MINISTRY OF SUPPLY

TELECOMMUNICATIONS RESEARCH ESTABLISHMENT
Great Malvern

PROGRAMME *for* OPEN DAYS

Tuesday, Wednesday and Thursday,
25th, 26th and 27th May, 1948

FOREWORD

The Telecommunications Research Establishment conducts research and development in radio and electronics for the R.A.F., the Naval Air Arm, the Ministry of Civil Aviation and the Department of Scientific and Industrial Research.

There are three major technical departments - Radar, Physics and Engineering.

Projects which engage the attention of the Radar Department are the location by radar of bombing targets, the location and attack of enemy aircraft, radio navigational aids and the use of radar for the control of air traffic.

The Physics Department is mainly concerned with fundamental research on the properties of extremely short radio waves, on infrared radiation, and on various problems in electronics. It includes a theoretical physics group and is responsible for fundamental measurements and the maintenance of the Station sub-standards. Some research on supersonics is also being carried out, and the application of radar techniques to various problems in meteorology is being studied.

The Engineering Department is responsible for the design and construction of apparatus to the requirements of the scientific staff, for the preparation of drawings and documentation to permit contract action being taken when tests have proved the designs, and for investigating new materials, finishes and component techniques to meet the wide variations of temperature and humidity encountered at high altitudes and in various parts of the world.

The Ministry of Supply School of Electronics is situated within T.R.E.. Technical instruction is provided in the school for Craft and Engineering apprentices. Radar familiarisation courses are arranged for all classes of new entrants, and advanced refresher courses for internal staff.

The Electronics Department of the Atomic Energy Research Establishment at T.R.E. is concerned with the development of high-energy particle accelerators for nuclear physics and medical research work, and with electronics and instrumentation for measuring all forms of radiation encountered in the field of nuclear physics.

LIST OF EXHIBITS

(for plan of T.R.E., see pages 10-11)

A summary of the exhibits and demonstrations is given:-

Title	Block	Spur	Page
Radar and rainfall	F	2	5
Microphone impactor for the determination of the size of rain drops	F	2	5
Cloud base meter	F	Roof Hut No. 2	5
Dielectric constant of gases	F	2	5
Millimetre wave components	F	4	6
Application of the electrolytic tank to electron optical studies	F	4	6
Millimetre wave oscillators	F	4	6
Magnetic DC Amplifier	F	6	6
Electronic digital computing techniques	F	6	6
Detection of heat radiation from low temperature bodies, using a thermocouple	F	8	7
Demonstration of the properties of photoconductive cells and their application to the solution of frictional problems	F	8	7
School of Electronics: Laboratory	F	7	7
School of Electronics: Workshops	F	7	7
School of Electronics: Basic principles of radar	F	9	8
The automatic recording spectro-photometer	F	9	8
The centimetric radar sonde	F	11	8
Demonstration of servo system	F	11	8
Demonstration of computer mechanisms	F	11	8
Automatic following telescope for astronomy	F	12	9
School of Electronics: Display of microwave components	F	12	9
No. 1 Radio Equipment Calibration Centre	E	1	12
Drawing Office	E	3	12
Air traffic control	E	4	12
Plotting air traffic	E	4	12
Workshop	E	8	13
Measurements Division	E	9	13
Gee Mark III	E	9	13
Gee-H Survey	E	9	13
Eureka Mark II	E	9	14
Rebecca Mark IV with meter display unit	E	9	14
1000 Mc/s techniques	E	9	14
Eureka Mark IV	E	Forecourt	14
Beam Approach Beacon System (BABS)	E	Forecourt	15
Cloud and Collision Warning Equipment	E	13	15
The Radar Bomber	E	13	15
The Night Fighter	E	14	15
Generation of high power pulses	C	2	16
Paralleling of magnetrons	C	2	16
15 MeV electron synchrotron (X-ray generator)	C	6	16
Measurement of radioactivity	C	6	16
The effect of ultrasonics on the ear	C	7	17
Absorption and flaw detection in metals	C	7	17
Crack detection in concrete and stone	C	7	17
Detection of obstacles using ultrasonic waves in air	C	7	17
Servicing of radar equipment in the R.A.F.	C	7	17
Sea-swell recorder	C	8	18
Influence of wavelength on receiver circuit design	C	8	18
Improvement in receiver performance	C	8	18
Suppressed aerials	C	10	18
Principles of microwave aerials	C	10	18
Speed indicator	C	Forecourt	18
Research on improved reliability of radar equipment	Library		19
Drawing Office and Workshops	Eng. Unit		20
Film: RDF to Radar	D Nelson	2	20

ERRATA

Page 3 — Bottom right hand column should read:

Film RDF to Radar - D 2) Nelson) 20

Page 5 — First item should read

F Block
Exhibit F1 Room F209

Page 7 — Last line bottom left hand column "in the use of hand and machine tools".

