described (on a lamp display) by further testing with equipments utilizing automatic telephone switching apparatus.

A preliminary review of the complete problem indicated that the Research Branch could best assist by the development and construction of equipments for the second stage testing. This was undertaken. The review indicated that at least four equipments would be required initially with possibly eleven more later.

Construction of the first four equipments was estimated as likely to take 25,000 manhours of work in the laboratory, chiefly in the assembly and/

1st May 1942

and wiring of apparatus. It would also absorb a considerable amount of apparatus some of which was in short supply. The steps taken to overcome these two difficulties are set out below:-

(1) The Research Group concerned had not been so heavily loaded during the past six months and in consequence some of its complement had been transferred to assist other Groups on urgent defence work. Such staff as could be were recalled but this still left a serious deficiency in Skilled Workmen grades capable of wiring up apparatus. The Group was then strengthened first by the diversion to Dollis Hill of four U.S.W's earmarked by the Department for transfer to the Combined Services Organisation in question in place of enlistment in the Army. These four men will accompany the first equipment to its destination, instal it and remain to undertake the maintenance of it and similar equipments. An approach was then made to the L.T.R. and it was found that the Region was willing to assist by loaning U.S.W's and S.W.II's with experience of exchange construction. Nine of these have or will be obtained to give assistance at Dollis Hill on the understanding that they will be released immediately should enemy damage to London exchanges make their return desirable. These increases in wiring staff left initially the completion of the circuit design and latterly the limited number of men who could obtain simultaneous access to the racks for wiring purposes as limiting factors to the speed of construction. At first the Combined Services Organisation would not consent to the object for which the equipment was desired being disclosed to anyone in the S.A.S. Group except Mr. Flowers, the Executive Engineer. He, therefore, had to proceed with the circuit design unaided. Strong representation was made to the Combined Services Organisation that this was delaying the work and eventually consent was obtained for full details to be disclosed to Mr. Broadhurst, Assistant Engineer. He then was enabled to take a share in the circuit design which has only proceeded a few hours ahead of the wiring up of the equipment. The staff in this Group worked on an average a 70-hour week during April and at the end of the month, when the additional wiring assistance had been obtained and the circuit design completed, a night shift was started.

(2) With the assistance of the Deputy Engineer-in-Chief, delay in obtaining stores was entirely obviated. He obtained the agreement of the Telecommunications Department that the job should be placed at the head of the current Master List/

1st May 1942 (Cont'd) List, and the necessary relays, racks, etc. were obtained through the Stores Department without delay.

5th May 1942 Assistance to the Aeronautical Department of the National Physical Laboratory

The Aeronautical Department of the National Physical Laboratory are carrying out tests on small-scale models with a view to improving the design of driving brakes on aircraft in order to reduce the stresses produced in the tail plane when the brakes are operated. The stress is recorded on an oscillograph by a method making use of the magnetostriction effect in a nickel rod. Owing to the great difference in the natural resonance frequencies of the actual and model tail planes, the stress in the actual tail plane could not readily be deduced from the records obtained from the model. The Research Branch designed and constructed a modified electrical circuit, including a corrective network, to compensate for the natural resonance of the model. The required information can now be obtained from the records. Research Case No. 11723 refers.

9th May 1942 Work for the War Office XXVIII - Works Order No. 2243 W/40 refers

Building work at the special P/W camp at Latimer is practically complete and installation of listening and recording equipment has been carried out.

Thirty-two cells and seven interrogation rooms have been fitted with microphones. The microphone amplifiers and the main power controls, fuses, etc. are housed in a separate room in order to avoid well-meaning interference by unauthorised and unqualified persons. This room will also contain a work bench and testing equipment for use by the permanent maintenance staff, which the War Office has agreed to provide. Six listening and recording positions, each equipped with recording amplifier and two machines, are provided in each of four rooms. Microphone circuits terminate on a jack field at the listening positions so that each has access to all cells and interrogation rooms. Four transcribing rooms have been provided and each will be fitted with three or more transcribing tables as required.

Tests carried out on the completed equipment indicate that the improvement over existing installations, which was to be expected as a result of the opportunity of designing rooms for their specific purpose, has been fully realised. Officers with experience of such work have expressed themselves as very satisfied with the results achieved.

Although the buildings are apparently ready for use, no date has yet been fixed by the War Office for bringing them into service. The interval is/

9th May 1942 (Cont'd)

is to be employed in giving the officers engaged on listening work a refresher course in listening and recording technique.

Tests of interfering effects of Aircraft Noise

About six months ago it was realised that an aerodrome was in course of construction at Bovingdon, some 2½ miles from the P/W camp at Latimer, and it was feared that aircraft might cause serious interference with the listening work. A series of tests was accordingly arranged for Thursday, 7th May, when a Halifax bomber was to fly over the camp at various heights to be arranged with the pilot on that morning. The War Office proposed that experienced officers should listen on the equipment while the aircraft was flying overhead and express an opinion as to the magnitude of the interfering effect. Experience has shown, however, that opinions of this kind are of very doubtful utility and it was decided to carry out articulation tests. Since it was not possible on security grounds to take experienced testing crews to the camp, recording of logatoms were made and these would be reproduced on high quality equipment in two of the cells under various conditions of window opening. The sounds received in the listening rooms were to be recorded and the records thus made sent for transcription by expert Intelligence Officers. By this means it was hoped than an analysis of the errors would provide some measure of the interfering effect of the aircraft which would independent of personal opinions and prejudices.

Everything was ready for the tests at 10.0 o'clock on Thursday morning when the pilot of the aircraft was due at the preliminary conference. At 12 o'clock news was received that the aircraft had been damaged by antiaircraft obstacles when landing at Bovingdon aerodrome. It transpired that the Department of the Air Ministry providing the aircraft had not contacted the Department of the Air Ministry building the aerodrome and ascertained that the latter was usable! No standard marking to indicate that the aerodrome was unfit for service was displayed at Bovingdon and the pilot had been unable to see the obstruction until touching down. As the aircraft was too badly damaged to take off again immediately, it was only possible to arrange a programme with the pilot which was to be carried out on Saturday morning. The programme was as follows. The aircraft would fly over the camp at 1000', 2000', 4000' and 6000' on a specified course, starting about four miles on one side and finishing five or six miles on the other. Arrangements were made for synchronising the articulation testing/

9th May 1942 (Cont'd) testing procedure with the progress of the aircraft by means of radio telephony. The weather conditions were perfect to-day and the tests were carried out satisfactorily. Some modification was necessary as the effect of the aircraft noise was considerably less than had been anticipated and, instead of carrying out the last test at 6000', this was altered to 500'. The records have been sent for transcription and on return will be analysed.

11th May 1942 Army S + D Telephone and Telegraph Equipment

Following the investigation carried out by this Branch, a meeting was held to-day between representatives of the S.E.E., Messrs. S.T. & C. and the Research Branch to discuss the uses of the Army design of S + D equipment. (Diary entry of 9th January 1942 refers). It has been decided that a simplified model should be designed, and the meeting discussed the exact facilities to be provided.

16th May 1942 Work in connection with the provision of Telephone Carrier Circuits in Scotland The progress of the various schemes was summarised in the Diary entry of the 31st May 1941. Further progress made in connection with some of the schemes is briefly referred to below.

(1) Wick Emergency Repeater Station

Equipment has been provided for Wick Emergency Station to enable one group (actually 11 circuits) to by-pass Wick and link the Inverness-Wick land coaxial cable with the Wick-Lerwick submarine cable.

The equipment has not been installed owing to delay in completion of the building. Research Case No. 11591 refers.

(2) Kirkwall No. 2 Station

Equipment has been provided for Kirkwall No. 2 Station to replace that already in service in the Kirkwall Temporary Repeater Station. The equipment concerned is the terminal equipment for the Wick-Kirkwall submarine cables (3-12-circuit systems + 2-1 + 2-circuit duplex systems). Kirkwall- Lerwick submarine cable (1 group-operated 12-circuit system + a 1 + 2- circuit duplex system).

The equipment has not yet been installed owing to delay in completion of the buildings. Research Cases Nos. 11312 and 11313 refer.

18th May 1942 "Two-tone" Method of transmission of Teleprinter Signals

A meeting was held to-day between members of Tg., W. and R. Branches to discuss the use of a "two-tone" method of transmission of teleprinter signals over radio links to America. It should be possible to provide nine telegraph channels over one telephone circuit if 120 c/s spacing of the carriers/

18th May 1942 carriers is used, but the American standard is a 170 c/s spacing and they may wish to use their standard apparatus. The question of the supply of the filters at both ends may be a determining factor as to which spacing is ultimately used.

23rd May 1942 Post Office and Signals Co-Ordination Committee

At the instance of the Research Branch representative it was decided that a formal protest should be recorded regarding the absence of information about the performance in the field of apparatus designed by the Department in co-operation with Signals. Two cases where there had been lack of co-ordination were mentioned specifically and the War Office representative promised to investigate.

26th May 1942 R/T Training Equipment for R.A.F. Fighter Pilots

Messrs. M.S.S. Recording Co. have a contract for 15 recording and replay equipments for training fighter pilots in the procedure and the correct use of R/T sets. When the first one was completed it was felt that there was some doubt as to whether this would really meet the requirements. The question was discussed with Squadron Leader Lloyd- James of "Woodlands" Stanmore, who is responsible for the direction of this training, and modifications were agreed. The modified set has been supplied to Squadron Leader Lloyd-James for examination and has received his approval.

Instructors at training centres have experienced some difficulty in operating and maintaining the recording equipment and it has been arranged that as other sets become available the officers or other ranks, who will be responsible for them, will spend two or three days at Dollis Hill becoming familiar with the operation and maintenance of the recording machines.

30th May 1942 Provision of Carrier Telephone Equipment for the operation of Circuits between Gt. Britain and Northern Ireland (Schemes 129 and Extension)

This Branch has assisted by construction in the laboratory of transmission equipment necessary to enable standard apparatus to be adapted to the unusual conditions of this route. The schemes provide 12 carrier circuits between Holyhead and Dundonald via the Isle of Man. These are operated as follows:

Holyhead-Creg-ny-baa (Douglas Radio):- Short wave radio using different frequencies for the two directions. This link was provided by W. Branch and transmits the carrier channels in the range 60-108 kc/s in each direction.

Creg-ny-baa/

30th May 1942 (Cont'd)

Creg-ny-baa-Port Erin:- In multi-pair land cables, transmitted in the frequency range 12-60 kc/s.

Port-Erin-Ballyhornan:- On the phantom circuits of the Port Erin-Ballyhornan (1929) 4-core balata submarine cables, transmitted in the frequency range 12-60 kc/s.

Ballyhornan-Dundonald:- On a new high frequency balanced pair cable, transmitted in the frequency range 204-252 kc/s from Dundonald to Ballyhornan and 12-60 kc/s from Ballyhornan to Dundonald. Completion of a duplicate terminal at Belfast is now proceeding.

The scheme is planned to enable the maximum number of circuits to be operated over the phantoms of the submarine cables, where phantom-to-phantom crosstalk is a limiting factor. Approximately 18 circuits can be provided in this way, but a maximum of 24 has been allowed for. In the final arrangement the circuits will operate in the range 12-108 kc/s on the submarine cable (i.e. as many circuits as possible in this range), 12-108 kc/s from Ballyhornan to Belfast and Dundonald, and 156-252 kc/s from Belfast and Dundonald to Ballyhornan.

The 12 circuits already provided operate with No. 5 System 12-channel terminals at Holyhead and Dundonald. Transmission, crosstalk and noise conditions are satisfactory, although the usual noise limits are exceeded on the radio link. The system is synchronized throughout.

The work will be briefly described in Research Reports Nos. 11461 and 11636.

Equipment of Mobile Carrier Telephone Terminals

Two mobile carrier terminals have been constructed for the Defence Services Line Telecommunications Board to provide rapid service over a submarine cable of the standard concentric paragutta type. The equipment used is the S0S.3F system of the type designed for the "Hedgerow" scheme, but rebayed to fit the vehicles. Additional receiving amplifiers have been fitted to enable the equipment to work over at least 110 nauts of cable, and equalizers are provided for 20-110 nauts. A reserve terminal is being equipped for one end.

The equipment provides three speech circuits and six telegraph channels in each direction (when used in conjunction with existing mobile 6-channel telegraph equipments).

Photographic and other Services for the War Office

(1) Supervision of the technical side of the London-Cairo Microgram Service has continued, 20,000 photographs having been transmitted during May. A visit has been paid to Farnborough to discuss a minor modification to the new equipment now/

30th May 1942 (Cont'd) now being made by Messrs. Williamsons. Six R.E's and eight A.T.S's are at present undergoing training at Dollis Hill in the use of the equipment.

(2) When a copy of a letter from a prisoner of war is required, it has been the practice to send it to a commercial firm for reproduction. A demonstration of a method of reflex printing suggested for other documents has been given by the Research Branch to the O/C. of the Department concerned and this method will now be adopted.

31st May 1942 R/T Speech Training Equipment for A.F.V. School, Bovington Camp, Dorset

The A.F.V. School at Bovington is responsible for the training of instructors of A.F.V. personnel in R/T and W/T signals procedure for all Commands in this country and abroad.

A request was received from the School during April for the provision of an R/T speech training recording equipment similar to those supplied by Messrs. M.S.S. Recording Co. to the R.A.F. It has been found by experience that slight modifications to this equipment to meet the particular needs of the user are generally necessary. His requirements were therefore discussed with Major Campbell of the School. It was found that two types of equipment were contemplated. The first in which the recording equipment was to be incorporated was to enable ten pupils, who were supposed to be in separate tanks, to be connected together by circuits which would simulate as far as possible the facilities and performance of the No. 19 wireless set. It was found that owing to limited apparatus available to the School, it was not possible to provide side-tone to the pupil who was transmitting. The only noise which was to be supplied was intended to represent the background noise and interference received on the No. 19 set. Experience gained during tests made for the Advisory Committee on Army Telephone Instruments had shown that side-tone and tank noise leaking past earpads were of paramount importance in determining the performance of operators in tank noise. It was, therefore, suggested to Major Campbell that these conditions should be simulated as far as possible and he was in full agreement with this proposal.

