Extracts from....
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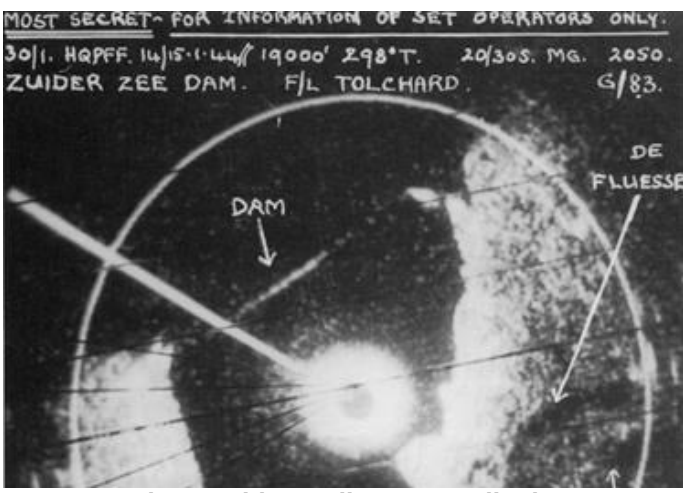
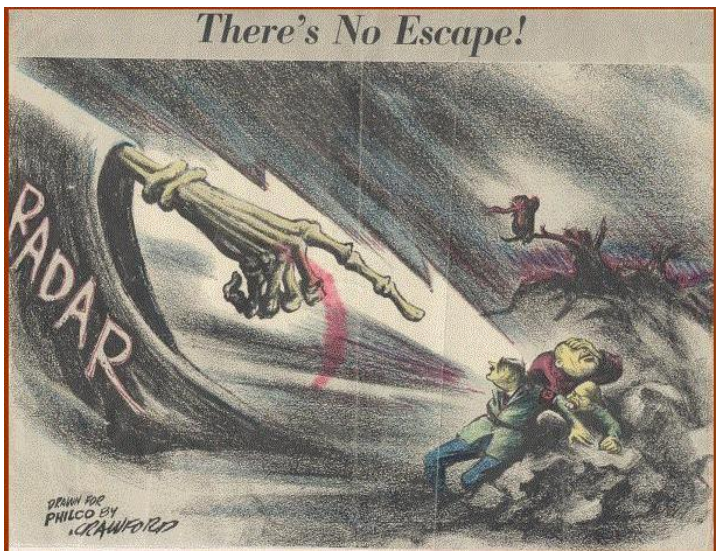
Rule Britannia

I never cease to be surprised by the technically advanced electronic equipment developed in Britain during WWII. British radio manufacturers moved quickly from the production of domestic wireless sets to designing and producing ground breaking communications sets for the military, such as the Wireless Sets No.19 and No.22, which were among the very first sets to incorporate common transmitter and receiver circuitry to make a compact and versatile transceiver. Similar dual-use circuit design was incorporated into the innovative Wireless Set No.38 which was small, light, portable and robust, making it possible to be used on the battlefield by squads and small infantry teams for direct short range wireless communications with section commanders and supporting armour for the first time. The Signals Experimental Establishment developed the Wireless Set No.10, a remarkable set operating at microwave frequencies, providing several channels of secure full duplex wireless telephone communications over distances up to 70 miles and employing sophisticated time division multiplexing techniques similar to those used by mobile telephones today. In 1940, the Telecommunications Research Establishment (TRE) was at the very forefront of primary and secondary airborne radar development at an astonishing rate, enabled substantially by the significant advanced development at Birmingham University that year of the resonant cavity magnetron by John Randall and Harry Boot. The new magnetron achieved spectacular results, producing up to a thousand times the power output of earlier magnetron developments and paving the way for TRE scientists. An airborne radar development team headed by Bernard Lovell came up with practical designs for the highly effective 10 cm H2S, the first ground mapping airborne radar, later versions of which remained in service until the 1980s. Twelve production prototypes of Randall and Boot's resonant cavity magnetron were built by GEC (not to be confused with the American company, General Electric) at their Research and Development Laboratory in Wembley, where it was quickly realised that considerable and unavailable production capacity was required to produce the magnetron in significant quantities.