Page 10 — Under Rest Rooms: for E799 read E709

Page 17 — Exhibit C5 should read "The effect of Ultrasonics on the Ear".

DETAILS OF EXHIBITS

F BLOCK

EXHIBIT F 1 — **ROOM F**

RADAR AND RAINFALL

Photographs of rain clouds and of the radar echoes obtained from them are shown; results of measurements of the variation of echo intensity with rate of rainfall are compared with theoretical predictions.

EXHIBIT F 2 — **ROOM F 207**

MICROPHONE IMPACTOR FOR THE DETERMINATION OF THE SIZE OF RAIN DROPS

The impact of rain drops on a microphone carried on an aircraft produces impulses which can be photographically recorded, and which bear a relation to the size of the drops. The operation of this method of measuring the size and distribution of rain drops is demonstrated.

EXHIBIT F 3 — **ROOF HUT NO. 2**

CLOUD BASE METER

An apparatus is shown in which pulse technique is applied to the determination of the height of cloud base. The "radio frequency" used is that of visible light. Echoes received from the base of clouds are displayed on a cathode ray tube, and a continuous record is also obtained from the reading of the direct current through a meter.

EXHIBIT F 4 — **ROOM F 206**

DIELECTRIC CONSTANT OF GASES

The dielectric constant of a gas can be deduced from the change in resonant frequency of a cavity when the gas which it contains is removed. The frequency used in the experiment which is demonstrated is about 24,000 Mc/s.

EXHIBIT F 5 ROOM F 404

MILLIMETRE WAVE COMPONENTS

A display is made of waveguide components used at millimetre wavelengths, including corrugated waveguides.

EXHIBIT F 6 ROOM F 404

APPLICATION OF THE ELECTROLYTIC TANK TO ELECTRON OPTICAL STUDIES

A 50:1 scale model of a reflection klystron valve is being used in the tank to study the paths of electrons in the valve.

EXHIBIT F 7 ROOMS F 407-8

MILLIMETRE WAVE OSCILLATORS

(a) The construction of a reflection klystron, tunable over the range 8 - 9 mm., is shown.

(b) The frequency of oscillation of an 8 mm. pulsed resonator magnetron is being determined by means of a cavity wavemeter, and its power output by means of a water calorimeter.

EXHIBIT F 8 ROOM F 602

MAGNETIC D.C. AMPLIFIER

The principle of this apparatus is that the D.C. input signal is converted to A.C. by a magnetic modulator system, and is then amplified by an A.C. thermionic amplifier and converted back to D.C. by a rectifier. Signal powers of the order of 10^{-15} watt can be successfully dealt with, and the apparatus is especially suitable for the amplification of small signals from thermocouples.

A model illustrating the basic principle of the magnetic modulator is also exhibited.

EXHIBIT F 9 ROOM F 608

ELECTRONIC DIGITAL COMPUTING TECHNIQUES

(a) Binary Number Memory System. A "memory" is demonstrated, which is based on the storage of the electrostatic charge distribution produced on the fluorescent screen of a cathode ray tube by a bombarding

beam of electrons. Many binary numbers of 32 digits can be simultaneously "remembered" by this system, which has been developed by T.R.E. in association with the University of Manchester.

(b) Binary Number Arithmetical Unit. An electronic unit is shown, which will add together two 32-digit binary numbers in less than 360 microseconds.

EXHIBIT F 10 **ROOM F 803**

DETECTION OF HEAT RADIATION FROM LOW TEMPERATURE BODIES, USING A THERMOCOUPLE

This demonstration shows how a suitable thermocouple and amplifier can be used to detect heat radiation from bodies, the temperature of which differs from that of the surroundings by only a few degrees.

EXHIBIT F 11 **ROOM F 803**

DEMONSTRATION OF THE PROPERTIES OF PHOTO-CONDUCTIVE CELLS AND THEIR APPLICATION TO THE SOLUTION OF FRICTIONAL PROBLEMS

Here the use of lead sulphide and lead selenide photo-conductive cells as detectors of thermal "hot-spots" is shown, the "hot-spots" being developed by the friction between a metal pointer and a rotating glass disc. Frictional effects, which are in many cases invisible to the naked eye, are clearly shown up by the cells, and the amplitude and duration of the "hot-spots" can be measured. This is a copy of an actual experiment carried out in the Department of Rubbing Solids at the University of Cambridge. The cells have been applied to problems associated with the wear of train break linings.

EXHIBIT F 12 **ROOM F 705**

SCHOOL OF ELECTRONICS: LABORATORY

A selection of equipment used in the School Laboratory is shown. Experiments which are set up include the multivibrator, electronic control of a radar scanner, and demonstrations of the principles of waveguides.