The equipment as finally designed gave the following facilities. In the receiving condition the pupils receive in their earphones noise corresponding to that which they would experience in a moving tank and also/

31st May 1942 (Cont'd) also the normal background noise of the No. 19 set. Speech received from other pupils is superimposed on this noise. In the transmitting condition the noise is modified to represent tank noise only, and the pupil hears his own side-tone at approximately the level normally provided by the No. 19 set. Should two or more pupils speak simultaneously, each hears only his own side-tone in addition to noise, while the remaining pupils hear all the speakers and also a heterodyne whistle intended to represent interference produced by two sets transmitting simultaneously. The recording equipment is connected in such a way that it is possible to transmit back to any pupil his own transmission as heard by the remaining pupils. Facilities are also provided for the attachment of morse keys to the pupils' sets so that consistently bad morse sending on the part of any pupil can be demonstrated to him.

The second equipment was intended mainly for W/T training and training in procedure during squadron or regimental exercises. Five rooms were to be equipped with 18 sets each, and the interconnection of the sets in each room, the control of radio background noise and of radio signal strength was to be carried out by means of a control box operated by two instructors. Again the limited apparatus available to the School made the provision of side-tone and continuous tank noise impossible, but a new design was suggested which gave similar facilities in these respects to the first equipment with the exception that the noise was not modified when the pupils changed from receiving to transmitting. Noise was provided for all five rooms by a single gramophone unit, a record of tank noise used for testing purposes at Dollis Hill being employed. The gramophone unit also contained two oscillators (one spare) for providing W/T signals.

One equipment of each type was completed and installed yesterday and was demonstrated to-day by the A.F.V. School to Signals instructors from all Commands. Both the School staff and the visiting instructors were impressed by the usefulness of the equipment and a conference of instructors will press the War Office to authorise the provision of similar equipment at all R/T and W/T training centres at the earliest possible moment. (R.Case No.11735 refers)

1st June 1942 Advisory Committee on Army Telephone Instruments

Following a meeting of the Committee on the 28th ultimo, a sample headgear assembly was submitted to-day to the Ministry of Supply, E.S.2.(T). The sample incorporates the new small Goodman moving coil telephone receivers and results from consideration by the Advisory Committee of all the known requirements in Armoured Fighting Vehicles. The assembly has rubber earpads designed to/

1st June 1942 (Cont'd) to give the maximum sound exclusion with the greatest comfort. These pads are held in position by a webbing strap passing over the head and pressed against the ear by a light piano wire spring passing round the nape of the neck. The assembly is easily stowable and in this respect it is an improvement on existing patterns. It is also capable of being worn under steel helmets and is, in fact, the only type likely to be suitable for use with the new P type helmet. As a manufacturing proposition, it is much simpler than any existing type of assembly and while rubber is used, the quantity of this material has been kept down to the minimum and reclaimed rubber may be used in some places. The assembly was shown to Brigadier Naesmyth and other officers at the A.F.V. School, Bovington, on Sunday, May 31st, and enthusiastically received.

5th June 1942 Special Work for Combined Services Organisation

(1) Case No. 11714

The first of the four equipments referred to in the Diary entry for the 1st May is being shipped to the Combined Services Establishment at Bletchley Park this week-end. Wiring of the equipment was completed about mid-May and some days were then absorbed in "chasing" and subsequently rectifying circuit faults. Bearing in mind that construction of the equipment was started before a circuit design had been properly completed, the number of circuit re-arrangements which had to be made was surprisingly few. The equipment has since been given a functional test, so far as is possible, in the presence of Services personnel at Dollis Hill and promises to do all that is required of it satisfactorily. It has been arranged that an Inspector from the Group concerned should be temporarily resident at Bletchley Park during the installation and period of early use of the equipment in order that any difficulties which may arise will be dealt with without delay. This equipment has been completed much in advance of the completion of the high speed equipments for preliminary testing being constructed at the Telecommunications Research Establishment and by the British Tabulating Company. The closest contact possible has been established with the latter and the Research Branch has offered all assistance in its power towards obtaining/

5th June 1942 (Cont'd)

obtaining the small quantities of standard Post Office equipment required.

(2) Case No. 11757

On the 12th May the assistance of the Branch was requested by the same Combined Services Organisation in connection with another problem. The Organisation had, by a brilliant piece of mathematical deduction, worked out the principles of operation of a ciphering machine for a five unit code. In principle the method of operation on the code is for each of the five units to be taken separately through a chain of commutating devices each of which may or may not reverse the direction of the current. An experimental "lash-up" using automatic telephone apparatus had been attempted by the Combined Services Organisation, but the facilities available to them did not permit them to proceed very far. Equipment to perform the ciphering operations was urgently required and the Research Branch was asked to undertake this. The requirements were studied and the job undertaken on 14th May.

The first equipment was completed and testing out started on Whit Monday, May 25th. Very few alterations were required and the equipment was demonstrated, successfully de-ciphering intercepted traffic at the end of the same week. It was transferred to Bletchley Park and installed there on June 3rd.

15th June 1942 — Records of Aeroplane Noise (Previous Diary entry 27th April, 1942)

It is understood that the aeroplane noise records supplied for training purposes to the R.A.F. are completely satisfactory, and that contracts have been placed by the M.A.P. for over 600 play-back equipments.

15th June 1942 — Portable Telegraph Distortion Measuring Set

The expansion of the teleprinter network to remote Stations under the D.T.N. scheme has produced the need for a simple portable means of measuring the overall distortion, and hence the real margin of a complete teleprinter circuit, including the terminal instruments. A simple tester which has been developed in this Branch indicates the distortion on a received signal by detecting the surges in the teleprinter electro magnet winding resulting from a movement of the armature. Early field trials were carried out at Hounslow to-day.

19th June 1942 — Work for the War Office in connexion with the Microgram Service

A service averaging 1400 photos per day is operating from Cairo to London and a heavy increase in this traffic is imminent. A second service between Jerusalem and London started to-day, and it is anticipated that within a few weeks traffic will be received from India and the United States. A total of nine processing units is envisaged to cope with these expansions, and it is proposed to set up further establishments in and around London.

The whole of the technical aspect of the microgram service, including the provision of equipment, planning of accommodation, training of Army operating personnel, and the processing of the records received to date has been supervised by the Research Branch.

20th June 1942 — Location of Buried Casualties

The special equipment developed by the Research Branch for detecting tapping noises made by persons buried under the debris of wrecked buildings was tried out recently following the air raids at Bath and the explosion in S.E. London. Detailed reports show that there is no fault apparent in the design of the apparatus, although the experience gained indicates that considerable improvements could be made in the organisation of the rescue squads.

22nd June 1942 — Demonstration of Auto-Teller

The procedure decided upon at the meeting between Post Office, Air Ministry and Fighter Command officers, and mentioned in the Diary entry of the/

22nd June 1942 (Cont'd) the 29th April has been followed and a series of plotting and accuracy tests has been made on the model auto-teller. These tests were made with the co-operation of the Operations Research Section (M.A.P.) using W.A.A.F. personnel. The results show that an auto-teller channel can be depended upon to convert teleprinted plots into uniform high quality speech. During the plotting tests covering a period of nearly three weeks, one auto-teller channel dealt with 20,000 plots of which 5,500 plots were checked. Of these 5,500, only four were mutilated by the auto-teller.

A series of 1,100 plots were dealt with simultaneously by means of the auto-teller and a retelling link from teleprinter tape at a speed of five plots per minute. Seven plots were mutilated by the autotelling link and ten on the retelling link. These errors include those due to the personnel concerned.

The efficiency of plotting was found to be much more dependent on the mental and physical state of the plotter than upon whether auto-telling or retelling was used.

30th June 1942 Advisory Committee on Army Telephone Instruments

A report has been sent to the Ministry of Supply (Committee Report No. 4) setting out in general terms the limits of the noise level in which carbon microphones can be usefully employed. These limits have been arrived at as a consequence of the experimental work carried out in connexion with certain specific questions. Although to a certain extent, the use of carbon microphones in noisy locations depends on such factors as the extent to which noise can be excluded from the microphone by its mouthpiece, it appears that the normal inset type of carbon microphone is unsuitable when the noise level exceeds 90 db. Use of a specially designed carbon microphone may be considered for noise levels some 10 db or so higher, but should be avoided if the substitution of other types is possible.

Models of two designs of headgear assembly for field line and radio equipment were submitted to the Ministry of Supply on 9th June. In the proposed assemblies, the telephone receivers are pressed against the ears by a steel spring passing behind the nape of the neck and held in position by a webbing band passing over the top of the head.

Vocoder/

30th June 1942 (Cont'd)

Vocoder Transmission

Experimental work is proceeding in connexion with vocoder transmission. With this system, speech at the transmitting end is divided into ten frequency bands and signals, corresponding to the energy in each of these and to the frequency of the fundamental larynx tone, are transmitted over the line. The signals control speech synthesising equipment consisting of variable frequency and harmonic generators at the receiving terminal.

A manually-operated synthesising equipment was successfully demonstrated by the Bell Telephone Laboratories at the New York World's Fair in 1939. Full design details for receiving and transmitting terminals were obtained from the Bell Telephone Laboratories and two terminals have been constructed. By the allocation of a frequency band, extending not more than 25 c/s on each side of the carrier, to each one of the line channels and using a quadrature method of transmission, it should be possible to transmit commercial speech within a range of 350 c/s. At the present stage, speech is intelligible, but further work is necessary to improve the naturalness. Research Cases Nos. 11577 (Terminals) and 11578 Transmission System) refer.

15th July 1942 — Work for the War Office - Works Order No. 2243 W/41

The special P/W camp, which has been built in the grounds of Latimer House and fitted with listening and recording equipment, was brought into use by the War Office to-day. Owing to the fact that the prisoners' accommodation has been specially designed for the purpose, overhearing results have been extremely good. Some difficulties have been experienced by the operators in familiarising themselves with the recording equipment, which is operated in a slightly different manner from that previously installed at Cockfosters. Experience is, however, reducing these difficulties and it is hoped that full efficiency will be reached very shortly.

It has been found that ventilation in the cells is insufficient and prisoners tend to sleep unduly. Experiments are in progress in co-operation with the Ministry of Works with a view to finding a method of improving the ventilation without increasing the amount of noise entering via the windows and without arousing suspicions in the prisoners' minds.

Since the War Office failed to provide the agreed maintenance staff by the opening date, Mr. G.P. Copping, one of the officers released to the War Office for this purpose, has taken over the maintenance on a full time basis pending his commissioning as an Army officer.

18th July 1942 — Provision of Transatlantic Multi-Channel Telegraph System

On 22nd June the Branch was requested to provide equipment for operating four 2-tone V.F. telegraph channels over a short wave radio link. A standard 12-channel V.F. telegraph system was modified, special pairs designed and constructed and the whole of the equipment was tested and assembled for operation by the 13th instant. Traffic tests were made with the distant end on two days later and highly satisfactory results were obtained, working 80 words per minute morse on all four channels. The system was put into operational traffic with Washington to-day, the channels on this side being terminated at London, Cheltenham and "Widewings". The system has proved satisfactory in operation and will shortly be enlarged to provide six channels.

24th July 1942 — Advisory Committee on Army Telephone Instruments

At a meeting of the Committee held to-day, Dr. Radley stated that he had been requested to attend a meeting of the Communications Committee of the Scientific Advisory Council, Ministry of Supply, on the previous day. He had done so and had spoken of the ground covered by the A.C.A.T.I. during the past/

24th July 1942 (Cont'd) past 12 months. Major-General Butler, Colonel Elsdale and Dr. Paris (C.P.R.S.D.) had asked him to convey to the Committee the appreciation of the work it had done. Closer liaison, especially with the U.S.A. through an American representative, had been discussed, and Dr. Paris and Dr. Radley had arranged to meet within the next few days to review possibilities. Dr. Radley stated that the Communications Committee of the Scientific Advisory Council had proposed that he should be co-opted as a permanent member. This would prove a useful link in ensuring that the characteristics of new radio sets were considered in conjunction with those of the microphones and telephone receivers with which they would have to work.

The Committee at its meeting to-day approved the issue to the Ministry of Supply of two reports. The first of these gives the results of tests on production samples of the moving-coil microphone as modified mechanically in accordance with the suggestions of the Committee. The tests showed that, even under severe atmospheric conditions, moisture will not penetrate the sealing, and that the microphone should be entirely satisfactory in service. The second report gives the results of tests on DLR. receivers for field line equipment constructed with diaphragms of alternative material. These tests were carried out in view of the supply position.

25th July 1942 Army carrier quad cable

Owing mainly to the shortage of polythene, the supply of this cable has fallen far below requirements. Two quite different types of cable, Pyrotenax (magnesia insulation) and paper core have been considered as possibilities for filling the gap. The former is excellent mechanically but supply is limited. The paper core cable can be got in quantity but, with an ordinary lead sheath, is too week and too heavy. Sheaths of such material as polyvinyl chloride are not satisfactory alone as they admit moisture. A thin lead sheath covered with polyvinyl chloride and a steel braiding is, therefore, being tried. Research Branch is assisting the Ministry of Supply in this development.

27th July 1942 Work for Combined Services Organisation

(1) Case No. 11714

The second of the four equipments referred to in the Diary entries for 1st May and 5th June was shipped to the Combined Services Establishment at Bletchley Park this week-end. The first of these equipments has now been/

27th July 1942 (Cont'd) been in service for a fortnight, working 24 hours per day, and has given entirely satisfactory results. As a result of the success of the first machine and the experience which has been gained during its operation, the Branch has been asked that the third and fourth machines should provide additional facilities. This will enable the testing to be carried out on material which is much more scanty in nature and which does not link together as a comprehensive whole. The results obtained from the second stage testing will also be subject to much more rigorous check by the machine for inconsistencies. The answer eventually displayed by the machine will be one of a few, instead of one of very many, possible answers. Provision of the additional facilities which have been discussed in conference with those who will have to operate the equipment has necessitated almost complete redesign of the circuits. This is now finished and construction of Nos. 3 and 4 has been stated.

(2) Case No, 11757

The purpose, principle, construction and installation of the first one of these equipments was referred to in the Diary entry of the 5th June last. The second equipment was installed and brought into use on the 18th instant. Considerable improvements have been made on the first model. The second is capable of operating at normal teleprinter speeds and occupies less than two-thirds of the space of the first.

29th July 1942 Work for the War Office - Works Order No. 2263 W/41

[redacted] The audio frequency outputs from the five sets have been extended to five listening and recording positions at St. James' Street. By means of a push-button, an operator at any one of these positions can step the uniselector to the desired extension. Reception on all extensions has been found to be excellent and the switching facilities have proved satisfactory.

