Exercise Feeler – A Precursor To D-Day

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The landings on the beaches of Normandy on 6 June 1944 by thousands of men, their equipment and all the paraphernalia of war was the greatest feat of massed onslaught on an enemy coast ever seen in the history of mankind. It is a story that has been told and retold many times.

Missing, though, from almost all the accounts of Operation Overlord is any reference to the part played in this epic by the radar and radio systems of the invading forces. This is probably not surprising given their highly technical nature but it should never be assumed that their role was peripheral to the fighting. Without radar cover and radio communications of the highest order chaos would have reigned and the outcome might have been rather different.

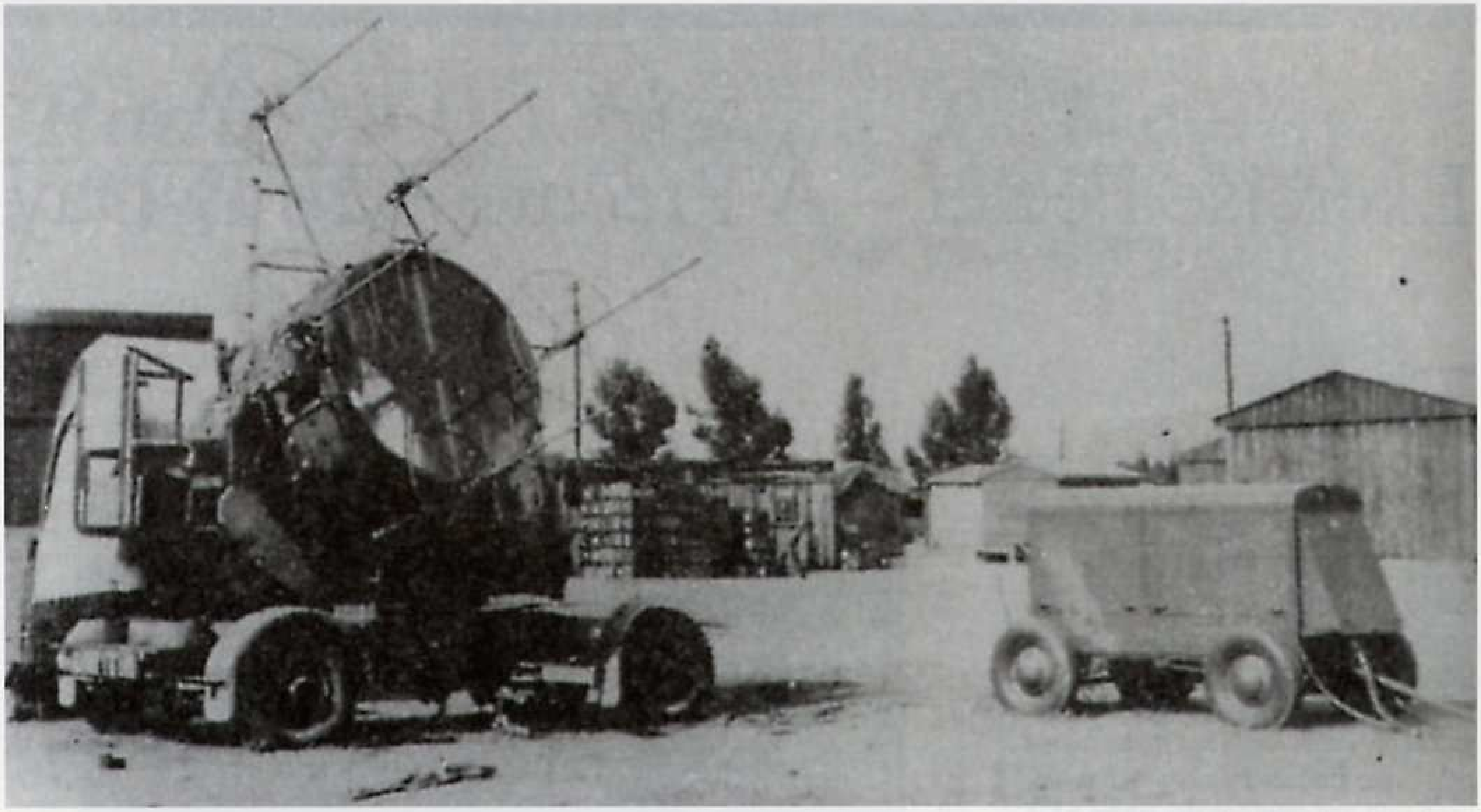
Mutual Interference

It was Brigadier Basil Schonland [1], scientific adviser to General Montgomery's 21st Army Group who on reading the reports about Operation Torch, the Allied landing on the coast of French North Africa in November 1942, first realized the danger of serious mutual interference between the radio and radar systems that were vital to the success of such a vast combined operation. The fact that the planning of a much more massive landing on the beaches of Normandy, to which Schonland was privy, was already well under way made the matter urgent and he immediately informed Brigadier A P Sayer, soon to become Director of Radar in the War Office. An assessment was therefore vital.

