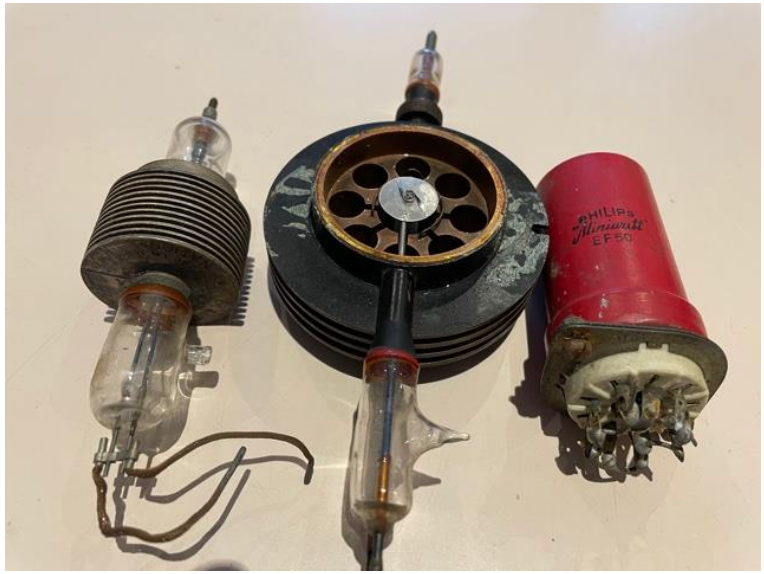
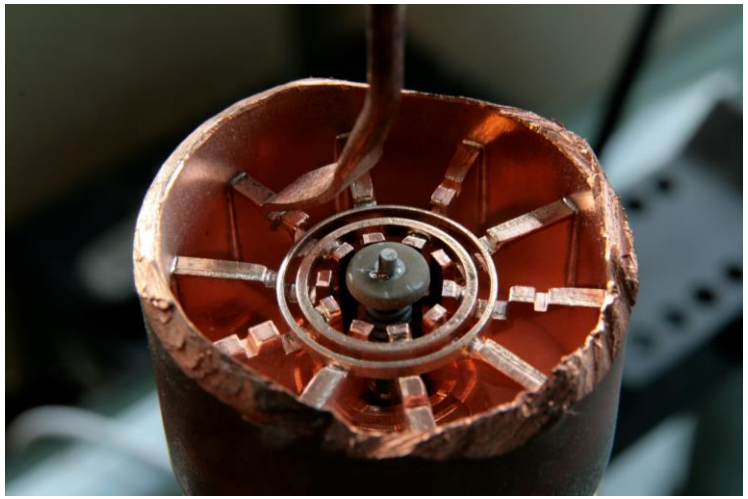
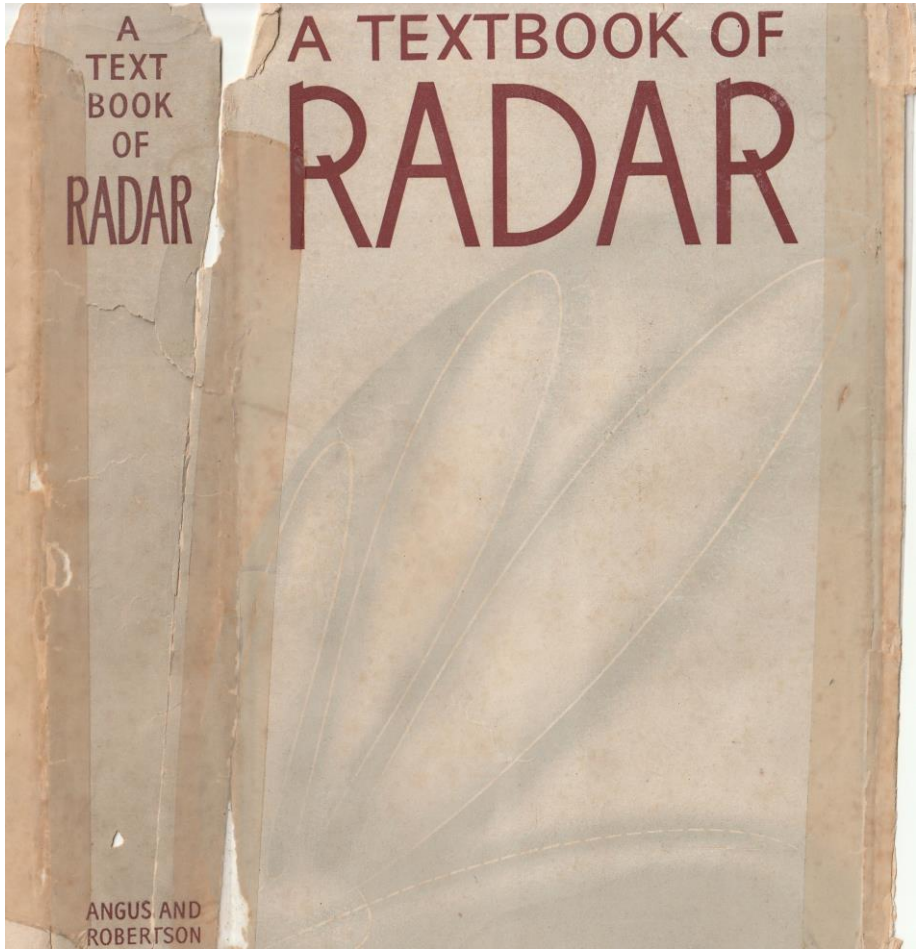
Professor Sir John Percival Vissing Madsen BSc, BE, DSc (1879-1969)

Radio & Radio Research in Australia 1927-1957.



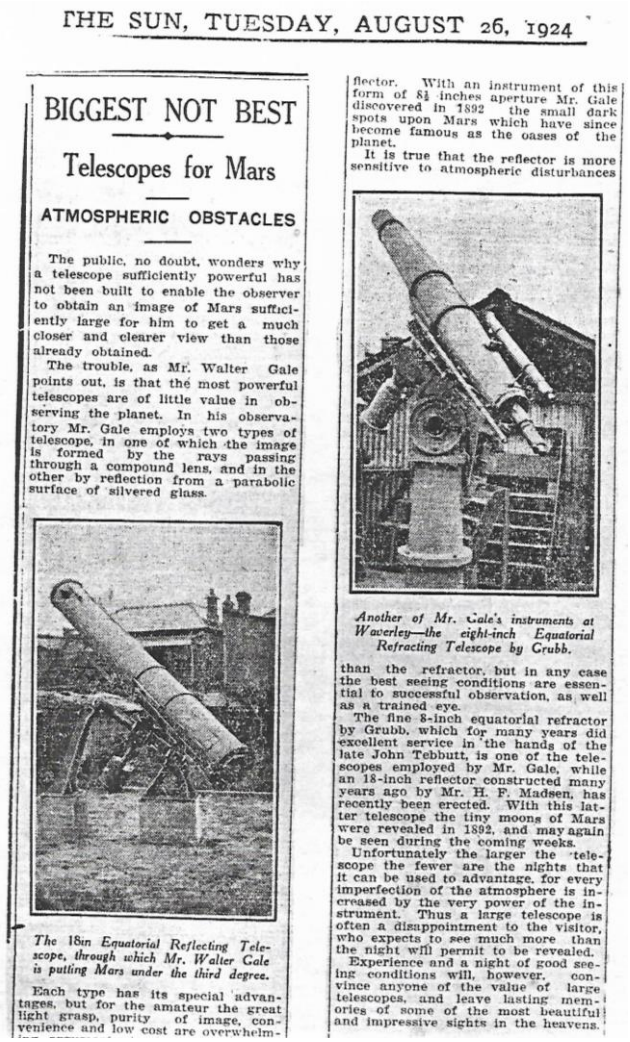


1.ANCURS 1950 & Textbook of Radar 1947-RPL.



2.Madsen Building, Sydney University.

3.Sydney University 1897-1900.



THE SUN, TUESDAY, AUGUST 26, 1924

BIGGEST NOT BEST

Telescopes for Mars

ATMOSPHERIC OBSTACLES

The public, no doubt, wonders why a telescope sufficiently powerful has not been built to enable the observer to obtain an image of Mars sufficiently large for him to get a much closer and clearer view than those already obtained.

The trouble, as Mr. Walter Gale points out, is that the most powerful telescopes are of little value in observing the planet. In his observatory Mr. Gale employs two types of telescope, in one of which the image is formed by the rays passing through a compound lens, and in the other by reflection from a parabolic surface of silvered glass.

The 18in Equatorial Reflecting Telescope, through which Mr. Walter Gale is putting Mars under the third degree.

Each type has its special advantages, but for the amateur the great light grasp, purity of image, convenience and low cost are overwhelm-

flector. With an instrument of this form of 8½ inches aperture Mr. Gale discovered in 1892 the small dark spots upon Mars which have since become famous as the oases of the planet.

It is true that the reflector is more sensitive to atmospheric disturbances

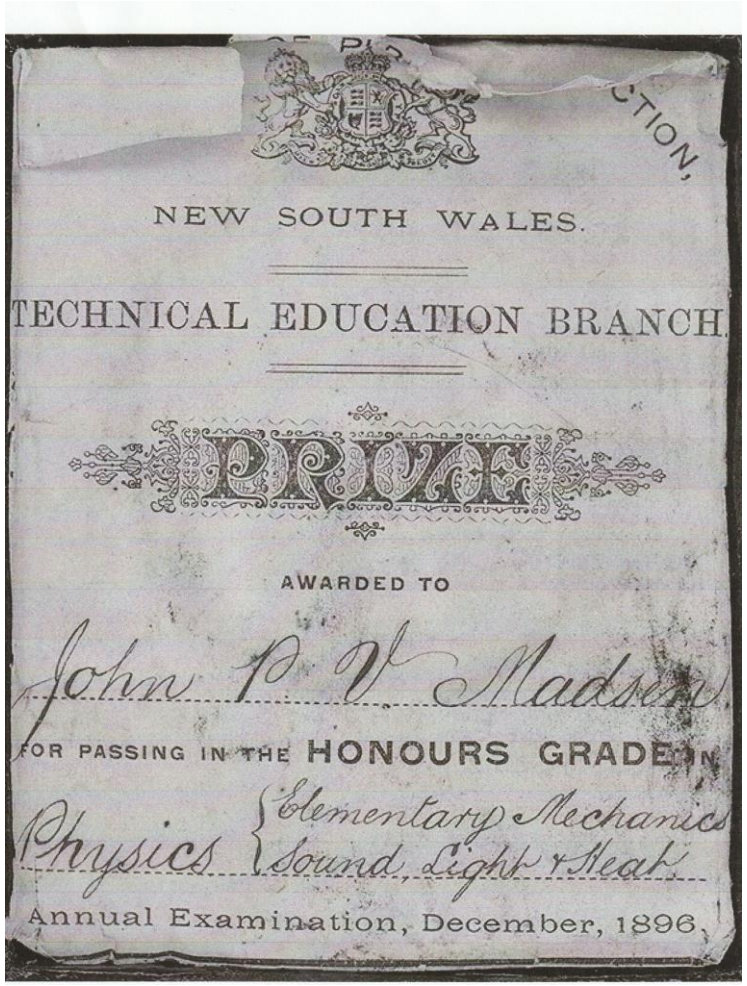
Another of Mr. Gale's instruments at Waverley—the eight-inch Equatorial Refracting Telescope by Grubb.

than the refractor, but in any case the best seeing conditions are essential to successful observation, as well as a trained eye.

The fine 8-inch equatorial refractor by Grubb, which for many years did excellent service in the hands of the late John Tebbutt, is one of the telescopes employed by Mr. Gale, while an 18-inch reflector constructed many years ago by Mr. H. F. Madsen, has recently been erected. With this latter telescope the tiny moons of Mars were revealed in 1892, and may again be seen during the coming weeks.

Unfortunately the larger the telescope the fewer are the nights that it can be used to advantage, for every imperfection of the atmosphere is increased by the very power of the instrument. Thus a large telescope is often a disappointment to the visitor, who expects to see much more than the night will permit to be revealed.

Experience and a night of good seeing conditions will, however, convince anyone of the value of large telescopes, and leave lasting memories of some of the most beautiful and impressive sights in the heavens.



NEW SOUTH WALES.

TECHNICAL EDUCATION BRANCH.

PRIZE

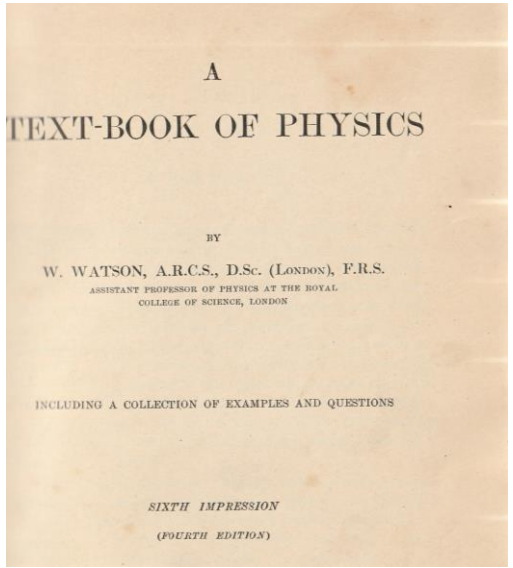
AWARDED TO

John P. V. Madsen

FOR PASSING IN THE HONOURS GRADE IN

Physics { Elementary Mechanics / Sound, Light & Heat

Annual Examination, December, 1896.