31st July 1942 Provision of 12 carrier circuits between Kyle (Ross-shire) and Benbecula (Scheme 123B)

The submarine cable on this route runs from Loch Slapin (Skye) to Benbecula/

31st July 1942 (Cont'd)

Benbecula and there are balanced pair land cable sections at each end, with a short submarine link between Kyle and Kyleakin.

Twelve circuits have been provided on the single pair by means of Carrier System No. 7 and group modulating equipment constructed by the Research Branch (12-60 kc/s from Kyle and 72-120 kc/s from Benbecula). There is an intermediate repeater station at Broadford (Skye).

Six circuits were made available for traffic on 17.7.42; the remaining six circuits will not be available until the end of August as additional filters are required to remove the 60-108 kc/s components from the output of the Carrier System No. 7. Research Report No. 11386 will refer.

15th August 1942 — Speech training equipment for personnel of Armoured Fighting Vehicles At a meeting with Capt. Hackworth of M.T.12 (War Office) and Major Campbell (Ministry of Supply) it was learned that the War Office had approved the use of speech training equipment similar to the experimental apparatus supplied to the A.F.V. School, Bevington Camp, for training A.F.V. personnel in the use of radio and intercommunication sets. All training Units were to be equipped and 15 sets would be required. Financial authority has been obtained and a request to arrange for manufacture and testing of the equipment is expected shortly from the Ministry of Supply. Case No. 11735 refers.

22nd August 1942 — Campbeltown-Port Ellen Circuits

Two 1 + 4 Circuit Carrier systems have been set up between Campbeltown (Kintyre) and Port Ellen (Islay), using modified Carrier Systems No. 4. Two submarine cables are used between Glenbarr and Port Ellen, one 4 core (No. 2) and one 8 core (No. 3). Four cores in the No. 3 cable are used for a V.F. telegraph system, leaving four cores in each cable for the new system.

A 2-wire audio circuit is operated over each of the four submarine cable pairs, being extended to Campbeltown on open lines. The carrier circuits operate 4-wire throughout, with "goes" and "returns" in separate submarine cables and in a single land cable between Campbeltown and Glenbarr. The carrier circuits only are repeatered at Glenbarr.

The new scheme replaces three audio circuits, two 2-wire and one 4-wire between Campbeltown and Port Ellen. Case No. 11446 refers.

25th August 1942 — Work for the War Office (Works Order 195 W/40)

The special P/W camp at Latimer being full, an Italian U-Boat crew has been housed at New Market P/W Cage. A mobile listening and recording unit was taken to New Market to-day and wiring, already installed there, was tested and found in good order. Considerable difficulty is being experienced owing to the fact that the War Office has not yet obtained technical personnel for these units. This matter is being pressed with the utmost urgency.

26th August 1942 — Provision of Auto-Tellers

A series of meetings has been held with the Telecommunications Department, Air Ministry, M.A.P. and Fighter Command regarding the immediate provision of Auto-tellers and S.T. & C.'s concentration equipment for/

26th August 1942 (Cont'd) for use with the new Inland Filter Room scheme which it is proposed to bring into operation on December 1st. The S.T. & C. have promised to equip two Groups with concentrators by that date, but it is expected that Auto-tellers cannot be provided before June 30th, 1943. The S.T. & C. gear reduces the staff required at the Filter Rooms and also the number of channels in the D.T.N. network required for broadcasting to Sector and Group Operations Rooms. The Auto-tellers used at Operations Room ends of the circuit would enable a very considerable reduction of staff to be made there, but the amount of equipment required is large, e.g., at Fighter Command H.Q. (the largest installation) 26 19" bays of equipment 8' 6" high plus power plant will be required. This includes a proportion of spare apparatus to allow for break-down. If all sectors are eventually equipped, over 30 installations of various sizes will be required.

27th August 1942 Advisory Committee on Army Telephone Instruments

Following the proposal that this Committee should be made a Sub-committee of the Communications Committee of the Scientific Advisory Council, Ministry of Supply, the new terms of reference were discussed to-day. The Scientific Advisory Council had pointed out that it had been advantageous to have terms of reference as wide as possible so that they could be taken to embrace any matters which could be taken legitimately as arising out of them. The Committee, however, thought it important that its new terms of reference should take cognizance of the fact that the performance of a microphone and telephone receiver may be profoundly changed by the characteristics of the apparatus to which they are directly connected. The target performance of the telephone instruments also depends on the characteristics of the remainder of the transmission link. Some trouble had arisen in the past due to the performance of the telephone instruments and connected apparatus not being considered sufficiently early as a whole. In addition, the Committee desired to have freedom to comment on the effect of other military equipment, for example respirators, on speech communication. The following terms of reference were, therefore, suggested:-

> To review and advise on research and development work on microphones and receivers for military purposes and to advise concerning features in the design of transmission or other equipment insofar as they may affect speech communication. To make recommendations for a method of assessing the overall speech performance of line and radio telephone links.

31st/

31st August 1942 Work for Combined Services Organisation

(i) Case No. 11835- Provision of W-W. Equipments

On August 4th Flowers and I visited T.R.E., Malvern, with Commander Travis in order to inspect the equipment developed by Dr. Wynn-Williams. This equipment is intended for connection to a standard British Tabulating Company's machine (called a "Bombe") and for each contact position of the latter applies testing conditions through 26 alternative circuit arrangements. The circuits are set up through a series of commutators rotating at high speed and pulses of testing current are generated and the required circuit condition recognised by means of gas-filled relays. The W-W. equipment as it stood represented the result of six months' experimental work at T.R.E., but has not yet been subject to trial as part of a complete setup including a Bombe. Its satisfactory operation under such conditions will not be known until it is shipped to B.P. early in September.

Mainly urged by Dollis Hill, a meeting was held at B.P. on August 10th with the object of co-ordinating future efforts of all parties concerned with supply of apparatus to solve their outstanding problem. Having previously consulted Sir Stanley Angwin, I then offered the assistance of the P.O. Factories in making the rack assembled relay part of the W-W equipment. It was agreed that manufacture of the commutator assemblies should be arranged through the Admiralty.

We came away from this meeting rather disturbed in mind. In order that results might be obtained sufficiently quickly to be of value, it appeared that 72 W-W. equipments were wanted for attachment to standard Bombes. At the meeting a statement had also been made that before these results could be utilised they would need further sifting by analysers of the kind already constructed at Dollis Hill and that up to 40 of the latter might be necessary. Later this statement appeared to be an over-estimate, but the construction of a large number of analysers concurrently with the other equipment was impossible. The only alternative then appeared to be the use of the new high speed Bombe being developed by the British Tabulating Company with so-called "mammoth" facilities. Each one of these would replace one standard Bombe plus two W-W. attachments which would produce information in a form which required little further analysis. The Company, however, estimated that the best they could do would be the provision of 12 such machines by April 1943.

A few days later it appeared that there would be considerable supply difficulties in constructing 72 W-W. equipments quickly, for example, 40,000 wire resistors, 10,000 small mica condensers and 8,000 high speed relays would have been required. All of these are in very short supply with Siemens/

31st August 1942 (Cont'd)

Siemens' immediate output of high speed relays in particular fully allocated. If the supply of other equipment urgently required by the Services were to be delayed by our appropriation of components in order to construct the W-W. equipments, it appeared important that there should be no uncertainty as to whether the latter would fully meet the urgent problem at B.P. Of this we had serious doubts. After consultation between Flowers, Broadhurst and myself, we formed the opinion that re-design of the W-W. equipment to reduce the required number of components in short supply and, at the same time, introduce additional testing facilities provided by the British Tabulating Company's mammoth machine, thus eliminating the need for additional analysers, was possible and that it could be done in reasonable time.

Flowers and I visited B.P. on August 24th, put this view to Commander Travis, and obtained his ready consent to our re-designing the equipment before proceeding with its construction. It was agreed that re-design and construction should be engineered completely through Dollis Hill. On the following day the whole position was examined with the assistance of Carter (S. Branch) and Hibberd (Factories Department). The following agreed procedure is noted as possibly it may be helpful in other similar cases:-

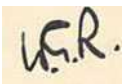
1. Concurrently with the re-design of the W-W. circuit, R. Branch will build one equipment in the laboratory. In order that this experimental model might serve as a prototype for subsequent Factory construction, contact will be maintained with the Liaison Officer representing the Factories.

2. R. Branch will also aim at producing manufacturing drawings by the end of September and, again, in order to facilitate subsequent manufacture of the bulk order, a Factory Liaison Officer will advise as regards choice of components, layout, etc.

3. In order that the necessary components might be rapidly obtained, Commander Travis will ask the Sub-Committee of the Chief of Staffs Committee to place the job in order of relative priority compared with other Fighting Service projects. He will then communicate this order of priority to the Admiralty representatives on the I.S.C.C. and I.S.V.P.C. with whom Carter will make contact.

4. R. Branch will place orders for all I.S.C.C. components and special items as early as possible, even if this means some small wastage due to over-estimating.

Authority has been received for the expenditure of £32,000 (direct charges) in connection with the construction of the equipments. This is excluding the purchase of such valves as may be required and these will be obtained by the Admiralty at a cost which may amount to £11,000.



(ii) Case No. 11757

Numbers 3 and 4 of the equipment referred to in the Diary entry of 27th July have been made and installed and the final equipment is nearly complete.

17th September 1942 — Work for the War Office in connection with the Microgram Service (Previous Diary entry 19th June 1942)

Continued technical supervision and assistance has been given to the War Office in connection with the rapidly developing microgram service. A visit was paid to the War Office to-day and Mr. Lambert, Under-Secretary of State, expressed to Dr. Radley the appreciation of the War Office of the work done by the Research Branch in assisting the scheme. On account of the increased amount of film incoming to this country which now exceeds the present capacity of the War Office equipment, arrangements have been made to develop the film and to process the prints at Harrogate.

20th September 1942 — Groups 6 and 7 Belfast-Stranraer cable

The Belfast-Stranraer submarine route has been equipped with new line amplifiers and equalised up to 450 kc/s. This will allow nine 12-channel groups to be worked over the route. Equipment for the 6th and 7th groups has been completed at Stranraer and Belfast and the groups are available for service. Groups 8 and 9, together with reserve terminal equipment for all groups at Port Patrick and Dundonald, are in hand. Preliminary tests indicate that a maximum of about 14 groups should eventually be possible on this route without the use of compandors. Research Case No. 11628 refers.

22nd September 1942 — Remote control for 7000 type stations

These stations comprise a series of radio transmitters whose phases have to be related in a predetermined manner. Three methods of phase control exist. In connection with one of these the Research Branch has developed remote control apparatus which gives push-button control of the phase advancing and retarding equipment over the Post Office telephone lines inter-connecting the stations. Operation is by means of impulses sent on a carrier frequency of 2300 c/s and it is necessary for the lines to pass up to 2400 c/s. Speech and phase control can take place simultaneously. Final tests in conjunction with the Radio Branch and the Air Ministry have had to be postponed.

25th September 1942 — Use of American Teletypes

The American Forces in this country are anxious to use teleprinters for administration and operational purposes and, in view of the acute shortage of British machines, are prepared to supply and maintain their own/

25th September 1942 (Cont'd)

own "Teletypes". These machines are, however, single current instruments and it is necessary to insert a single-current-to- double-current converter to enable them to work on the D.T.N. network. A suitable unit has been designed. Since this also will be maintained by the American Army, it uses mainly American components but it was agreed at a meeting held to-day between the American Army, the Telecommunications Department, Tg. and R. Branches that 50 sets, sufficient for 25 circuits, would be supplied by the Post Office to tide over the interval which must elapse before the American apparatus can be imported. On account of several differences between the keyboards of the American and British machines, Teletypes will, for the time being, be restricted to point-to-point services.

Provision of Transatlantic Multi-channel Telegraph System

The two-tone V.F. telegraph system described in a previous note (18th July 1942) has since been extended to six channels since the original four channels were very satisfactory in service. For the past two weeks experiments have been made with teleprinter working and using two "two-tone" channels working in parallel with additional, coupled, constant volume amplifiers. Highly promising results have been obtained over several days tests indicating that at the present time a grade of service better than 2000 received characters per fault can be reasonably expected. The method of working is, therefore, a commercial possibility but the traffic carrying capacity of the whole circuit is reduced by 60% by converting six channels working Wheatstone to three channels working teleprinter.

30th September 1942

Work for Combined Services Organisation

Case No. 11835 - Provision of W-W. Equipments

Considerable progress has been made since the Diary entry of 31st August was written. Concurrently with the design and construction of the prototype equipment in the laboratories at Dollis Hill, Factory drawings have been made and stores ordered for the whole of the 36 double equipments.

In greater detail the stores position is:-

(1) The London and Birmingham Factories have all Rate Book stores in hand.

(2)/

30th September 1942 (Cont'd)

(2) Contracts have been placed for all non-Rate Book stores with delivery times varying from two to ten weeks from to-day. The greatest delay is with the 3000 type relays which have been promised by mid-September. This factor is so far setting the time for completion of the work. The Factory estimate that they can commence delivery one week after receipt of the relays and complete the full number of equipments four weeks later.

(3) Valves are being supplied by the Admiralty and have been earmarked. They will be delivered to Dollis Hill very shortly.

The position regarding Factory production is as follows:-

(1) The London Factory is making all the racks and display panels without delay

(2) The Birmingham Factory has acquired all the blank valve panels

(3) It is intended to make one Factory model before embarking on the bulk order and the London Factory is making one complete set of relays for this purpose.

(4) All other work is being held up until Dollis Hill have completed their field trial.

The position regarding the construction of the two commutating equipments is not quite so happy. The manufacture of these is being arranged by the Admiralty, but it is gathered that considerable trouble has been experienced with the prototype on account of bouncing of the brushes. If, however, this difficulty proves insuperable, it is proposed that the detecting equipment, being constructed at the Post Office Factories, should be tied to the high speed machines, being constructed by the British Tabulating Co., instead of to the Wynn-Williams commutators. The initial field trial necessary before the Post Office Factories can proceed with the construction of the 36 double detecting equipments will take place in a week or so's time with one of these equipments coupled to a British Tabulating Co's machine at Letchworth.

20th October 1942 — WORK FOR THE WAR OFFICE - W.O. 2263 W/42

The original C.S.D.I.C. camp at Cockfosters has been turned into a normal Prisoners of War camp but limited listening facilities have been retained. All the original R.C.A, microphones (Diary entry December 16th, 1939) which were concealed in special boxes let into the ceilings and papered over have been removed as these have been found to become visible after a time. The listening and transcribing rooms have been partitioned off from the remainder of the building and can be reached only from outside the building by means of a specially protected entrance.

