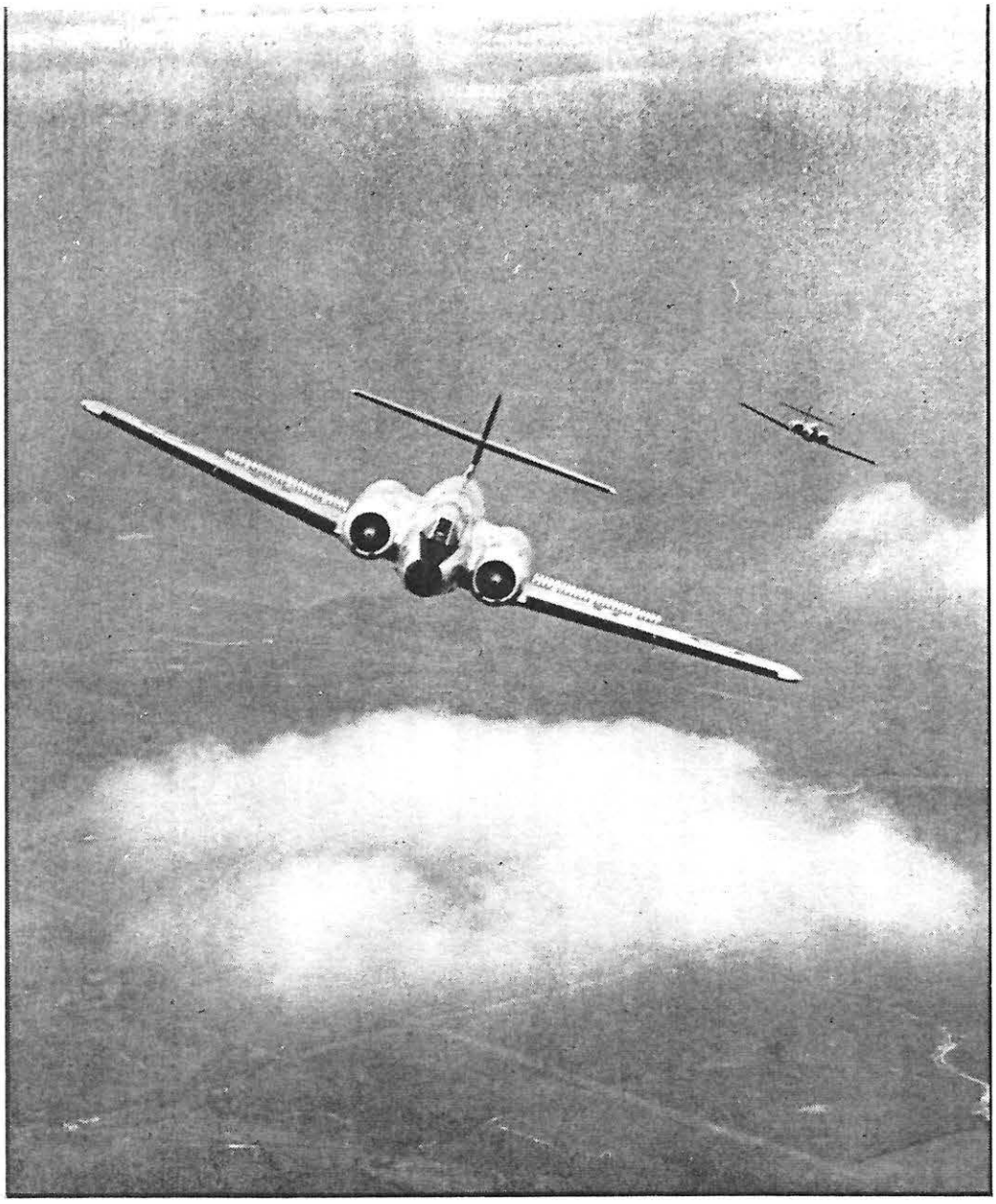

Elements of Canadian Air Defence

TWENTY-FOUR HOURS A DAY, THE AIR DEFENCE SYSTEM STANDS GUARD

SECURITY-conscious military men of any nationality have never been known to grow loquacious about the strength and disposition of the forces at their disposal, and no exception in this respect is the RCAF. But sometimes strength is difficult to conceal; sometimes friendly innocents must be warned away lest they unwarily trigger the trap set for enemies.