EXHIBIT F 13 **ROOMS F 706-707**

SCHOOL OF ELECTRONICS: WORKSHOPS

In the School Workshops, apprentices are trained, during their first year, in the use of band and machine tools; normal work is in progress here.

EXHIBIT F 14 — ROOM F 901

SCHOOL OF ELECTRONICS: BASIC PRINCIPLES OF RADAR

The echo principle, which is fundamental in radar, is illustrated by using sound waves instead of radio waves. A loud-speaker acts as transmitter, and a microphone as receiver, signals being displayed on a radar indicating unit.

EXHIBIT F 15 — ROOM F 909

THE AUTOMATIC RECORDING SPECTRO-PHOTOMETER

This instrument was designed in association with the Medical Research Council for recording automatically absorption curves of liquid specimens, particularly in the ultra-violet region. The result appears as a curve photographically recorded by means of a spot of light from a galvanometer.

EXHIBIT F 16 — ROOM F 1105

THE CENTIMETRIC RADAR SONDE

The Sonde equipment which is displayed is an application of radar technique to the problem of weather forecasting.

A centimetric radar set, weighing, with its associated power supplies, only 4½ lb., is attached to a free balloon and ascends through the lower atmosphere into the stratosphere to a ceiling of 75,000 feet. A set of precision meteorological instruments is incorporated in the Sonde, and by means of telemetering equipment, data on atmospheric temperature, pressure and humidity are transmitted back to base. In addition, automatic tracking from the ground station gives a record of wind in the upper air.

EXHIBIT F 17 — ROOM F 1106

DEMONSTRATION OF SERVO SYSTEM

A demonstration is given of the remote control of the position of a power driven mechanism, by means of a servo system.

The component units and associated circuits for an A.C. position control servo mechanism are shown in use.

EXHIBIT F 18 — ROOM F 1106

DEMONSTRATION OF COMPUTER MECHANISMS

The speed control of power driven mechanisms and the integration of electrical quantities is demonstrated.

EXHIBIT F 19 ROOM F 1203

AUTOMATIC FOLLOWING TELESCOPE FOR ASTRONOMY

A model illustrates the work which T.R.E. has been doing at the Royal Observatory, Greenwich. A small telescope is mounted so that its position can be controlled by a servo motor. The telescope contains a device capable of determining the position of a star in its field of view, the star being simulated in this case by a point of light. The position information is fed to the servo motor so that, as the star moves, the telescope is driver to follow it.

EXHIBIT F 20 ROOM F 1201

SCHOOL OF ELECTRONICS: DISPLAY OF MICROWAVE COMPONENTS

The School of Electronics has arranged a display of the following equipment:-

Airborne transmitter-receiver units,
Magnetrons and magnets,
Klystron oscillators,
Waveguides and waveguide fittings,
Pulse transformers.