B.F.J. Schonland as a colonel in 1942 when he was superintendent of the Army Operational Research Group (AORG)

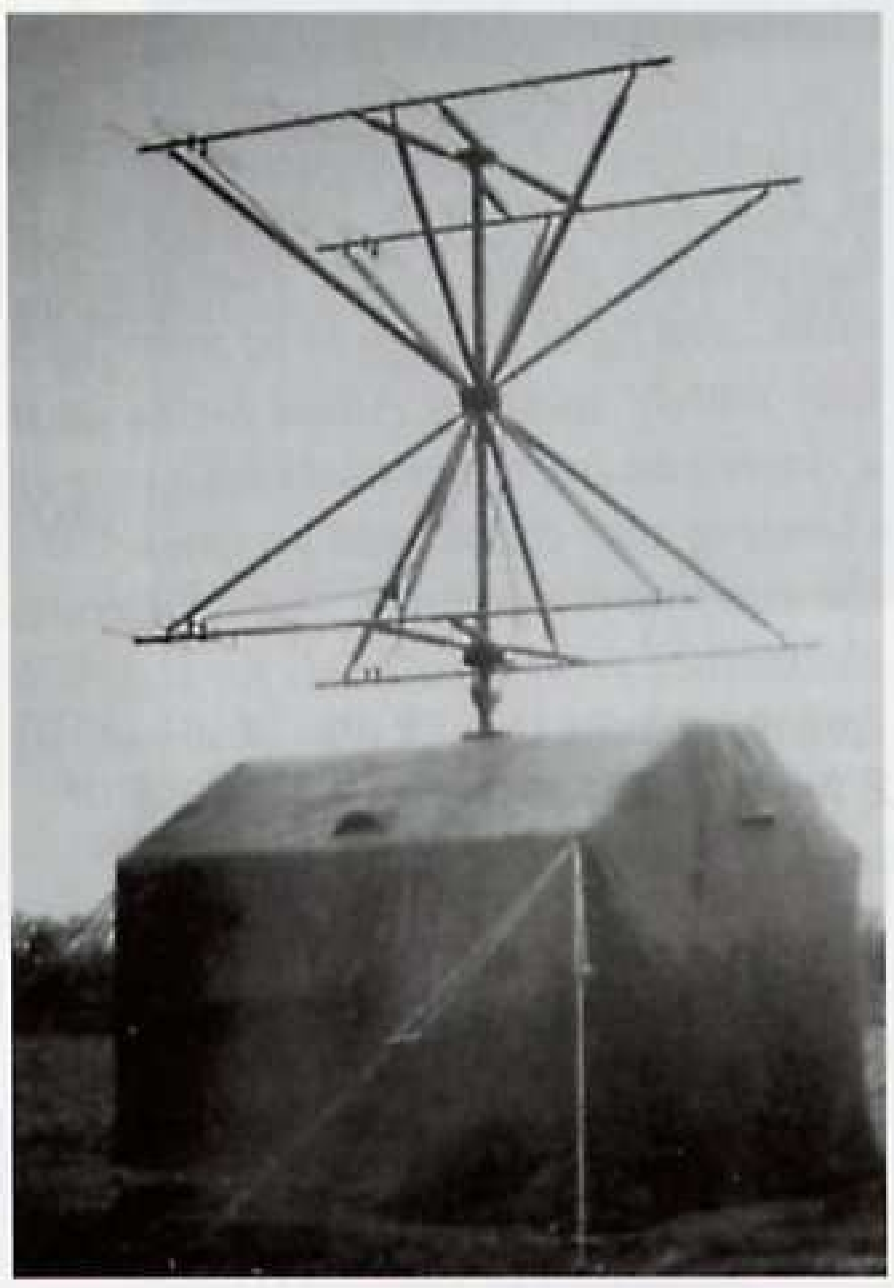
Schonland, a South African, was one of his country's leading scientists who, at the outbreak of war, was made aware of the secret of RDF as were his counterparts in the other Dominion nations Australia, Canada and New Zealand. By December 1939 his small team of engineers and physicists in Johannesburg had produced a working radar set that received its first 'echo' from a nearby watertower [2].