An experimental microphone concealed in the statuary in the garden in order to pick up the conversation of a German General, who used the garden during fine weather, has also been recovered.

22nd October 1942 — PROVISION OF DUPLEX FACILITIES ON THE SHETLANDS-FAROES-ICELAND TELEGRAPH GABLE

Previous work done in connection with this cable was described in Diary entry of 19th May 1941. Until recently the circuit operated on a simplex basis and was extended to Aberdeen by means of a simplex repeater at Lerwick. Owing to the heavy traffic it was decided to duplex the circuit and extend it to London. The Great Northern Cable Company were responsible for the arrangements in the Faroes and Iceland and the Research Branch has provided a receiver and balance network at Lerwick. This receiver is designed to overcome the effects of earth currents, which are very severe on this cable, and for this purpose signals are received via a transformer followed by a push-pull amplifier which incorporates means for the restoration of the d.c. and very low frequency signals.

Duplex speeds up to 120 w.p.m. were obtained between Thorshavn and Lerwick and the circuit was finally handed over to traffic to-day.

Temporarily the speed is limited to 60 w.p.m., between Seydisfjord and London, by the apparatus at Seydisfjord which is not yet in its final form and it will always be limited to approximately 80 w.p.m. by the V.F. channels used between Lerwick and London. Case No. 11810 refers.

24th October 1942 — SCHEME 145

Two mobile carrier telephone terminals have been constructed to enable 12 circuits to be provided over a coaxial submarine cable of the Anglo-Dutch type. A Carrier System No. 7 provides go and return groups in the range 12/

24th October 1942 (Cont'd)

12-60 kc/s; this band is transmitted directly from the A terminal to the B terminal and is modulated to occupy the frequency range 72-120 kc/s for transmission from the B to the A terminal. The equipment is arranged to operate from an A.C. supply external to the vehicle and a power cubicle provides normal repeater station supplies, i.e., 130 and 21 volts D.C.

The system includes sufficient amplification to provide zero circuits over about 90 nauts of submarine cable but at this distance the resistance noise level is high. Standard noise limits are reached at about 65-70 nauts.

Equipment has also been constructed to allow a 1 + 2 circuit duplex system to be operated in the range below 12 kc/s. This is not included in the vehicles on account of loading limitations but could be mounted separately and used in conjunction with either Post Office or Army 1+4 circuit carrier equipment.

WORK FOR THE WAR OFFICE - W.O. 2122 W/40

The buildings at Wilton Park Prisoners of War camp have been completed for some time. M.I.19 have now requested a limited service at the camp. Four listening positions dealing with about half-a-dozen cells and interrogation rooms have been brought into use. Owing to difficulty in securing suitable listening staff, it is doubtful whether the camp can be brought into full operation for some months but the equipment will be completed during the next few weeks.

27th October 1942

COLNBROOK FACTORY, M.S.S. RECORDING COMPANY - W.O. 2300 W/41 Experimental discs made at this factory proved noisy owing to the presence of dust which was traced to the granolithic floors of the process building. Treatment with sodium silicate proved ineffective and the floors have, therefore, been covered with a layer of synthetic asphalt. The discs now being made are of excellent quality and the factory will be brought into full operation as soon as staff have been obtained and trained.

During September the Ministry of Labour were asked to provide a specially good type of labour for spraying and grading both at Colnbrook and Wraysbury. Although the order was given special priority by the Central Man Power Board, the results have been disappointing to/

27th October 1942 (Cont'd) to date, only three persons out of fourteen having been provided. The matter has been pursued afresh as the output of the factories is not sufficient to meet present demands. If the required staff is not forthcoming shortly the Department will appeal directly to the Minister of Production and the Minister of Labour.

28th October 1942 ADVISORY COMMITTEE ON ARMY TELEPHONE INSTRUMENTS

The Committee has been asked by the Ministry of Supply to suggest and agree, if possible, with the other Services a readily applied subjective test for assessing the overall efficiency of a telephone link, including the microphone and receiver. It has, moreover become apparent recently that progressive development of microphones and telephone receivers for military purposes would have been very greatly facilitated had various laboratories in this country and America been able to interchange results readily.

The Committee includes engineers who have been actively associated with the development of telephone instruments over a long period of years and who are familiar with the various subjective methods that have been in use for assessing the quality of telephone transmission. As a whole the Committee is fully aware of the divergence of views that has led to the adoption of different techniques and different methods in various laboratories both in this country and in the United States. It does, however, feel that if the problem is confined to the testing of equipment for military purposes, the requirements to be met by the testing method may perhaps be more readily agreed.

As a first step towards such agreement, the Committee has very carefully considered the published results of the work already done in this field both in this country and in the United States and has prepared a brief preliminary report outlining the requirements to be met by any widely adopted testing method. This report has been discussed with Admiralty and Air Ministry representatives in this country and it is hoped that agreement will be reached between the experimental laboratories of all three Forces. In order, however, that additional advantages might be obtained by extending such agreement to include the principal laboratories engaged on the development of microphones and telephone receivers for military purposes in the United States, the draft report has been sent to Harvard University (Research on Sound Control) and the Bell Telephone Laboratories. The criticism and views of these laboratories have been solicited.

In/

28th October 1942 (Cont'd)

In order that any points which the American Laboratories may raise may be cleared up with the least possible delay, copies of the correspondence and the report have been forwarded to Dr. A.F. Rawdon- Smith and Mr. H.G. Beer who are acting as liaison officers on telecommunication questions in the United States respectively for the Ministry of Supply and the Post Office.

30th October 1942

PHOTOGRAPHIC WORK

The second microgram processing unit for the War Office is now in operation at Curzon Street and the first film from India has been received. Plans have been prepared for increasing the Curzon Street accommodation to eight machines.

Discussions have taken place with Major Culbertson of the American Army regarding a microgram service for them. He appears to have been much impressed with ours and will probably press for something similar.

Discussions have also taken place with War Office and Admiralty officers on various special photographic matters.

2nd November 1942

WORK FOR COMBINED SERVICES ORGANISATION

Case No. 11835 - provision of W-W. equipment

The position regarding the construction of the commutating equipment developed by Wynn-Williams and of which 36 were to be constructed as an Admiralty contract is still not happy. Trouble is being experienced both on account of high resistance brush contacts and low insulation between commutator segments. In the meantime, the prototype detecting equipment designed at Dollis Hill and constructed in the laboratory there has been completed. Trial of this equipment as part of a complete set-up including the commutator device is only awaited before the Post Office Factories are allowed to go ahead with the construction of 36 such (double) detecting equipments. It is now proposed that this trial should take place with the detecting equipment connected up to one of the new high-speed machines constructed by the British Tabulating Co. and to which a fourth wheel has been added in place of the Wynn-Williams commutator. This trial should take place within the next fortnight.

Dr. Radley being somewhat anxious regarding the position, which had changed materially due to the failure of the Wynn-Williams commutators, asked Commander Travis for an informal discussion regarding

2nd November 1942 (Cont'd)

immediate policy. This took place at Bletchley Park to-day. It was agreed that:-

1. 40 high-speed, 4-wheel machines would be ordered from the British Tabulating Co. immediately. These could either be completed with relay- type detecting equipment or could advantageously be associated with the valve-type detecting equipment constructed by the Post Office. The latter would permit a high speed of operation provided the machines were capable of faster running.

2. Provided that the tests to be carried out within the next fortnight at Letchworth showed that the prototype detecting equipment constructed in the Dollis Hill laboratory is reasonably satisfactory, the Post Office Factories will immediately proceed with the manufacture of 36 such (double) equipments. If minor modifications have to be made later, due to these equipments being attached to British Tabulating Company's machines and not to Wynn-Williams' commutators, or for other causes, they will be made at Dollis Hill during the final assembly. A certain amount of work will, in any case, be necessary in the Dollis Hill laboratory as, for security reasons, some parts of each equipment are being made at the Birmingham Factory and some parts at the London Factory. They will only be associated at Dollis Hill.

12th November 1942 — PROVISION OF TRANSATLANTIC MULTI-CHANNEL TELEGRAPH SYSTEM

The six-channel 2-tone V.F. telegraph system mentioned in the Diary entry of 25th September is now being worked on a transatlantic radio link as follows:- Two 4-tone teleprinter circuits, one 2-tone morse circuit, and one 2-tone circuit for experimental purposes. Very satisfactory results have been obtained on these circuits and five more systems are required as soon as possible. At a meeting held today between the Telegraph and Research Branches and representatives of the S.T. & C. Co. it was agreed that four of these should be constructed completely by S.T. & C. Co. to Research Branch design, but as these cannot be ready before June 1943, one system will be supplied in advance by Research Branch using as much existing equipment as practicable. It is hoped to complete this within four months.

21st November 1942 — M.S.S. RECORDING COMPANY -Works Order 2300 W/41

Existing labour difficulties were noted in the Diary entry of the 27th October and the intention of the Department to appeal directly to the Minister of Production and Minister of Labour indicated, if these difficulties could not be cleared up in any other way. The Colnbrook factory has been ready to go into production for over a month but the continued difficulty in obtaining suitable staff for process work and the machine shop has made it impossible to reach a 50% production level. Out of 14 persons necessary for spraying and grading, only seven have yet been provided and out of six Government trainees required for machine production, only two have been allotted. This is after a renewed appeal to the Headquarters of the Ministry of Labour at Portman Square. Unless the labour situation improves, it will not be possible to meet commitments in regard to the supply of direct recording discs undertaken on behalf of the War Office (Intelligence and A.F.V. speech training equipment), Air Ministry (speech training equipment) and the B.B.C. (Ministry of Information and propaganda programmes). Also it will not be possible to meet a demand for over 100 recording machines which is expected shortly from the Ministry of Supply.

24th November 1942 — COMPANDORS FOR S.R.D.E.

At the request of the Ministry of Supply (S.R.D.E.) a very compact compandor has been designed for use as an auxiliary unit with a radio set. The unit functions as a compressor when transmitting and as an expander when/

24th November 1942 (Cont'd) when receiving, this alteration of function being brought about by the normal manipulation of the changeover key. Only one valve is used and the Ministry of Supply is considering the incorporation of the unit in the radio set itself. The overall dimensions, excluding a compartment for cords, is 8½" x 6½" x 5". Case No. 11679 refers.

27th November 1942 ELECTRO-ACOUSTICS SUB-COMMITTEE

The Electro-Acoustics Sub-Committee of the Ministry of Supply, for which a considerable amount of experimental work is being done at Dollis Hill, has had its first meeting and made its first report to the Advisory Council on Scientific Research and Technical Development

The improved telephone headgear assembly for A.F.V. crews, first referred to in the Diary entry of 1st June, 1942, is to be adopted as it stands, sufficient favourable evidence being available from field trials to justify immediate production. Sample models of a new and much lighter microphone case attached to this telephone assembly have been made up and submitted for field trial and opinion. This would replace the present clumsy Microphone, Hand, No. 7. The new design has been welcomed in the field and a much larger number, incorporating suggested modifications, is to be constructed.

The conditions under which Army telephone equipment is to operate differ very considerably from those in Post Office practice, particularly with respect to the presence of ambient noise. Nevertheless, the reports already submitted to the Ministry of Supply by the late Advisory Committee on Army Telephone Instruments (which the Electro-Acoustics Sub-Committee replaces) may contain incidental information of value to the Department. In order that this information may be brought to the notice of Branches of the Engineer-in-Chief's Office particularly concerned, the reports are being re-issued as secret Research Reports.

30th November 1942 PHOTOGRAPHIC WORK

Work has now been commenced on further accommodation at Curzon Street and a new unit is being established with the 1st Army. Up-to- date a million micrograms have been received from the Middle East and India. One of the latest patterns of reprograph has been tested at the Reading factory of Messrs. Williamson.

1st December 1942 — WORK FOR COMBINED SERVICES ORGANISATION

Case No. 11757

On the 28th October we were asked to design and construct equipment and de-cipher some intercepted radio teleprinter messages passing between Germany and Derna in North Africa. The system of ciphering was similar to that used by the machine described in the second part of the Diary entry for the 5th June in that all or any of the five elements of the code could be reversed in accordance with the pre-determined scheme. In addition, the elements could also be changed over amongst themselves, e.g. element 3 could be made to occupy fourth place and vice versa. Apparatus to de-cipher such messages was constructed and demonstrated on 13th November. Unfortunately the circuit had by that time ceased to operate for the 8th Army had entered Derna on the 11th. The apparatus was, however, immediately installed and has been used to de-cipher messages previously picked up.

16th December 1942 — WORK FOR COMBINED SERVICES ORGANISATION

Case No. 11835 - Provision of W.W. Equipments

I saw Commander Travis today at Westminster and expressed to him my uneasiness at the course events were taking with regard to our provision of W.W. "sensing" equipments. Laboratory and Factory-made prototypes had been constructed and tested in so far as the circumstances permitted. We were fairly confident that they would work as part of the complete high-speed testing chain and the Post Office Factories were organised for the production of 36 equipments (i.e. 18 double-sided racks) in January and 36 in February 1943. After the pressure that had been put on the Station and on the Factories to meet these dates, I said that I would hesitate to interfere with this programme but, in view of the other demands on the Department, would like his reassurance that there was still an urgent need for these equipments.

Travis told me that, due to a fortunate capture, valuable information was being obtained by the use of the existing slow-speed machines but that after January 1st high-speed machines would probably become a vital necessity. It was most unfortunate that, despite the priority given by the Admiralty to the work, the commutators which, in combination with the existing slow- speed machines and W.W. sensing equipments would provide high-speed testing chains, were not likely to be ready in any number before March. The trouble and/

16th December 1942 (Cont'd)

and delays experienced by Wynn-Williams had been both unexpected and disappointing and Mawdsley's were not expected to deliver the first Factory-made commutator for two or three weeks.

I reminded Travis that our sensing equipment could be used in conjunction with high-speed machines which B.T.M. were constructing. It would replace their relay sensing attachment which was yet unproven and might not be capable of operation at the highest machine speeds. Travis agreed that this was a possible solution and one which he would bear in mind. He would endeavour to place a B.T.M. machine at our disposal for trial as early as possible.

Travis agreed that construction of the 72 W.W. sensing equipments by the Post Office should proceed as quickly as possible, the question of their most effective utilization being left in abeyance. The majority would be installed at Stanmore and I concurred that any minor modification could be made there by Dollis Hill staff.

