Short Range Blind-Fire

At the end of the war the 3 cm (X band) wavelengths were coming into use. An auto-follow radar to provide blind-fire with a twin Bofors gun-mounting was the first development, Type 262, but was not available for fitting until after the war. The mounting was self-contained; guns, predictor and radar were all on the mounting. The peak power output of the radar was 30 kW, with a single mirror for transmission and reception. Conical scanning was given by spinning the mirror itself, its axis being skewed from the axis of rotation. The requirement was to pick-up an aircraft target at 7000 yards range and be able to track it in all three co-ordinates sufficiently accurately for fire-control purposes by the time it had reached 5000 yards. Hence to pick-up the target in the shortest possible time the "search and lock-on" had to be entirely automatic immediately a target had been 'indicated' to 262 from the TI radar, first Type 293 and later 992 with its much faster rate of aerial rotation (90 rpm initially!) and 1 MW output power on 10 cm. The 262 then scanned 30° in azimuth in one second, the aerial being elevated 3° at the end of each sweep; at the same time it explored the space 750 yards either side of the indicated range 30 times a second. When the target was picked-up the aerial automatically locked on to the target, the predictor ran into alignment with the mirror's axis of rotation and the guns automatically followed the predictor. (See ref 40d on p 147, pp 371 and 2.)

Radar for Guided Missile System (Seaslug)

In 1944 DNO was asked by the Naval Staff to develop an up-to-date Fire Control System for AA batteries in ships when provision of computers from the US ceased. For up to 5.25 in guns in all types of ships destroyers and above, and for both aircraft and ship targets. The system would have consisted of a fully stabilised director on which the radar was mounted, and a 'transmission station' in which was housed the computing mechanism and the radar auto-follow, and possibly display equipment. However "with conventional guns most people are agreed that AA-fire can only be efficient out to about 7000 yds. Beyond this range, due to the long time of flight greater than 10 secs, it can only be deterrent in value ..... Beyond 7000 yds will eventually, it is expected, be catered for by controlled projectiles". Work proceeded on X-band towards this Long Range System 1. Type 262 was in effect Medium RS1. The later MRS3 with Radar 903, based on the US Mk 56, by Sperry Gyro Co Brentford was to control 4.5 in. turrets as relatively close range weapons when the GWS covered the long ranges.

But in Nov 43 a staff requirement for 'directed projectiles' was launched by DGD.

> "The advent of jet and rocket propelled aircraft makes it necessary to prepare for aircraft speeds in the vicinity of 600 mph at heights of 30 to 40 thousand feet. Airborne radar makes it possible for the aircraft to attack at such great heights even when cloud only permits fleeting glimpses of the target; and completely blind attacks may take place. The advent of the directed or propelled projectile and the imminment addition of homing devices has released the aircraft from the constraint of an aiming run, straight, curved, level or diving. Any form of long-range gunnery depends on the prediction of future position at a future time at least equal to the duration of the time of flight after gunfire. Even a perfect blind-fire system giving present and immediate past movements, with a perfect curved-course predictor, would thus be ineffective against the incoming attack. It is clear that a radical change in our attack on this problem is required. No projectile of which control is lost when it leaves the ship can be of any use to us in this matter."

Since there was a similar General Staff requirement the Guided Air Projectile (GAP) programme began. On 16.3.44 the Assistant Controller (R & D) Dr C F Goodeve, acting as chairman held the first GAP committee meeting. It was convened to consider the desirability of setting up an organisation for dealing with problems relating to guided AA projectiles and the form such an organisation should take. It was attended by senior representatives of the War Office, Ministry of Supply, MAP, and Admiralty departments concerned. It was unanimously agreed to set up the organisation; vice-chairman Mr Ben Lockspeiser Director General SRD (MAP). Four sub-committees were formed Propulsion, Dr Crow, Controller Projectile Devt; Aerodynamics, Mr Lockspeiser; Radio and Radar Dr Paris MOS; Stabilisation and Servos, Col Morrison Supt AGE. Subsequent to the meeting definite staff requirements were put up by DRA War Office and DGD Admiralty GDO 2248/45 of 27.8.45, target date for first prototype June 1947.

