

THE APPLICATION OF RADAR IN THE UDF DURING WORLD WAR II

Throughout the history of large decisive campaigns and wars, and more so when opposing forces are clearly defined, appearing on a massive scale, conventional weapons and methods of warfare are produced in enormous quantities, to be used by every able-bodied person available; this because every war holds the threat that a state of attrition will be reached when superiority in numbers will tip the scales. To bolster morale, to minimise what is indeed a fateful attitude, a great deal of effort and energy is devoted to developing the secret weapon, the one that will more than restore the balance. Such were in their time: ballistae, the short sword, bows and arrows, gunpowder, breech loading rifles, machine guns, submarines, aerial bombs, tanks, and poison gas. The World War II crop was roughly: Blitzkrieg, radar, V.-type bombs and the atomic bomb. Great leaps ahead like these, in advance of current practice, were the fruits of labour by devoted and untrammelled "Backroom Boys". They produced the strategic ideas and material which were then handed over to the combat forces to exploit tactically. With a strong element of secrecy and national security ever-present, it was invariably necessary to create new units in the field for such exploitation, rather than to extend the functions of existing organisations. It is against this background that the development of radar in the South African Armed Forces must be seen.

Great Britain, 1938-1939

The 'known' or current technique of locating aircraft was at this time Sound Location, i.e. listening for the sound of the engines with directional microphones. This was a method used towards the end of World War I and developed in the years between the wars to an advanced stage, especially in the USA, where the Radiolocation idea had not germinated. However sophisticated this method may have become, it cannot be compared with Radiolocation, or even called the forerunner or harbinger, because only direction information was obtained on the spot. The vital element, range, had to be calculated from information obtained from more than

one apparatus. The discovery of Radiolocation is not at issue here; sufficient to say that from the time of the Munich crisis British military authorities and scientists knew it to be imperative to install whatever radiolocation equipment they could manufacture in stations along primarily the East coast, so that sufficient warning of the approach of bombers could be obtained for Anti-Aircraft batteries to come to the ready, and for combat aircraft to be in position over France or over the Channel, to execute their defensive tasks. High Chain (CH) and Low Home Chain — [C(H)L] stations were erected and, later, Aircraft Interceptor Radar was incorporated in Spitfire aircraft, operating in a nightfighter role.

Even before the declaration of war scientific and military authorities, in that order, were given an inkling of what Radiolocation was all about, and furthermore, that South Africa, Canada, Australia, New Zealand and India must design and build their own equipment as Britain had her hands full and would not be able to export that sort of material for some considerable time after the start of a war, if indeed at all.

South Africa, 1938-1939

The message about details (Radiolocation techniques and possible developments) was conveyed to Dr Basil Schonland personally by Dr Ernest Marsden, a New Zealand scientist, on his way home. It is on record that their meeting took place aboard a mailship between Cape Town and Durban.

Dr. Schonland was then the Director of the Bernard Price Institute of Geophysics at the University of the Witwatersrand, Johannesburg, and he arranged with the UDF authorities for preparatory work to be done at his Institute and in the Department of Electrical Engineering (across the road) where Dr Bozzoli was Professor of Electrical Engineering.

The South African Corps of Signals became the military administrative control; obviously well-suited to do so in all respects, especially insofar as secrecy was concerned as the Director of Signals (Colonel Freddie Colins) al-

ready administered the Intercept and Cryptographic departments, important elements of Military Intelligence.

When war was declared the Special Signals Services (SSS) came into existence, with Headquarters at the Bernard Price Institute, using the workshops there. Accommodation and other military facilities were provided by Witwatersrand Command.

Recruiting was done by word of mouth, mostly within the South African Universities, whence came the Staff: Professors Hodges (Durban), Bozzoli (Wits) and Phillips (Durban); and graduates Hewitt (Rhodes), Gane (Rhodes), Roberts (Cape Town), Boden (Durban) and many others.

Training in the construction, operation and maintenance of Radiolocation equipment took place at the Bernard Price Institute and at Howard College, Durban. At the latter institution Professor Clarke, with a small staff, undertook the 'crosstraining' of SSS recruits with a grounding in subjects outside Light-Current Engineering discipline into, shall we say, Radiolocation Electronics.