When an enemy is warned to take care, it could be a bluff, but when friends are told not to step from their declared paths on risk of stumbling into a mine field of explosive destruction, it is usually a true sign of strength.

The Department of Transport has given the clue to the power to which Canada's air defence system has grown. By mid-summer of this year, the RCAF's Air Defence Command operations had moved smoothly into high gear. It was time to issue a warning. From the DoT's Civil Aviation Division went Information Circular 0/15/54, directed to all pilots, aircraft owners, and other interested parties.

Laconically headed, "Interception of Civil Aircraft", the circular outlines the recommended procedure to follow when under the suspicious scrutiny of a military aircraft. "Interceptions," it is explained in 0/15/54, "are made in a serious manner presuming the unidentified aircraft to be hostile until definitely proven to the contrary. Therefore, for example, night interceptions are made with all lights out and the interceptor approaches into close proximity and identifies the unknown aircraft by reading the identification marking by means of a light . . .

"Intercepted aircraft should maintain a steady course and under no circumstances take retaliatory action such as shining a light on an interceptor or attempting evasive action. Retaliatory action on the part of an inter-

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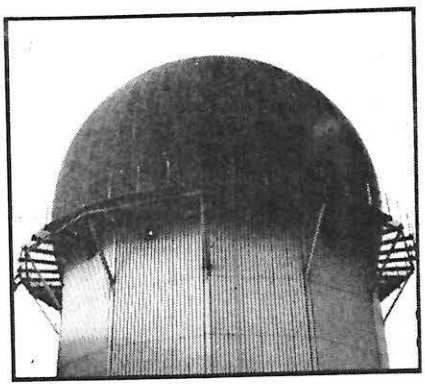
cepted aircraft could be construed as hostile intent and might result in drastic consequences."

A year ago, such a warning might have been regarded with faint amusement by a known enemy, for though the early warning system was operational, the fighter squadrons were too flimsily armed to back it up with any authority. Since then, the numbers of these squadrons has increased by three, but more significant, about a third of them are now heavily armed with modern aircraft. By the time this year ends, nearly half the fighter force (which will also have increased further in the number of squadrons) will be flying CF-100's. By mid-1955, it is possible that all regular interceptor squadrons will be operational and the auxiliary units will be re-equipping with Avro Canada's big all-weather fighter.

Fifteen Up: The total number of fighter squadrons available for interception work in Canada has reached 15, of which five are Regular units and ten are Auxiliary formations. The five Regular squadrons are re-equipping with Mk. 4 CF-100's, which are also in service with No. 3 All-Weather OTU at North Bay. The four remaining Regular squadrons still to be formed (and which former Defence Minister Brooke Claxton said would probably be in existence by the year's end) will also receive CF-100/4's as original equipment. Thus, there should be nine fully operational all-weather squadrons standing by 24 hours a day by the spring of 1955. And it is well to remember that the Mk. 4 CF-100 is the most heavily-armed fighter in squadron service anywhere in the western world.

Once all the Regular squadrons have been formed and equipped with CF-100 aircraft, then attention will turn to the Auxiliary squadrons. It is not possible to predict with any degree of accuracy exactly when this will occur, as the length of time it will take and the procedure to follow in converting the part-time airmen to the complex CF-100's is still somewhat vague.

Soon to go into effect are plans calling for the operation of a few CF-100's, on an experimental basis by one of the eastern Auxiliary squadrons. Reports indicate that this squadron will probably be 438, based at St. Hubert, near Montreal. When the results of this trial operation have been assessed, the Air Force then intends to proceed with the equipping of further Auxiliary squadrons with the all-weather fighters. It is expected that initially, the Auxiliary units will equip with Mk. 3 versions made surplus as the Regular squadrons convert to Mk 4's.



Inside this electronically transparent, rubberized fabric dome is the radar antenna, vital component of the early warning system. Domes are a feature of most radar stations.

