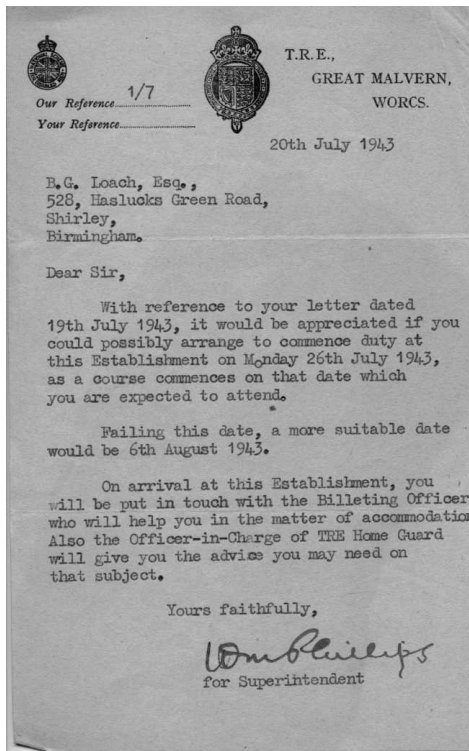


TRE, Malvern 1943-45 -Radar

How Bernard came to TRE is not recorded in detail but it is believed that the authorities were known to have head hunted suitable individuals from the University. Clearly he had shown certain valuable traits beyond just issues of fermentation.

He is recorded in his diary to have actually started at TRE on Sunday 8th August 1943 as Assistant grade 3 in Group 9 in House 8 on the Malvern College site which had been requisitioned under wartime powers. Leslie Mullet with whom he worked records this as the ASV Mk2 group, which coincides with the H₂S group under Bernard Lovell. Air-Surface Vessel radar at this time lead to the development of H₂S, which was primarily a bombing aid. But due to its ability to show the ground features below as a form of map on the display, it was also a navigation aid and became one of the most useful and significant forms of radar to be developed during the war.



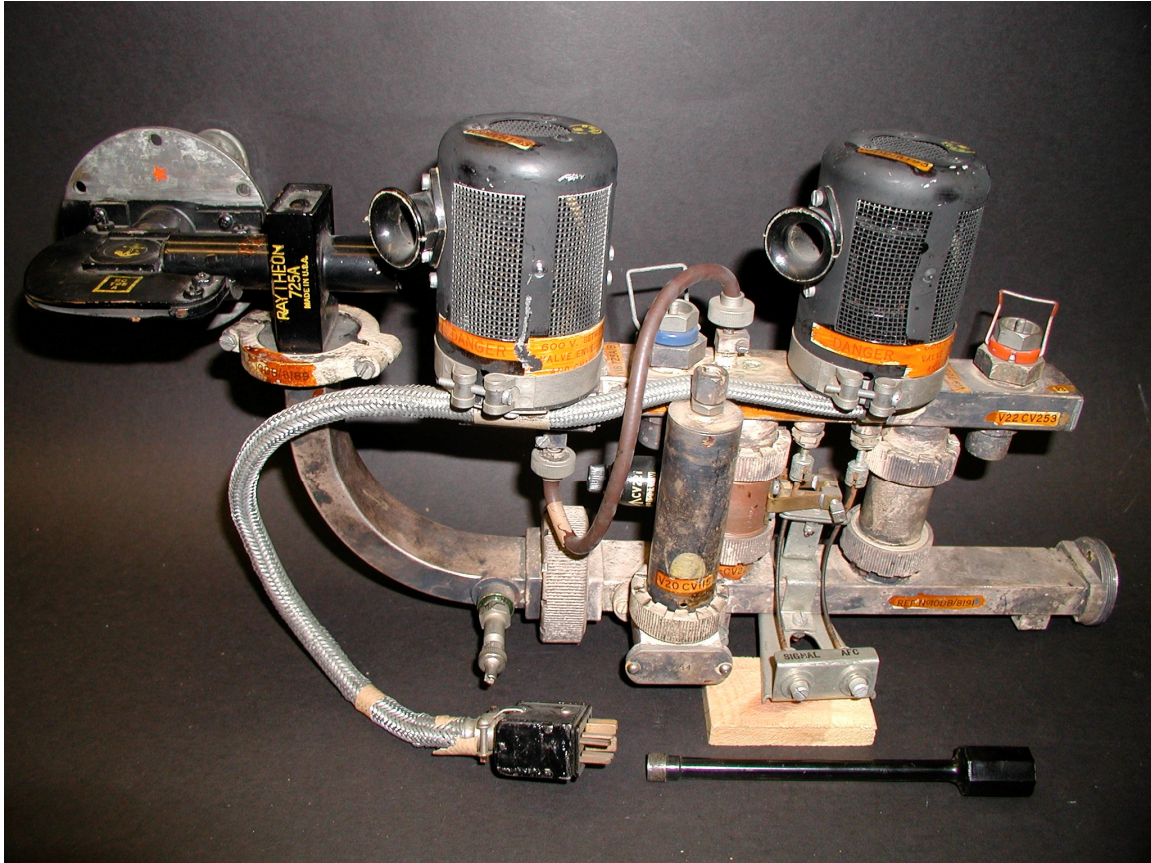
Letter of appointment



House 8, Malvern College (TRE)