A

TEXT-BOOK OF PHYSICS

BY

W. WATSON, A.R.C.S., D.Sc. (London), F.R.S.

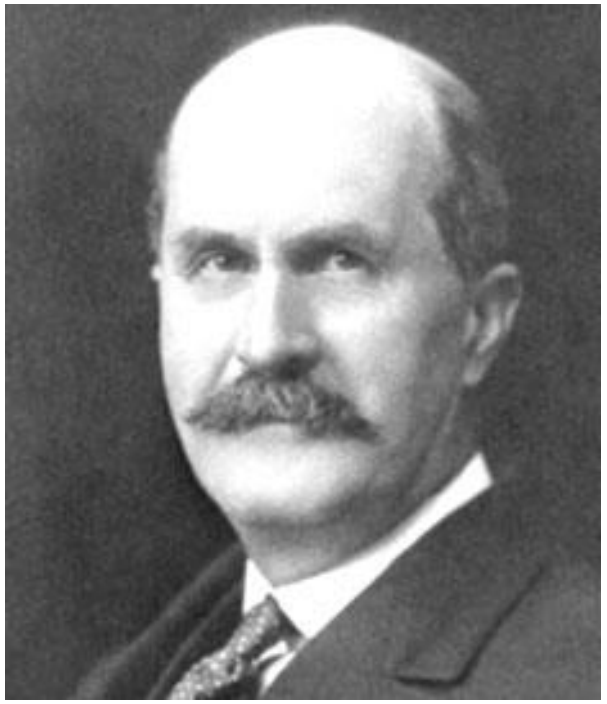
ASSISTANT PROFESSOR OF PHYSICS AT THE ROYAL COLLEGE OF SCIENCE, LONDON

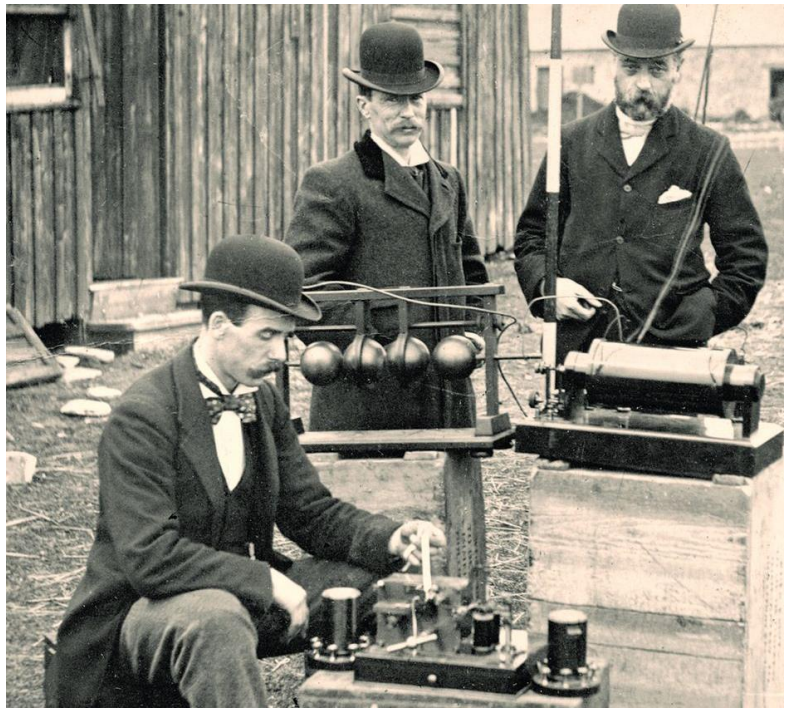
INCLUDING A COLLECTION OF EXAMPLES AND QUESTIONS

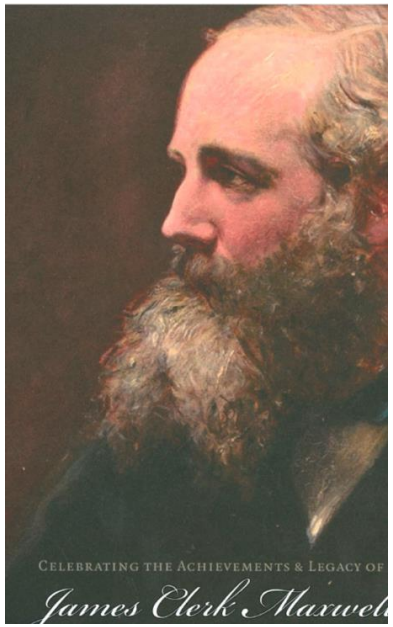
SIXTH IMPRESSION

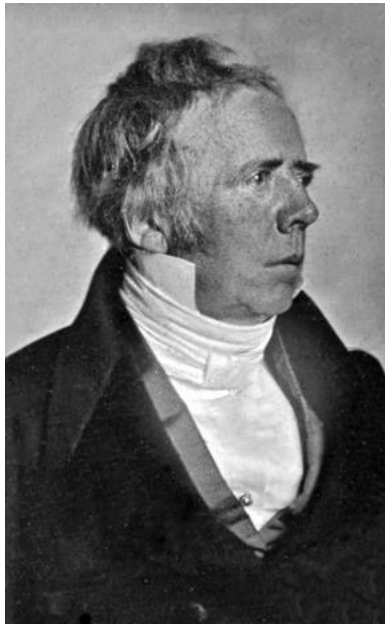
(FOURTH EDITION)

4.Early Research Inspired By Ernest Rutherford.

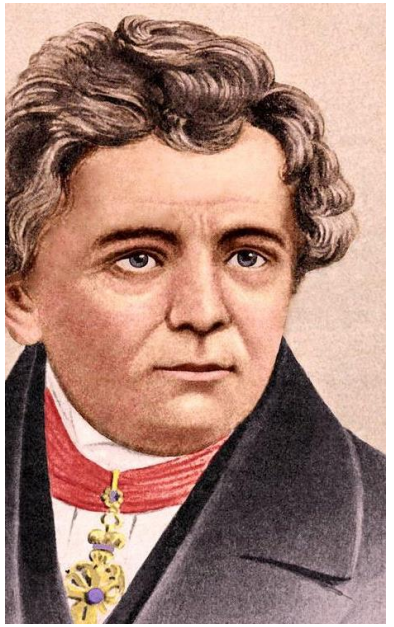












5.Early Pioneers in Electricity, Magnetism & Radio.

6.Adelaide University 1901-1908. DSc 1907.

No. 422

1903

The University of Adelaide.

From J P V Madsen B.Sc
University

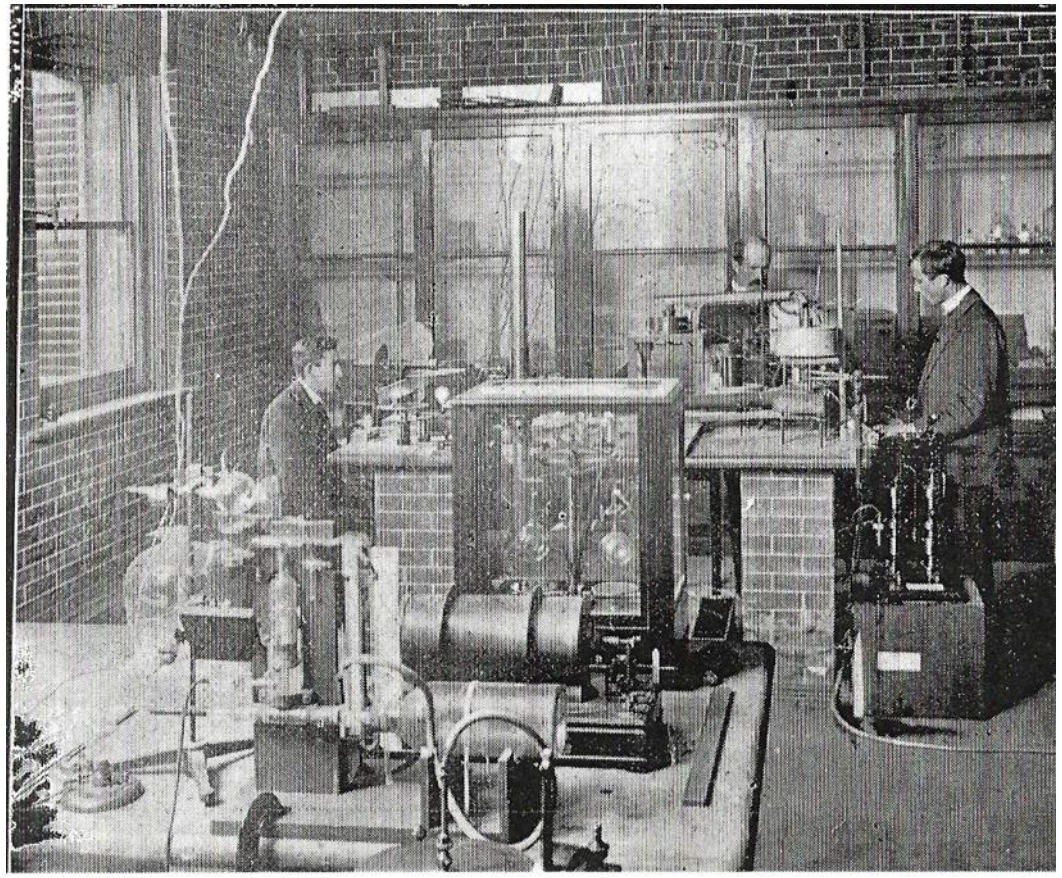
Subject Report recent tour
through England and
America

Enclosures

Dated 26 | 6 | 1903 | Acknwlgd. | | 190

Received 26 | 6 | 1903 | Answered. 30 | 7 | 1903

Vide C. M. vol VII page 337
L. Book XXIII page 196



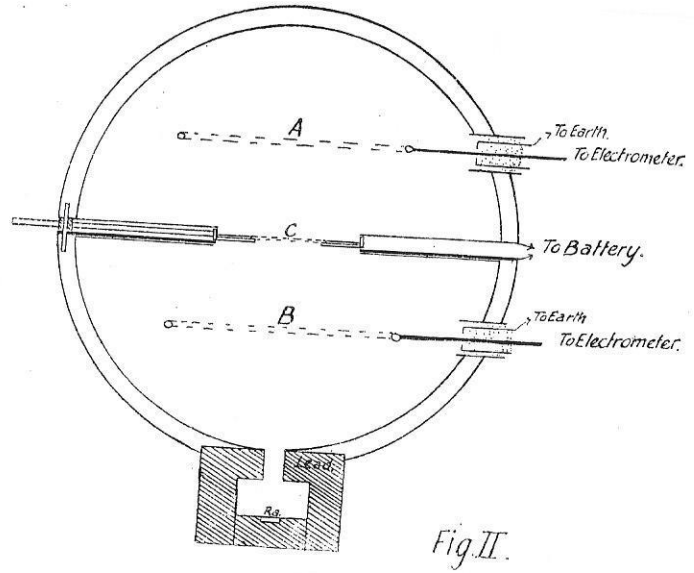


Fig. II.

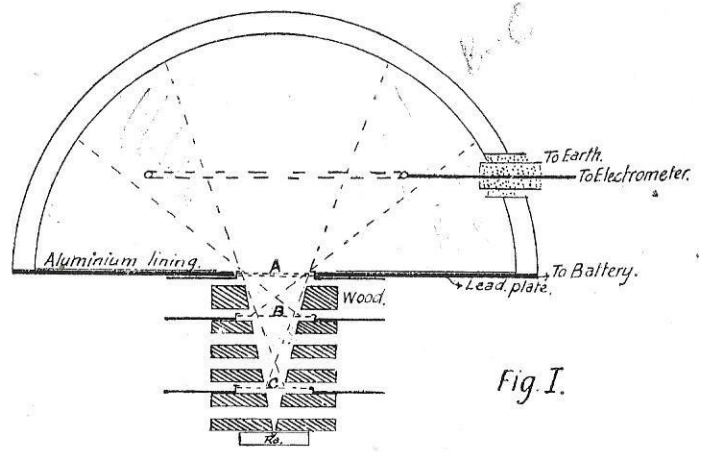


Fig. I.

7.Rutherford's Nuclear Atom March1911.

17, Wilmslow Road,
Withington.
March 8th, 1911.

Dear Mr. Madsen

I saw Bragg yesterday and he was telling me about your work on the large scattering of β particles for different materials. As I have been working at this problem theoretically for the past few months, it may be of interest to you to give an account of the relations that should hold experimentally on the theory.

In the first place, the theory of small scattering as developed by J.J.Thomson is fairly correct as far as it goes; but it takes no account of large scatterings which we know from your work, and that of Geiger and Marsden on the α particles, must always be present. The model atom of J.J.T. only admits of comparatively small scattering, so I have made calculations on an atom which consists of a central point charge, either positive or negative, surrounded by a uniform spherical distribution of electricity opposite in ~~amount~~ sign. One may suppose provisionally that this sphere has a diameter of the same order as that of the atom as ordinarily understood. I will give in the accompanying ~~paper~~ abstract the main deductions from the theory which I find, as far as experiment has gone, fits in well with the observed facts. I find that the

4

relation will be somewhat departed from for thicknesses where the probability of a large deflexion exceeds 1. It is evident in such a case that the theory must be modified, probably by a mixture of the theory of large and small scattering.

I am writing thus fully as I had intended to test my theory by experiments with β rays along very similar lines to that which I understand you are doing. I shall be glad, however, to leave the matter to you if you will be able to get through the work in reasonable time. I shall be very glad to hear from you how your ~~results~~ results are going.

Yours sincerely,

E Rutherford

Give my remembrances to Professor Pollock. I am hoping to visit Australia at the time of the B.A. meeting

Abstract of theory.

Nomenclature.

Ne = central charge on atom.
E = charge on scattered particle
m = its mass
u = its velocity.
t = thickness of matter
n = number of atoms per unit volume.
φ ~~phi~~ = angle of deflexion
p = perpendicular distance from centre of atom on direction of motion of entering particle.

If we suppose the central charge positive, an α particle directed straight to the centre of the atom will be turned back at a distance $b = \frac{2NeE}{mu^2}$; b is an important constant.