In conclusion I said that Dollis Hill had put a very big effort into the speedy development of these sensing equipments and, of all the parties concerned, had come nearest to meeting promised completion dates. However, I did not wish these facts to affect the way in which he tackled his problem. We all fully realised that the one thing of paramount importance was the adequate provision of highspeed testing equipments of some kind at the earliest possible date. We also realised that, despite his constant review of the problem as a whole, changing tactics of the enemy might make it impossible for his organisation to specify with any accuracy equipment which could not be delivered at short notice.

W.S.R.

20th December 1942

VALVE REPEATER FOR THE ICELAND SUBMARINE TELEGRAPH CABLE

Partly as a result of complaints made by the Great Northern Telegraph Company's representative at Thorshaven, comparative tests have been made of the Post Office valve receiver and the G.N.T. Company's repeater at any fixed speed within the range 40-80 Bauds. Both receivers are equally efficient. With the valve repeater, however, the distortion over this speed range is constant, but with the G.N.T. Company's receiver the distortion increases with the change of speed and constant readjustment of component values in the vibrating relay circuit is required. This gives a decided advantage to the valve repeater and repeaters of/

20th December 1942 (Cont'd) of this type have been provided at Wick and Lerwick on the Wick-Lerwick submarine telegraph cable to form a duplex link in the London-Iceland reserve circuit. Satisfactory conditions at 65 Bauds were obtained between Lerwick and London. (This circuit was diverted to Aberdeen to provide a duplex teleprinter circuit during the period of heavy Christmas traffic.)

29th December 1942 NEW FORM OF CABLE FOR ARMY COMMUNICATIONS

The Branch has been co-operating with the Ministry of Supply (S.R.10) in the development and testing of a new form of cable. This was designed originally as a means of quickly running a line which can be used for multi-channel carrier telephony and consists of two 70 lb. wires embedded about ⅝" apart in a ribbon of a rubber substitute dielectric. Some 30 miles of this cable have recently been put up by the Royal Corps of Signals. Attenuation measurements agreed with the results obtained on short lengths in the laboratory at Dollis Hill, but the loss increases considerably and erratically when the surface of the ribbon is both wet and dirty. Its development, however, appears to be well worth pursuing as its manufacture is very simple indeed compared with that of more normal types. A line erected broke repeatedly during the windy weather but it is thought that this difficulty may be overcome.

29th December 1942 WORK FOR THE WAR OFFICE - W.O. 2263

Major D. McMillan has spent some four or five weeks in this country on his way back to Cairo after a technical duty tour of C.S.D.I.C. installations in India, Australia and America. Valuable conversations based on his experiences have been carried on with M.I.19, and arrangements have been made to prepare mobile units of the standard type for use in North Africa, Burma and Australia. The equipment of a number of highly mobile units (without recording), which he has found useful in other theatres, is being pursued in preparation for operations on the Continent.

His reports on the equipment in use by the Americans show that it is very inferior to that developed for use in this country. This is confirmed by Captain Copping who has just returned from a visit to the U.S.A. with Colonel Kendrick for the purpose of studying their methods and giving assistance. It appears very probable that we shall supply all mobile equipment for the Pacific theatre and production is going ahead in anticipation of this. The/

29th December 1942 (Cont'd)

The Japanese language requires a much higher standard of reproduction than German or Italian and production of a new and much improved cutterhead, designed at Dollis Hill, is being pushed ahead to meet these requirements.

The technical establishment of fixed and mobile C.S.D.I.C. installations in this country has now been approved by the W.E.C. and promulgated. Lists of suitable men who have been, or are out on W. reserve, have been supplied to M.I.19 and these are being drafted to Latimer soon. A second officer must also be found to assist Capt. Copping.

31st December 1942

M.S.S. RECORDING COMPANY, LTD.

Minor difficulties have been encountered during the bringing into operation of the new factory at Colnbrook. The laying of a carpet of synthetic asphalt eliminated the loss of discs due to cement dust settling during drying. Some difficulty has been experienced during the recent cold weather due to moisture collecting on the cloth filters and freezing but the Ministry of Works was approached and is substituting a glass wool filter washed with running water and a pre-heater. The cold weather also disclosed the fact that the supply of warm air to the drying and seasoning rooms is not sufficient to maintain equal temperatures in all rooms. Auxiliary heaters are therefore being fitted.

The staff position in regard to sprayers (now called Chemical Process Operators by the Ministry of Labour) has improved, although owing to the high incidence of sick leave at Wraysbury, more workers are required there. There is no doubt that the sick leave is due to the conditions in the Process Department, which, although probably not sufficiently bad to cause serious illness, are depressing and discouraging. This situation will be improved as soon as the Colnbrook factory can carry its full load.

A very serious shortage of Instrument Maker Trainees (female) is handicapping the production of machines and other equipment. The Ministry of Labour is being pressed to supply these.

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SECRET

Memorandum prepared for Communications Committee (M.of S.) July 23rd 1943

WORK OF THE ADVISORY COMMITTEE ON ARMY TELEPHONE INSTRUMENTS

1. The personnel of the Committee includes on the one side officers who are able to state military requirements and on the other technical experts from the Signals Research and Development Establishment, the Post Office Research Laboratory, and from the telephone manufacturing industry. The latter were chosen, not as representing particular firms, but in a personal capacity on account of their background of experience, It is safe to say that they combine between them acquaintance with every important British development that has been made in the design of telephone receivers and microphones in the last 20 years. They are also fairly well informed as regards American developments.

2. At the time when the Committee was formed in July 1941, the most urgent of the problems to which its attention was directed was that of providing telephone receivers and microphones to give the best results when used with the No.19 Radio Set. This set is being manufactured in large numbers and has become the standard for use in A.F.V.'s. Conditions in some of these vehicles render communication extremely difficult, for example, measurements made last August in Infantry Tank Mk. IV (Churchill) gave a noise level of 130 db when travelling closed down and at full speed. This is approximately 50 times as loud as the noise in a tube train, and makes normal conversation completely impossible. Some months later, measurements were made by Post Office research engineers in all the principal types of A.F.V. Actually, although the particular vehicle already quoted is the worst, conditions in all types are bad. In view of these difficulties, it had been considered essential that the telephone instruments should give the highest quality speech reproduction practicable. Cheap moving-coil telephone receivers and microphones *were* already in production, although the choice of these types had been challenged.

3. One of the first things the Committee did was to set up in a laboratory at Dollis Hill by artificial means noise conditions similar to those existing in an A.F.V. This gave the facility for making quantitative measurements of the articulation efficiency /of

of the moving-coil instruments and of other types which had been suggested. It enabled the decisions of the Committee to be made with far greater certainty than if they had been based on snap judgment in the field often given under conditions which could not be repeated. The laboratory articulation tests made in the presence of very loud noise showed conclusively the best results with moving-coil receivers and microphones. It is possible that alternative types of apparatus might have approximated more nearly in performance to the moving-coil units had the remaining components of the system been appropriately designed. Further experimental work is yet required and is in hand, but it is already clear that the overall response of the speech transmission system, including the telephone instruments, should have no sudden changes in efficiency within the transmitted speech frequency range. The reason for this is interesting, and has not previously attracted much attention. Briefly it is due to the fact that with conditions as existing in the Infantry Tank Mk. IV, the margin between the noise heard by the crew, even when wearing padded earphones, and the sound which gives rise to a sensation of pain,

or at least saturation of the acoustic sense, is small. Pronounced resonance in the response of the communication system gives rise to overloading of the ear at frequencies in the neighbourhood of the peak, and it follows that, if the received signal level is reduced to avoid painful overloading, the signal/noise ratio at other frequencies is deteriorated. It is interesting to note that a report quite recently issued by the National Research Council of America on the characteristics of inter-phone equipment, chiefly for use in aircraft, presents conclusions agreeing closely with those of the Committee, although the investigations have not been carried quite so far. Much yet remains to be learned as regards the best general shape of the overall response curve and of the value of such expedients as some form of signal limitation. Such information is not solely of academic interest, but will be potentially of extreme value in guiding future designs for systems which have to be operated under conditions rendered doubly difficult by radio interference to the transmission link and very loud noise at the two ends of the circuit.

The Committee Report recommends slight alterations in the mechanical construction /of

of the moving-coil receivers and microphones which were in production. Features were present in the Army Units which had been the cause of very early failure in Post Office microphones when subject to repeated use in call boxes. The changes recommended were made without interfering with production and without effect on the speech efficiency of the units.

5. The Committee has recently submitted to the Ministry of Supply a new form of headgear assembly for use by A.F.V. crews. This assembly is lighter and more comfortable than the existing pattern and also gives better noise exclusion. The wearing of a steel helmet is not practicable with the existing assemblies, but the new type can be worn comfortably under the present standard steel helmet and will just fit under the proposed new P type helmet. It can also be worn with a respirator. Incidentally the problem of designing telephone headgear assemblies has drawn attention to the desirability of the dimensions of steel helmets and respirators being fixed so that telephone receivers can also be worn.

6 . The attachment of the microphone to the soldier is a more difficult problem and one which at the moment is being actively investigated by the Committee. A first step seems ,to be the reduction of the size and weight of the microphone to the minimum possible. This, from semi-official information, appears to be the objective of much work going on in the U.S.A.

7. The throat microphone has often been suggested as ideal for a user who must have maximum freedom of movement. It has the added advantage that air-borne noise at the sending end is excluded from the telephone circuit. The throat microphone, therefore, appears doubly appropriate for use in A.F.V.'s or aircraft. Unfortunately, the high frequency sounds which contribute much of the intelligibility of speech, especially in distinguishing consonants, are formed in the mouth, and can only be very imperfectly picked up by a throat microphone placed over the larynx which is the generator of vowel sounds, Thus the throat microphone starts with a severe initial disadvantage as compared with a mouth microphone, although something can be done to rectify this by designing throat microphones to be more sensitive at the higher frequencies or /appropriate

appropriate alteration to the characteristics of the amplifier or radio set to which it is connected. The Committee is fully aware of such possibilities and with the active co-operation of the S.R.D.E. and the contractors, is endeavouring to find the best all- round solution.

8. An electrically satisfactory throat microphone also provides one solution to the problem of using a microphone when wearing a respirator. Other solutions necessitate the fitting of a special speech valve to the respirator as in the new Mk. I light respirator for use by airborne troops and tank crews. The design problem is more difficult than would appear at first approach for, in addition to the sound attenuation provided by the respirator, the many cavities which are formed give rise to resonances which considerably distort the voice sounds. Development is being effectively guided by measurement at Dollis Hill of the impairment to articulation arising from the wearing of respirators with various designs of speech valve.

9. Problems associated with Army line telephony and field radio sets are somewhat easier as generally both speaking and listening points are quiet compared with A.F.V.'s. The Committee had little difficulty in recommending for use with light field wireless sets the standardisation of an inset type of carbon transmitter similar to the P.O. Inset No. 13. It was aware that the Post Office, in co-operation with telephone manufacturers, had had under review for a considerable period the development of a carbon microphone having a better electrical performance. It was equally aware that this was not yet in commercial production nor had been subject to the test of extensive field use. Again the Committee was able to point out changes in mechanical design, such as the elimination of oiled silk. These changes, from Post Office experience, should give increased reliability in service.

10. The Committee has also reported to the Ministry of Supply that it is desirable that the CLR. type of telephone receiver at present in use with field line equipment generally should be replaced by a type giving better results. Alterations were recommended after careful consideration of tests carried out at Dollis Hill and designs which were already being manufactured or capable of early manufacture in very large numbers. It /is

is gathered that in America a long-term objective is the standardisation of one type of telephone receiver for use by all Forces. This does not appear immediately possible in this country but the two types which have been recommended by the Committee as alternatives for use with field line equipment represent a very considerable improvement on the CLR. receivers at present in use. In the case of lines which are at present workable only with difficulty, they would effect a considerable increase in clarity. The Committee has rounded off this part of its work by the development of a headgear assembly for use with field line and radio equipment which it has submitted to the Ministry of Supply. The assembly, apart from the omission of earpads, is of the same general design as that produced in A.F.V.'s. It is light, comfortable and can be more easily stowed away than the existing assemblies and very easily manufactured in large numbers.

h.7.9.39.

(COPY)

CONFIDENTIAL.

Colonel A.S. Angwin, D.S.O., M.C., M.I.E.E.,
Alder House.

Dear Colonel Angwin,

I have given some thought to the most effective use of the staff and laboratories comprising the Research Branch under possible war conditions. The present organisation of the branch is shown on the attached chart and the type of work undertaken by each group in more detail by E.I. B 0020, attached.

With the outbreak of hostilities, it is assumed that certain work would he suspended indefinitely, e.g. the entire work of the Postal Engineering Group, the work of the Durability Laboratory and work in connection
with interference from power circuits. The branch

contains, however, a large number of engineers whose scientific training and experience fit them to tackle many of the problems which are certain to call for rapid solution during war. It appears essential in the national interests that the branch should be maintained as a unit and that its work should be

directed/

directed towards meeting the needs of the emergency.

It is known that under war-time conditions, part of the accommodation at Dollis Hill would have to be surrendered for other purposes. Most of the laboratories however and their equipment will remain available for experimental work. It is suggested that the following groups should continue to function:-

(1) The Telegraph Group.

(2) The Carrier and Voice-Frequency Repeater Groups.

(3) The External Plant Group would be largely disbanded but the Executive Engineer and a few of the staff would be retained for working in conjunction with the Carrier and Repeater Groups on account of their experience in cable balancing. If extensive sections of the trunk network are destroyed, it may become a matter of urgency to provide additional circuits by means of carrier over existing routes.

(4) Much of the present work of the Local Transmission and Acoustic Groups would disappear, but a nucleus from these groups could usefully be retained for attacking such problems as those associated with location of the enemy by sound. It will be recollected that the Branch assisted in/

in this way during the war of 1914-1918 and also in the production of special telephones for use in aircraft.

The Signalling Group would work on problems associated with recording the presence of hostile aircraft.

Much of the present work of the Chemical and Metallurgical Group would cease, but it is considered that the group could advantageously be retained as a unit. It has had contacts with such bodies as the Research Department, Woolwich Arsenal.

The present work of the groups under Dr. Ryall, Mr. Hadfield and Dr. Speight would largely cease, but it is recommended that these officers, together with a few of their staffs, should be retained in view of their exceptional ability for devising apparatus to meet novel requirements.