Six months later South African-designed RDF equipment was operating in defence of the Kenyan coast against possible attack by the Italians and, soon after, the first of many improved versions of this JB radar went into service around South Africa's own coastline. Three JB sets were also deployed in the Canal Zone to provide radar cover against air attack on that vital sea-lane and their performance was highly commended



Searchlight Control radar (SLC or Elsie) with its 200MHz Yagi antennas mounted on the searchlight

by the RAF. In 1941, at the invitation of John Cockcroft, an old colleague from the Cavendish Laboratory at Cambridge, Schonland became Superintendent of the Army Operational Research Group in Richmond and from there took up his appointment under Montgomery just prior to the Invasion.



Light Warning (LW) radar operating at 200MHz. These lightweight systems with their four Yagi antennas were usually the first to land on the beaches

The Exercise

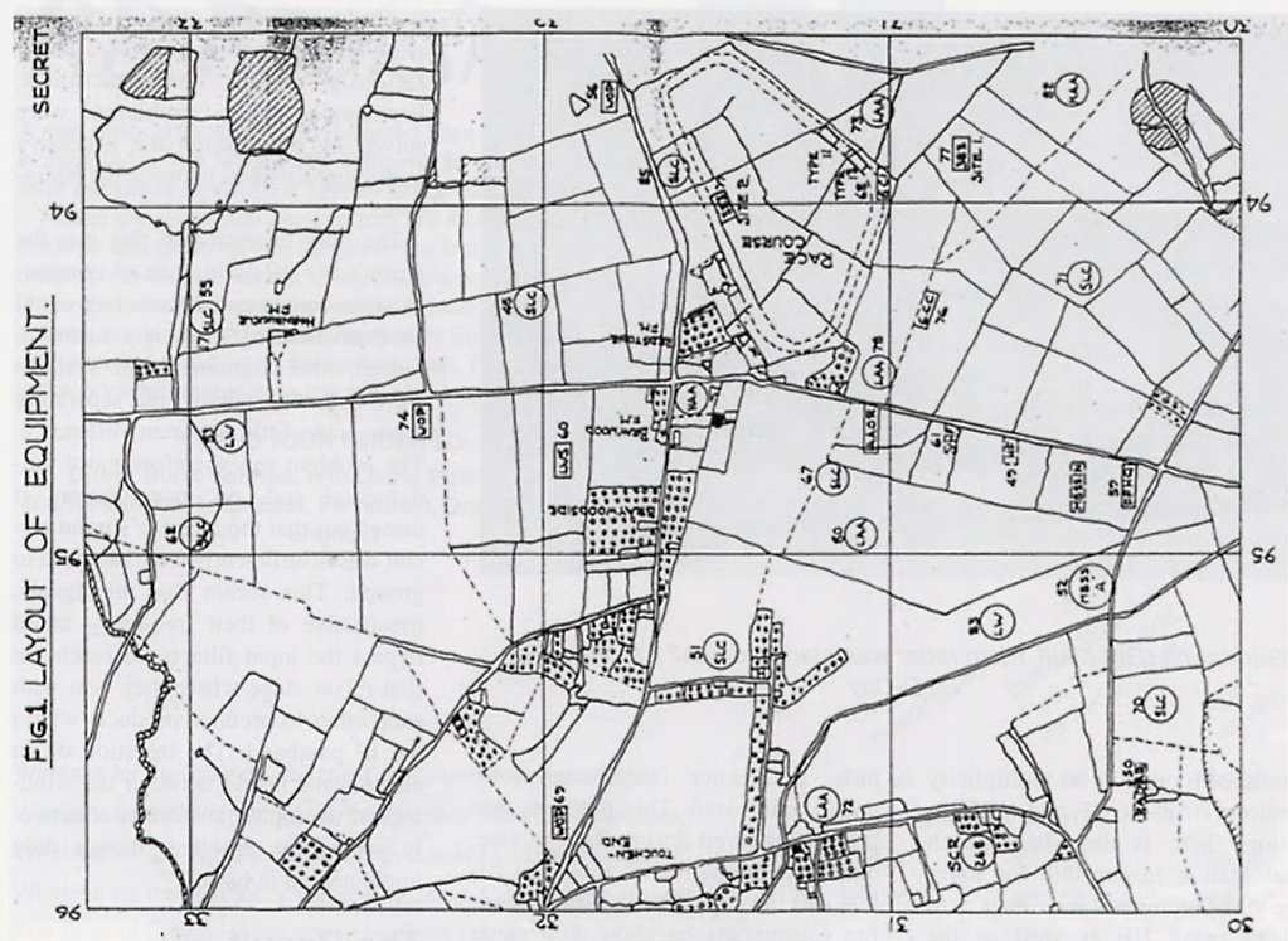
To ensure that the radar and communications equipment to be deployed on the Normandy beaches during the early phases of an opposed landing would not interfere with each other Schonland planned a special trial. Named Exercise 'Feeler' [3], it took place over ten days in December 1943 on a heavily guarded site near White Waltham in Berkshire (see map). Examples of every type of radar set to be used during the invasion were set up in an area of about eight square kilometres. Their relative positions and the distances between them were carefully chosen to represent, as accurately as possible, their disposition on the invasion beaches soon after D-Day.