It can easily be shown that in order to suffer a large deflexion an ordinary α or β particle should approach within 10^{-11} or 10^{-12} cms of the central charge. In this region, the forces may be supposed to be entirely due to the central charge, and to vary inversely as the square of the distance. The path of the particle is consequently a hyperbola, and the value of the deflexion φ ~~phi~~ can be shown to

December 1, 1917. THE LONE HAND

The Military Engineers'

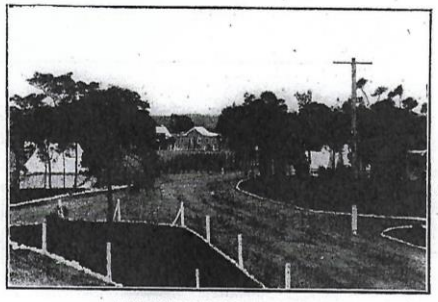
Roseville, N.S.W.

Great Military Display in aid of the War Chest or

EVERYONE who has a friend or relative at the War is eager to know what the actual conditions of warfare are like. One may read all that is obtainable about the trenches, artillery, tanks, aeroplanes, etc., and get a fair idea of what they are like; but no written description will give the reader an adequate notion of what the bursting of a high-explosive shell is like, what sort of illumination is given by star shells and very lights. Nor does a printed story help much to visualise a trench raid and make one realise what rapid bridge building actually means. These things are to be seen and heard in order to be understood.

In order to give the New South Wales public some idea of what the soldiers' do and what sort of noise high explosives make, and to benefit at the same time the War Chest, th Military Engineers at Roseville will hold a demonstration on the 1st December, which should easily be the best thing of its kind ever done in Australia.

The Engineers' Camp is situated in Roseville Park, about twenty minutes' walk from the Roseville



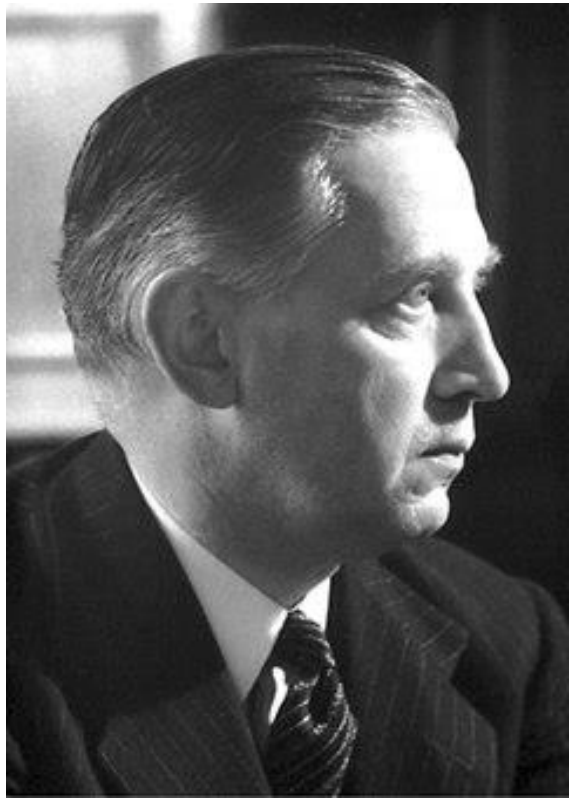
ENTRANCE TO ROSEVILLE CAMP.

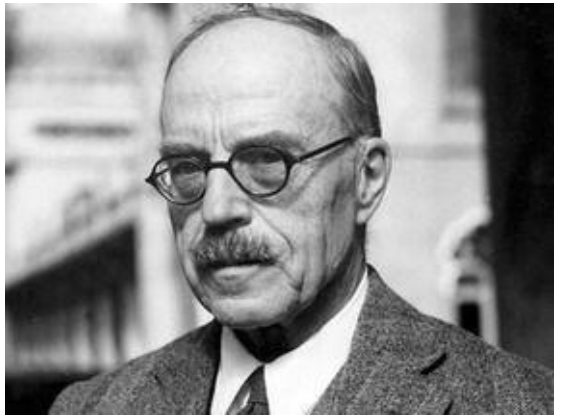
ground, and plenty of good camping places for those who take their own picnic baskets.

The following is the programme: 3 p.m. to 4.15 p.m.—Grooming, ition of lemon slicing, exhibition of tent pegging, Balaclava melee, musical chairs, wrestling on horseback, tug-of-war (mounted), tilting bucket, trick horse.

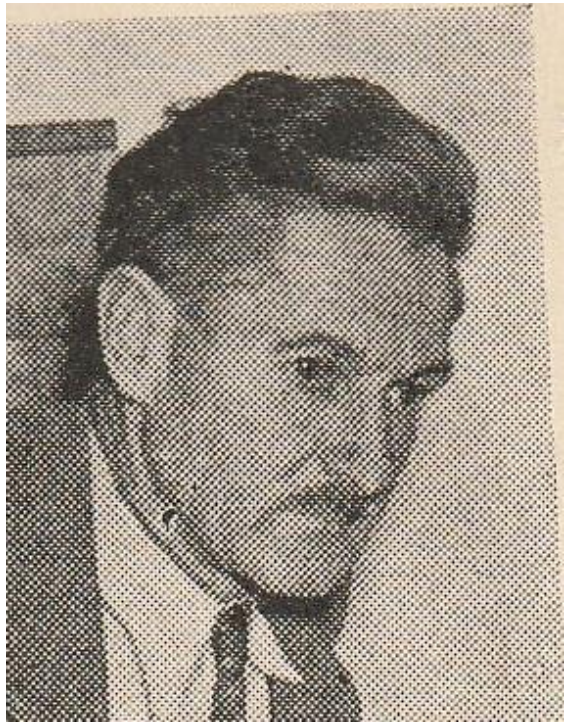
8.WW1 & Roseville Engineers Camp.

9.British Radio Research Board 1920 (DSIR).





10.Australian Radio Research Board 1927.



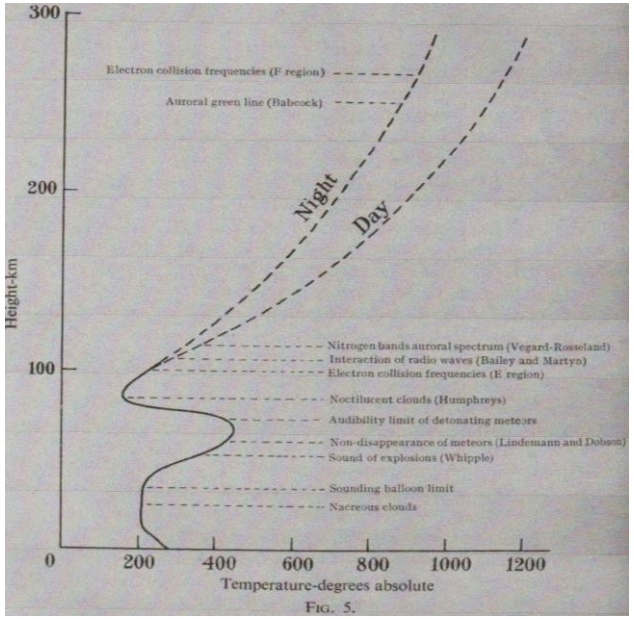


FIG. 5.

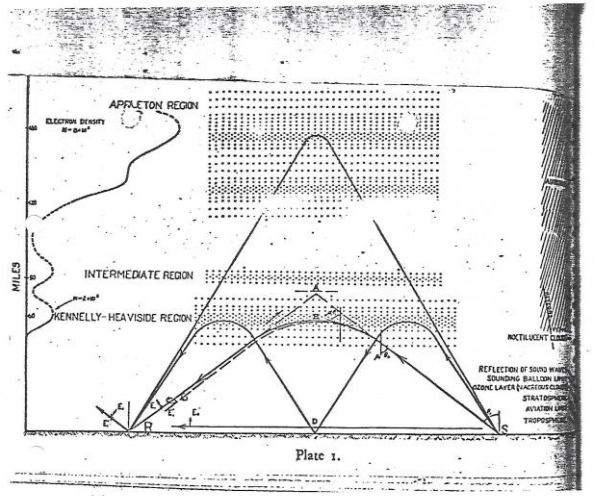
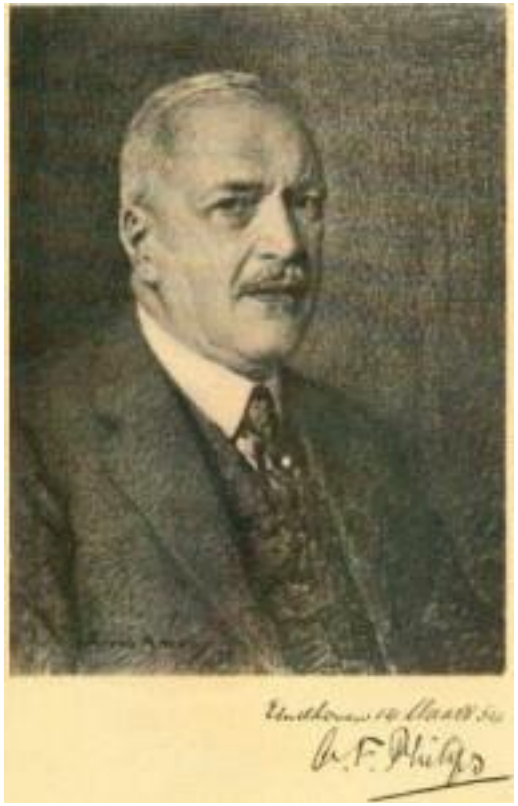


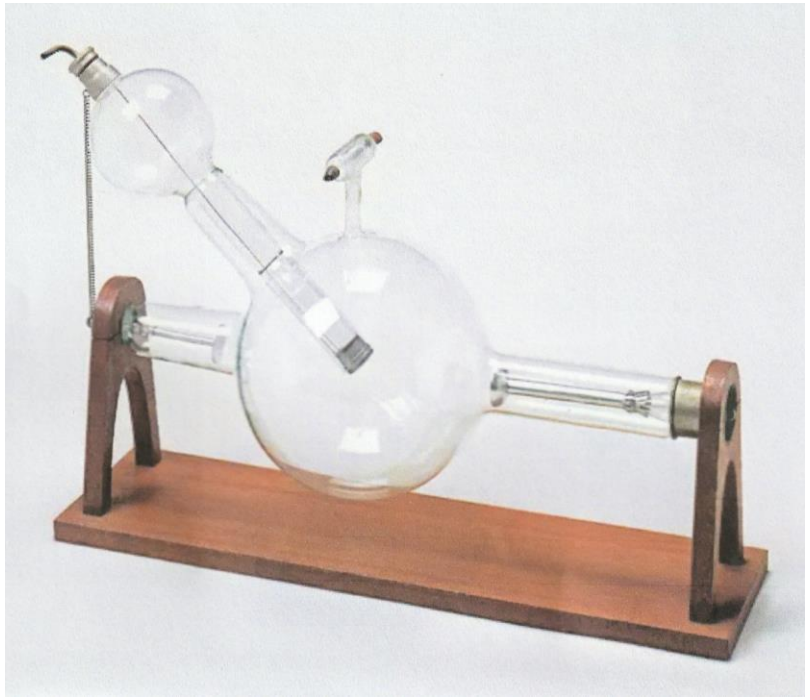
Plate 1.

11.Early Research at RRB to 1935.

12.Philips Eindhoven.
Gerard, Anton & Frits Philips. Giles Holst.

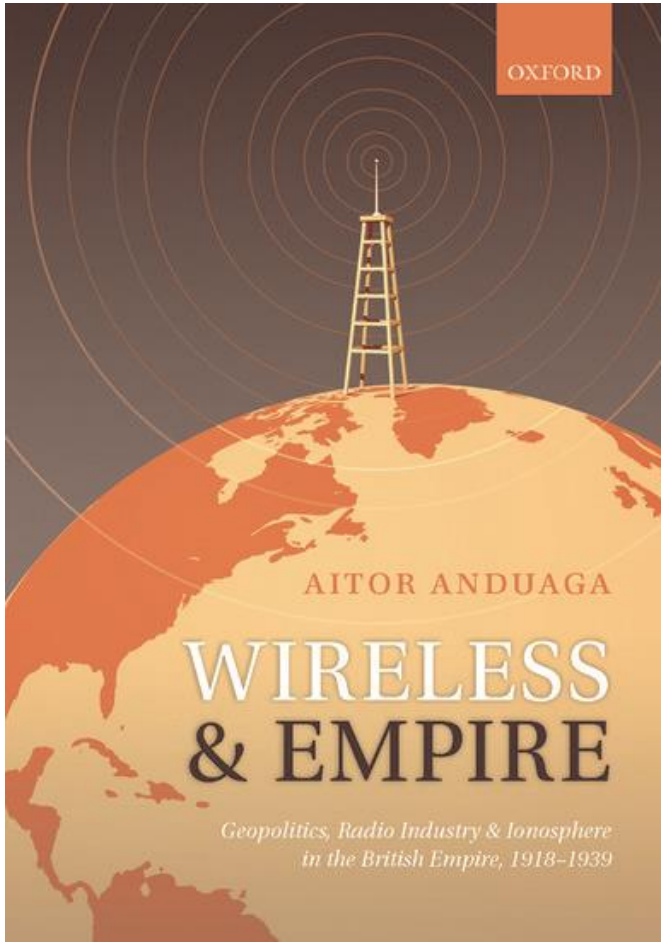


13.Philips early radio valves & sets-1920's.



November 10, 1928

14.Philips, AWA Sydney 1930's.



15.Jansky, EF 50 & airborne Navigation 1930's.