The workshop should be retained in its entirety. The great value of the shop as a place where equipment of new or semi-experimental character can be constructed in less time than by outside manufacturers has been demonstrated on a number of occasions. Recent examples of/

of this have been our construction of the illuminated maps in connection with the distribution of air raid warnings, the construction of carrier equipment to provide additional circuits to Scapa Flow and the provision of 17 testing racks for voice frequency signalling equipment after contractors had refused to meet the required delivery date.

About 40 members of the Research Staff are already spending all their time on problems connected with National Defence. Work is being done for the War Office (M.G.0.14) and the R.E. & S. Board, the Air Ministry, the R.A.F. (Fighter Command) and the Home Office. It is recognised that the fighting services possess their own experimental establishments and that under normal conditions they might be unwilling to pass on work other than that for which the Post Office is obviously better qualified. It is obvious however that under war conditions the "tempo" would be quickened and these establishments might be glad to find relief by transferring additional work to Dollis Hill. Such transfer would be of special value in the event of one of the service establishments being put out of action.

This/

This applies particularly to the S.E.E., Woolwich.

Despite the contacts already existing it would be advantageous if the availability of Dollis Hill as a station at which war-time experimental work could be carried out and apparatus rapidly constructed, were made better known. This might be done possibly through one of the Liaison Committees already existing or perhaps more efficiently as a result of personal interview with the Director of Scientific Research, Admiralty, the President of the R.E. & S. Board and the Director of Communications Development, Air Ministry. It seems essential to improve the channels through which assistance might be given by Dollis Hill in times of National Emergency, before the emergency arises.

It has always been understood that all training at the Central School would cease at the outbreak of hostilities. Accommodation etc. has been planned on the assumption that the students would return to their Districts, the school staff be transferred elsewhere and the school premises become available. Can it be confirmed that this is so and that neither the school staff nor buildings will be required for the training of/

of personnel who during an emergency may be called upon to undertake duties different from those to which they are accustomed?

I should appreciate an opportunity of discussing the matters raised in this memorandum with you.

Yours,

(Signed) W.G. Radley,

11th July, 1939.

c.11/10/40.

Extract from the Liverpool "Daily Post", 12th September,1940

FIGHT FOR B.E.F. CABLES

Communications Won and Lost

The Postmaster-General, Mr. W.S. Morrison, speaking to Cirencester Rotary Club, paid a warm tribute to civilian personnel of the Post Office for the important part played by them in the maintenance of communications over the period of evacuations of the British Expeditionary Force from the Continent, and the collapse of Holland and Belgium and the defection of France.

Mr. Morrison said that special equipment was fitted on a Dutch telegraph cable ready to give telephone service to The Hague when it became evident that there was a danger of the normal telephone route being interrupted. This equipment had to be specially designed by research engineers to match the electrical characteristics of the submarine cable so that ordinary speech would be practicable on a cable designed simply for the transmission of telegraph signals.

Lines Destroyed

"Then", he went on, "Holland was occupied by the enemy, and possible links to Belgium were lost. There remained two routes to Belgium, one via La Panne and the other via Calais. For a few days communication with Brussels continued satisfactorily and contact could be maintained through Brussels with the various towns in the hands of the Allies.

"The break through at Sedan then occurred and King Leopold surrendered. The difficulties of maintaining communications were at once intensified tenfold, for very soon the direct routes to Paris were destroyed, and, with the loss of Brussels, on which all the existing Belgian communications were centred, dependence had to be placed on any circuits which could be found via the smaller Belgian towns. There remained also the need for communication with Paris, and, in view of the German advance, the need also for circuits to other points in France independently of Paris.

"Some high speed work had again to be carried out by Post Office research engineers on a telegraph cable to Le Havre. The personnel were flown to Le Havre by the R.A.F., and, working day and night, they were able to get a telephone channel and eighteen telegraph channels working to Paris on a cable which previously had carried only two telegraph circuits."

Mr. Morrison pointed out that much of their labour went for nothing, as the circuits in France passed through Rouen. The crossing of the Somme by the Germans led to the destruction of communications in Rouen, and the Post Office had to rely on a new cable which had been laid to France via the Channel Islands. Meantime, the Expeditionary Force was being evacuated under grave difficulties via Dunkirk, and all the resources of the Post Office were thrown into the battle to get more and more circuits working. Extraordinary expedients had to be adopted.

Mr. Morrison also spoke of courageous conduct by Post Office staff since the commencement of air raids on this country.

f.17.10.40

Col. Angwin,

It is felt that at this period in the war some review of the recent activities of the Research Branch may be helpful to the definition of a general policy guiding its activities in the immediate future.

The Branch's war experience to date may be roughly divided into three periods.

First Period

(1) From the beginning of September 1939 until June 1940.

With the outbreak of war the strength of the Branch, apart from changes in the Training School, was reduced by one Assistant Staff Engineer, two Executive Engineers, 12 Assistant Engineers and five Chief Inspectors and Inspectors as a result of mobilization or dispersal. Early in September 1939 all investigations in hand were carefully scrutinised in consultation with the Executive Branch concerned and as a result 32 investigations which were no longer of importance under the new conditions were cancelled and 64 suspended. During the ensuing period requests continued to be received from other Branches for new investigations to be started and, although these were carefully scrutinised to see if work were warranted under war conditions, the total inflow of new cases during the first six months of 1940 was slightly greater than during the corresponding period in 1939 (194 and 192 cases). A few long term investigations, for instance those in connection with the mechanisation of letter facing, were kept going during this period although with reduced staff. During the same period R. Branch's contacts with certain sections of the Fighting Services, for instance the Military Intelligence Branch of the War Office, grew closer and an increasing volume of work began to come to Dollis Hill from such sources as a matter of course.

Second/

Second Period

(2) The second period dated from the emergency meeting of the Co-ordination Committee on June 14th 1940 and may be said to have finished with the end of the following August. It will be recollected that at the meeting in question the general policy of the Department was reconsidered and it was stated that the Department as a whole might be compelled to confine its activities to tasks necessary for the prosecution of the war. As a contribution to the general effort this Branch offered to release from its research (apart from Training School) staff, one Executive Engineer, three Assistant Engineers, six Inspectors, one Senior Chemist and two Chemists for transfer elsewhere if urgently required. It may be remarked that the changing conditions coincided with a period of intense activity for those Groups, the External Plant, Voice Frequency Repeaters, Carrier and, to a certain extent, the Telegraph Group, whose work could assist in the provision of circuits between this country and the Continent. These activities are described in the Branch's Secret War Diary as is also experimental work which was commenced during this period at the request of:-

(1) The Signals Experimental Establishment
(2) The Ministry of Supply
(3) The War Office (M.I. Branch)
(4) The Research department (Woolwich Arsenal)
(5) The Air Ministry Research Establishment

All this resulted in considerable pressure being placed upon the Research workshops and for a considerable period the staff in the shop were working a 12-hour day (10 hours Saturdays and Sundays) and a 7-day week.

Third Period

(3) During the past two months the position has to some extent become stabilized and, assuming a continuation of the present general conditions for some time to come, it is possible to assess the likely demands on the Branch.

Excluding those engaged on Training duties, the number of major engineering and chemist staff at present employed compares with August 1939 as follows:-

August/

	August 1939	October 1940
S.E.	1	1
A.S.E's	4	3
E.E's	13	11
A.E's	39	26
C.I's	7	5
I's	41	35
Senior Chemists	1	2
Chemists	7	6

The number of investigations on the books is 371 of which 62 are in abeyance by agreement with the originating Branch and some 40 others have been suspended or not started on account of more urgent work. This may be compared with 390 cases nominally in hand in August 1939, but of which a number were not being actively pursued owing to shortage of staff. In general it may be stated that under war conditions investigations are brought to a conclusion more quickly than previously.

Of the investigations still on the books, approximately 100 have been completed as far as experimental work is concerned and only require writing up when time is available to the officers responsible. The remaining 162 cases may be classified as under:-

(a) Investigations undertaken at the request of one of the Fighting Services and not connected with the Department's plant 25

(b) Investigations in connection with the development or extension of the Department's plant made necessary solely on account of the war 33

(c) Investigations in connection with the maintenance or development of the Department's plant 104

A more accurate picture is, perhaps, obtained from the way in which the activities of the staff are distributed.

	Investigations for the Fighting Services (a) above	Enagaged on Departmental Investigations made necessary by the war (b) above	Engaged on Investigations in connection with maintenance of the Telecommunications system (c) above
	9	10	7
C.I's and I's	8	13	14
Chemists	-	3	3

The situation differs from that during the first phase of the war in that, while recently there has been some reduction in the rate at which new investigations have been requested by other Branches of the E-in-C's Office, an increasing amount of work is being undertaken at the request of the Fighting Services. It differs from that during the second phase in that a greater proportion of the new work demands comparatively lengthy research rather than the construction of equipment to meet very urgent requirements.

Proposal as to future Work

It is felt that there is again occasion to review the situation, not only from the point of view of our war effort, but also with regard to the position of the Department when the war is over. There is a strong feeling in this Branch that, insofar as it can be done without interfering with our war effort, steps should be taken to avoid this country being left after the war with an out-of-date telecommunications system as a result of developments which have taken place in the U.S.A., and possibly in Germany during the war period. The matter is one which concerns primarily the Branch of the Department responsible for research and development.

I should like, therefore, to keep a few engineers studying three fundamental problems on the solution of which progressive development of the system will depend. The three problems selected are:-

(i) Contact phenomena, especially wiping contacts.

(ii) The improvement of the subscriber's transmitter and receiver and redesign of the subscriber's circuit generally.

(iii) methods of voice frequency signalling and dialling.

With regard to the above:-

(i) A great amount of information is available, but much experimental work remains to be done before this can be correlated. When I was last at the Bell Telephone Laboratories I was informed by several Research Groups that contact noise was one of the outstanding difficulties limiting development of the telephone system.

(ii)/

(ii) Much was done by McMillan towards the development of both a transmitter and a receiver with improved frequency characteristics and reduced distortion. It would be a pity if this work wore not brought to fruition.

(iii) This country has taken a pioneer part in the introduction of new methods of trunk line signalling and dialling and the war period should provide an opportunity for clearing up such difficulties as have arisen and, possibly, for a certain amount of fundamental redesigning in the light of the experience gained, before the use of these methods is extended.

It will be noted that none of the subjects selected is associated with trunk line transmission, but the war work of the Groups concerned (especially the Carrier Group) in connection with the emergency provision of circuits and on behalf of Army Signals, with whom the Branch has always maintained close contact, is in itself leading to considerable advances in technique.

The total staff occupied with the above work would not exceed one Executive Engineer, two or three Assistant Engineers and a Chemist (in connection with (i)) with some assistance from more Junior staff. They would be available to undertake work for the Fighting Services or work for the Department made necessary by the war should urgent necessity arise. The fundamental researches would, however, have a prior claim on the time of the officers engaged thereon when compared with investigations requested by other Branches of problems connected with the day-to-day maintenance of the system.

Even if these long distance researches were not undertaken it would be impossible to release the officers concerned from the Branch as they represent the bare margin of reserve man power necessary if such coincident and urgent war demands as have already been experienced are to be met without delay.

I/

I should be glad to know that this general policy had your sanction.

Research Branch,

October, 1940.

SECRET

WORK FOR M.I.9(a)

W.O. 2035 W/39(1) - Original Installation at Cockfosters

The recording machines for the original installation were provided by Messrs. R.C.A. who also manufactured, the cross- connecting switchboards for linking the machines to the various sleeping and interrogation rooms. Special Post Office fittings of the binaural type were placed in two rooms only but the wiring of all the rooms and of the speech and lamp signalling multiples were carried out by the Research Branch staff. Messrs. R.C.A, have been paid for their share of the work but as far as can be ascertained, no arrangements as to payment for the Post Office work were made at the time. The position in this respect has been discussed with Colonel Kendrick at Cockfosters and he has suggested that these costs should be added to the cost of the extension which has since been carried out. The binaural equipment was purely experimental and has since been recovered, and it is therefore not proposed to include this in the above cost.

W.O. 2121 W/40 - Extension at Cockfosters

In May of this year a request was received from M.I.9(a) to extend the installation at Cockfosters. The binaural equipment was to be replaced by normal fittings and four additional rooms were to be equipped. A new machine room containing six recording positions of the Post Office type was to be equipped. The extension which consisted of Post Office equipment throughout has therefore been kept quite separate from the R.C.A. installation. The work was completed during June and has been working satisfactorily ever since, although minor modifications to the machines have been carried out as their further development at Dollis Hill has proceeded.

W.O. 2122 W/40 - Beaconsfield Installation

This was originally called the base installation and was intended for Dieppe. Portable huts were designed and discussed with a firm of builders selected by the War Office, but events in France prevented the installation being carried out as originally intended.

When an invasion of this country seemed likely, M.I.9 requested that the apparatus prepared for this work should be installed at some place to be chosen by them in the west Country and to serve as a reserve camp if the one at Cockfosters was in danger of falling into enemy hands. By the time a suitable site had been discovered the prospects of invasion had faded somewhat/

somewhat and it was decided to construct a camp at Beaconsfield. Since the results obtained at Cockfosters had been so satisfactory this was to be an additional installation instead of a reserve. The present position is that the site has been chosen, the Office of Works have practically completed the design of special buildings and the work should be commencing very shortly. The number of listening positions originally asked for at Dieppe was six. When the installation was required as a reserve for Cockfosters, this number was increased to 10. The final requirement for which the buildings have been designed by the Office of Works is 16 listening positions having access as required to 32 sleeping rooms and 8 interrogation rooms.

W.O. 2123 W/40 - Mobile Installation

This was intended for use in France or Belgium and consisted of a 3-ton six-wheeler truck fitted With two recording machines and microphone fittings and amplifier which could be installed in any suitable premises at short notice. Directional microphones for use near P. of W. exercise grounds were also required.

The rear portion of the truck contained a 50 volt battery and petrol charging set, a Tungar rectifier and motor alternators so that the truck was completely independent of local supplies. A work bench and a number of tools to enable repairs to be carried out and special fittings to be manufactured, was also included. Lengths of special waterproof screened lead and waterproof connectors of Admiralty type, were supplied as considerable portions of the wiring might be exposed to severe weather conditions. All amplifiers, recorders, power units, etc. were enclosed in special waterproof boxes to which connection could be made by the above connectors.

The work was completed in September but was then unable to proceed overseas. It is, however, being used with success in this country and further vehicles have been asked for. The directional microphones have not been tried out in practice and owing to their size (2 ft. or 4 ft, diameter) I am inclined to believe that they never will be.