Somewhere in the Canadian north, this team of radar controllers concentrate on their radar scopes, carefully picking out the "blips" and relaying information to pilots.

In the plotting room, airwomen keep track of all aircraft flying within range of their radar. From the plot, fighter controllers can determine how to deploy fighters.

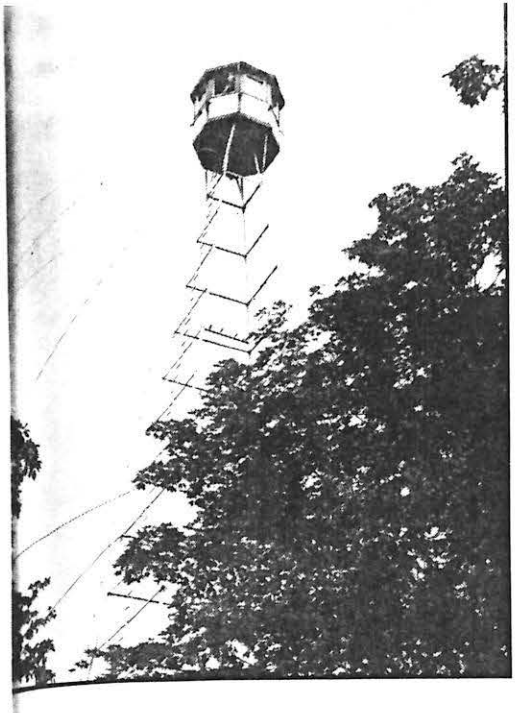
Conversion Problem: The Air Force anticipates some difficulty in converting Auxiliaries to the new airplanes, which are somewhat more complicated to operate and to maintain, as compared to the relatively simple Vampires and Mustangs.

The basic composition of the Auxiliary squadrons is expected to be affected as a result of the re-equipment program. At present, each Auxiliary squadron has a small detachment of Regular force personnel attached to it. These personnel are largely responsible for keeping equipment serviceable, and for carrying out the day-to-day routines that are required to keep the squadrons operating with a reasonable degree of smoothness.

However, when the CF-100's come into service with the Auxiliaries, it is expected that the Regular component of each reserve unit will be increased substantially . . . possibly to the point where half of each squadron's strength will be made up of Regular force personnel.

Apart from the Regular and Auxiliary squadron formations, extra strength for the air defence system is available from the two fighter OTU's. No. 1 Fighter OTU at Chatham, N.B., where pilots are given operational training on Sabre day-fighters, and No. 3 All-Weather OTU at North Bay, Ont., where aircrews learn to fight with CF-100's, are each capable of throwing a considerable force into the air. Because the flying personnel at both units are made up either of valuable instruction staffs, or of comparatively inexperienced aircrew at various stages of training, it is not likely that they would be ordered into action until the interceptor squadrons had encountered more than they could cope with. At the same time, it is inconceivable that in an extreme emergency at least some of the OTU aircraft would not see action.

THE SUCCESSFUL operation of any air defence system depends as much on an alert early warning organization as it does on a strong



interceptor force. The basic components of early warning comprise radar, backed by a 65,000-member Ground Observer Corps, and an elaborate communications system.

In Canada such an early warning organization has been operational for many months, standing guard 24 hours a day. At present, it consists mainly of the so-called "Pinetree" radar chain, which extends across the northern reaches of Ontario, Quebec, and Labrador, an electronic watchdog that an out-of-the-north attack must pass to reach the industrial heartland of eastern North America.

Pinetree, a joint U.S.-Canada project, cost some $300,000,000 to establish, two-thirds of this being financed by the U.S. Procedure is for U.S. personnel to man those stations which give early warning to vital American centres, while Canadian service men operate those stations guarding the approaches to Canadian cities.

Early Warning: Now being installed across the Canadian Arctic tundra, is an additional early warning aid, the "McGill Fence", an electronic device which presumably will perform the function of a burglar alarm. That is, unlike the radar network, it is incapable of identifying aircraft which come within its range. While its capabilities are a closely-guarded secret, it is probably able to determine speed and direction of flight at the time the Fence is crossed, in this manner alerting Pinetree to the fact that an intruder may be on the way and making it possible to calculate approximately when he will arrive at any given point. Chief disadvantage, of course, is that the McGill Fence cannot discriminate between friend or foe.