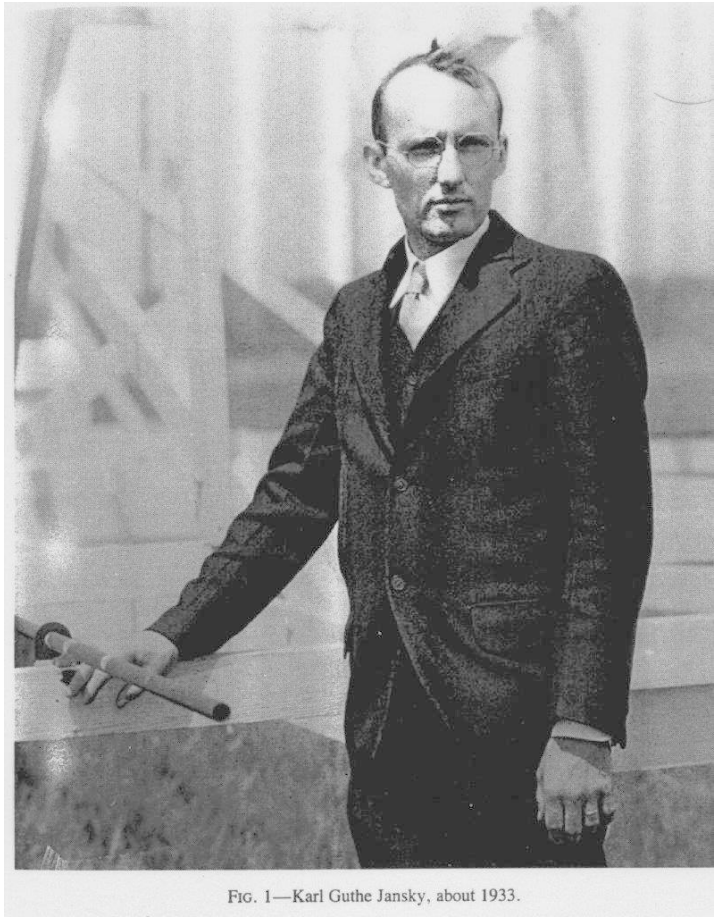
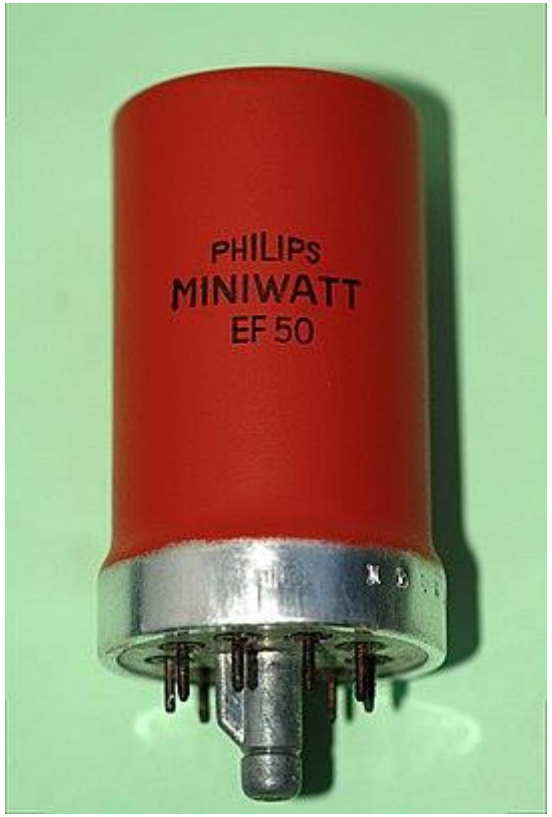
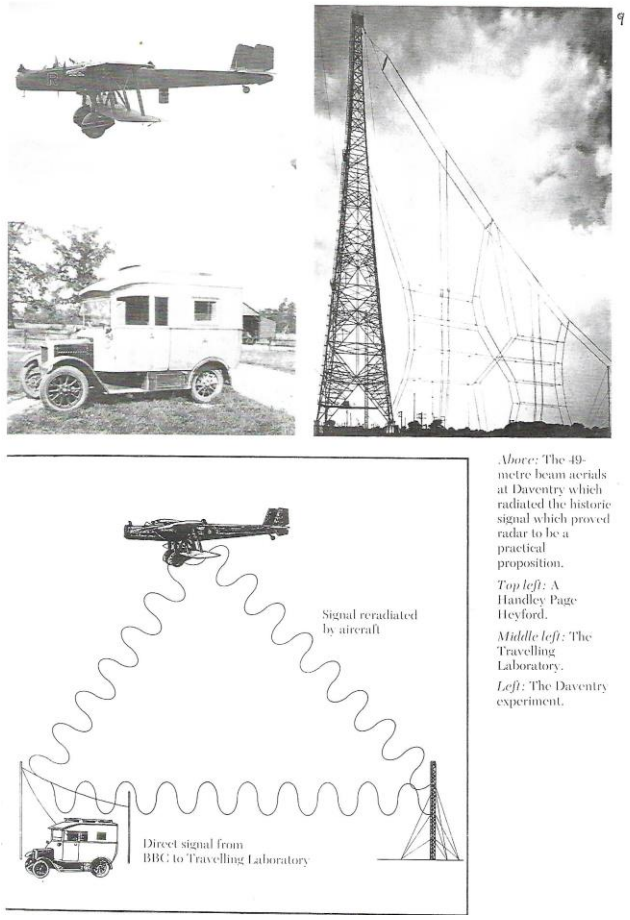


FIG. 1—Karl Guthe Jansky, about 1933.



16.UK Radar Development from 1935.

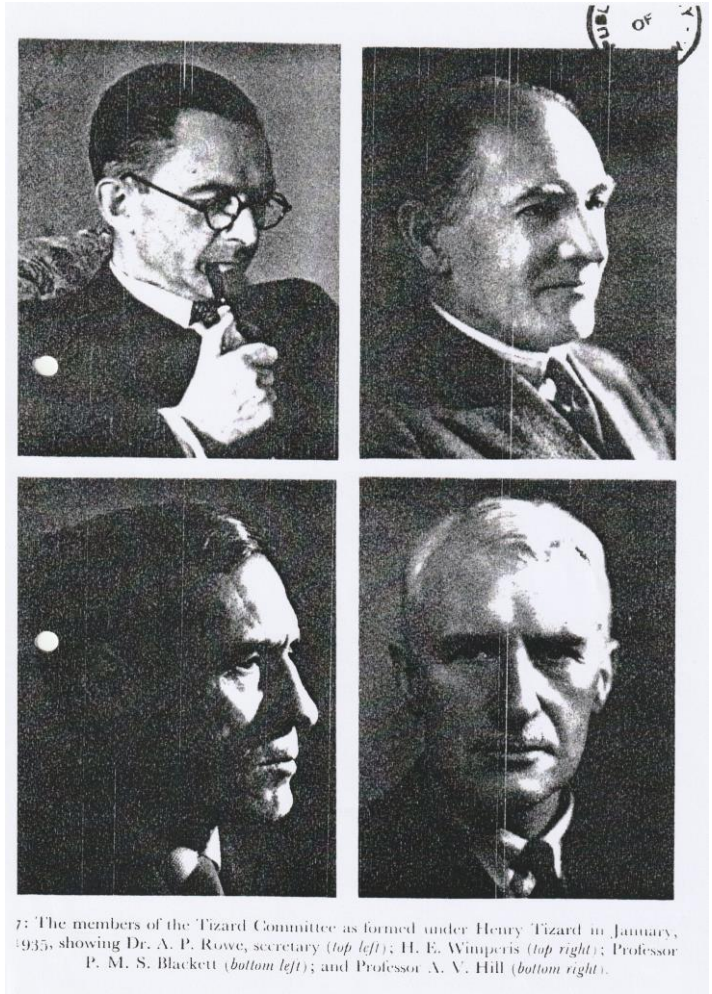


Above: The 49-metre beam aerials at Daventry which radiated the historic signal which proved radar to be a practical proposition.

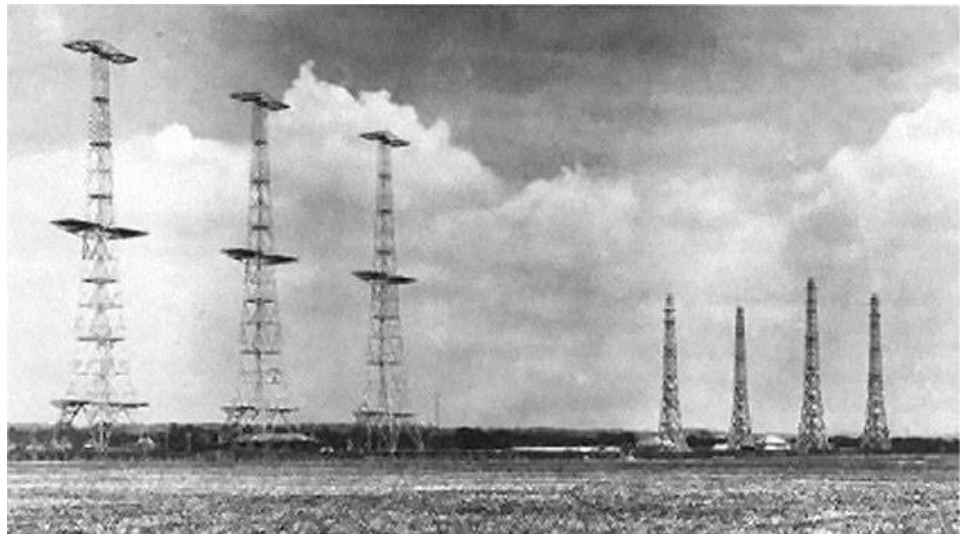
Top left: A Handley Page Heyford.

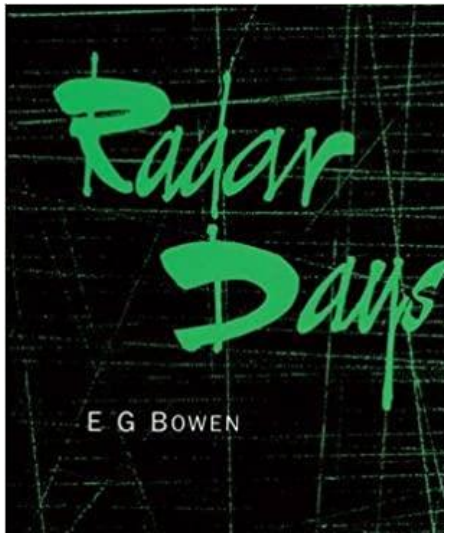
Middle left: The Travelling Laboratory.

Left: The Daventry experiment.



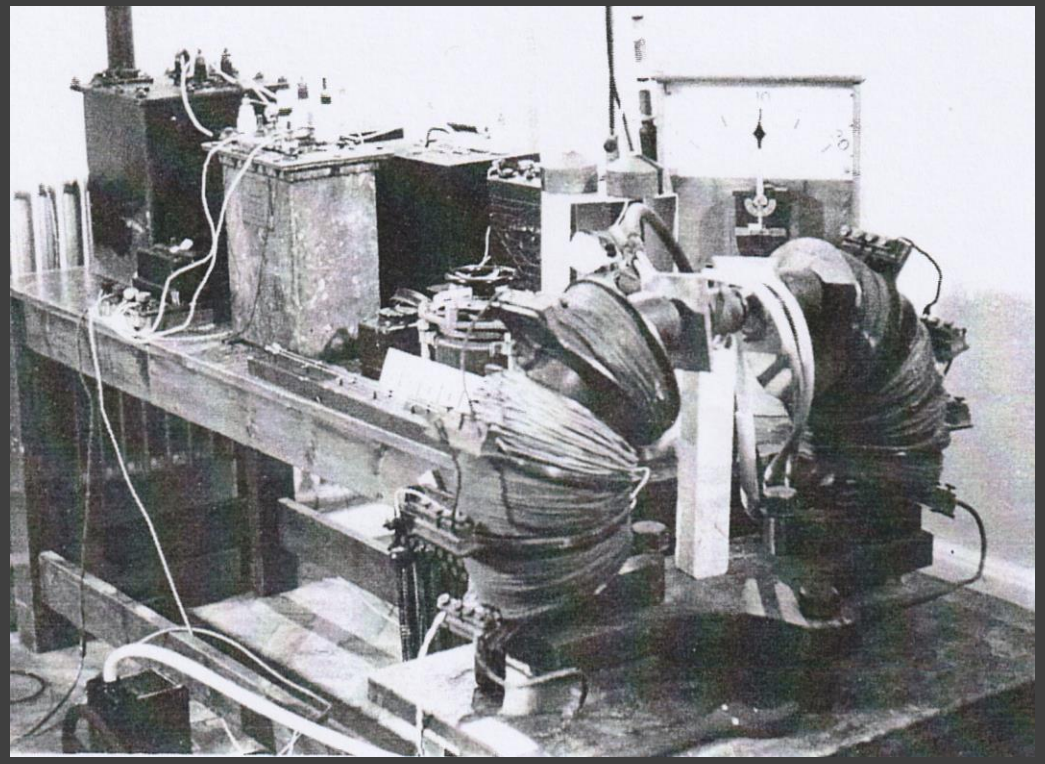
7: The members of the Tizard Committee as formed under Henry Tizard in January, 1935, showing Dr. A. P. Rowe, secretary (*top left*); H. E. Wimperis (*top right*); Professor P. M. S. Blackett (*bottom left*); and Professor A. V. Hill (*bottom right*).