On 2.5.44 the GAP Committee made its first report that there was a reasonable prospect of successful development "but the r and d effort will be very great: the minimum period for development under the most favourable circumstances will be two years ..... The project should be tackled in two stages. First to carry out the experimental work to determine the essential data for the design of a prototype; second the development proper". The working committees proposed 17 officer staff on Radio and Radar (ADRDE 7, RAE 4, ASE 6) and 6 at AGE.

For the control of the projectile in the air it was early agreed that self-control to maintain itself in the radar beam to the target should be the system (beam riding). The newly proposed Naval X-band set (known as 901 and

initially for LRS1: see paper of May 1944 by J F Coales in file FI/901) soon came to be regarded as naturally the set for the control of the naval missile. On 12.1.45 DGD wrote after discussion with Mr Coales: "It is now reasonably certain that the Radar for LRS1 will also do as the Radar for CAP." The latter took precedence over LRS1 and then had overriding priority; in 1949, surprisingly late, LRS1 work ceased and the effort available was devoted to the epoch-making GMS1 which finally came to fruition in the late fifties. The full story of the first 10 years, 1944-54, has been recorded by H W Pout and other members of the 901 Project (unpublished; preserved as 'Archives 17': see also technical note GX/48/2A and B on the X-models which went to the Aberporth trials range in 1949).

Merchant Marine Radar

The use of radar specifically for navigation had been studied at ASE for some years. The requirement first arose in connection with combined operations, when modified 10 cm airborne (H2S) radars were fitted in some landing craft. Experience with these sets showed the need for higher frequency in order to obtain better bearing discrimination and low cover, to assist in recognising coast lines. An X-band set was used in navigational trials in the Scheldt Estuary with considerable success, and further tests in the Thames with Type 972 confirmed the importance of characteristics obtainable only by operation on higher frequency in the 3 cm band.

With the end of the war the Ministry of Transport sought Admiralty advice in drawing up a performance specification for a Merchant Ship radar, and a specification calling for an X-band equipment of high discrimination was agreed on. ASE produced sets approximately to the required performance; an experimental set primarily used for tests with corner-reflectors; and a more fully engineered set designed to meet the specification in order to demonstrate the facilities to the shipping interests, and to provide a source of information for assisting radio manufacturers who attempted commercial production of merchant ship radar. A Ministry of Transport group of approx 15 staff has continued within ASE/ASWE since that time.

Fighter-Direction Radar

In parallel with the missile system work, the first line of defence, the fighter, operating at ranges beyond the missile coverage was provided with the (probably) ultimate in carrier-borne radar, the 3-D 984, operating into the comprehensive display system, CDS. The creation of this fighter-direction system began in 1948, the first one going into HMS 'Victorious' in 1957; and 'Eagle' (only) had the first computerised system (Action Data Automation) in 1964. Only the conception of the system falls to be highlighted within the

early post-war period with which the present work concludes: the aircraft and electronics of these great ships deserve and will possibly have, one day, their own historian. I should have done this

An important component associated with these complex radar systems is the shore based 'trainer'. Extensive notes recording the major trends and stages in the evolution of these for Naval user training have been specially contributed by A D Brown (filed in 'Archives 13').

The narrative has now arrived at the time of the Golden Jubilee of the first WT Dept of the Navy born 20.8.1896 on HMS "Defiance" at Devonport. We have seen how "Vernon" took over control in 1898 and how the Dept was transferred in June 1917 to HM Signal School, Portsmouth. This School had been founded early in the 19th century and was responsible for training all naval signal personnel in the signalling methods then in use, flags, semaphore and lamp. The staff from "Vernon" were incorporated in a new Experimental Dept, the title of Wireless Commander being changed to Experimental Commander. The training side of the Wireless Section was amalgamated with the training of signalmen in the School. The expanded Establishment thus had charge of experiment, development and training on all aspects of Signals and particularly in the latest and most important method, wireless telegraphy.