On the other hand, the McGill Fence is comparatively cheap to install, and its operation is largely automatic. Maintenance and servicing operations will be carried out with the aid of helicopters, and it is with this phase of early warning in mind that the RCAF has recently acquired a number of Sikorsky S-55's.

The McGill Fence is perhaps more correctly known as the "Mid-Canada Line", as the McGill device is simply incorporated in the "Line."

A description of the Canadian segment of the early warning system was recently given in "The Roundel" by Squadron Leader J. E. Mahoney, a senior controller at a large RCAF radar station.

According to S/L Mahoney's outline, the Aircraft Control & Warning System, part of Air Defence Command's organization, consists of an elaborate network of radar stations, located in strategic positions across Canada. It entails the provision of vast quantities of expensive radar and communications equipment and the training of thousands of operating personnel. It must be capable of displaying the location of all airborne aircraft at all times, of controlling the fighters, and of passing all pertinent information to the AOC for his guidance in defence planning and the conduct of the air battle.

High Point: The top level of operation is the Combat Operations Centre (COC), which is responsible for the efficient operation of all air defence facilities. The senior officer at the COC is the direct representative of the AOC of Air Defence Command, and is known as the Command Controller.

The OC receives information on all hostile, fighter, or unidentified aircraft, and on aircraft in distress, and it presents a picture of the movement of those aircraft in the form of arrows on a large horizontal map in the operations room. The status of all aircraft, weapons, and AC & W facilities is displayed on special large boards. In addition, he has direct communications with the Commanding General of the USAF's Air Defence Command, with whom he works in close liaison.

For air defence purposes, Canada is divided geographically into sectors. Each sector is administered by a Sector Commander at an Air Defence Control Centre (ADCC), who is responsible to the Command Controller for

Civilian ground observers, like fire ranger in tower (L), report any a c they spot to local filter centre, which plots location (above) and reports to RCAF, which scrambles fighters (below) if identification is necessary.

the supervision of operations within his sector. He displays the current air picture in his operations room, disseminates all operational information received from his subordinate units, relays orders received from the OC, and carries out liaison with the adjacent sectors and USAF counterparts.

Subdivision: Sectors are further divided into sub-sectors. Each subsector is the responsibility of the Chief Controller at an Aircraft Control & Warning Squadron (AC & W Sqn.), or Ground Control Intercept station (GCI). This unit is the counterpart of a fighter squadron, and works in close liaison with the squadron or squadrons assigned to it for operational control.

The function of an AC & W Squadron is to detect and identify all aircraft within its area of radar coverage. When it has identified an air-

craft as unknown or hostile, it then scrambles fighters to intercept it, and controls them by radio telephony until the fighters are in sight of their target.

Detection of aircraft is accomplished by means of radar. Each GCI is equipped with a radar transmitter and receiver which enable the position of aircraft in flight to be read from radar scopes indicating the bearing and range from the station, and the altitude. These aircraft, so detected, are kept under observation, and their position in space is passed to the Surveillance Section in the same building.

The Plot: In the Surveillance Section, the track of the aircraft is plotted on a huge plotting table. The identification personnel, watching this map constantly, compare the track with the information they have on friendly aircraft movements, received from the DoT's Air Traffic Control Centre, or from RCAF airports.

If the track can be correlated as to position, speed and altitude, it is identified as friendly; if it cannot, it is called "unknown", and fighters must be scrambled to intercept and investigate it. As a suspected aircraft travels at at rate of five or six miles a minute, every effort is made to reduce the identification time to a minimum. Sometimes, because of delays and human error, unknown aircraft are really friendly. For this reason, standard procedures for the approach to and identification of all intercepted aircraft have been laid down, to prevent undue interference with, and anxiety to, pilots and passengers.

While the fighters are closing on the target aircraft, the Intercept Controller keeps them fully informed as to the height and airspeed of the target, together with its position. Meanwhile he is manoeuvering the fighter into the best position for identification and attack.