Radars from all three British services were deployed. These were the SLC, Baby Maggie, LW and GL Mk IIIB of the Army; a type 277 radar from the Royal Navy, plus GCI and types 11 and 13 sets from the RAF. In addition, an SCR268 radar was set up to represent the American equipment operating on the British flank. Every radar installation was also equipped with its appropriate radio communications facilities operating at HF and VHF. These ranged from the 250W No.12HP transmitter of the Army to the ubiquitous Nos.19 and 22 sets, producing 50 and 5W respectively, as well as the No.26 multi-channel telephony equipment running 100W between 80 and 95MHz. Numerous other transmitters and receivers such as the Nos. 17, 36, 107, 109 and 208 were also deployed.

The RAF communications equipment included the high power T1190 HF transmitter, the 50W T1154 and R1155 transmitter/receiver combination which operated at MF/HF, types T1478 and R1481 VHF equipment and various other sets that covered the spectrum from 100kHz to 120MHz. The Royal Navy's hardware (with some deployed in vehicles to simulate the ships off-shore) included the TCS transmitter and B28 receiver at HF as well as VHF equipment, known as Stratton, operating between 85 and 95MHz.

The objective of the tests was carefully defined: "To ascertain the degree, nature and origin of mutual interference which is likely to be experienced if Naval, Military and Air Force radar and communications equipments are operating on land under congested conditions in the early stages of an opposed landing". From the findings suitable recommendations as to possible modifications to equipment and methods of deployment would be made and put into practice.

The complexity of the problem is well illustrated in the diagram from



The layout of the various radio and radar equipment at White Waltham during Exercise Feeler