In the beginning the arrangement was for the man who built and installed the set also to operate it, a workable concept as the first sets were to be deployed outside the borders of the Union. During the latter half of 1940, however, it was decided to form a chain of stations along the coast from St Lucia, on the remote Natal North coast, round to Veld-drift, north of Saldanha Bay, in the Cape Province. This undertaking would overtax the technical manpower if the Operator-Mechanic system was to persist, consequently the Radiolocation Operator came into being here as was already the practice overseas. SAWAS officers, Miss Nancy Blue and Mrs Hartshorn (wife of the Brigadier, 2TS) were seconded to the SSS to attend to the recruiting and training of women as operators and Filter Room personnel.

UDF Radiolocation outside the Union borders

The first two sets were designed and built at the Bernard Price Institute, numbered JB 1 and JB 2, to indicate their place of origin, and shipped to East Africa to operate with the UDF at, among other places, Mombassa. As the campaigns in Africa progressed, this equipment moved north, to end up at El Arish, in the Suez Canal zone; this time no longer with the UDF, but with British Forces. By

mid-1941, the sets were recalled to the Union, as the SSS effort was being concentrated on the defence of ports and the South African coast.

UDE Stations

From the beginning of 1941 the British authorities were in a position to provide South Africa with Radiolocation equipment. It is known that some of the sets were lost in transit as the result of enemy action, but ultimately the SSS was fully equipped to put the coastal chain into operation, without any gaps, using CH, Low Overseas Chain [C(O)L] and Anti-Aircraft sets. The C(O)L sets replaced most of the JB and JB Mobile equipment which had rendered valuable service for a period in excess of one year. In addition, one ASV I¹ and quantities of ASV II were delivered for installation in SAAF aircraft, together with some YH and YJ beacons. All ground-based installations were designated UDES, following the British practice of AMES (Air Ministry Experimental Station). The equipment mentioned above was all metric or long-wave in design as such was the state of the art at the time. It was only towards the end of 1941 that the microwave equipments, CD and CA² became available in South Africa. It was also about this time that the name 'Radar' came into use.

Scope

The SSS progress and development, in its separate roles, took place along chronologically parallel lines: UDE Mobiles (JB's) were deployed; SSS sub-HQ's opened at Durban and Cape Town, together with their associated Filter Rooms (at Brighton Beach and German Club respectively); AA, CD and CA stations installed and manned; ASV I fitted (at Wingfield) and tested in an Anson of a Coastal Reconnaissance Flight; ASV II installed in Ansons and Venturas (at Youngsfield, Ysterplaat and Darling); personnel detached to SAAF to install, operate and maintain airborne radar in Squadrons based at stations in West Africa, Palestine, Western Desert and in Italy and two GCI³ systems operating in Libya, later in Italy.

1. ASV: Air-To-Surface Vessel an airborne radar apparatus for detecting, and ranging on, floating craft.
2. CD. CA: Coast Defence and Coast Artillery radar.
3. GCI: Ground Control of Interception. Similar to Anti-Aircraft radar.

Deployment

The first JB equipment installed as coast-watching radars, either in the mobile or static configuration, used the 'separate T-R' technique, which means that two synchronously rotatable antennae (broadside arrays mounted on vertical poles coupled — ganged — with a hand-operated chain-drive) supplied the necessary range and bearing information to the display. This arrangement was mechanically tiresome, clumsy and not very accurate; the advent of 'common T-R working' (single, hand-rotatable antenna) was an improvement welcomed by all Radar Operators. When this was followed shortly afterwards by the power-driven C(O)L type of equipment, the SSS Headquarters' staff could confidently leave the operation in the hands of the gentler sex.

The deployment of Radar equipment was as follows:—

1. UDE Stations in the Cape Area:

- Baviaansberg — JB
- Ysterfontein — C(O)L
- Somersveld — CH
- Blue Hills — JB, followed by C(O)L
- Signal Hill — JB Mobile
- Karbonkelberg (Fort Collins) — CD and NT 277A
- Cobra (Slangkop) — JB
- Rooikrantz — CD
- Cape Point — CD
- Hangklip — JB
- Silversands — C(O)L
- Hermes (Port St. Johns) — JB, followed by C(O)L

These stations reported results to the Filter Room at, successively, Signal Hill, The German Club and The Castle. In addition, AA Radars were installed on Green Point Common with the AA batteries and CA (Gun-laying) equipments for 9.2 inch guns at Robben Island, Llanelly (Apostle) and Simons-town (Scala) Batteries.