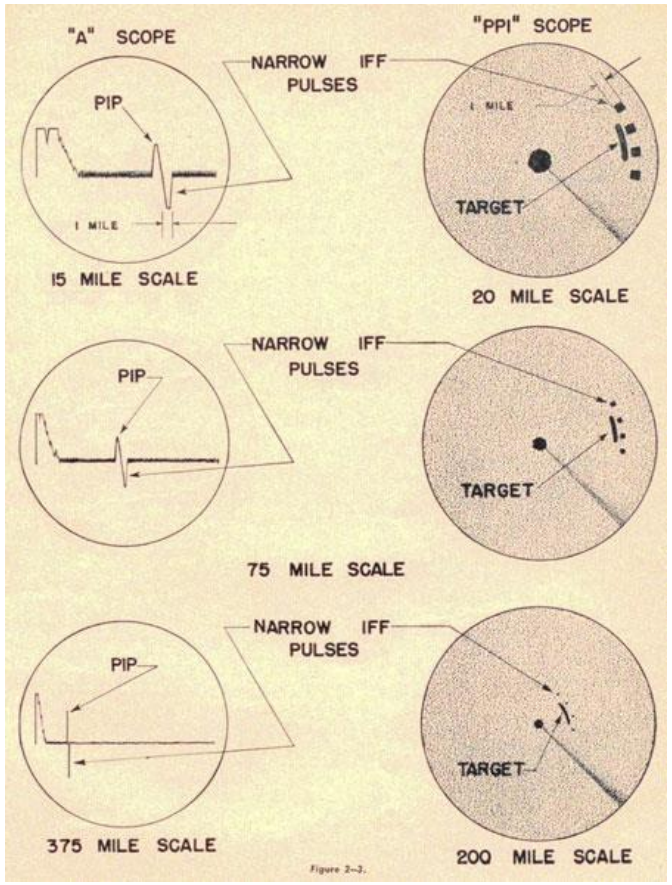


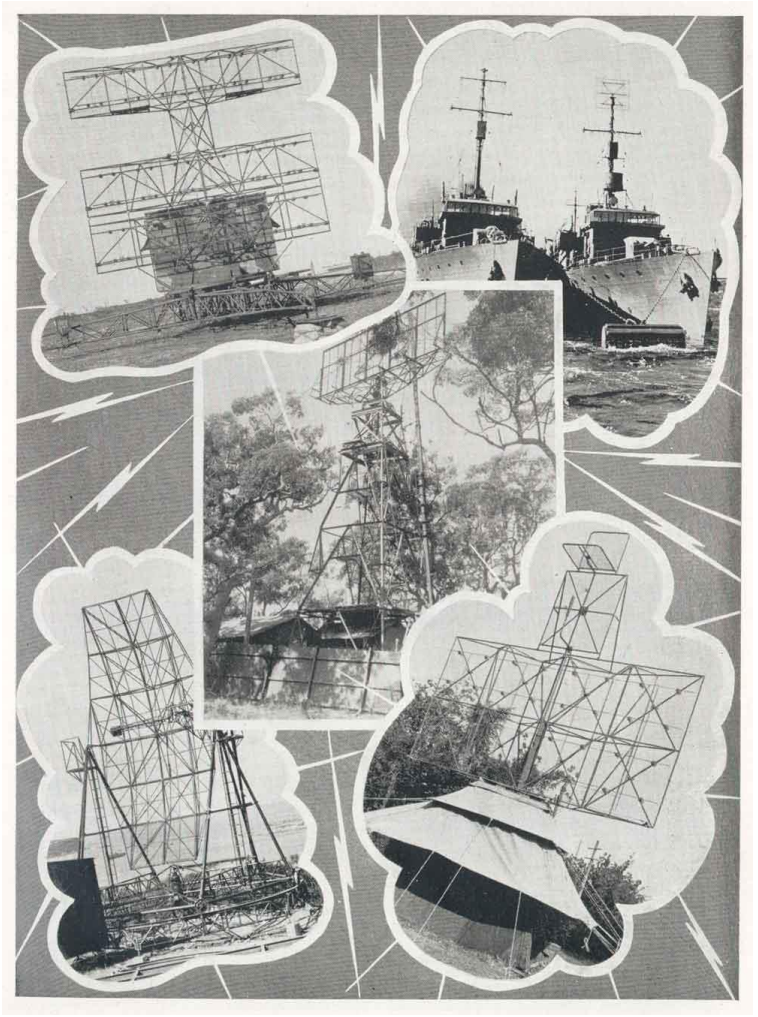
17.Biggin Hill Experiment, Battle of Britain.

18.The 10cm Cavity Magnetron 1940, Tizard Mission & Scientific Liaison.

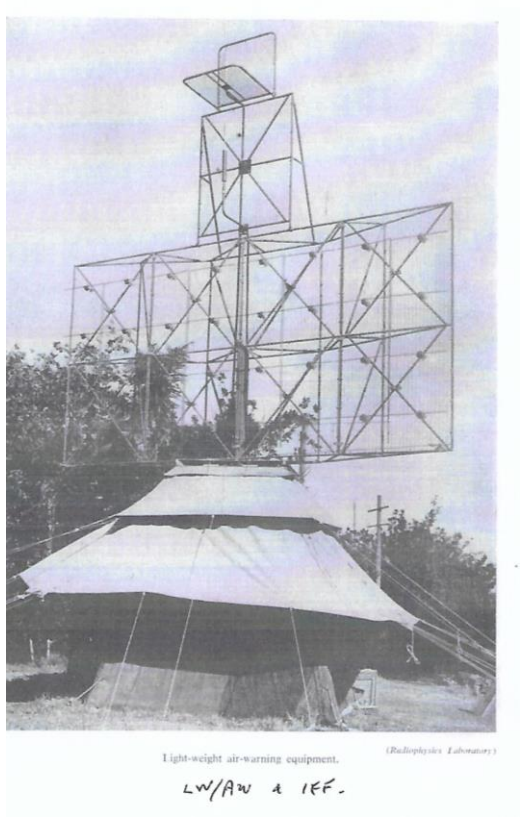


19.Australian 1.5 mtr Radar: VT 90 Micropup.



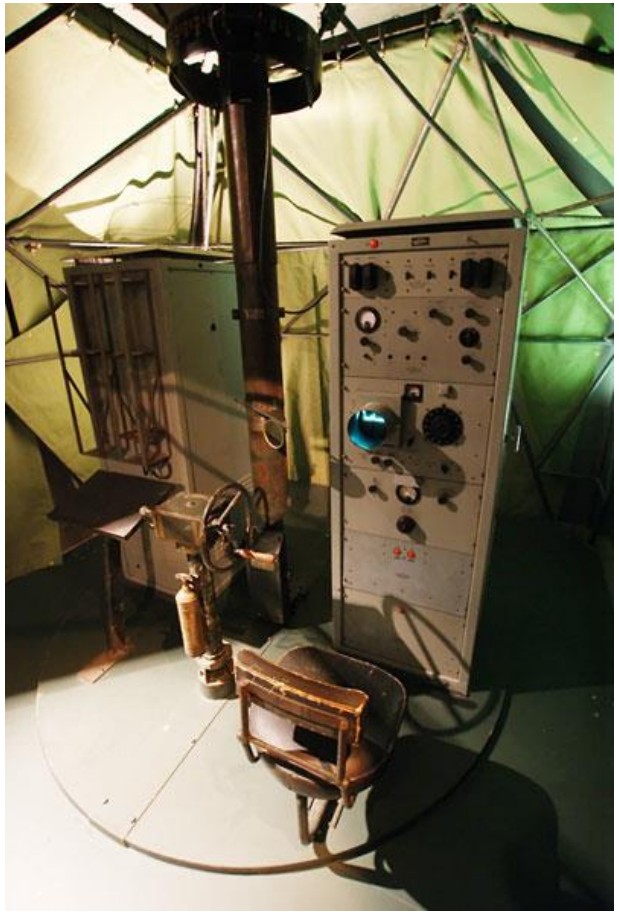


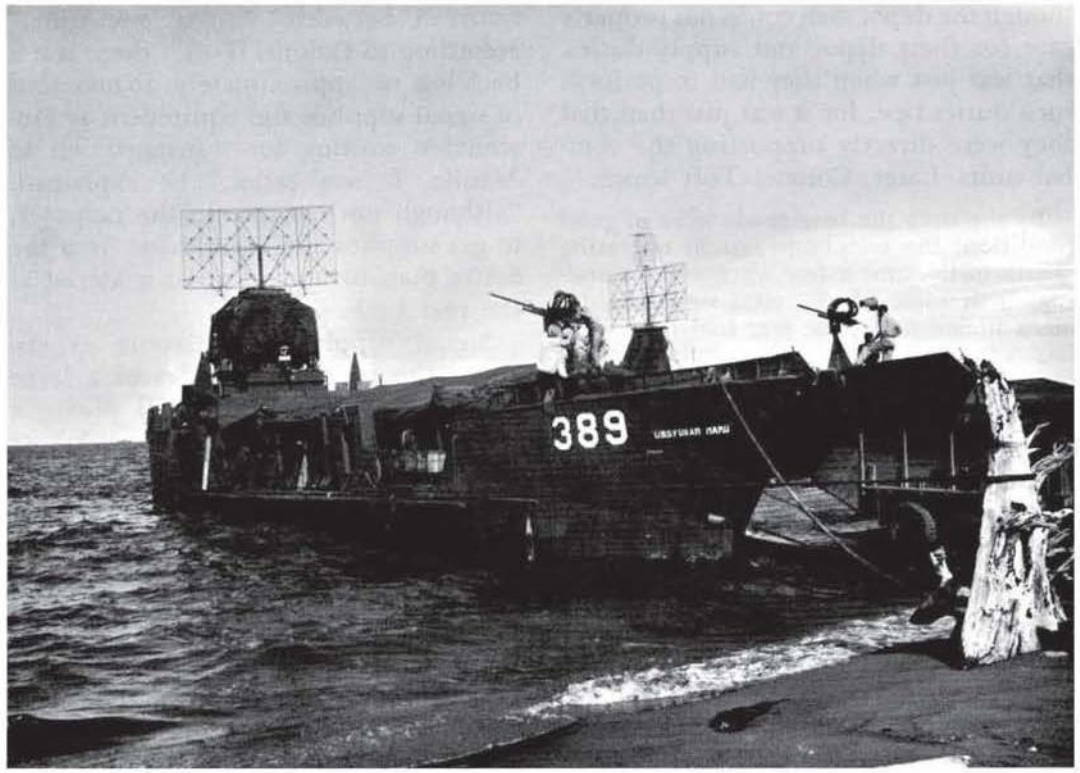
20.The Australian LW/AW set.



Light-weight air-warning equipment. (Radiophysics Laboratory)

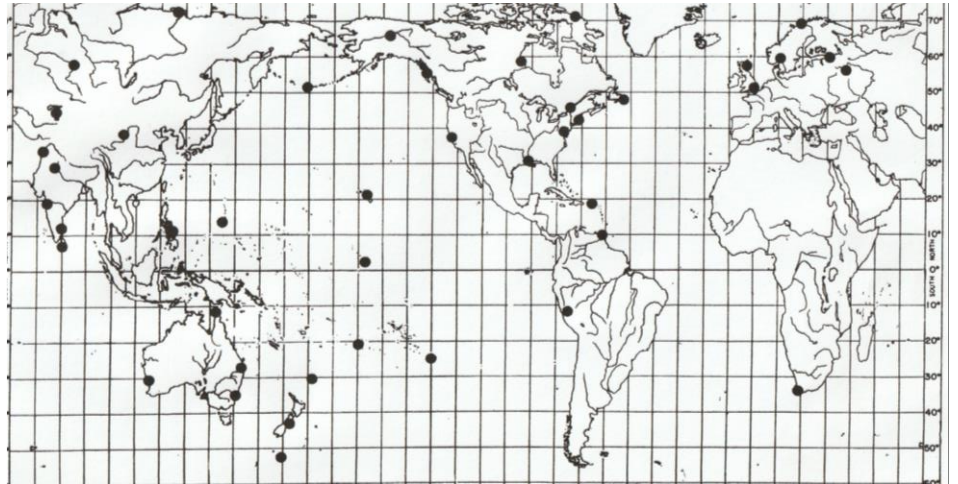
LW/AW & IFF.