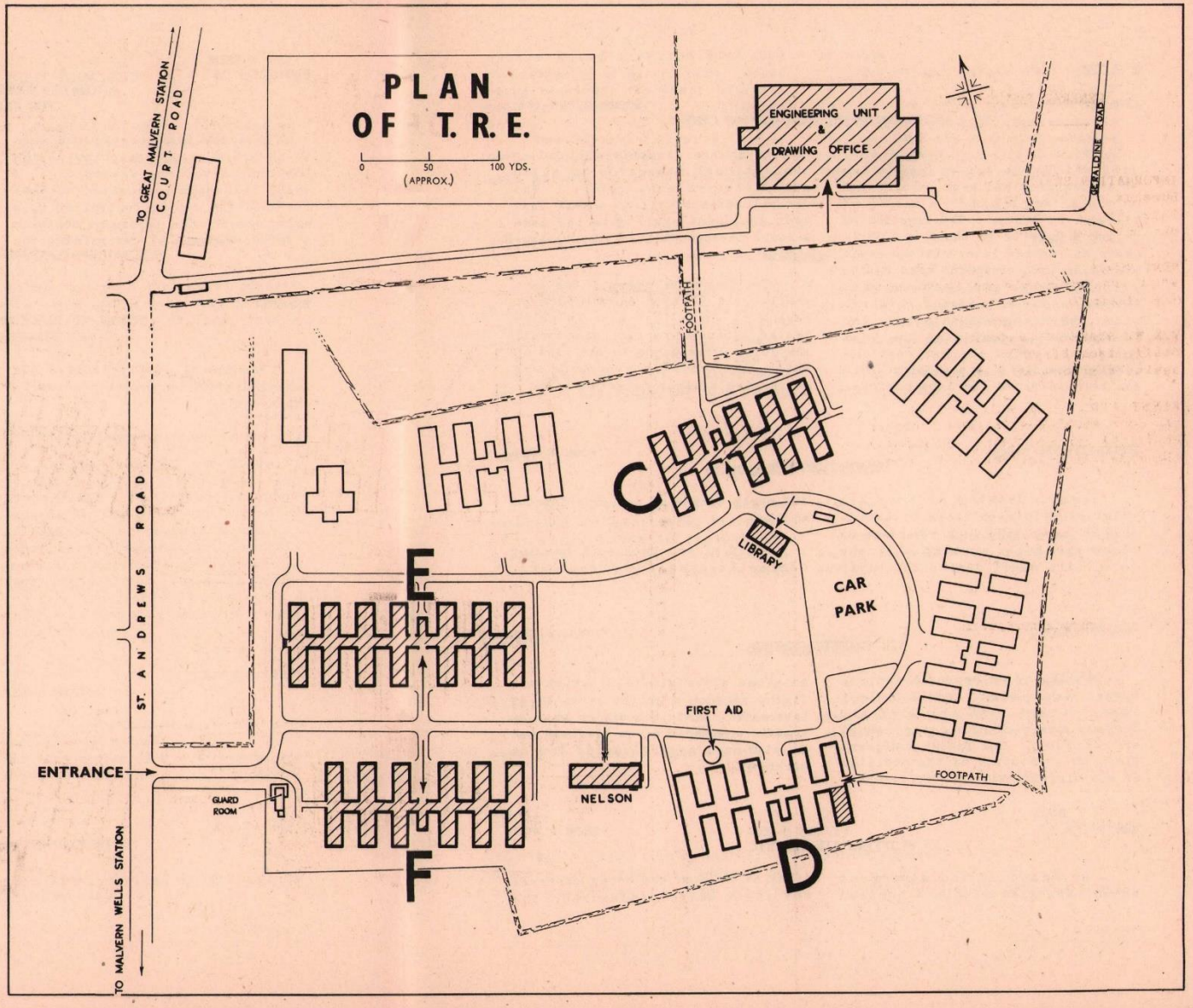
GENERAL INFORMATION

INFORMATION BUREAUX - Information Bureaux are situated near the Main Gate, in C, E and F Blocks, and in the Engineering Unit.

REST ROOMS - Rooms C202, E799 and F506 are available as rest rooms for visitors.

T.R.E. STAFF - Members of T.R.E. Staff, identified by a badge, will assist visitors as required.

FIRST AID - T.R.E. thanks the St. John Ambulance Brigade (Malvern Division) for providing and manning the First Aid Post outside D Block.



E BLOCK

EXHIBIT E 1 — ROOMS E 105-106

NO.1 RADIO EQUIPMENT CALIBRATION CENTRE

No.1 R.E.C.C. is an R.A.F. unit which was set up at Henlow after training had been carried out at T.R.E. and R.A.E.; a sample of its work is shown. The function of No.1 R.E.C.C. is to check and calibrate at regular intervals the radio and radar test equipment used by the R.A.F. at home and in North West Europe. The methods of calibration, which are worked out by the Establishment designing the test equipment, refer the calibrations used in the field to standards which can be maintained for long periods, and which are directly related to the national standards to which manufacturers must refer. The general intention is to ensure that test equipment shall give the same answers throughout its life, wherever it may be used.

Two rooms are shown. One is a small-scale version of the room at Henlow in which test gear is calibrated against transfer standards; the other corresponds to the room in which the transfer standards are calibrated against sub-standards.

EXHIBIT E 3 — ROOM E 301

DRAWING OFFICE

Small drawing offices are maintained in each block of buildings so as to take full advantage of close proximity working with the scientific staff during the birth and early stages of new experimental models.

In E Block, the local drawing office is open for inspection.

EXHIBIT E 4 — ROOM E 407

AIR TRAFFIC CONTROL

Models of an Approach Control Radar Equipment and a Control Tower fitted with the Airfield Surface Movement Indicator (ASMI) are exhibited. The former equipment gives an indication of the position of all aircraft within, for example, 25 miles of an airfield, which are flying at such a height as to be of interest. ASMI is a device whereby traffic movements on an airfield can be observed regardless of fog or darkness.

EXHIBIT E 5 — ROOM E 408

PLOTTING AIR TRAFFIC

By means of the equipment shown, aircraft within a hundred miles of Malvern are being observed and their heights measured, the

system being operated with the assistance of an R.A.F. crew. After being received, the Radar information is transferred to a plotting board.

The Daylight Display, a new device which represents a considerable advance in technique, is also on view.

The movement of aircraft over a considerable area of Southern England is being recorded on a plotting screen. Information is obtained from the displays operating here, and also, by radio link, from London Airport and elsewhere.

