56. It was on 1st October, 1940, that radar was first used to control anti-aircraft gunfire. The first sets had actually been received at the end of 1939 but a delay in applying them to anti-aircraft work had been caused by their complete inability to give any indication of the height of the aircraft and the intervening months had been spent in trying to overcome this handicap. In this work I must especially mention the untiring and valuable help given by Major-General M. F. Grove-White, C.B., D.S.O., O.B.E., at that time G.O.C.2 AA Division. The only use to which it had been possible to put the few available sets was direction-finding, but, as the heights still had to be found visibly by a height-finder, there was only a very small improvement on the old system, in that targets could be picked up a little earlier.

57. The first important attempt to provide an improved height-finding apparatus, which would operate against unseen targets, for use with radar arose from the invention of Visual Indicating Equipment. This was an elaborate sound-locator, the findings of which were converted electrically into a visual image on a cathode ray tube.

In practice, the equipment failed to give the results hoped for, since, apart from some difficulty in following the target and suspectibility to bad weather, it suffered from the same limitations as the sound-locators in the Fixed Azimuth System. Its range was limited, it was upset by extraneous noises such as gunfire and the presence of a number of targets at once was confusing.

58. The first real promise of a solution was found in the application of the radar principle to elevation as well as to bearing. Much of this work was achieved by Mr. Bedford, Chief Designer to A. C. Cossor Limited. The existing radar sets were modified as soon as possible by the fitting of this Elevation Finding attachment, and they went into action on 1st October, 1940. The chief limitation of this equipment was that when the angle of sight increased to more than 45 degrees the sets lost all accuracy in bearing.

To test the value of the new equipment orders were given that even against seen targets by day, provided they were over 10,000 feet up, the new unseen methods should be used and the results analysed. The results convinced me that the only real success being obtained was with this radar equipment and that the entire future of anti-aircraft shooting must be associated with it.

59. An entirely new system of unseen barrages was now developed. However great the improvement of the new equipment over the old, it was still far from attaining the required accuracy. In order to increase the chance of destroying the target we considered that it must be used to produce a volume of fire from many guns at once. Guns were, therefore, re-sited in groups, generally of eight and a master site, equipped with the new radar, was selected to control them. The master site plotted the target and informed the other sites of its position, height and direction. As soon as the enemy entered the barrage belt all guns opened fire independently.

This system was continued until 20th January, 1941, when I came to the reluctant conclusion that it could not be made to produce the success for which I had hoped. Since 1st October, 1940, the anti-aircraft defences had shot down over 70 planes by night and probably destroyed or damaged 53. I shall be referring a little later to our night fighter defences, but it is of interest to mention here that these successes were about four times the number scored by the R.A.F. in the same period.

The chief reason for ordering a change of method in January, 1941, was the limitations of the latest radar methods at angles of sight over 45 degrees. As long as guns, whether individually or in groups, were left to plot targets for themselves, there was in effect a very large blind zone right over the guns themselves and for some distance around them in which they could not operate. If control were vested once more in the Gun Operations Room, the combined information from all sites should eliminate these blind zones.

Consequently sites were ordered to pass their plots to the Gun Operations Room, where predictions were worked out and from which orders to fire would in future emanate. In other words, the plotting on the gunsite was divorced from the shooting and the greater part of the responsibility for the successful conduct of the battle was transferred from the Gun Position Officer to the Commander in the Operations Room.

60. Meanwhile, similar troubles had been experienced with searchlights. Their sound-locators had been subject to the same disadvantages as those used with guns and illuminations had consequently been erratic. In the same way as I had found them insufficient for use with the guns and had had to develop methods of unseen fire, so the R.A.F. had found them insufficient for successful co-operation with night fighters.

A further difficulty which arose when searchlights were used with sound-locators was that there was a tendency to over-estimate the speed of sound and to assume that the target was behind its actual position. Consequently, fighters following up an enemy raider frequently found themselves illuminated and an easy target for the enemy rear-gunners.

In order to give the night fighters more opportunity of engaging the enemy, a new technique was introduced known as "Fighter Nights". The theory was that the most likely place for a fighter to intercept the enemy was over the target area and that once contact was made the night fighter would have a very good chance of destroying the bomber.

The disadvantage of the scheme was that in order to safeguard the fighter our guns could not fire or, alternatively, had to be restricted to heights below that at which the fighter had instructions to operate.

Although some results were achieved on moonlight nights, the scheme was not popular. The lack of gunfire incensed the civilian population who thought the gunners were being negligent, and this resulted in a great loss of civilian morale. The enemy bombers, free from all anxiety over anti-aircraft fire, flew straight to their targets and bombed them accurately; nor was this compensated for by a larger number of bombers destroyed by fighters for, in practice, it was extremely difficult for our pilots to see the enemy and even after a "visual" had been made the bomber nearly always shook off the fighter.