2. UDE Stations in the Eastern Province and Border Area:

- Sea View — C(O)L
- Cape Receife followed by C(O)L
- Mount Pleasant — (C(O)L
- Schoenmakerskop — CH
- Hougham Park — CD-NT 271
- Bat's Cave — C(O)L
- Coega Mouth — C(O)L

Also CA equipment associated with the 9.2 inch Humewood Battery

3. UDE Stations in Natal:

- Mainhluayami (St. Lucia Bay) — C(O)L
- Port Durnford — C(O)L
- Umhlanga — CD-NT 271
- Avoca — JB
- Island View — JB
- Bluff — CD-NT 271
- Brighton Beach — C(O)L
- Amanzimtoti — C(O)L
- Baven-on-Sea — C(O)L

These stations reported to the Filter Room at, successively, Stamford Hill and Brighton Beach.

In addition CA equipment was installed as gunlayer for the 9.2 inch Da Gama Battery, on the Bluff.

For a short while the original ASV I, using a Floodlight transmit antenna and a Yagi search aerial, was installed almost at sea level, below the Bluff, to keep a watch for intruders into the Durban anchorage, which is outside Port Natal.

YH and YJ Beacons were installed at the selected stations to serve as a navigational aid to SAAF reconnaissance aircraft. At Darling a BABS⁴ (Mobile) equipment was in use to assist coastal patrol aircraft operating from that airfield.

Radar in the SAAF

For a short while an ASV Mark I set (without antenna), which had been sent to South Africa during 1940, was used experimentally at the Bernard Price Institute to establish certain essential features to do with EHF output and input feeder lines and the matching into antennae. After this it was installed (June 1941) in an Anson Aircraft of 22 Reconnaissance Flight, operating from Wingfield.

The aerial system was a Sterba array, mounted longitudinally within the fuselage. As the Anson has a fabric skin, this method was effective and snags that could arise with outside mounting, such as drag and factors of general air-worthiness of the aircraft, were

4. BABS: Blind Approach Beacon System, a ground placed system enabling the pilot to effect a blind landing

obviated. This installation was successful insofar as target detection was concerned — a range of seven nautical miles was achieved — but the 'homing' onto targets could not be fully accomplished. This was because of the placing of the antenna system; in other words, the Radar was sideways- instead of forward-looking.⁵

To make full use of the ASV system's homing capability, the fuselage-mounted Sterba array was abandoned and an entirely different configuration employed in the Anson type of aircraft: only forward-looking. Half-Yagi stubs were fitted, outside, one on each side of the nose (metal alloy) of the aircraft, using the wing root, plated, as a reflector and mounting the radiator and one director projecting, slightly fared, horizontally from the nose portion of the airframe. This method was very successful and two Ansons were so fitted, to operate from the Darling airfield.

By this time, September 1942, ASV II sets, with matching (Rake) antennae (one complete Yagi for mounting accurately under each wing of an aircraft) had been supplied to South Africa by the British Air Ministry, and a number of these were fitted to Ventura aircraft. The latter were based at Ysterplaat and also used airfields at Eerste Rivier and Darling. A facility for ASV fitting, testing and maintenance was created by SSS at Ysterplaat, a mobile BABS was built for use there and elsewhere and assistance in repair of the ASV type of Radar was given to Netherlands Navy Catalinas and to RN Walrus aircraft.

At Congella, Durban, a small Radar workshop was opened by SSS for attending to the needs of SAAF Sunderland Flying Boats who were using an ASV XIII, a centimetric equipment, in fact, a version of H₂S⁶ adapted for aircraft where the belly could not be used for the mounting of the radome: the dishes were fitted under each wing (this configuration needed special arrangements for one dish to take over from the other when the latter was blanked off by the hull of the Aircraft).

At the UDF Commands the Filter Rooms became valuable adjuncts to the Operational Headquarters, which meant that here, as elsewhere, for the greater proportion of time during the war, Radar information was vital to the conduct of operations.