When the fighter has made a sighting, known as a "tally-ho", on his assigned target, he closes in and noti-

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"ONE HOSTILE, ATTACKING"

This description of an imaginary visit to an RCAF Ground Control Intercept station (GCI) is an extract from an article by Squadron Leader J. E. Mahoney, "Aircraft Control & Warning in the RCAF", which first appeared in "The Roundel". S/L Mahoney is a senior controller at a large radar station. It should be noted that, for security reasons, figures used in any dialogue that follows are fictitious, and the R/T phraseology only approximates the standard procedures and code words. For fuller explanations of the duties and functions of the various components of the GCI organization, see the references to radar which appear in the article on the preceeding pages.

—Editor.

Imagine a huge operations building, standing majestically on a hilltop. An imposing radome, adjacent to the Operations Building, houses the radar antenna, and appears as a gigantic observatory. As we enter the building, a security guard carefully checks our identity and issues us with a pass-button.

Going into the Surveillance Room, we find our attention drawn immediately to the plotting table, around which are numerous plotters wearing headsets, intently listening to reports of aircraft, and plotting them on the table by means of plaques and arrows.

Against the far wall is a huge display board, on which is displayed all information concerning the tracks on the table—the track number, the time it appeared, the altitude, the quantity of aircraft, the speed and identification. We cannot see them, but behind the board are a number of "Fighter Cops" (Fighter Control Operators) who are listening to the same information as the plotter.

At the other end of the room is a long dais, behind which are seated the Surveillance Controller and his assistants. They are constantly watching the plotting-table and display boards, and comparing the information displayed with that of known flights, as received from control towers at RCAF aerodromes and the DoT Air Traffic Control Centre. Above the main dais is another dais, at which are seated "tellers," who are relaying to the Air Defence Control Centre (ADCC) the information displayed.

We next visit the Reporting Room. At first we see very little, for this room is almost completely dark. It is here that the radar scopes are located. As our eyes gradually become accustomed to the darkness, however, we see a number of "scope reporters" seated at the scopes, intently watching them for the blips which indicate the paths of aircraft through the sky. A constant mumble of voices is heard, as the scope reporters relay the information to the plotters and display-board operators in the Surveillance Room.

After leaving the reporting room, we enter the Control Section. Here we meet the mainstay of the GCI, the Duty Controller, and his assistants, the Operations Controller and Operations "B". From his vantage point, strategically located so that he can view the plotting-table and the display boards, the Duty Controller directs operations. In front of him is a miniature switchboard, to provide him with direct communications to all operational positions in the building. His chief concern is to order aircraft to states of preparedness as required, to scramble them after unknown and hostile tracks, to allot missions to Intercept Controllers, and generally to supervise the conduct of the air battle.

He has direct control over the Intercept Controllers, who are located at radar scopes in rooms adjacent to the control section. It is they who actually control the fighters when they become airborne and give them directions which will enable them to intercept the target aircraft.

And now let us imagine, from what we know of the Aircraft Control & Warning system, what would happen if an enemy aircraft were to invade our country.

Conversation Piece

IN THE reporting room, the first inkling of it would be a tiny blip appearing, just like hundreds of others, on a radar scope.

"Initial plot at Able Baker 5132," states the scope reporter.

In a few seconds word comes back from the plotter: "Track 49." The scope reporter marks "49" on his or her scope, and follows its progress carefully across the scope, passing its position each minute.

Meanwhile, in the Surveillance Room, the plotter has placed a round disc on the plotting-table, with a small black plaque beside it, indicating the track number "49".

The Identification Officer is hard at work, checking the pre-plot board on which known flights are pre-plotted, and scanning through his flight plans. Nothing on it. Soon an arrow appears on the table. Heading south. One minute has passed since the initial plot appeared. He looks on the display board opposite Track 49. No height yet. Again he checks his flight plans, then turns to his assistant:

"Contact ATC centre on track 49."

A minute later his assistant tells him: "Negative."

He picks up his 'phone and cuts in on the plotting line: "Track 49 identified unknown."