EXHIBIT E 6 **ROOM E 801**

WORKSHOP

Small workshops exist in each main building to make, often to the roughest sketches, the first experimental models needed by the scientific staff at an early stage of their investigations. Experience gained in experimenting with these first models enables the research staff to specify requirements which can then be referred to the Drawing Office for more advanced design.

The workshop in E Block is open for inspection.

EXHIBIT E 2 **ROOMS E 902-910**

MEASUREMENTS DIVISION

The Measurements Division maintains the electrical standards of T.R.E., tries to improve the methods of measurement at present in use, and develops new methods when required.

The work which the Division is at present carrying out is exhibited.

EXHIBIT E 7 **ROOM E 901**

GEE MARK III

Transmissions from Gee ground stations produce a lattice, the lines composing which are numbered on a map carried in aircraft. Gee Mark III, which is demonstrated, is a miniature airborne equipment provided with a counting mechanism from which the position of the aircraft on the lattice can be read.

EXHIBIT E 8 **ROOM E 901**

GEE-H SURVEY

Gee-H, used during the War as a bombing aid, has been adapted for use in map-making from aerial photographs.

The function of the equipment

is to control an aircraft along parallel tracks, so that rapid photographic coverage is assured, and to fix the position of each picture in relation to the accurately-known positions of two ground stations.

This technique of mapping is now being used in a survey of some British possessions.

EXHIBIT E 9 — **ROOM E 901**

EUREKA MARK II

The primary purpose of Eureka beacons during the War, in conjunction with the Rebecca airborne equipment, was to enable troop and supply dropping to be carried out. The Eureka beacons were planted by an advance party, and the aircraft fitted with Rebecca "homed" on to the Eureka.

The Eureka Mark II equipment is exhibited.

EXHIBIT E 10 — **ROOM E 901**

REBECCA MARK IV WITH METER DISPLAY UNIT

The post-war model of Rebecca is used for homing on to Eureka beacons as an aid to navigation; also, in conjunction with BABS (Exhibit E 13), Rebecca enables a beam approach to be made to a runway.

Rebecca Mark IV, which is on view, embodies new techniques - miniature components are used in its construction, it is pan-climatic, and it is pressurised to ensure satisfactory operation at heights up to 55,000 feet.

The normal display in Rebecca is a signal on a catnode ray tube; a Meter Display Unit for the pilot's use is also demonstrated.

EXHIBIT E 11 — **ROOM E 901**

1000 MC/S TECHNIQUES

The Distance Measuring Equipment (DME) for use in civil aircraft in the future will operate in the 1000 Mc/s band. Demonstrations are given of the techniques which will be used in this application.

EXHIBIT E 12 — **FORECOURT, E BLOCK**

EUREKA MARK IV

Eureka Mark IV, which is demonstrated, is a high-power beacon to which aircraft fitted with Rebecca can "home" from a distance of the order of 200 miles. The transmitter power is 5 Kilowatts. Eureka Mark V, a 1 Kilowatt beacon, has a range of about 90 miles, and is intended to assist aircraft in a later stage of their approach to an airfield.

EXHIBIT E 13 — FORECOURT, E BLOCK

BEAM APPROACH BEACON SYSTEM (BABS)

A BABS equipment in a van is on view. When in use, the van is placed at the end of a runway on an airfield; reception of an appropriate signal from an aircraft causes the beacon to transmit a pattern of dots and dashes, observation of which in the aircraft - for example, on a Rebecca set - indicates whether the runway is being approached correctly.

EXHIBIT E 14 — ROOM E 28

CLOUD AND COLLISION WARNING EQUIPMENT

This is an airborne search radar equipment for the detection of dangerous clouds and high ground up to a distance of 40 miles. The display to the pilot or observer is on a plan position indicator on which the shape and position of clouds or of obstacles on the ground is evident.

The equipment, of which the first prototype model is displayed, is miniaturised and pan-climatic.

EXHIBIT E 15 — ROOM E 1301

THE RADAR BOMBER

H2S and AGLT (Airborne Gun-Laying in Turrets) are shown. H2S gives the navigator a picture of the Earth's surface beneath the aircraft, while AGLT detects enemy fighters approaching from the rear, and assists in training the rear turret guns on them.

EXHIBIT E 16 — ROOM E 1408

THE NIGHT FIGHTER

An Air Interception equipment (AI) designed to be installed in night fighter aircraft, is shown. AI searches the sky ahead of the fighter, and indicates the distance and direction of other aircraft within the space swept by the radar beam. Echoes from the ground are also seen, but these can be minimised by careful design. As the fighter approaches the enemy aircraft which is to be attacked, the AI scanner can be locked on to the target - that is, the scanner can be made to move as necessary to keep the target in the beam - and a spot indicating the direction of the target is projected on the pilot's windscreen. The fighter is then manoeuvred into such a position that the pilot can see the enemy aircraft and attack it.