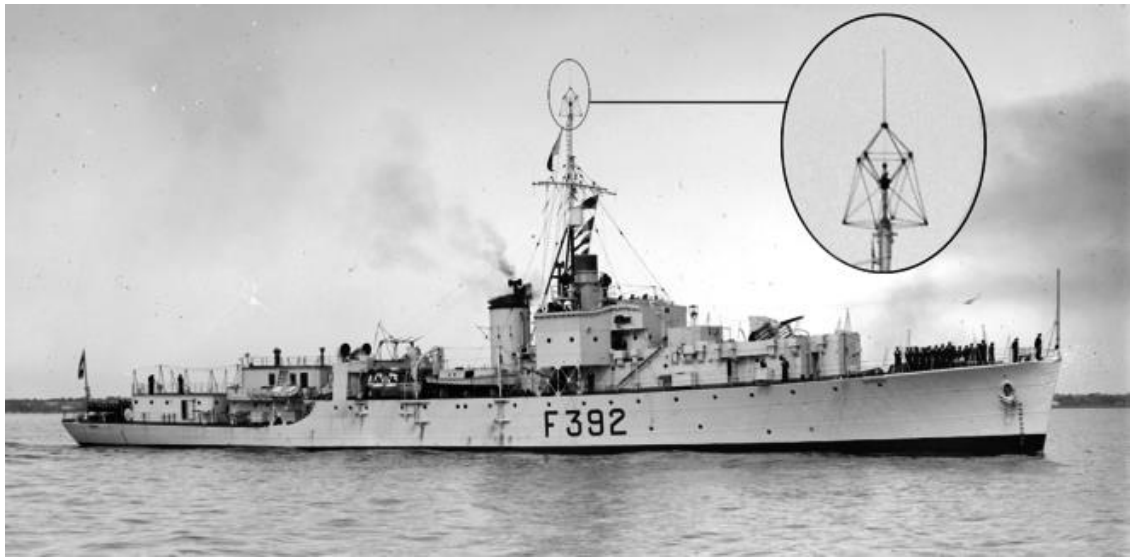


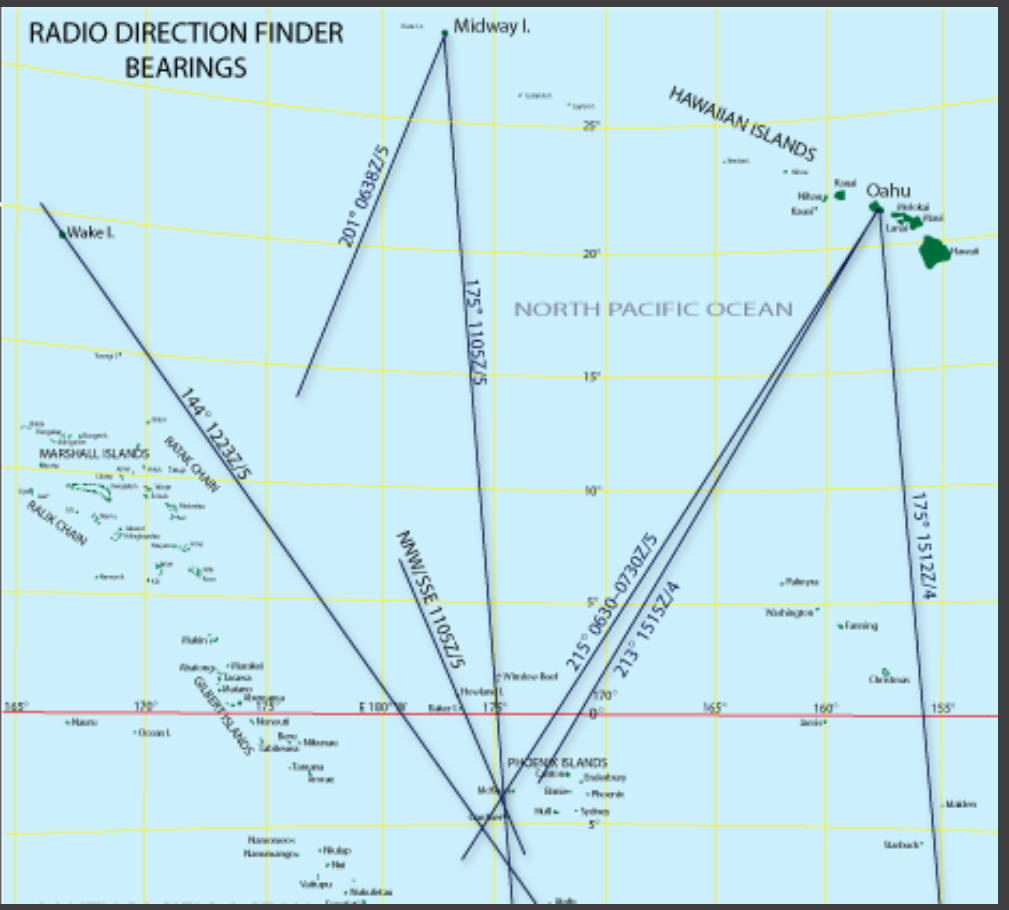
LW Radar Mounted on LST, New Guinea

21.RRB- Ionospheric Prediction Service WW2.



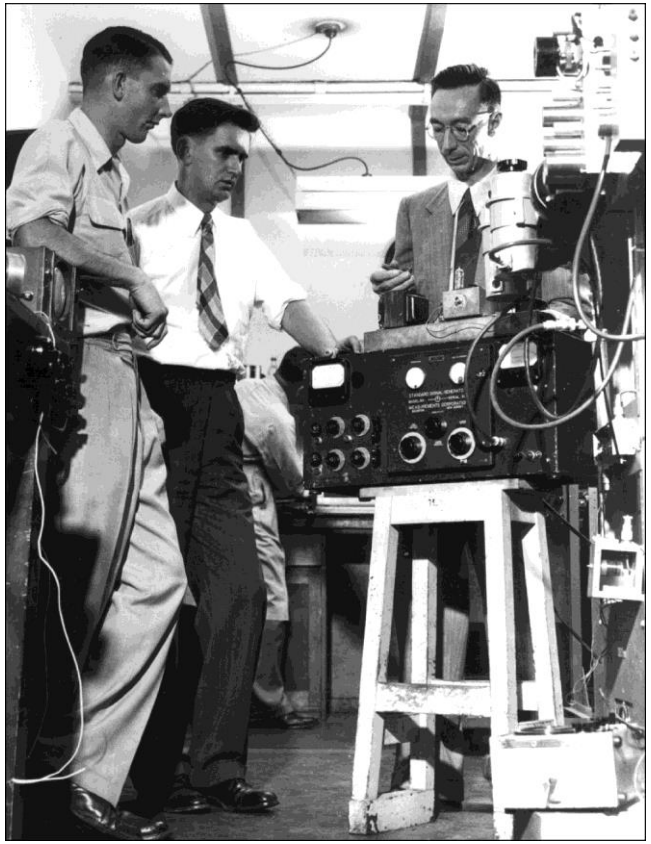
22.Battle of the Atlantic-U Boat Defeat in May 1943.

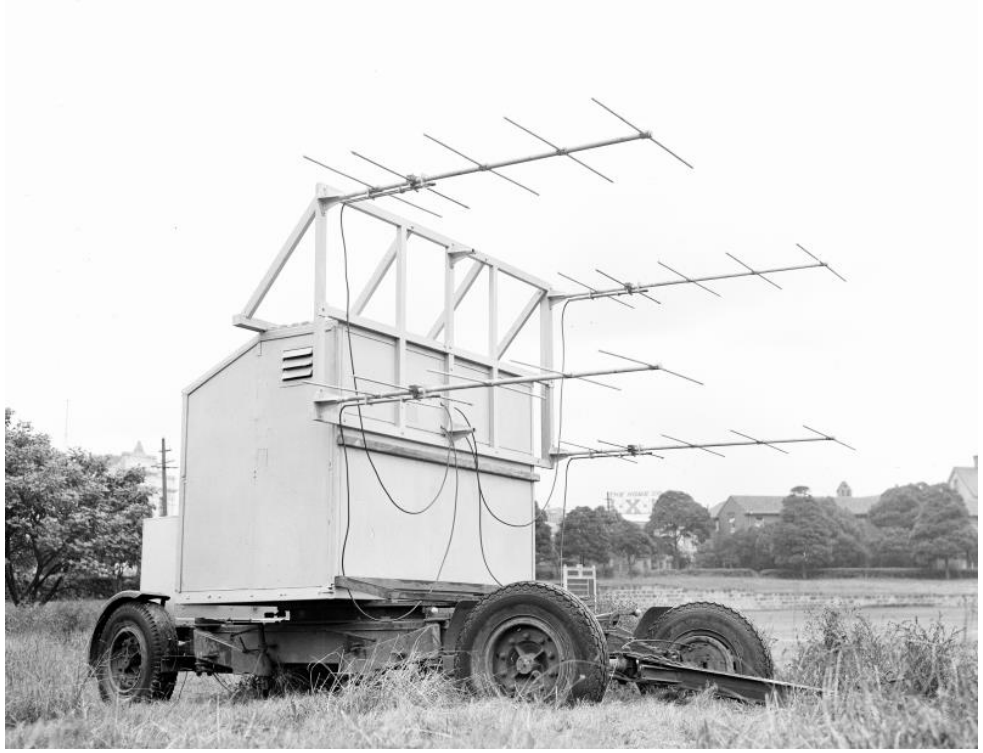




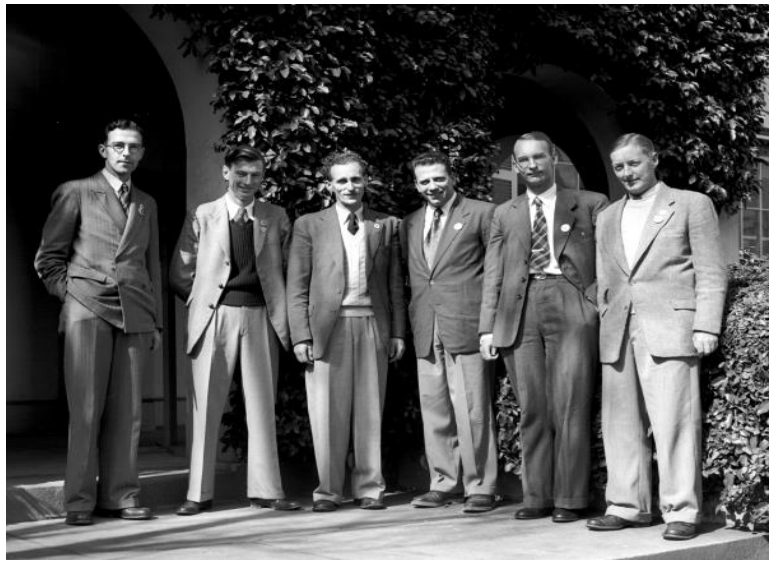
23.RPL Lab, AWA Teleradio, Pan Am Pacific Navigation.

24.Early Radio Astronomy-Joe Pawsey.





25.URSI 1952: The 21 cm Hydrogen Line.



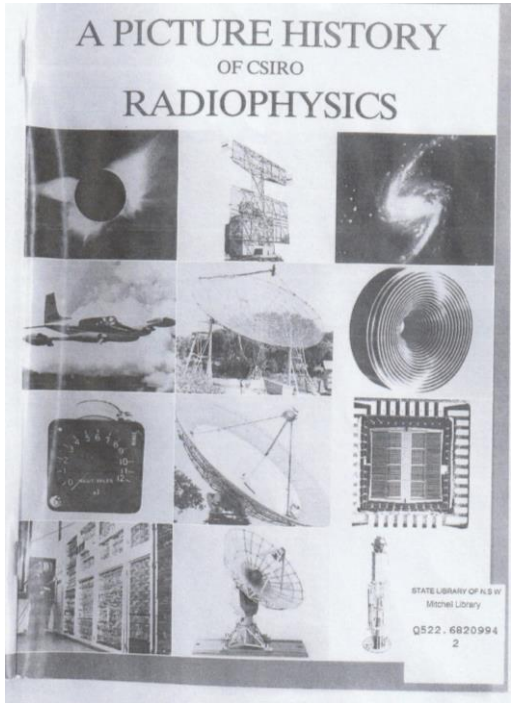
De radio-telescoop te Kootwijk (zie ook de voorplaat). De middellijn van de spiegel is 7½ m. Het gevaarte kan op zijn voetstuk draaien. De spiegel zelf kan omhoog en omlaag gericht worden.

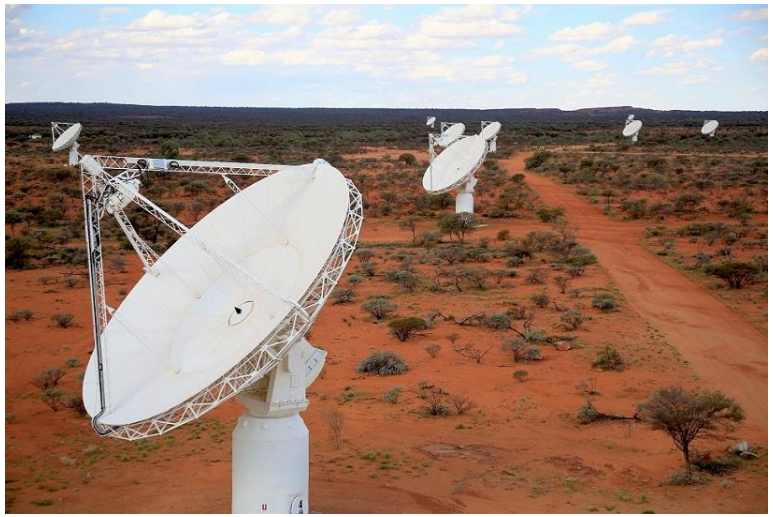
26.Dutch Wurzburg & German Stockert 1955.

27.CSIRAC 1950. Sydney University Computer Conference.

28.RPL Parkes & Narrabri.

29.Voyager, Interscan & Wi-Fi.





30.Jindalee & ASKAP

J P V Madsen BSc, BE, DSc (1879-1969)

Radio & Radio Research in Australia 1927-1957.

Manly Warringah Radio Society June 16, 2021.

Talk by Roger W Madsen at the suggestion of Prof. Philip Leong (VK2APL).

Introduction.

Percy, as he was known was born in Lochinvar in the Hunter Valley-his Mother Annie Bush was born in Gresford near Barrington Tops where her Father was the schoolmaster. His Father, Hans Frandsen Madsen originally from Denmark was a surveyor with the NSW Lands Dept for 36 years.

John Percival Vissing Madsen was the 1st Australian university graduate to concurrently complete the BSc & BE degrees graduating in 1900-1901 at Sydney University for which he obtained University Medals (Mathematics & Civil Engineering). At Adelaide University 1901-1908 he was under W H Bragg (1862-1942) firstly as a lecturer in Maths & Physics then as the 1st Lecturer at the University in Electrical Engineering & with whom he did research experiments in Physics using radioactive material especially radium. JPVM returned to Sydney University in 1909 as Lecturer in Electrical Engineering & continued with radium experiments through to mid 1911 but then concentrated on the engineering work. In 1920 became the 1st & only professor of Electrical Engineering in any Australian University until 1947. In 1926-27 he again took up research, this time with radio becoming the founding Chairman of the Australian Radio Research Board as part of the newly formed CSIR & was to remain Chairman until 1957. At the outbreak of the War in 1939, RRB personnel became the key staff at the RPL (Radiophysics Laboratory) developing radar (RDF) & were supervised by the Radiophysics Advisory Board (RAB) of which JPVM was Chairman until August 1942 & he then continued as a member of the Board until the end of the War. At the end of the War the RPL was the only allied radar research body to remain intact as researchers at MIT (Massachusetts Institute of Technology)& TRE (Telecommunication Research Establishment) mainly returned to their universities. The 1927-1957 era covers the Golden Years of Radio (1921-1950's) & the Golden Years of Australian Radioastronomy (1945-1956). Radar valves being production firsts: Philips EF 50 (1938), GEC VT90 (1939), GEC Resonant Cavity Magnetron (1940).[12.2 cm magnetron anode for microwave oven].

Slide 1: ANCURS 1950 & Textbook of Radar 1947- RPL.