W.O. 2163 W/40 - Apparatus Reserve

At the end of June it became evident that the work for M.I.9(a) was assuming considerable proportions and that in view of war conditions special steps would have to be taken to obtain the quantities of equipment required. The matter was discussed with Major Rawlinson and a request was received from him to place orders for a large number of Recording machines. The opportunity was also taken at his suggestion, to order microphones, amplifying gear, cable, switchboards, etc. to form an apparatus reserve from which equipment/

equipment could be transferred to any works subsequently required. This work is known in this Branch as work for the War Office (VIII) and all equipment is now ordered under this Works Order and transferred to other Works Orders as required. A statement was received from the Director of Military Intelligence that this work was regarded by the War Office as of the utmost importance and that the highest priority should be obtained. This statement was shown to Mr. McGuffog in his capacity of principal Priority Officer and he was taken partially into our confidence with the consent of M.I.9. As a result he agreed that all equipment ordered under this Works Order should have 1(a) priority.

W.O. 2164 W/40 - Installation for the Middle East

During a recent visit to this country the C.-in-C. Middle East was given some idea of the work carried out at Cockfosters and asked for a similar installation to be set up in Egypt. A complete equipment comprising 10 listening positions and associated amplifiers, microphone fittings, switchboards, etc. was prepared and sent with all cable, small stores, testing equipment and necessary tools to GHQ Cairo. It would thus be possible, when a suitable building had been found, for the complete equipment to be installed without any danger of its becoming known through unusual local purchases. As an officer of this Branch could not be spared to go to Egypt and supervise the installation and maintenance of the camp, it was arranged that this should be carried out by Capt. D. MacMillan of the Royal Corps of Signals, who was formerly an Executive at Dollis Hill. At present, all that is known is that the equipment has arrived safely in Egypt and the work of installation is presumably going forward.

Four Mobile Installations (one for the Middle East)

The success of the mobile installation already in use has been such that M.I.9 have requested the Research Branch to produce four additional trucks, one of which is to be specially fitted for service in the Middle East. Experience gained on the first truck has shown that certain modifications in the arrangement of the apparatus, chiefly for administrative reasons, are necessary and these are at present under discussion. Any special features necessitated by the Egyptian climate will be indicated by the War Office in due course.

No Works Order Number has yet been obtained for this Work.

Maintenance of Equipment for M.I.9(a)

A request has been received from M.I.9 to maintain the equipment/

equipment supplied to them at Cockfosters and as necessary on the mobile unit. When work is completed at Beaconsfield, maintenance services will be required there also. It is understood by M.I.9 that the cost of this work will be charged to them and the accounts are being kept separate from those for the maintenance of Latchmere House. No Works Order Number has yet been allotted.

c.29/10/40.

SECRET

MEMORANDUM

WORKS FOR M.I.5

W.O. 2035 W.39(3) - Installation at Richmond

This was the first installation of its kind carried out by us for M.I.5 and I think you are conversant with its history. A certain amount of experimental work was carried out here to discover whether photographs of callers could be taken without their knowledge at all hours of the day. A satisfactory scheme for daylight operation was fitted but I am not in a position to say whether it was used very extensively. Considerable progress was made towards providing the same facilities during the night but limitations of photographic materials prevented a completely successful solution. No very great expenditure was involved in the photographic work.

The house has recently been evacuated by all the members owing to bombing activities and the apparatus has all been recovered.

NOTE: In reckoning the cost of works from which apparatus has been recovered I estimate the life of our amplifier gear under those conditions at two years and I propose to charge a proportion of the total cost depending on the actual time the apparatus has been in use.

W.O. 2035 W/39(5) - Installation at Sackville Street,
Oratory Schools and Holloway Prison

The installation at Sackville Street was in the offices of a firm of which the householder at Richmond appeared to be a member. It was intended that while listening facilities were given at Sackville Street with the knowledge of the people there, it should also be possible to listen at Shepherds Bush, even when the amplifiers were switched off (apparently). A very pretty piece of apparatus was developed for this purpose, but unfortunately the nominal head of the firm died in mysterious circumstances just as it was completed and the apparatus has since been recovered.

Oratory Schools was a temporary repository of internees and the installation there was to enable the reactions of cross examinees to be observed at Shepherds Bush. Since the fitting of Latchmere House this apparatus has become unnecessary and is in process of being recovered.

The installation at Holloway Prison was to be similar to that at the Oratory Schools, but partly owing to difficulties encountered in the building itself, it has not been proceeded with and, in fact, is not now required.

2035 W/39(6)/

[redacted]

From the transmission point of view results were satisfactory. The experimental apparatus used on this occasion has been recovered

and a standard equipment for similar occasions has been designed. The cost of designing this standard equipment has, to some extent, been included under this Works Order.

W.O. 2151 W/40 - Installation at Latchmere House

The original installation consisted of five sleeping rooms and three interrogation rooms in the old building. Eight recording positions were fitted. Four additional "association" rooms in the hospital block have since been equipped but the number of recording positions has not been increased. This work is now practically completed, the only outstanding requirement being the provision of supervisory listening facilities in Major Stephens' office. It is hoped to carry this out in the near future.

Work at Swansea

The two living rooms and the two main bedrooms of a small private house were fitted and amplifiers and listening equipment were placed in a bedroom of the house next door. A Works Order Number has not yet been received for this work.

Radio Set Installation at Piccadilly

In this case the installation is similar in principle to that at Avenue Exchange, except that instead of a telephone a radio set with a direct line to Broadcasting House is used. The apparatus has been in use for about a week now but it is not known what measure of success has been obtained from the transmission point of view. As no complaints have been received, however, it is assumed that the measure is sufficient.

Maintenance of M.I.5 Equipment

request has been received from Major Stephens at Latchmere House, to carry out all maintenance of the equipment installed there. This maintenance includes a supply of consumable stores, such as discs, cutters, etc. No Works order has been received for this work but an account is being kept pending a decision as to Whether it should be charged to 523 Fl(B)/36.

W.O. 2169 W/40 - Apparatus for M.I.(R)

During April of this year Capt. T. A. Robertson introduced Colonel Adrian Simpson of M.I.(R) who was going to the Middle East and who required amplifier and microphone apparatus for similar purposes to those for which they were used on behalf of M.I.5 in this/

this country. He also required a technical assistant and asked if the Research Branch could recommend anybody. Mr. Hayward, an Inspector of the Research Branch, was thought suitable and as he was about to be called up, arrangements were made to transfer him to the War Office. He was transferred on a Clerical grade for security reasons and went to the Middle East on Colonel Simpson's staff. Some specially small battery operated amplifiers were designed and supplied, together with such tools and spare equipment and components as could be easily carried in two small suitcases. It was agreed that the charge for this equipment should be sent to M.I.(R). At the end of July a cipher telegram was received from the C-in-C. Middle East via Capt. Robertson asking for eight additional amplifiers and microphones to be sent to Colonel Simpson at an early date and, if possible, by air. The amplifiers have been completed and packed and three of them have been sent from Hendon Aerodrome. The remaining five have not yet been asked for by M.I.(R) and, incidentally, it is understood that the first three failed, owing to enemy action, to reach their destination. It is intended that an account for this work shall be submitted to M.I.(R) and a Repayment Works Order is presumably therefore necessary.

c.2/1/41.

Memorandum

Mobile Units

((Work for the War office (XIII)))

A meeting between M.I.9(a) and Research Branch Was held on the 1st January, 1941 at Wilton Park and it was agreed that the policy outlined in the following should be followed:

General

Four mobile units are to be provided one of which will be for service abroad. Special features to be incorporated in the latter on account of local conditions will be communicated to R. Branch on receipt of information from Capt. MacMillan. The mobile units will be regarded primarily as a reserve to replace existing permanent installations in emergency but the fitting and equipment of the trucks will be arranged as far as possible to permit independent service in the field.

Each unit will consist of two trucks. No. 1 truck will contain a machine room and a small play-back room. No. 2 truck will carry power supply equipment, work bench, tools, and spares.

M.I.9 will endeavour to obtain suitable chassis which may be of the lorry or bus type. If completed single-decker buses are readily available, an endeavour will be made to fit the equipment in these. Since no secret apparatus will be in the form of fixtures in the trucks, there is no reason why any body-building work and the construction of benches, cases for the machinery, etc should not be done by some suitable contractor. The Research Branch will endeavour to find a firm prepared to undertake this work.

Staff will be required to operate and maintain the equipment when the trucks are completed and M.I.9 will endeavour to get such staff allocated at an early date. The staff will be loaned to Dollis Hill for the purpose of fitting the power equipment into the trucks and for training in the operation of that equipment and in the maintenance of the special equipment.

Equipment of Trucks

The machine room will contain two tables each carrying two completely independent machines. Each machine will have access to any one of four microphone amplifiers, and switches will be provided to enable the telephone associated with any machine to be switched to the output of any other machine. This will enable a rapid change-over to be made from one machine to an adjacent one

at/

at the end of a disc. The equipment will thus provide the equivalent of two normal double machine listening positions or four single machine listening positions. A portable wooden case containing four microphone amplifiers and power units will also be housed in the machine room.

Since it may be desired on occasion to work in a building, tables and microphone cases will be provided with covers, detachable legs, etc., so that a rapid transfer can be made. None of the apparatus of the machine rooms will be permanently fixed to the truck so that in the event of Truck No. 1 being put out of action the recording apparatus can be removed to Truck No.2.

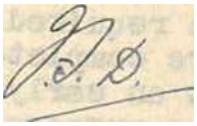
Separate play-back units will be provided which will be operated in the small play-back room as it is considered that this will give greater flexibility in the use of the recording machines.

No. 2 Truck will be equipped with power supply apparatus similar to that of the existing unit, i.e. battery and motor alternators for generating 240 V. A.C. 50 c/s When no public supply is available and petrol generator and Tungar rectifier for charging batteries. One spare recording machine and one spare amplifier of each kind will also be carried in this truck.

Accommodation

If possible Truck No. 1 will contain sleeping accommodation for four officers, two in the play-back room and two in the machine room. Truck No. 2 will be arranged to give sleeping accommodation for six other ranks.

NOTE: If the fitting of bunks, etc. is likely to present difficulties or delay completion, it will be proceeded With later as opportunity offers.



3rd January, 1941

Memorandum

Fitting of listening Facilities at Certain Centres

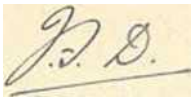
Special fittings will be installed by M.I.9 at five centres. 20 fittings for this purpose will be supplied by R. Branch by January 22nd.

20 battery-operated amplifiers will be supplied to operate with the above fittings by that date or as soon after as possible.

Each amplifier and its battery and telephones will be housed in a case for two 2-gallon petrol tins. A sample case will be supplied by M.I.9 as soon as possible in order to enable the design of the internal fitting to proceed. The remainder will be supplied in time to be fitted by 22nd January. 20 mains operated amplifiers with power units will be supplied in similar cases as soon as possible. The battery amplifiers will then act as a standby equipment in case of mains failure.

Seven portable battery-operated listening sets will be provided. The special fittings will be mounted in service gasmask cases which will be carried, together with an amplifier, telephones and battery, in a small suitcase. It is hoped that these portable sets will be available by January 22nd.

Batteries for both portable and standby amplifiers will be of standard Post Office pattern and not of War Office types and replacements will always be arranged through Research Branch.



3rd January, 1941.

SECRET

NOTE ON THE WAR TIME WORK OF THE ENGINEERING DEPARTMENT'S RESEARCH BRANCH

Introduction

The declaration of war found the Research Branch engaged upon the solution of engineering problems arising in the day to day operation of the Post Office services and also undertaking scientific research designed to lead to the development of telecommunications plant, increased efficiency of operation and new facilities for the subscriber. Suppression of electrical echoes, maintenance of electrical stability of long distance circuits and other difficulties in the way of development of a trunk telephone system with zero transmission loss between main centres had been successfully solved by experimental work in the laboratories. An active part had been taken in the development and utilisation by the Post Office of systems of multi-channel telephony; signalling apparatus enabling an operator to complete the setting up of a call in a distant centre by dialling over the trunk line had been developed. Fundamental research in acoustics and co-operation with the telephone contractors had been responsible for successive improvements in the telephone transmitter and receiver. Research Branch chemists had contributed considerably to knowledge concerning corrosion phenomena.

Staff

Engaged on problems similar to the above the Branch had a staff of 397* including approximately 50 university trained engineers, physicists and chemists. On the outbreak of war numbers were reduced by about 25% due to mobilisation and the dispersal of some officers to reinforce the engineering staff of the Regions and Districts. In addition to the laboratories Which were fully equipped for telecommunication research, the staff had the assistance of a workshop capable, if required, of constructing such apparatus as a speaking clock.

Position at the Outbreak of War

The Branch had already in hand a considerable amount of work connected with the country's preparation for a possible war. This work had arisen in various Ways; for example, as a result of the very close liaison that had always existed with the Signals Experimental Establishment at Woolwich, from the Branch having assisted in the development of equipment required in connection With the distribution of air raid warnings and also because of the provision already being made for additional telephone and telegraph/

* excluding Training School staff

telegraph circuits on strategic routes to meet the possible demands of the Fighting Services.

4. Work undertaken for the Fighting Services: September 1939 to November 1940

The more important work undertaken by the Research Branch in connection with national defence during the first 15 months of the war may be roughly classified under the following heads :

(i) Emergency provision of additional telephone and telegraph circuits for military purposes.

(ii) Assistance in the improvement of Army Signals systems and equipment.

(iii) Development and construction of equipment required in connection with defence against Air Attack.

(iv) Special work for the War Office.

4.1. Emergency provision of additional telephone and telegraph circuits for Military Purposes

The Branch has worked in close co-operation with the Headquarters War Group and has been called in to assist in all major schemes for the provision of large groups of circuits to such strategic points as the Orkney and Shetland Islands. Provision of the required circuits generally involved novel applications of carrier current telephony and the construction of the necessary repeaters, modulating and demodulating equipment in the laboratory. As a result of this work 42 circuits have been provided to the Orkneys over two single-core submarine cables and 15 circuits to the Shetland over one such cable. Members of the Telegraph Group using laboratory constructed equipment have also contributed to the provision of special circuits in this area where several of the staff have worked for considerable periods.