C BLOCK

EXHIBIT C 1 — **ROOM C 205**

GENERATION OF HIGH POWER PULSES

An experimental high-power modulator is shown, which produces pulses of 5000 Kilowatts, the pulse duration being 2 microseconds and the recurrence frequency 500 cycles per second. The modulator uses the DC Transformation Circuit with a VX 387 mercury arc valve; the same circuit and valve have been used to produce pulses of 50,000 Kilowatts.

A BM 735 magnetron, fed from the modulator, is being used to produce radio frequency oscillations at a wavelength of 10 cm., the power output from the magnetron being 2000 Kilowatts peak and 2 Kilowatts mean.

EXHIBIT C 2 — **ROOM C 205**

PARALLELING OF MAGNETRONS

Two magnetrons are locked in frequency, and their outputs combined. Observation on a spectrum analyser shows the increased output produced by this arrangement.

EXHIBIT C 3 — **ROOM C 603**

15 MEV ELECTRON SYNCHROTRON
(X-RAY GENERATOR)

The principle of synchrotron acceleration was demonstrated for the first time with the equipment which is on view. Electrons are injected at an energy of a few kilovolts into a doughnut-shaped vacuum chamber placed between the pole pieces of a magnet. The magnetic field is increased continuously as the acceleration proceeds, and in due course the electron beam is made to collapse on to a tungsten target, producing X-rays. The acceleration cycle can be repeated 50 or 150 times per second.

EXHIBIT C 4 — **ROOM C 603**

MEASUREMENT OF RADIO-ACTIVITY

The instruments shown are a selection of those being developed for the measurement of the high-energy radiations met with in research in nuclear physics, radio-chemistry, radio-biology, etc.

The first five instruments are so-called 'health monitors', which are used to ensure that workers are not being exposed to amounts of radiation sufficient to cause appreciable bodily harm.

The instruments are:-

Portable Beta and Gamma Monitor,
'Pistol' Monitor,
Portable Integrating Gamma Monitor,
Installed Gamma Monitor,
Scintillation Alpha Counter,
Beta Counting Equipment.

EXHIBIT C 5 **ROOM C 703**

THE EFFECT OF ULTRASONICS ON THE AIR

It is shown that two sources of ultrasonic vibration, individually inaudible, produce a beat note which can be heard. (Frequencies used: 20-30 Kc/s.)

EXHIBIT C 6 **ROOM C 703**

ABSORPTION AND FLAW DETECTION IN METALS

An application of pulse technique to observe the absorption of ultrasonic waves in metals, and to detect flaws, is demonstrated. (Frequencies used: 5-15 Mc/s.)

EXHIBIT C 7 **ROOM C 703**

CRACK DETECTION IN CONCRETE AND STONE

The propagation of ultrasonic waves (30-100 Kc/s) in concrete, and their failure to propagate beyond a crack, is illustrated.

EXHIBIT C 8 **ROOM C 703**

DETECTION OF OBSTACLES USING ULTRASONIC WAVES IN AIR

Pulses of ultrasonic waves are emitted as a beam of radiation, which can be reflected by obstacles and picked up by a receiver adjacent to the transmitter. (Frequencies used: 20-120 Kc/s.)

EXHIBIT C 9 **ROOM C 701**

SERVICING OF RADAR EQUIPMENT IN THE R.A.F.

A display is made of the three stages in which R.A.F. equipment is serviced - in the aircraft, in the station workshop, and in the base repair unit.

EXHIBIT C 10 — ROOM C 21

SEA-SWELL RECORDER

An experimental model of the Sea-Swell Recorder is shown. The device provides a continuous record of undulations on the surface of the sea. The minimum amplitude of swell which can be detected is about a foot.

The study of sea-swell is of interest to the meteorologist and oceanographer.

EXHIBIT C 11 — ROOM C 21

INFLUENCE OF WAVELENGTH ON RECEIVER CIRCUIT DESIGN

Receivers are exhibited showing the different types of circuit which are used at different frequencies - lumped circuits giving way to line circuits as we pass from the longer wavelengths to the decimetre band, and then to waveguides in the centimetre band.

EXHIBIT C 12 — ROOM C 21

IMPROVEMENT IN RECEIVER PERFORMANCE

The importance of signal-noise ratio is shown experimentally. The ratio can be improved by giving attention to the design of valves and crystals, and a display of these components is featured.

EXHIBIT C 13 — ROOM C 1002

SUPPRESSED AERIALS

By means of comparative models of aircraft fitted with external and suppressed aerials, and by a display of specimen aerials, the contribution made to clean lines and high speeds by the use of suppressed aerials is shown.