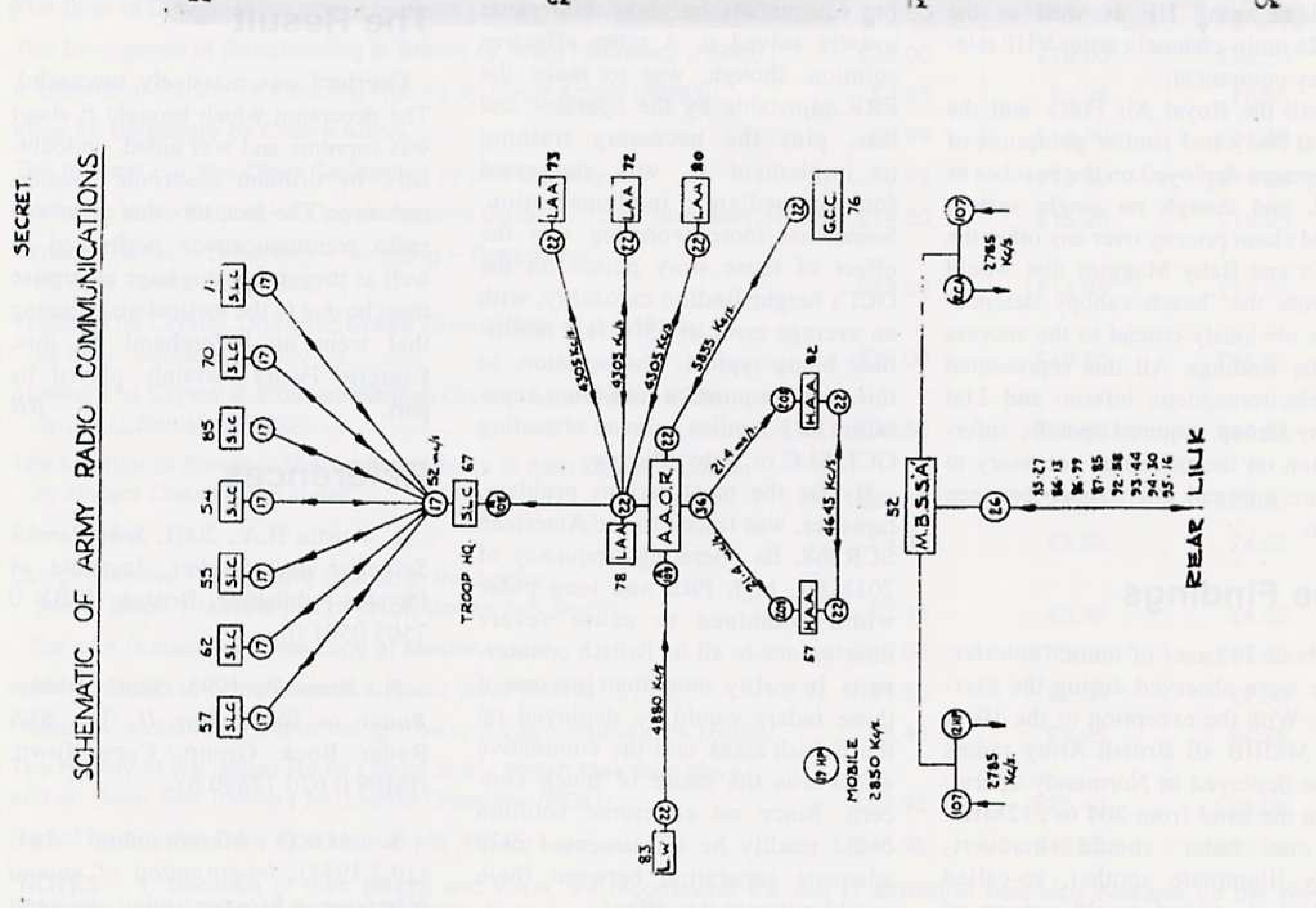
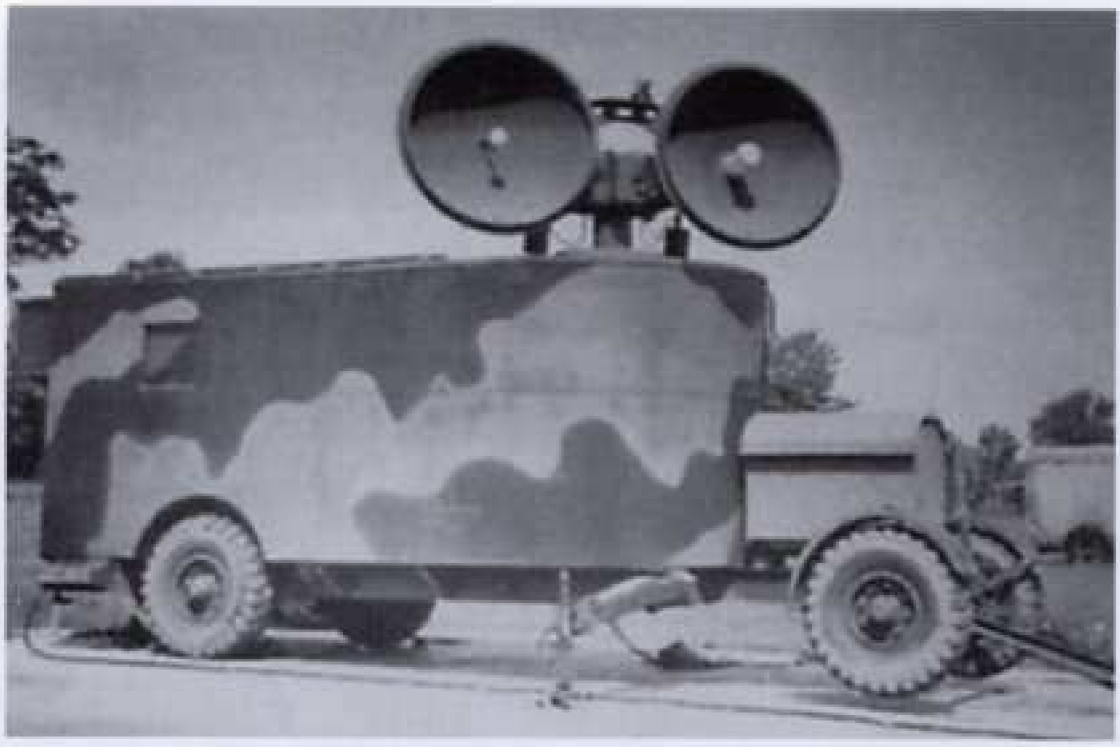