During this time he worked primarily on waveguide design problems for radar, in particular H₂S 3cm radar, including the TR3523 transceiver unit for Mk IV H₂S radar and the associated scanners (mirrors-dishes etc). H₂S was adopted in the USA as AN/APS-15. This form of radar works by transmitting a beam of microwave radiation and measuring the time and direction of returned echoes. The earlier versions used 10 cm wavelengths, but the Mk IV version was one of the first to use the shorter 3cm wavelengths which gave a much improved resolution. The transceiver generated the microwave energy which was then piped to the scanner by waveguides, and also received the return echoes picked up

by the same scanner. Klystrons were used to generate the high powers required at this wavelength initially, but for these later versions the Magnetron was used for the first time as it was capable of generating much higher powers at the shorter wavelength, in the order of kilowatts of energy in each transmitted pulse. The magnetron has now of course become common as the power source in the microwave oven.



The heart of the TR3523 receiver, showing magnetron, waveguides and associated receiving equipment.

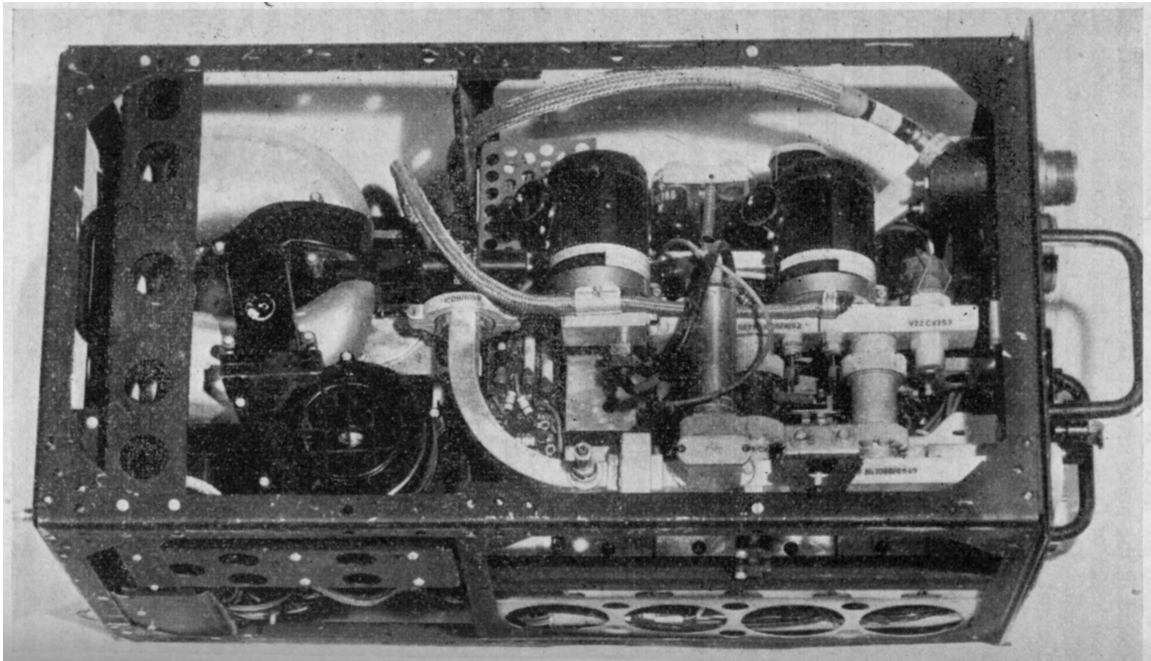
He would have spent time in various hostels away from home for the first time, including the Crown Lea hostel in Malvern. In 1944 he was at Sidmouth House, Worcester Rd.

His job would involve lots of training, note taking etc, which over 60 years later provide a rich source of information. The first notebook reads like a diary.

October 43, many drawings, machine drawing skills.
 Waveguide developments including rotating joints,
 matching into free space (scanner work), mica seals, bends,
 TR Box Mk III,
 Tuning range of American Klystron 723A,
 Swordfish TR3530 working with Mullett, and waveguides (Alan Shaw, 2009)
 Blackburn Aircraft Ltd, Barracuda waveguides.
 TR3523 to be used for H₂S mark IV 1944.

His private diary really reads very boring, many trips to the local picture house, dances etc. Apparently he was still retained in the local home guard. His first pay day was August 31st when he received £13-7-7d. He is clearly very careful not to cross the boundary between secret war work and the outside world. There is one very interesting exception. For 16th November 1943 he says, "went for first flight in Wellington in afternoon over Worcester, Shrewsbury (Wyre Forest) Liverpool and ½ way to Isle of Man, - back in about 1 hour and 50 minutes. To put this into context, these flights (from Defford) were frequent to test equipment. 17 months earlier Alan Blumlein was killed in a famous crash by the river Wye at Welsh Bicknor doing just this kind of exercise. He was testing H₂S in a Halifax bomber, and after the crash priority was given to recovering the secret magnetron. The actual crash was kept secret for several years.