1944 H2S Plan Position Indicator PPI display photograph used in training RAF bomber crews

Also at TRE, British physicists Samual Curran and William Butement came up with a practical design for what became, alongside radar, one of the most important military developments of WWII, the radar proximity fuse, known as the Variable Time, or VT fuse. Curran and Butement's design used radar signals and employed Doppler techniques to detect the proximity of an artillery shell to its target. The name VT was derived to conceal the fact that radar signals were its primary source for controlling the detonation which was pre-selectable at distances of 3–40 ft from the target. Cambridge radio manufacturer Pye took on further development of the VT fuse as a private venture but was unable to take it to large scale production because of financial and manufacturing capacity constraints at its factories. Artillery and anti-aircraft shells would eventually be fitted with the VT radar proximity fuse, which consisted of sensing and activation circuitry to receive radar returns originating from the firing point and reflected from the target to the approaching shell. The distance of the shell to the target was calculated using accurate Doppler frequency shift measurements between the two received radar signals and the shell automatically detonated once it had achieved the appropriate proximity to the target, resulting in significantly higher levels of efficiency in inflicting damage than had previously been achievable. Alongside radar, developments of the VT fuse were accorded the highest levels of secrecy and regarded as a major contribution to later successes in the invasion of Europe by Allied forces and the destruction of many of the 9,500 V1s launched against London in 1944 and shot down by anti-aircraft guns using the new proximity fused shells.



Radar publicity pamphlet cartoon issued by the Philco Company in WWII

In 1940, Britain was at its lowest ebb, having suffered defeat and enforced withdrawal from France and enduring a prolonged aerial assault by the Luftwaffe over its homelands. Industrial production was stretched to beyond its limits and was incapable of meeting all the demands for equipment being placed upon it. Priority was given to re-equipping the Army after massive losses of equipment in France and, despite stirring speeches from Churchill, there was serious concern within the Government that Britain was in imminent danger of invasion. The possibility of mounting effective defences was limited by the inability to produce new military developments in volume and British hopes turned to the massive industrial capacity of the USA. At the height of the Battle of Britain air campaign in August 1940, Sir Henry Tizard flew to the USA on a mission to offer a package of the most secret British military scientific developments in return for access to US industrial capacity and research and development facilities for the projects in the USA. The remainder of Tizard's team was composed of leading British scientists and senior officers from the three armed services and on offer from Britain as inducements to America for their help with production were advanced developments in the resonant cavity magnetron and revolutionary H2S ground mapping radar, radar controlled VT proximity fuse designs, jet engine developments and the clandestine advancements in Tube Alloys, the cover name for the British/Canadian nuclear weapons development programme. Also in the package were technical innovations such as plastic explosives,

gyroscopic gunsight designs, aviation engine superchargers, power operated gun turrets, submarine detection systems and several other technical advancements developed in Britain in support of the war effort. As an ice-breaker, details of Watson-Watt's Chain Home RDF system, then being used successfully for defence in the Battle of Britain, were revealed to the Americans. Unimpressed, the Americans revealed the existence of their RCA produced CXAM 200 Mc/s ship-borne radar currently being installed in some of their capital ships and which was claimed to have similar capabilities to an individual station in the Chain Home High system used in Britain. However, developments in Chain Home Low, capable of detecting low flying aircraft and which employed narrow beam rotating scanner aerials (originally turned by WAAFS pedaling bicycle-driven chains) and CRT plan position indicators (PPI), elicited a slightly warmer response. Introduction of the GCI ground control interception radar, under development at TRE, created more excitement but when "Taffy" Bowen, a member of the Tizard Mission, introduced the resonant cavity magnetron, which was capable of producing 10 kW at 10 cm frequencies, American interest perked up considerably. Their own efforts in radar development had been hindered by the limitations of the klystron, which had been at the core of US radar development efforts to date and which could only operate at low frequencies and at low power. They were quick to grasp the quantum leap that the small and powerful magnetron could provide in performance, size, weight and tactical superiority that high power centimetric radar made possible. From then on, the alliance between America and Britain in radar development and production was assured, but it was at considerable cost to British industry and their post-war commercial technology interests. With the full connivance of the British Government and military, Tizard had freely handed over a great deal of hard won British technology development secrets to American universities and industry which were greatly enriched by vast wartime production contracts and considerable financial investment. The technologies they had been given were fully exploited by a hugely prosperous and powerful post-war USA while bankrupted Britain had to rebuild its severely damaged industry, infrastructure and economy with a population that was exhausted and impoverished by six years of all-out war against the Axis powers.

Sources:

The Tizard Mission to the USA and Canada by E.G Bowen
http://www.radarworld.org/england.html
The National Archive, Kew

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