A highlight of JPVM's radio career was as President of the Australian URSI (International Union of Radio Science) Committee for the URSI Congress held in Sydney in August 1952 which was the 1st time it had been held outside of Europe & North America. & was noted for Australia's leading role in the 21 cm Hydrogen Line discovery. The Australian National Organising Committee which JPVM was in charge of as Australian President included many RPL scientist of radar experience who had gone on to radio astronomy after the War (Taffy Bowen [1911-1991], Joe Pawsey [1908-1962]). The Sydney URSI Congress was in recognition of the radio work done in Australia over the previous 25 years.

To make best use of the RPL radar experience gained during the War the RPL in 1947 compiled a Textbook of Radar with Taffy Bowen (1911-1991) as general editor & each chapter written by the most experienced relevant physicist. The dust cover shows the lobe pattern of the LW/AW (Light

Weight Air Warning) set. The Textbook went to a 2nd edition in 1954 with Cambridge University Press.

Slide 2: Madsen Building Sydney University.

In 1939 JPVM was given special authority by CSIR to choose a site & build a National Standards Laboratory (NSL) which he did in the grounds of Sydney University & this building was immediately extended in late 1939 to house the RPL for radar with JPVM in charge of both the sister laboratories. In 1977 CSIRO vacated the NSL & moved to Lindfield as the National Measurement Laboratory (NML) after the earlier move by RPL to Marsfield. In 1977 the NSL was named the Madsen Building by the University.

JPVM's father, Hans Frandsen Madsen (1842-1937) was a Danish surveyor & pioneer telescope maker who lived at Queen Street Newtown, quite close to the University. JPVM is shown in 1909 when he joined the University staff.

Slide 3. Sydney University 1897-1900.

JPVM matriculated in 1896 from Sydney Boys High School with an Honours pass in Physics (no mention of electricity, but by 1905 in William Watson's textbook a great deal [35%] on magnetism & electricity). JPVM's University Medals & IEEE Peter Nicol Russell Medal are deposited with Sydney University Archives with his elder son's (Jack -J A Madsen, [1905-1986]) 1929 University Medal in Engineering.

Slide 4. Early Research Inspired by Ernest Rutherford.

Ernest Rutherford (1871-1937) briefly visited W H Bragg (1862-1942) Professor of Physics at Adelaide University in 1895 whilst going from Christchurch to take up his 1851 Scholarship at Cambridge in the Cavendish Laboratory under J J Thomson (1856-1940) having completed electrical work for his degrees including a magnetic detector for Hertzian oscillations (radio waves). At Cambridge in late 1895 early 1896 Rutherford (1871-1937) used his NZ transient magnetic detector to pick up radio waves at a 1/2 mile range through 6 brick & stone walls & gained a great deal of notoriety for his experimental skill which JJT recognized & soon had him working on new experiments such as X-rays the discovery of which Rontgen (1845-1923) had published in late December 1895. Rutherford came to be known as the greatest experimental physicist since Michael Faraday (1791-1867). In 1897 Rutherford published a paper with the Royal Society on his Magnetic Detector of Radio waves & its practical uses-possibly a lighthouse warning device for ships in fog but not lucrative. ER wavelengths at this time were 6-7 metres. (ER married his wife Mary in NZ in 1900).

W H Bragg was the 1st in Australia to give a public demonstration of Hertzian waves at Adelaide University in July 1897. Bragg in 1898 on a 12 month sabbatical to the UK visited the Marconi works & met Marconi (1874-1937.) It was in 1904 that Bragg famously took up research building on his great skill as a physics lecturer. Arthur Rogers (1860-1939) was the laboratory technician who was making Bragg's apparatus in Adelaide.

In 1894 Marconi visited with Prof. A. Righi (1850-1920) in Bologna & used Righi's 4 ball spark oscillator in his transmitters.

Guglielmo Marconi came from Bologna in Italy to England in May 1896 & promptly applied for a British patent for his improved radio system which was granted & then in June gave a demonstration to the British Government/Post Office no doubt using a bell to show the reception of a radio signal. The Marconi apparatus shown is with Post Office Engineers in May 1897 when Marconi was able to

demonstrate radio waves being transmitted over sea (3 miles then to 10 miles) across the Bristol Channel but only after the aerial was increased by 50 ft to 150 ft (aerials appear to have been a key feature of Marconi's efforts even at Bologna to increase the range beyond line of sight).

In 1901 Marconi made a magnetic wire detector receiver based on Rutherford's principle of 1895 which was more sensitive than the iron filings coherer & was also suitable for shipborne use as it was not affected by vibration. The Titanic / Carpathia liners had Marconi magnetic detectors & saved many lives by picking up the SOS (CQ-D) signal. Marconi's transmitter for the 1st trans Atlantic signal in 1901 was built by Ambrose Fleming (1849-1945) who 3 years later invented the 1st vacuum tube thermionic valve.

Slide 5. Early Pioneers In Electricity, Magnetism & Radio.

JPVM always took a long term view of his plans including a good understanding of the original work done by the pioneers. Left to right but not in chronological sequence: Hans Oersted (1777-1851), Michael Faraday (1791-1867), Heinrich Hertz (1857-1894), James Clerk Maxwell (1831-1879) & Alessandro Volta (1745-1827).George Ohm (1789-1854).

Heinrich Hertz experiments confirming James Clerk Maxwell's theory of 1865 were carried out in 1886.

Slide 6. Adelaide University 1901-1908, DSc 1907.

In February 1903 JPVM submitted a short report on his recent 4 month study tour, at his own expense, of England & America looking at University & Technical College teaching of Electrical Engineering as preparation for the position of lecturer in Electrical Engineering at Adelaide University under W H Bragg. JPVM visited the Cavendish but apparently did not pursue any radio matters which by then was 12 months after Marconi's 1st trans Atlantic signal, of uncertain wavelength. It was not until 25 years later that JPVM undertook his 2nd study tour to look into radio research & physical standards visiting England, America (URSI in Washington in October 1927) & the Continent.

In 1906 JPVM (left) is shown with Bragg in the research laboratory & in 1907 JPVM completed experiments on ionization in gases & published a paper "On ionization remaining in gases after removal of the ionizing agent" for which he was granted his DSc. This knowledge of ionization was to be of great value years later in considering the properties of the ionosphere ("nature''s laboratory") as part of the RRB research from 1927.

The experimental apparatus used by JPVM in 1908 shows his most important work which demonstrated only a single collision by a beta particle/ electron in passing through very thin foils (especially aluminium, but also silver, gold & carbon). W H Bragg who in 1909 had returned to England to take up a position at Leeds University to be near Rutherford at Manchester drew Rutherford's attention to JPVM's experimental results which he was confident with. In May-November 1941 JPVM stayed at the RI (Royal Institution) with W H Bragg.

Slide 7. Rutherford's Nuclear Atom March 1911.

On March 8, 1911 Rutherford wrote to JPVM from Manchester with details of his new nuclear atom which he had announced the night before & asked JPVM for further experiments to prove his theory. Unfortunately JPVM was unable to produce the expected results using thinner foils & Rutherford completed a series of experiments in Manchester confirming the nuclear nature of atoms. JPVM did not pursue any further research work until his RRB activities starting in 1926/27.

Slide 8. WW1 & Roseville Engineers Camp.

JPVM was Chief Instructor & later Officer Commanding the Engineer Officer Training School in Roseville (near the Golf Course) & in December 1917 was involved with organizing a major Military Display including the use of wireless work. Radio for the RAN during WW1 had become indispensable & was used very early in the war by HMAS Sydney in the destruction of the Emden at Cocos Island Communication Station. A crystal radio detector of 1913 invented by J G Balsillie & made by Shaw Works Randwick is shown. (J G Balsillie [1885-1924] was involved with Australia's 1st coastal radio network for use in WW1). In the UK in WW1 at Admiralty "Room 40" decoding of intercepts from the powerful Telefunken transmitter at Nauen near Berlin were helped by the RAN seizure of German naval code books on the steamer" Hobart "on 11 October 1914, an Australian-German boat. The January 1917 intercept by Room 40 of the Zimmerman telegram brought the US into the War in April. In 1916 Nauen transmissions were detected by Australian coastal stations.

Slide 9. British Radio Research Board 1920 (DSIR).

From left to right: Admiral Sir Henry Jackson (1855-1929) -Chairman, Robert Watson-Watt (1892-1973), Edward Appleton (1892-1965), Jack Ratcliffe (1902-1987), Henry Tizard (1885-1959) Secretary. DSIR-Department of Scientific & Industrial Research.

In July 1927 JPVM left with wife Maud (1879-1932) on a 6 month study tour of England, America & the Continent having gained approval from CSIR to form an Australian Radio Research Board comprising Prof. Tom Laby (1880-1946) of Melbourne University, Sir Harry Brown (1878-1967) of the PMG, Cmdr F.G.Cresswell of the RAN & JPVM himself from Sydney University as Chairman. Probably the most important part of the trip was making contact with the British Radio Research Board formed in 1920 as part of the DSIR & chaired by Admiral Sir Henry Jackson who had been a pioneer of ship to ship radio communication in the RN dating from 1897. JPVM was given the forward research programme to be carried out in England & Robert Watson Watt (1892-1973) provided a CRDF atmospheric radio direction finder which was to be used by George Munro (1901-1994) in Melbourne & in fact, on the ship coming to Australia identifying central Africa as a major source. Henry Tizard (1885-1959),was a chemist from Oxford University & a pilot in the RFC in WW1 who had devised an aviation fuel octane rating system in 1921 based on his wartime concern for the performance of aircraft & from that time he had shown a great interest in aviation defence matters & radio in particular. Edward Appleton (1892-1965) & Jack Ratcliffe (1902-1987) from 1920 had been encouraged into radio work by Rutherford who was by then head of the Cavendish.

It appears that JPVM's interest in radio research was prompted by what he may have read in Nature & the Royal Society Proceedings including Appleton in 1925 on the reflection of radio waves from the ionized portion of the atmosphere & radio thus representing a powerful tool of investigation. (also in 1925 G. Breit [1899-1981] & M. Tuve [1901-1982] in the US used a pulse technique for investigation of the ionosphere.) The RCA (ex Marconi in 1920) Radiola super heterodyne set 1st introduced in March 1924 drew attention in the Sydney Press as "A Wonder Broadcast Receiver" albeit 18 months later.

In July 1927 Fisk wrote a letter of introduction for JPVM to meet Marconi in London but the letter addressed c/- the "SS Cephee " at Darling Harbour did not arrive in time. It is not clear who JPVM met at the Marconi offices in London.

JPVM at this time in England arranged for Rutherford, Tizard & Appleton to form a selection panel to choose 3 researchers (D. Martyn [1906-1970), G.Munro (1901-1994) & L. Huxley [1902-1988]) in England to come to the RRB in Sydney & Melbourne. One of the 1st experiments carried out in

Sydney was by Alfred Green (1905-1951) to repeat an Appleton experiment which had been carried out with a transmitter at the NPL (Teddington-National Physics Laboratory) London directed north to Peterborough which showed that the received wave travelling down & nearly parallel to the Earth's magnetic field was nearly circularly polarized & was Left Handed. The Sydney experiment at a similar latitude transmitted from 2BL to the Jervis Bay Navy Station in a southerly direction & the wave travelling in the opposite direction to the Earth's magnetic field, was also found to be polarized circularly, but Right Handed which confirmed Appleton's Magneto Ionic Theory (& no doubt helped him gain the Nobel Physics Prize in 1947).

Slide 10. Australian Radio Research Board 1927.

From left to right: Ernest Fisk (1886-1965)-AWA, David Martyn (1906-1970), George Munro, Jack Piddington (1910-1997).

The main users of RRB research material were the PMG, the RAN, the commercial radio stations mainly in Sydney, Melbourne & Brisbane, & AWA which was majority owned by the Commonwealth Govt. (Fisk was a "Marconi" man).

David Martyn from Scotland showed an exceptional knowledge of the upper atmosphere, George Munro was to give 37 years of service to RRB related positions starting with the Watson-Watt atmospheric programme & Jack Piddington who had trained under Jack Ratcliffe at the Cavendish is remembered for his design of the radar air warning sets during the War, especially at Darwin in early 1942.

Slide 11. Early Research at the RRB to 1935.

It was fortunate that Sir Harry Brown head of the PMG saw the value of the RRB research reports as at the time of the Depression the PMG funded 70% of the Board's costs. Tom Laby (1880-1946) in Melbourne was interested in the atmospheric work for radio stations & made good progress in looking at field strengths of radio transmissions in different regions of Victoria & NSW but in the end it was the advent of the tuned quarter wavelength transmitting mast which favoured the ground wave at the expense of the sky wave which was decided on, increasing coverage, reducing fading & solved the problem of atmospherics using medium wavelengths.

JPVM in Sydney, fortunately for him, led the investigation of the ionosphere using Breit & Tuve's pulse technique & in a summary paper to Queensland University in 1935 showed the reflections from the different regions of the atmosphere. Sir Harry Brown is shown & also the temperature graph of the atmosphere produced in 1935 by Martyn & Oliver Pulley (1906-1966) which was proven to be remarkably accurate in the upper atmosphere but not for the reasons given.

Slide 12. Philips Eindhoven. Gerard, Anton & Frits Philips. Giles Holst.

JPVM became a director of Philips Australia in 1948 & for 15 years attended Board meetings in Sydney & was also involved with setting up a research facility at the Hendon factory complex at Hendon, near Adelaide. JPVM was especially aware of Philips research during the war with tropic proofing work which had been carried out earlier by Philips in the DEI (Dutch East Indies-Indonesia) which was vital to the operation of radar & radio equipment in the SWPA.

Frits Philips (1905-2005), the son of Anton (1874-1951) became head of Philips in 1962 & visited Australia at this time & referred to JPVM as "Uncle John". JPVM had visited Philips in Eindhoven & London in 1949. The older brother Gerard (1858-1942), who founded a light bulb manufacturing business in 1891 in Eindhoven was very good at production engineering & was joined by his younger

brother Anton in 1896 who proved to be very good at marketing the quality Philips product. In 1914 Giles Holst (1886-1968) joined Philips to head a research laboratory starting with X-ray tubes & then on radio valves as an extension of the lamp production. In 1919 Philips were making a copy of a Telefunken radio valve until 1926 when Holst (& Bernard Tellegen [1900-1990] made a significant breakthrough with his power pentode. Research Bulletins from around 1936 were widely circulated, including to JPVM during his time as a Director.