Because the bulk of SAAF squadrons was operating overseas, using the Pretoria airfields,

Zwartkop and Waterkloof, as departure points for personnel and material, a fairly comprehensive Radar workshop was established at Waterkloof by SSS. In this workshop, for instance, an ASD⁷ Radar was fitted in the York aircraft used by Field Marshal Smuts.

The same arrangement arrived at in the Union, whereby SSS personnel, in the form of established sections, were attached to SAAF formations for Radar duties, was followed outside the borders of South Africa. The sections were integral parts of wings or squadrons and shared workshop space with SAAF at the various bases. The sections, their Radar equipments, the venues and formations are enumerated below:—

West Africa (Takoradi). 26 Squadron: ASV II in Wellingtons, BABS and YJ Beacon.

Egypt (Cairo and Helwan). SAAF HQ: a Staff Officer for administration of GCI Sections. Later this Staff Officer moved to MAAF, Rear of Bari.

Italy. 25 Squadron: Beaufighters, ASV and GCI.

31 and 34 Squadrons and 2 Wing, Celone (near Foggia): Liberators, GEE⁸ Navigator and GEE Trainer; also Mandrel (RCM). 40 Photo-Reconnaissance Squadron, San Severo: Mosquitoes, GEE and GEE Trainer.

3 Wing, Ravenna and elsewhere:

SHORAN⁹ in Marauders.

Palestine (St. Jean). 17 Squadron: PV 1 carrying ASD and ASD Simulator.

Radar Developments

The radar art developed at a rapid pace. Spurred on by the vital necessity of staying ahead of the enemy in all departments, the laboratories and factories strove to produce electronic equipment which would give the

5. The RAF Convoy Escort and Patrol Wellingtons and Hudsons used ASV II with a dual aerial system for a single set: search was sideways-(both) looking by means of a Broadside type of array mounted vertically along the back of the aircraft, and forward homing with a pair of Yagis, one under each wing; the operator could switch from one function to the other as required.

6. H₂S: An airborne (American-built) microwave radar used by USAF, over land, as a bomb-aiming device. RAF and SAAF employed this type of radar in a coastal reconnaissance role; it therefore carried an ASV mark number.

7. ASD: Anti-Submarine Detector.

8. GEE: A navigational aid for aircraft.

9. SHORAN: Short Range Aerial Navigation.

fighting man that extra edge. The ideal radar set would display unambiguously all the important information about target: range, speed, type, identification and a forecast of the next move. The perfect navigational aid would enable the navigator, afloat or in the air, to pinpoint his position without having to use a slide rule or other device where, under stress of battle, mistakes could be made.

South Africa was far removed from the Operations Research centres and development laboratories and this made it difficult to keep up-to-date to prepare technical personnel for their tasks. As many officers were selected as could be spared to attend extempore courses on new equipment and techniques overseas. At one stage Dr Schonland was faced with the choice of having to detach all prospective South African Radar technical personnel to British training centres in Canada and the USA (Britain being under threat of invasion) for preparation if they were to contribute to the Radar war effort; because of commitment to coastal defence, and having already manned the Radar sections overseas, he compromised to the extent that only six South Africans were detached to British units, where they served without direction from the SSS.

Development and training in South Africa, therefore, progressed at SSS Headquarters at the Bernard Price Institute and in situ, where radar equipment and Filter Rooms were in operation, making use of the knowledge gain-

ed by those who had been overseas, or by using the standard Books of Reference issued by manufacturers.

Conclusion

It is not possible to give any exact statistical record or a score for the SSS. The nature of the work was not always direct, the unit did not attack the enemy, the members themselves were not lethally armed; they were the men behind the men behind the gun! Sufficient to say that the last War Establishment Table (1945) showed a total of 2 200 persons.

After VJ-day the SSS was demobilised very rapidly because so many of the members were scientists and engineers who were required in essential tasks in returning the country to normal. The unit itself was dis-established, but certain Radar facilities were, of course, kept going, e.g. airborne equipment and the CA-CD establishments at the four ports.

No exclusively Radar units were established in the Permanent Force; those functions remaining were absorbed by the Signals organisations of the branches of the UDF.

When Dr Schonland created the Council for Scientific and Industrial Research he made full use of SSS members. The nucleus of the CSIR were all ex-SSS, and a fair proportion of the apparatus and special instruments used for radar manufacture and maintenance, now redundant, went to that new organisation.