There were many recycled sheets of paper, formerly drawings for TR3523 dated 1943, used for note taking. TRE Report T1690 by Mullet 6/44, "Waveguide report for HF unit TR3523", documents this work but no credit is made to Bernard's work at this stage.



TR3523, complete unit containing the magnetron and waveguides

This work continued until August 1944 when the Test Set 232 Mk 2 project began. This test set enabled bench testing of waveguide components, and included a source of appropriate microwave radiation, means of detection and measurement of standing waves etc. Complete sets of different couplings and transformers were included in a transportable form that could be taken to equipment still installed in the aircraft.

Report T1712 (BGL & Mullett) seems to outline current facts and use of the Mk 1 set, and improvements for a Mk 2 set. One of the improvements suggest that the use of lossy bakelite is not ideal for dummy loads and attenuators, especially as they are affected by atmospheric conditions. The use of wood, in particular, ash, was found to be superior in

these respects! Lists for later versions (1946) show incorporation of the $\frac{1}{4}$ wave American/British waveguide transformer which was invented by Bernard (see later). A BICC sales leaflet, of 1945, seems to incorporate some of these attributes into their 3cm Waveguide test bench.



Test Set 232 with power unit

Other names which appear frequently during his work, include Walkinshaw, and Dee who approved all TRE reports. (for example see “Echoes of War, The story of H₂S Radar”, Sir Bernard Lovell, or “One Story of Radar”, AP Rowe, 1948)

A significant part of the job seemed to involve making machine drawings for ordering parts and modifications from the workshops. In a form of order book are drawings for TR3523b and American test gear modifications, both dated 1/45. Soon after this are drawings related to the start of ideas for a $\frac{1}{4}$ wave American to English waveguide transformer. These drawings continue until March 1945.

Bernard’s report on X band English to American sized waveguide transformers is published April 45, as T1855 (actual report missing, only the manuscript is available). This report recommends the adoption and production of several different transformers for use in place of the tapered transformers used previously. The purpose of this item is to allow the joining together of British waveguide, (which measures 1 by 1 $\frac{1}{2}$ inch) to American waveguide (which measures 0.4 by 0.9 inch). The American guide happens to have the same external dimensions as British waveguide internally, so it can be joined in a way which does not interfere with the electrical continuity of the waveguide system. Simple tapers were previously used but were a compromise in terms of matching. Bernard was able to prove mathematically that, as the external dimension of one was the

same as the internal dimension of the other, by inserting one inside the other and cutting away certain parts of the walls, a perfect match was possible. This invention is referenced/acknowledged by LGH Huxley in his book "The Principles and Practice of Waveguides, 1947.



British to American waveguide matching transformer.
Note also the different union on each type.

Finally, on the domestic front during summer 1945, Bernard built his own radio receiver for use at home. This set was to be used as the family radio set well into the 1960s at Bath St. At this time domestic radio production had ceased for the war and they were hard to get hold of, hence the government initiative to produce basic sets, now known as the "Utility" set. Prior to this he had probably started building this type of equipment before leaving home. Other items like the all wave radio set and others were already built by this date. In May 1945, he started designing an amplifier system for Rodrigo puppets, the show run by his brother Roderick for local charity, which had started during the war years in Aberdovey. This equipment included amplifier, deck, mike, etc all to be constructed during 1946-47.



TRE 1942-43



Radio tuner, Pre Amplifier, and 20 Watt audio amplifier all homebuilt.

During the TRE days there was a social club which met under the name of the Piers Plowman club. This continued to be a very strong social group which continued to hold annual reunions in Malvern up until the 1990s when members were dwindling in numbers or simply becoming too frail to continue to attend. With a noticeable upsurge in interest in wartime radar and other historic issues some further reunions were held in recent years as specific TRE reunion events, but again the original people were becoming of such an age that numbers remaining were becoming very small. In recent years there has been at least one exhibition held in Malvern to mark the development of Radar and these included many photos and interesting displays of equipment.



Inside TRE in college



Possibly VE Day?? Piers Plowman??



Possibly VE Day?? Piers Plowman??



TRE or Piers Plowman?

M.A.P. Form 108

MINISTRY OF AIRCRAFT PRODUCTION
Official Secrets Acts

Special attention is called to the provisions of the Official Secrets Acts 1911 and 1920.

Among other things it is an offence under these Acts for any person to disclose, otherwise than to an authorised person or in the course of his duty, any matter or information which he has obtained or to which he has access owing to his official position. This covers disclosure in any form, whether verbally or in writing or by publication in the press or in book form, and applies to all persons employed in the service of the Crown, not only during the period of service but also after that employment has ceased.

I have received and read a notice of which the above is a copy.

B. G. Loach Signature
LOACH, BERNARD Full Name
GUEST (BLOCK CAPITALS)
Assistant IV Grade
T. R. E. Malvern Branch
6th August 1943 Date

(*9592—X8119 Wt. 11208—303 15,000 5/42 T.S. 700

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