EXHIBIT C 14 — ROOM C 1002

PRINCIPLES OF MICROWAVE AERIALS

The focussing and bending of 3 cm. waves, including the use of metal plate lenses, is demonstrated.

EXHIBIT C 15 — FORECOURT, C BLOCK

SPEED INDICATOR

By means of experimental equipment installed in a fixed trailer, the rate of approach (speed) of moving vehicles is being measured. This illustrates the principle of the rate of descent meter which is being developed for use in flying boats.

LIBRARY

RESEARCH ON IMPROVED RELIABILITY OF RADAR EQUIPMENT

One of the most important features in the design of radar equipment is a high standard of reliability. If an equipment is liable to incorrect operation or failure, it may give wrong information, or none at all. This would make the task of the operator uncertain and difficult, and could have disastrous results, involving the loss of lives and of aircraft.

The exhibits in this section give an indication of the work being carried out here towards improving reliability.

PAN-CLIMATIC TESTING

The display illustrates the effect of operational and climatic conditions on performance. Equipment is being tested in conditions simulating the vibration experienced in aircraft, and under tropical conditions of heat and humidity; also, measurements of the rate of leakage from pressurised containers are being made.

COMPONENT DEVELOPMENT

Much of the equipment now being designed - for example, Cloud and Collision Warning, Gee Mark III, Rebecca Mark IV - uses miniature components.

Developments which have made miniaturisation possible are illustrated.

CONSTRUCTIONAL TECHNIQUES

Various methods which facilitate construction and maintenance are illustrated by diagrams and sample assemblies; a rate of descent meter of novel design is shown.

The problems of heat-dissipation associated with sealed equipment are demonstrated, with the means by which these difficulties can be overcome. New processes, including the printed wiring technique, are shown.

PACKAGING

Adequate packaging of equipment to withstand the arduous conditions of Service transit and storage is essential. Recent developments in the use of plastic materials for packaging are demonstrated.

FILMS

Short films are to be shown, dealing with the manufacture of carbon resistors and of condensers, and the shock-testing of radar equipment.

ENGINEERING UNIT BUILDING

DRAWING OFFICE AND WORKSHOPS

In this building are situated the central drawing office and main workshops. Their function is to follow up the preliminary work carried out in the small workshops and drawing offices in the separate experimental buildings.

In this workshop, no work is carried out except to full drawings prepared by the drawing offices. This provides a good check on the correctness and practicability of design before advancing to the production stage.

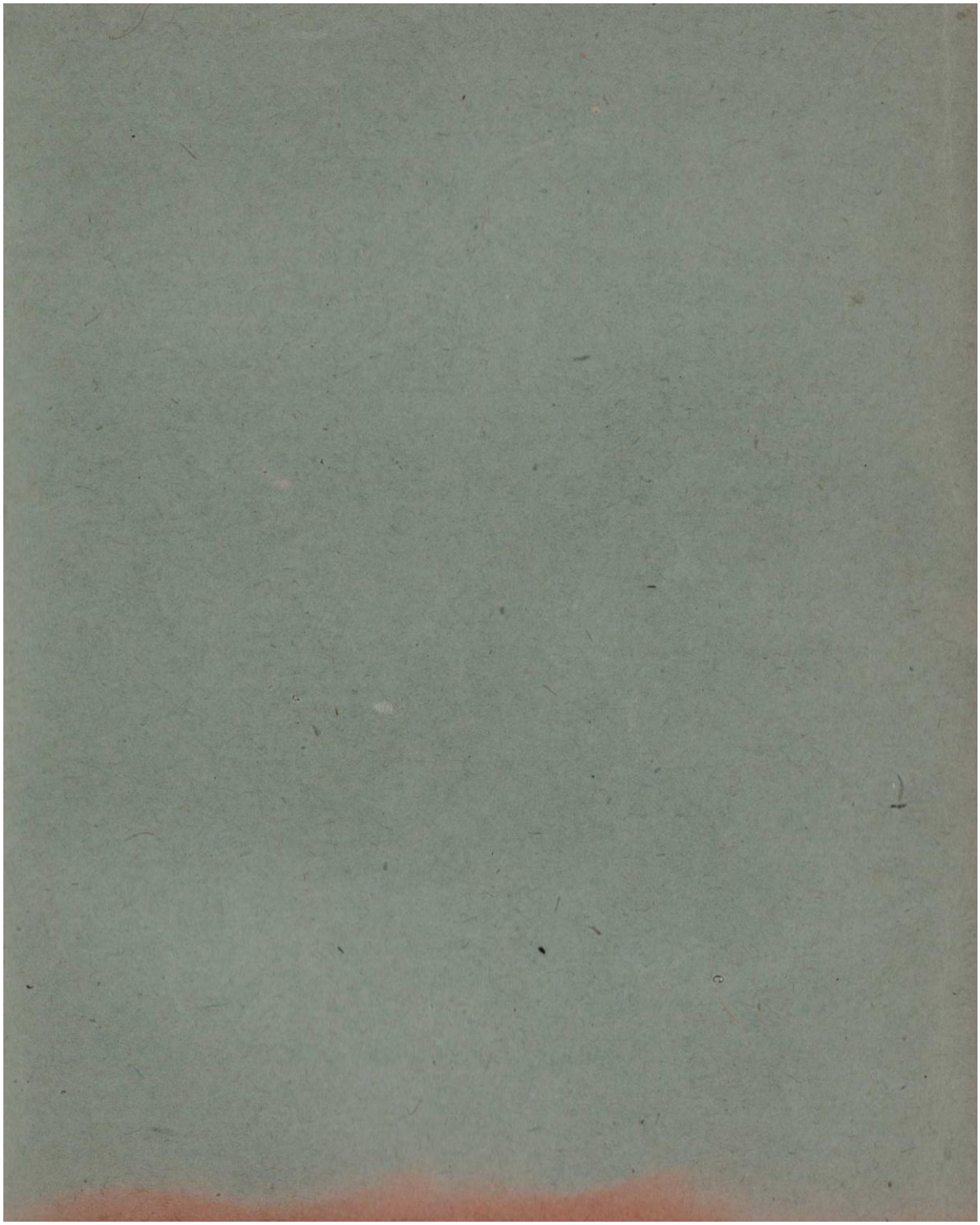
It may be of interest to note that this workshop is the largest in the country employed on purely model-shop lines.