The early part of June 1940 found nine officers of the Carrier Group in France and the Channel Islands busy installing laboratory constructed equipment which was to provide a total of 30 telephone Circuits over two submarine cables between England and France. The work was not finished, although the officers in France did not leave until the evacuation of the B.E.F. was nearly complete. The target date for the completion of the necessary equipment had been, however, improved upon by more than three weeks as a result of continuous work in the laboratories at Dollis Hill during May.

Frequent/

Frequent assistance has also been given in the urgent provision of temporary communications, for example after the break through of the German armies to the Channel ports in May 1940 and the loss of most existing telephone circuits to France, Dollis Hill was asked to try to provide circuits over an old and faulty telegraph cable between Cuckmere Haven and Le Havre. Apparatus and staff were flown to the French side by the R.A.F. and by day and night work were able to get a telegraph circuit and 18 telephone circuits working to Paris on a cable which had previously carried only two telegraph circuits.

4.2. Assistance in the improvement of Army Signals systems and equipment

Working in collaboration with the Signals Experimental Establishment, the Branch had developed the P.O. 1+4 carrier- telephone system into one suitable for use by the Army over 2-wire open line or a 4-core cable. There has been further very close contact with the Royal Engineer and Signals Board (now Ministry of Supply) in connection with the design and development of cables for use by the Army in the field. An Army requirement which has not yet been completely satisfied is for telephone repeaters which can be inserted by unskilled staff in any type of 2-wire line where speech amplification is required. This particular problem has always been impossible of entirely satisfactory solution but a repeater developed in the laboratory at Dollis Hill was taken to France and there demonstrated in January 1940 and has promise of usefulness.

4.3. Development and construction of equipment required in connection with defence against Air Attack

In connection with the distribution of air raid warnings from a central point, the Research Branch developed and constructed in 1938 display equipment enabling controlling officers to be kept aware of the state of warning in all warning areas in Great Britain. Three complete equipments have subsequently been made and have involved approximately 30,000 manhours of work. In most cases the time between the date at which it was possible to start Work and that when each equipment was required for use was very short, so that considerable burden was thrown on to the Staff of the Group engaged on Signalling research and on the workshop, but in every case equipment Was ready for service before the due date. The Branch has more recently taken over from the Air Ministry Research Establishment (now the Telecommunication Research Establishment), experimental work in connection with the development of equipment for the automatic transmission of information given on an

illuminated/

illuminated display at Radio Stations to the Filter Room at Fighter Command as well as other problems involving equipment commonly used in automatic telephone switching.

In January 1939 assistance was requested in connection with the synchronisation of (CH) Radio Stations concerned with the distant location of hostile aircraft. The problem was difficult on account of the permissible time error (±100 microseconds) being less than momentary fluctuations liable to occur during the transmission of a synchronising signal over a trunk circuit and means had to be developed for absorbing these fluctuations. A system was worked out in which, incidentally, the synchronising tone is accommodated by the filtration of a small band of frequencies from the telephone circuit providing communication to the Station. Equipment for 33 outstations and two control stations costing in all more than £50,000 was constructed in the Dollis Hill laboratories.

4.4. Special Work for the War Office

Shortly after the outbreak of war the Department was asked to instal concealed microphones in certain rooms in the Tower of London in order that the conversations of prisoners might be overheard. This type of work developed rapidly. Sleeping and interrogation rooms in a large house used as a camp for officer prisoners of war were next equipped; following that preparations were made for a base camp in France and later transferred to a site in England; another large country house used for the accommodation of important civilian internees was extensively equipped and apparatus despatched to the Middle East for installation in a camp there.

This work has led to a very rapid improvement in acoustic technique and excellent reproduction of whispered conversations at a considerable distance from completely hidden microphones is now possible. Owing to the importance of the conversations means for making some form of record had been desired from the start. Available commercial apparatus, all of foreign origin, was investigated and it was found that there was nothing suitable. In co-operation with a British firm, however, an entirely new design of portable recorder was evolved of simple and relatively cheap construction. The necessary amplifiers for the microphone and recorder had also to be designed and more recently it has become necessary for Research Branch chemists to tackle the problem of making cellulose acetate discs in this country for direct recording, owing to the cessation of the more suitable French supplies.

In addition to the larger installations the members of the Local Transmission and Acoustic Groups, who have been chiefly concerned, have frequently been asked to make temporary installation of a

hidden microphone and recording equipment in private houses and elsewhere. The conditions have sometimes been such as to present a difficult technical problem but results have been obtained in all cases.

68 microphones and amplifiers and 57 recording machines and amplifiers have already been installed or shipped to the Middle East and as many more have been requested by the War Office for use early in 1941. The greater part of this equipment has been constructed in the Dollis Hill Workshop.

The Military Intelligence Branch of the War Office have repeatedly expressed their appreciation of the equipment. It is understood that much information concerning enemy dispositions has been obtained in this way and also that its use led to the recent conviction of the two German spies Waldberg and Meier.

5. Other Work undertaken by the Branch in connection with the War

The unclassified war work of the Branch covers a very wide field. Attention has had to be paid to the investigation of engineering materials suitable for replacing those which have become scarce or unobtainable on account of the war conditions, for instance, zinc base die casting alloys have now to be used instead of aluminium. Research is at present being undertaken with

a view to obtaining increased economy in the consumption of fuel and lubricating oil by the Post Office motor transport fleet.

The Branch has given to the Army an electrical geophone which is an improvement on that at present used for detecting underground mining operations. It has also rendered assistance in connection with the detection of electrical interference from military mining equipment.

Assistance has been sought from the Branch, in common with other Research Organizations, in connection with such general problems as the location of unexploded bombs. While the full assistance of the most appropriate Research Group has been given, endeavour has been made to prevent such problems interfering with equally important work in the Branch's proper field.

6. Post-War Problems

The work undertaken for the Fighting Services has placed a very heavy tax on the resources of the Branch and it has sometimes been necessary to move specialist officers out of their own Groups in order to meet pressure elsewhere. Some groups, for instance, the Carrier Group where the staff has been increased by 140%, have had to be strengthened very considerably since the beginning of the

war. It has frequently been necessary to construct large quantities of laboratory developed equipment in the workshop owing to the impossibility of getting it made elsewhere in the time available. This has necessitated the working of very long hours by the workshop staff.

There are at present certain outstanding fundamental problems which to various degrees are limiting the development of telephone systems. Typical of these is the generation of noise at switch contacts which is a major difficulty with automatic switching systems and problems associated with fuller utilisation of voice- frequency dialling and signalling systems. Post-war development will necessitate the solution of such problems. They are being watched and a careful selection made of the features which can be most usefully investigated as and when work connected with immediate defence

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W.G.R 16/12/40.

(Intld.) A.S.A.

P.M.G.,
You will be interested to see this report.

(Intld. W.R.B.

31.12.40

D.D.G.,

This is a fine record of work.

(Intld.) W.S.M.

2.1.41.

For D.G. on return.

(Intld.) W.R.B.

2/1.

E-in-C.

The D.G. has not been able to look at this report. Perhaps it could be brought up to date or presented to him when he returns to the office.

(Intld.) TH.B.

13/1.

c.3/3/41

Revised 1.3.41.

SECRET

NOTE ON THE WAR TIME WORK OF THE ENGINEERING DEPARTMENT'S RESEARCH BRANCH

1. Introduction

The declaration of war found the Research Branch engaged upon the solution of engineering problems arising in the day to day operation of the Post Office services and also undertaking scientific research designed to lead to the development of telecommunication plant, increased efficiency of operation and new facilities for the subscriber. Suppression of electrical echoes, maintenance of electrical stability of long distance circuits and other difficulties in the way of development of a trunk telephone system With zero transmission loss between main centres had been successfully solved by experimental work in the laboratories. An active part had been taken in the development and utilisation by the Post Office of systems of multi-channel telephony; signalling apparatus enabling an operator to complete the setting up of a call in a distant centre by dialling over the trunk line had been developed. Fundamental research in acoustics and co-operation With the telephone contractors had been responsible for successive improvements in the telephone transmitter and receiver. Research Branch chemists had contributed considerably to knowledge concerning corrosion phenomena.

2. Staff

Engaged on problems similar to the above the Branch had a staff of 397 including approximately 50 university trained engineers, physicists and chemists. On the outbreak of war numbers were reduced by about 25% due to mobilisation and the dispersal of some officers to reinforce the engineering staff of the Regions and Districts. In addition to the laboratories which were fully equipped for telecommunication research, the staff had the assistance of a workshop capable, if required, of constructing such apparatus as a speaking clock.

3. Position at the Outbreak of War

The Branch had already in hand a considerable amount of work connected with the country's preparation for a possible war. This work had arisen in various ways; for example, as a result of the very close liaison that had always existed with the Signals Experimental Establishment at Woolwich, from the Branch having assisted in the development of equipment required in connection with the distribution of air raid warnings and also because of the provision already being made for additional telephone and

* excluding Training School staff

telegraph/

telegraph circuits on strategic routes to meet the possible demands of the Fighting Services.

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The Branch has worked in close co-operation with the Headquarters War Group and has been called in to assist in all major schemes for the provision of large groups of circuits to such strategic points as the Orkney and Shetland Islands. Provision of the required circuits generally involved novel applications of carrier current telephony and the construction of the necessary repeaters, modulating and demodulating equipment in the laboratory. As a result of this work 42 circuits have been provided to the Orkneys over two single-core submarine cables and 15 circuits to the Shetlands over one such cable. With the experience gained, the Carrier Group has developed methods of working a maximum of 8 standard 12-channel carrier systems over one cable where the cable characteristics make this possible. The additional systems are provided by transfer of a standard group of 12-channels to frequency ranges above that of the standard group, the modulating and demodulating equipment for doing this having been designed and constructed in the laboratories at Dollis Hill. Members of the Telegraph Group using laboratory constructed equipment have also contributed to the provision of special circuits in the North of Scotland where several of the staff have worked for considerable periods.

The early part of June 1940 found nine officers of the Carrier Group in France and the Channel Islands busy installing laboratory

constructed equipment which was to provide a total of 30 telephone circuits over two submarine cables between England and France.

The work was not finished, although the officers in France did not leave until the evacuation of the B.E.F. was nearly complete. The target date for the completion of the necessary equipment had been, however, improved upon by more than three weeks as a result of continuous work in the laboratories at Dollis Hill during May.

Frequent assistance has also been given in the urgent provision of temporary communications, for example after the break through of the German armies to the Channel ports in May 1940 and the loss of most existing telephone circuits to France, Dollis Hill was asked to try to provide circuits over an old and faulty telegraph cable between Cuckmere Haven and Le Havre. Apparatus and staff were flown to the French side by the R.A.F, and by day and night work were able to get a telegraph circuit and 18 telephone circuits working to Paris on a cable which had previously

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work and that when each equipment was required for use was very short, so that considerable burden was thrown on to the staff of the Group engaged on Signalling research and on the workshop, but in every case equipment was ready for service before the due date. More recently changes in the plans for the distribution of warnings have necessitated changes in the equipment and the substitution of new equipment all of which has had to be carried out without interference with operations.

In the summer of 1940 the Post Office offered to assist the Ministry of Aircraft Production with work directed towards the development of communications. Contact was established between Dollis Hill and the parallel Air Ministry Research Establishment at Worth Matravers and certain experimental developments utilising automatic telephone switching apparatus taken over. It appears that more extensive Use of this type of apparatus may provide a solution to what now is beginning to constitute a problem and experimental work is proceeding in connection with several schemes.

The problem referred to is concerned with the transmission from R.D.F. stations to central control points of the locations of enemy aircraft and the presentation of the information before controlling officers. Telephone operators speak this information at present. Future alternatives may include completely automatic transmission of teleprinter code and automatic display of the information on panels at the control centre.

Other work has recently been done in connection with the development of aerial switching apparatus for R.D.F. stations and a prototype equipment has been built in the laboratory.

In January 1939 assistance was requested in connection with the synchronisation of R.D.F. (CH) Stations concerned with the distant location of hostile aircraft by reflected radio pulses. The problem was difficult on account of the permissible time error (±100 microseconds) being less than momentary fluctuations liable to occur during the transmission of a synchronising signal over a trunk circuit and means had to be developed for absorbing these fluctuations. A system was worked out in which, incidentally, the synchronising tone is accommodated by the filtration of a small band of frequencies from the telephone circuit providing speech communication to the Station. Equipment for 33 outstations and two control stations costing in all more than £50,000 was constructed in the Dollis Hill laboratories. A further large extension to

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68 microphones and amplifiers and 57 recording machines have already been installed or shipped to the Middle East and nearly double these numbers have been requested by the War Office for use early in 1941. In addition, five mobile units for service in this country or abroad are under construction. Each unit consists of two large vehicles With specially constructed bodies containing listening and recording rooms, and living rooms for intelligence officers and other ranks. Power equipment which will render the units completely independent of external supplies is being installed.

The Military Intelligence Branches of the War Office have repeatedly expressed their appreciation of the equipment and such importance is attached to the results already obtained that the Chief of Staffs Committee of the War Cabinet has given instructions

that the highest priority is to be given to all equipment used in connection with this work.

5. Other Work undertaken by the Branch in connection with the War

The unclassified war work of the Branch covers a very wide field. Attention has had to be paid to the investigation of engineering materials suitable for replacing those which have become scarce or unobtainable on account of the war conditions, for instance, zinc base die casting alloys have now to be used instead of aluminium. Research is at present being undertaken with a view to obtaining increased economy in the consumption of fuel and lubricating oil by the Post Office motor transport fleet.

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The work undertaken for the Fighting Services has placed a very heavy tax on the resources of the Branch and it has sometimes been necessary to move specialist officers out of their own Groups in order to meet pressure elsewhere. Some Groups, for instance, the Carrier Group where the staff has been increased by 140%, have had to be strengthened very considerably since the beginning of the war. It has frequently been necessary to construct large quantities of laboratory developed equipment in the workshop owing to the impossibility of getting it made elsewhere in the time available. This has necessitated the working of very long hours by the workshop staff.

There are at present certain outstanding fundamental problems which to various degrees are limiting the development of telephone systems. Typical of these is the generation of noise at switch contacts which is a major difficulty with automatic switching systems. The setting up of a call in a remote local centre by dialling over the trunk network has outstanding problems still associated and the

merits/

merits of a number of signalling systems based on different principles but applicable to modern trunk networks require experimental investigation. In many fields experimental work will be a pre-requisite to post-war development.

The position is being watched and a careful selection made of the features which can be most usefully investigated as and when work connected with immediate defence permits.

W.G.R.

1.3.41.