

to secure effective co-ordination at lower levels was more difficult. Inevitably the requirements and interests of guns and fighters must sometimes conflict, and to achieve a satisfactory adjustment between them through two different chains of command was not an easy problem. This change did not prove to be the final answer to it, but it was a step in the right direction.

222. Other important changes belonging to this period concerned the deployment of searchlights.

223. At this stage of the War searchlights were used to illuminate enemy aircraft for the benefit of both guns and fighters. In 1940 they gave disappointing results in both capacities, partly because they relied on sound locators which could seldom cope satisfactorily with the speed of the modern bomber and partly because clouds and haze often made them ineffective. As a means of overcoming the second diffi-

culty, recourse was had to the expedient of siting them in clusters of three so as to provide a stronger illumination. This arrangement was found in practice to confer no advantage sufficient to compensate for the drawback of wider spacing, and in September, 1941, General Pile and I decided that the lights should be re-sited singly. In the meantime calculations had been made to determine the size of the area in which a single night-fighter aided by searchlights could hope to effect an interception, and the pattern in which the searchlights were deployed was based on this conception. The method of operating this "fighter box" system of searchlight-aided interception has been described above. (See Part I, paragraphs 63-67.)

224. The following table shows the numbers of heavy and light A.A. guns and searchlights deployed on various dates, together with the approved scale on the outbreak of War:

	Heavy A.A.	Light A.A.	Searchlights
Scale approved before War	2,232	1,200	4,128
Outbreak of War	695	253	2,700
End of 1939	850	510	3,361
July, 1940	1,200	549	3,932
May, 1941	1,691	940	See below
December, 1941	1,960	1,197	

225. Although the approved scale of searchlight defence on the outbreak of War stood at 4,128, a total of 4,700 lights was recommended. Early in 1941 the figure of 4,532 lights actually deployed was reached, but subsequently the need for economy in manpower led to a reduction.

226. It was hoped that the introduction of the "U.P." A.A. rocket projector would do much to remedy the shortage of heavy A.A. guns, but the effective use of this weapon by A.A. Command was delayed by a number of factors, including shortages of ammunition. It was not until the crisis had passed, therefore, that they could be used for home defence in substantial numbers.

227. The total number of balloons authorized to fly and actually flying in the various barrages at the beginning of the period covered by this account was 1,958 and 1,741 respectively. In the Spring of 1941 it was 2,191 and 2,115. Subsequently a further expansion brought the number of balloons, actually flying at the end of 1941 up to 2,340—some 900 more than the total initial equipment of the barrages on the outbreak of War.

(g) *Expansion of the Raid Reporting Radar Organisation.*

228. In common with other forms of Home Defence, the Radar Chain of coastal stations of No. 60 (Signals) Group in my Command entered into a phase of intensive expansion to complete early warning radar cover to our Western sea approaches and also to face the problem of the enemy low-flying raiders. During 1941 the constructional programme involved nearly 100 radar stations—equivalent to setting up all the stations of several B.B.C.s within a period of a few months only. The War Cabinet had instructed that the highest priority should be accorded to this effort. The burden of this work fell heavily on the No. 60 Group

organisation. Short of technicians for installation, calibration, and maintenance duties, an acute shortage of the crews of radar operators to man the new stations also had to be faced. No. 60 Group nevertheless proved equal to the task, despite the fact that officers, airmen and airwomen in the Group were almost exclusively non-regular personnel of the R.A.F.V.R. without any previous service experience. 1941 was certainly the most hectic year of its existence.

229. The expansion of the Group and Sector organisation in my Command permitted a decentralisation of the radar reporting system. Originally all radar information had been reported to a Filter Room at Command Headquarters at Stanmore, the tracks of aircraft being passed on to the Operations Room. At the end of 1940 it was possible to decentralise the Stanmore Filter Room and split it between Fighter Groups throughout the country. This was also in accord with a decision to delegate the Air Raid Warning control from my Command Headquarters to the Headquarters of each Fighter Group. Owing to the heavy telecommunications re-arrangements involved, the complete decentralisation of radar reporting was not achieved until September, 1941.

230. Together with the great expansion of the radar chain and the decentralisation of the reporting system, there was an equivalent technical progress, not only with regard to equipment, but also in the handling and filtering of the radar information. The Operational Research Section of scientists at my Headquarters, working in conjunction with No. 60 Group, made many improvements to extract the maximum benefit from the available radar information. This application of the scientific method to the use of weapons through the medium of Operational Research Sections began first on problems within Fighter Command and subsequently spread throughout all Royal Air Force Commands.