In the period after the Armistice the organisation of the Experimental Dept was established formally by its then head, Cdr James Somerville, along lines very similar to those which had existed for the preceeding 15 years at least, and which continued broadly unchanged for the next 17 years.

After the rearmament programme got under way in the 1930's the WT staff expanded considerably and then further by the introduction of radar work in 1936 and later by the outbreak of war. By the end of 1940 it had become necessary to seek new quarters for the Experimental Dept which therefore moved to Haslemere in April 1941 on the Communication side, and to Witley in Sept '42 on the Radar side, and became an independent command ASE on 26.8.41, under a Captain Superintendent. At about the same time the Signal School proper moved to Leydene.

By 1945 the Scientific and Experimental (S and E) staff was some 460 in number. It is instructive to show the growth of expenditure on fleet equipment from 1925 to 1946/7:

1925	£85 000					
1928	£35 000					
1930	£25 000	+	30 000	for	new	construction
1932	£20 000	+	35 000	"	"	"
1933	£25 000	+	85 000	"	"	"
1934	£35 000	+	85 000	"	"	"
1935	£55 000	+	65 000	"	"	"
1936	£125 000	+	220 000	"	"	"
1937	£195 000	+	240 000	"	"	"
1939	£1M +					
1944	£35M (40 000 total personnel in the whole of ASE and outports					
1945/6	£12.5M + 558 000 new construction					
1946/7	£3M + 412 000 new construction					

The expenditure on R and D itself during this period is not available but in 47/8 it was of the order of £750 000.

Mr C E Horton, after a period in DSR, became Chief Scientist on 9.10.45. A major reorganisation followed in Feb 1947, the new organisation coming into force gradually during the year with a nominal S and E complement of 275. A copy of the Memo is in 'Archives 7', the main objectives being:

> "the full development of a few important projects; high quality scientific work to form the basis of future advance; and the education of every member of the Establishment for potential responsibilities and activities of the future. It is hoped that staff on scientific work will not fall below 20% of those on projects ..... It is proposed to organise Project Development by self-contained teams capable of producing their own bread-board models. The Project Leader may be a physicist or an engineer and he will be responsible for
>
> a. the technical soundness of the plan as a whole,
> b. production of the detailed technical specification,
> c. seeing that the units of the project are properly matched to one another and progressed at suitable relative rates,
> d. liaison and argument with other branches of ASE.
>
> The Project Leader is in command up to the stage of a successful trial in a ship at sea, but he will always have associated with him one or more members of the Design Dept. The essential point is that the engineer who designs and organises the pre-production models will have been in the project from the start. Up to the point of a successful sea trial of a first model his allegiance will be to the Project Leader, after that his allegiance is to D.
>
> The projects have been grouped on the chart in a way which is intended to parallel as closely as possible the corresponding groupings in the Admiralty and HM Ships .....
>
> Close financial control and scrutiny are a fundamental feature of our British constitution; we must expect the financial implications of our activities to be questioned. Accurate and timely knowledge of financial details is therefore of prime importance."

The four major project divisions were then: Communications, D/F and ECM; Radar Warning and Action Information Organisation; Weapon Control and Target

Indication; Shore WT, Y and DF Stations and RNAS.

The tendency towards replacement of the Design Dept mentioned above by outside Development Contractors began at about this time, the first case being the Type 600 series of HF communication system units referred to on p 127. And during the 1950's it became normal for the whole of the electronics side of projects to be done by development contract. Aerial techniques and engineering have remained largely 'in-house' together with basic system research, system formulation and assessment which always from the earliest days have been the province of the naval specialists and their scientific and engineering colleagues. The latter became the RNSS in Sept 1946, and thus 50 years almost exactly from radio's beginnings in "Defiance", with Sir Charles Wright KCB, DSR from 1934, as the first Chief of the RNSS and Sir Frederick Brundrett succeeding him in May 1947. On the 1 Jan 1948 ASE became ASRE; the preparation of the Portsdown site began that year. The Headquarters continued at Lythe Hill House until 1.5.52 when the move to Portsdown was completed.*

*W V Vidler 'The Story of Portsdown' 1969: in 'Archives 13'.