Diagram from the official exercise report showing the army radio communications nets for the exercise and ultimately on the beaches of Normandy

the Army Operational Research Group's report on the exercise. It shows the network of equipment to be deployed on the landing beaches. Amongst them are the SLC searchlight control radars with their individual No.17 transmitter/receivers for co-ordination purposes; the LAA light anti-aircraft gun sites and the LW light warning radars with their No.22 sets; as well as the heavy anti-aircraft, HAA, emplacements with their Baby Maggie and GL MkIIIB radars plus radio equipment. All were under the control of the Anti-Aircraft



Gun-laying (GL) MkIII 10cm radar was standard in all AA batteries on D-Day

Operations Room with its multiplicity of radio systems at HF and VHF. In addition, there is the Main Beach Signal Station responsible for long-range communications back to England using HF as well as the No.26 multi-channel carrier VHF telephony equipment.

Both the Royal Air Force and the Royal Navy had similar groupings of equipment deployed on the beaches as well, and though no single system could claim priority over any other the SLCs and Baby Maggies that would provide the 'beach canopy defence' were obviously crucial to the success of the landings. All this represented an electromagnetic inferno and 21st Army Group required specific information on the measures necessary to ensure minimal interference between them.

The Findings

About 30 cases of mutual interference were observed during the exercise. With the exception of the 10cm GL MkIIIB all British Army radars to be deployed in Normandy operated in the band from 204 to 212MHz. If one radar should inadvertently illuminate another, so-called 'unlocked pulses' would appear on the cathode ray tubes along with those of the required target.

If the radar frequencies were well separated the effects were not unduly serious as long as the respective pulse recurrence frequencies were not synchronised. This problem was indeed observed during the exercise, but the combination of anti-jitter filters and the separation of the offending equipments by about 800 yards usually solved it. A more effective solution, though, was to make the PRF adjustable by the operator and this, plus the necessary training to implement it, was suggested for immediate implementation. Somewhat more worrying was the effect of these stray pulses on the GCI's height-finding capability, with an average error of 1300 feet in altitude being typical. The solution, in this case, required a minimum separation of 1-2 miles from an offending GCI, SLC or Baby Maggie.

By far the most serious problem, however, was traced to the American SCR268. Its operating frequency of 201MHz, high PRF and long pulse width combined to cause severe interference to all its British counterparts. In reality, more than just one of these radars would be deployed on the British flank and the cumulative effect was the cause of much concern. Since no electronic solution could readily be implemented only adequate separation between them would mitigate this effect.

Whenever a radar antenna pointed at a communications site direct breakthrough of the powerful radar signals desensitised the receiving equipment. In addition, all the radars were shown to produce spurious emissions at discrete HF frequencies and these could seriously disrupt communications. Fortunately, both problems were solved by establishing the necessary minimum distances between the equipment.

The only exception to this was the Army's No 26 multi-channel communication equipment. Its receiver could be overwhelmed when any radar or, indeed, other communications systems were operating nearby and separating them made little apparent difference. The problem was therefore more fundamental and, on investigation, it turned out that the receiver's input circuit was insufficiently well-balanced to ground. This meant that all signals, irrespective of their frequency, could bypass the input filters and reach the first mixer stage where they beat with each other to produce products within the IF passband. The insertion of an electrostatic shield between the windings of the input transformer effectively solved the problem. It was duly implemented in haste.

The Result

Overlord was massively successful. The deception which brought it about was supreme and was aided, undoubtedly, by brilliant electronic countermeasures. The fact, too, that radar and radio communications performed as well as they did in this huge enterprise must be due to the meticulous planning that went on beforehand. In this, Exercise Feeler certainly played its part. ***RB***

References

1. Austin B.A., 2001, *Schonland – Scientist and Soldier*, Institute of Physics Publishing, Bristol, (ISBN 0 7503 0501 0).

2. Brain P., 1993, *South African Radar in World War II*, The SSS Radar Book Group, Cape Town, (ISBN 0 620 17890 6).

3. AORG Memorandum 281, (19.2.1944), *Investigation of mutual interference between radar and communications equipments under the congested conditions of an opposed landing: Final report on Exercise 'Feeler'*, Public Record Office WO 291/614.