These departments will be working normally; no demonstrations are arranged, but members of the staff will be pleased to answer questions from visitors.

FILM: **RDF TO RADAR**

This film, in which the development of radar is traced, will be shown as follows:-

Tuesday 25th May	In Room 210, D Block, at 3 p.m. and 4 p.m.
Wednesday 26th May	In Room 210, D Block, and in Nelson, at 10 a.m., 11 a.m., 2.30 p.m., 3.30 p.m., 4.30 p.m.
Thursday 27th May	In Room 210, D Block, and in Nelson, at 10 a.m., 11 a.m.
	Also in Room 210, D Block, at 3 p.m., 4 p.m., 6 p.m., 7 p.m.
	The film runs for 45 minutes.



Modern Methods of Detecting Heat Radiation

Heat waves are electromagnetic radiation similar in nature to both radio waves and light waves. They differ only in their wavelengths from these other forms of radiation being of longer wavelength than light waves and shorter than radio waves. In general, heat waves, or infra-red waves as they are called, lie in the wavelength range one to three hundred microns where one micron is equal to one ten thousandth of a centimetre. They obey the same laws of radiation as do light waves being capable of reflection by mirrors and of focussing by lenses if these are made of suitable materials.

These waves are, however, due to their long wavelength, outside the visible range of the eye and other means must be used to detect them.

Two of the best modern detectors of infra-red radiation are

(a) The Thermocouple

(b) The Photoconductive cell.

The principle of operation of the thermocouple depends on the fact that when two dissimilar metals are brought into contact and their junctions heated by exposure to heat radiation an electric voltage is generated at the contact. The magitude of this voltage depends on the amount of radiation falling on the junction. This type of detector has been known for many years, modern forms only differing from their predecessors in that they can detect much smaller amounts of radiation.

The photoconductive cell is a very recent form of detector whose action depends on the observed fact that thin films of various lead salts change their electrical resistance when heat waves fall on them. The amount by which the resistance changes is a measure of the quantity of heat falling on the cell. These detectors are much more sensitive than thermocouples and are also quicker in responding to rapid changes in intensity of the incident radiation. They suffer from the disadvantage that they will only respond to heat waves of special bands of wavelengths whereas the thermocouple responds equally well to heat radiation of all wavelengths. The demonstrations show these two forms of detector in operation.

/The Thermocouple

The Thermocouple

Here a thermocouple associated with a suitable amplifier is being used to detect the heat from the human body and also from a kettle of boiling water.

The heat radiation from these sources is interrupted at 5 cycles/sec. by a chopper disc so that the output from the thermocouple is modulated at this frequency. The following amplifier is tuned to 5 cycles/sec, and the effect is finally displayed on a pen recorder.

Photoconductive cell

The photosensitive layer in this cell is made from lead sulphide. It is being used to demonstrate the heat generated by friction when two moving bodies come into contact. For example when a train wheel comes into contact with the brake 'hot spots' are generated on the surface of the wheel due to the braking action. These may not always be visible but can be detected by the use of a photoconductive cell which shows them to be short pulses of energy the amplitude and duration of which can be measured as an output from the cell. This is an actual application of photoconductive cells that has been made in industry.

12th May, 1948.