Slide 13. Philips early radio valves & sets-1920's.

At the start of WW1 Philips was asked to carry out repairs on X-ray tubes for the Allies & by 1919 were able to produce its own X-ray tube & this also led Philips into producing radio vacuum tubes, initially a Telefunken valve. In 1926 Giles Holst research had produced a powerful 5 element pentode which gave Philips a big advantage & then realized they could also make a good profit by making the complete radio set starting in1928 (typically with a separate speaker) & then in 1931 produced a compact cathedral radio which had the speaker built in & sold very well.

Slide 14. Philips, AWA-Sydney 1930's.

Philips Australia radio valve production started in Sydney around 1935 in a factory on Parramatta Rd at Camperdown & continued there until Philips factories were centralized at Hendon after the War. The well known AWA tower in York Street was built in 1937-39. The geo-politics of wireless, especially in the 1930's, of the British empire & including extensive reference to JPVM & the RRB research has been analysed by a Spanish author in recent times.

Slide 15. Jansky, EF 50 & Airborne Navigation 1930's.

Several significant radio developments in the 1930's are worth noting:

Karl Jansky (1905-1950) in the U.S in 1931 found that radio waves were coming from sources outside the Earth's atmosphere (from the Milky Way), the investigation of which gave birth to radio astronomy- a significant factor for the course of RPL after the war.

In December 1939 JPVM (with George Munro) flew to London to see Watson-Watt about radar, by the Ç' Class Empire Flying boat which took some 10 hops. The Marconi homing radio navigation system on these planes involved a retractable rotatable loop aerial & a trailing antenna running fore to aft whereby the combined signal indicated whether the plane was either on or off course.

In May & November-December 1941 JPVM flew in Boeing 314 aircraft to the US & England & return. The radio navigation of these planes at this time appears to have used radio direction finding & in the case of crossing the Pacific with Pan Am ground stations at Honolulu, Midway & Wake Island were used. JPVM was on the last Pan Am flight out of Honolulu heading for Auckland before the Japanese attack & learnt by radio on the last leg going to Auckland from Noumea that War had broken out. (In 1935 Hugo Leuteritz [1897-1992] for Pan Am for the Pacific Crossing to the Philippines had devised a navigation system of 8 large Adcock type antennas at each stop-Alameda/San Francisco, Honolulu, Midway, Wake Island, Guam & Manila).

Slide 16. UK Radar (RDF) Development from 1935.

Henry Tizard in 1935 had formed a Committee to consider the defence problem that "the bomber will always get through" & this led to a proposal from Watson-Watt at the British RRB for a radio direction finding method which was concept tested in the Daventry experiment using a BBC

transmitter & led to the Chain Home system (transmitter & receiver towers for a station shown-12 metre wavelength) using commercially available componentry used by the Post Office & radio stations. Taffy Bowen (1911-1991) who came to work at the RPL in 1944 at Tizard's suggestion, has given a very interesting account of this early work & on his own airborne system at 1.5 mtrs & the later 10 cm wavelengths in his book "Radar Days".

Harry Wimperis [1876-1960] (top right) who was on Tizard's Committee, & was a good golfing friend of Rutherford's, came to Australia in 1937 at the invitation of the Australian Government to advise on setting up an aircraft industry in Australia. Rutherford had written to JPVM about this & when JPVM met Wimperis quietly in his Melbourne hotel room he indicated to Wimperis that he thought the UK was working on RDF & this came as a great shock to Wimperis as the work in England was supposed to have been kept highly secret.

Air Vice Marshal Philip Joubert de la Ferte (1887-1965) was on special RDF duties when JPVM was in London in January 1940 & the memorandum prepared jointly by Watson-Watt & JPVM on radar for Australia & NZ was submitted to Joubert for transmission to the Secretary of State for Air Sir Kingsley Wood.(1881-1943) In 1941 (June-November) JPVM was again in contact with Joubert who had become C in C of Coastal Command & trying to deal with the U-boats in the Battle of the Atlantic finally won in May 1943.

Slide 17. Biggin Hill Experiment, Battle of Britain.

The operational technique of how radar was to be used against the expected German bombers & fighters & to become a highly integrated system included the aspect of contact between the sector control & the fighter squadrons in the air. Air Vice Marshal Hugh Dowding (1882-1970) in charge of Fighter Command during the Battle of Britain at the Bentley Prior Filter Room knew only too well that to achieve the greatest effect available to him with RDF he had to husband his squadrons very carefully allowing for rotation to relieve & replenish them with additional planes & pilots. The end result of the success of the Battle of Britain would not have been possible without radar & 100 octane fuel along with the Spitfire & Hurricane combination with the Rotol constant speed propeller. The Chain Home Low sets used in the Battle of Britain may have benefited from the Australian- RPL developed T-R (Transmit-Receive) switch allowing duplexing of aerials. Air Vice Marshal Keith Park (1892-1975) [Uxbridge 11 Group Ops Room Shown on LHS) was closely allied to Dowding's policy & led the vital 11 Group defending London.

Slide 18. The 10 cm Cavity Magnetron 1940, the Tizard Mission & Scientific Liaison.

The 10 cm cavity magnetron invented by John Randall (1905-1984) & Harry Boot (1917-1983) in Mark Oliphant's (1901-2000) Birmingham Physics Laboratory on 21st February 1940 was made into a powerful & stable valve by GEC at Wembley. Sir Mark Oliphant (1901-2000), Sir Frederick White (1905-1994) & JPVM are seen together at a radiophysics meeting in 1957. In early 1941 JPVM arranged with the Commonwealth Government to establish a Scientific attache in the Australian Legation in Washington (George Munro) & took charge himself of Scientific Liaison to the US (MIT-RadLab, Boston-Joe Pawsey) & UK while in 1944 Fred White discussed in America & the UK the requirements of lightweight tropic proofed radars suitable for the southern Pacific area which were different to the conditions in Europe.

Slide 19. Australian 1.5 mtr radar: VT 90 Micropup.

Apart from developing the T-R switch, the first major radar project undertaken by the RPL was for the Army to build a shore defence gun control system for coastal batteries located at Australian

ports which proved to be very successful but were never called on to be used. The RAAF were less interested until Pearl Harbour & Darwin however RPL had made an ASV Mk 1 (Aust) in 1940 & were in the process of redesigning a Mk II (Aust) to overcome a number of problems when an English ASV MkII became available which resolved the issues & so production in Australia, & also in the US, was standardized on this equipment at 1.5 mtrs & used the special radar VT90 radar valve. The AW (Air Warning) set assembled at RPL straight after Pearl Harbour was based on the ASV & Shore Defence sets , benefited from Jack Piddington's pre-war experience at the Cavendish & also on the ASV Mk1(Aust). The 1.5 mtr (200 mc/s) wavelength originated from Taffy Bowen using EMI TV chassis in 1937 for airborne radar. The 1.5 mtr antenna for Australian radars were produced by the NSWGR (NSW Govt. Railway) led by Mr J G Q. Worledge. The IFF system for air warning was crucial & in the case of the LW /AW the "A" scope was used. – IFF MkIII entered service in 1943 & quickly spread.

Slide 20. The Australian LW/AW set.

The best known Australian radar in the SWPA was the LW/AW delivered to the RAAF & US Signals Battalions (100 to the RAAF & similar number possibly have gone to US Signals & 20 to the RAF in Burma). In New Guinea in 1942 it was vital to have forward radar cover in the fast moving encounter & the US forces had nothing at all which could be loaded into a DC3 to fulfill the role. Both the outside view with IFF & an internal picture at the AWM show the hand rotatable base & the transmitter & receiver cabinets. Tropic proofing was an important feature of this set (especially by keeping the valves warm). The US forces also adapted the LW/AW to radar picket boats by mounting them on LST's. Trent Telenko, a subject matter expert with the US Defense Contract Management Agency has supplied this photo & is a keen historian of Macarthur's radar in the SWPA. The LW/AW was slated to be part of US radar in the tentative plans to invade Japan in Operation Olympic.

Slide 21. RRB- Ionospheric Prediction Service in WW2.

The single remaining role of JPVM's RRB during WW2 was to provide an Ionospheric Prediction Service to US & Australian signals units to identify up to 3 months in advance on a 24 hour basis the best frequency to use. The work was carried out by Dr Frank Wood at Sydney University with George Munro in Washington attending meetings on IPS in the US & Fred White also making contributions to this vital service. After the War JPVM had the service transferred out of his research environment to a Commonwealth body specially set up to continue with the work.

The map of stations used by the Allies for IPS towards the end of the War is shown & also Macarthur's rhombic receiving antennas at Capalaba which allowed him voice contact with East Coast America from 1943. Laurie (Laurence) Murray (VK4LO) at Thornlands is very knowledgeable about this high frequency work. The transmitter was 5-6 miles from Capalaba at Hemmant.

Dr Karl Compton (1887-1954) President of MIT is shown with Dr F W G White at the RPL Sydney in January, 1944. JPVM advised Compton on the Operations Research work being done.

Slide 22. Battle of the Atlantic- U Boat Defeat in May 1943.

The role of radio in the defeat of the German U Boats is well known including intercept of "talkative" submarine captains, Huff Duff direction finding on allied warships & airborne radar on long distance Consolidated Liberators (in this case shown with the ASV MkII antenna in 1941) which were in short supply to Coastal Command who had to allow priority to Bomber Command. The Leigh Light in 1942 & Centimetre ASV MkIII in 1943 countered U-Boat tactics.

Slide 23. RPL Lab, AWA Teleradio, Pan Am Pacific Navigation.

The RPL grew substantially throughout the War & an extension to the building was made & the magnetron equipment moved by convoy to Melbourne University to make room. The AWA teleradio was vital to Coastwatchers especially in the Guadalcanal campaign (July 1942- February 1943) when radar in US ships eventually overcame the Japanese night fighting tactics. HMAS Canberra had an Australian 10 cm radar at Savo Island but was not able to make effective use of it under the conditions (no IFF at this stage).

By the time of JPVM's lucky trip back to Australia leaving Honolulu on Wednesday December 4, 1941, Pan Am appear to be using radio direction finder bearings from Wake Island, Midway & Honolulu to determine the boats position probably involving a Sperry Automatic Direction Finder with a loop antenna in a streamlined housing.

Slide 24. Early Radio Astronomy- Joe Pawsey.

Joe Pawsey (1908-1962) who had become part of the RRB programme in 1931 was involved with microwave work for RPL at the MIT Radlab & in Sydney during the War. In October 1945 he had become interested in possible radio emissions from the Sun & using an RAAF 1.5 mtr station at Collaroy was fortunate to pick up signals at sunrise which started him on a long career leading fellow RPL workers in the new field of radio astronomy. Joe Pawsey is shown with 2 very good researchers, John Bolton (1922-1993) & Gordon Stanley (1921-2001) in the early days at Dover Heights when Yagi (up to 12) antennas were used. A mobile 4 Yagi unit was used for a trip to NZ in 1948 & also at West Head.

Slide 25. URSI 1952: The 21 cm Hydrogen Line.

The 21 cm hydrogen line was first calculated in 1944 by Henrik Van de Hulst (1918-2000) in wartime Holland & actually confirmed in early 1951 by *C. Muller & J. Oort (1900-1992) in Holland, *H Ewen (1922-2015) &E. Purcell (1912-1997) in the US & * Chris Christiansen (1913-2007) in Sydney. Chris Christiansen (on the left) is shown at Potts Hill during URSI with Edward Appleton (right-President of URSI), Balthasar Van De Pol (1889-1959) & Fred White. At the URSI dinner JPVM is with Fred White & Edward Appleton. The 16 ft X 18 ft parabola at Potts Hill was used a great deal.

Slide 26. Dutch Wurzburg & German Stockert, 1955.

The Hydrogen Line group at URSI was indicative of the international co-operation in radio astronomy which has continued to the present time. The German Wurzburg used after the War in Holland to detect the 21 cm Hydrogen Line at Kootwijk. The Germans themselves did not use Wurzburgs for their radio astronomy but in 1955 built a dual purpose radar/ radio astronomy facility at Stockert built by M.A.N who went on to build the Parkes telescope.

Slide 27. CSIRAC 1950. Sydney University Conference.

RPL built CSIRAC an early digital computer which was 1st presented at the Sydney University Computer Conference in August 1950, chaired by JPVM. JPVM had recommended the funding of the project.

Slide 28. RPL Parkes & Narrabri.

The Compact Array at Narrabri (1988), the Parkes telescope (1961) & control desk during the Moon landing in 1969 with John Bolton & Taffy Bowen at work.

Slide 29. Voyager, Interscan & Wi Fi.

Notable achievements of RPl were the Wi Fi development by John O'Sullivan's team (John is a BSC-BE double degree from Sydney university) & includes , with the beard, John Deane- [1949-2020, a 2nd cousin of the author]. The Interscan landing system team was led by Paul Wild (1923-2008) in 1977 & the Voyager satellite tracking programme led by Bob Frater (1937-) from 1977 up to the present. Voyager 1 & 2 after 44 years are still transmitting to Canberra Deep Space Station at a distance in the order of 17-20 billion Kilometers thanks to the plutonium nuclear battery, surely a Rutherford legacy.

Slide 30. Jindalee & ASKAP.

Radar defence work after the War in Australia was separated in 1948 from CSIRO & was taken up in Adelaide by what is now the DSTO (Defence Science Technology Organisation). The OTH (Over the Horizon) Jindalee system relies greatly on the measurement of electron density in the ionosphere. The Square Kilometre Array programme at Murchison in WA is a direct descendent of the early radio astronomy work at RPL.