The plotter places a red marker on the plaque on the table, which indicates that it is unknown and requires interception.

Up in the Control Section, the Duty Controller sees this. He looks at the aircraft status board, then gives an order to the Operations Controller:

(Continued on page 117)

er R. C. Stapie, who was assigned to AAFCE headquarters (code-named "AIRCENT") to play a key role in strengthening Western Europe's air defence communications.

Last leg of the $9,000,000, highly mobile, RCA microwave radio relay system was recently completed for AIRCENT under the supervision of the Headquarters Radio Telecommunications Division, where S/L Staple has been working for more than two years as part of an international staff. Covering 660 route miles, the microwave network is laid out in several legs converging on AIRCENT HQ at Fontainbleau. The two major extensions are those connecting the HQ with its two Allied Tactical Air Forces.

Air defence of Europe, like air defence anywhere, depends for its success on a secure and almost instantaneous system of communications. Thus, from the beginning of NATO, installation of modern communication equipment has had high priority.

Truly Wireless: Describing the new microwave relay system, which provides telephone and teletype hookups with no poles or overhead wires, S/L Staple says, "Substituted for the wires of a conventional telephone system are sharply-beamed radio signals which are transmitted at a speed of about 186,000 miles per second across line-of-sight distances to the next relay point. The mobility of our AIRCENT system derives from the fact that all these relay points have been designed to operate out of van trucks, which carry tower and antennae, cables and accessories, receiving and transmitting equipment, power generating apparatus, and personnel. Four men can set up or dismantle a station in less than five hours so, should any ground prove untenable, or should redeployment be required, the networks can be shifted at short notice, leaving no equipment behind.

"Since microwaves travel through the air, technicians are freed of the tedious job of line maintenance. Nor do they have to cut pathways through difficult terrain when networks are shifted. Instead, it is necessary only to set up repeater stations at selected points. Another good feature from the military point of view is that the system is almost impervious to weather. Wind or sleet don't bother it. You can't blow down a radio beam and ice won't form on it."

The precision-beaming of the microwave signal also increases the security potential of the system. Unlike broadcast radio, microwave relay does not radiate a signal which can be received from all directions. Instead, the signal is directed by means of dish type antennae in a straight line to the next relay point. It can be intercepted only within the limits of this narrow beam, and similarly sources of interference or jamming would have to be very accurately directed to disrupt communications.

AIR DEFENCE ELEMENTS

(Continued from page 50)

fies the Intercept Controller of the complete identity of the aircraft. The controller then orders further airborne surveillance, target destruction, or the return to base of the fighter aircraft, as applicable.

All information is passed immediately to the ADCC and the COC. The Duty Controller, guided by the fighter's reports, will scramble other fighters if required.

No Control: In order to extend the radar coverage and give additional time in which to scramble fighters and intercept hostile aircraft, we have what are known as Early Warning Uits. Such units are located beyond or on the fringe of the area covered by the GCI, but require modification to be able to control fighter aircraft.

An additional source of surveillance information is the Ground Observer Corps, which passes to a GCI reports on aircraft sighted or heard by ground observers.

The GCI also works in close liaison with the Anti-Aircraft Artillery*. The Artillery Controller, in the same room as the Duty Controller, is able to observe the movements of all aircraft as displayed on the plotting table. He passes all pertinent information, together with instructions received from the Duty Controller, to the Anti-Aircraft Operations Centre. In this way, anti-aircraft weapons may be brought to bear against hostile aircraft flying over gun-defended areas.

**Canadian Army anti-aircraft units now come under the operational control of Air Defence Command.*

ONE HOSTILE

(Continued from page 50)

"Scramble Whiskey Red section. Vector 360, angels thirty. Bring Whiskey White to stand-by."

At the aerodrome, jet engines are turning over almost as soon as the order has been received from the GCI.

The Operations Controller, immediately after giving the scramble order, calls an Intercept Controller on the 'phone:

"Whiskey Red section scrambled, vector 360, angels 30. Track 49. Channel C Charlie."

The Intercept Controller, huddled over his scope marks this information on his Intercept Report form. Checking the plotting table, he locates the position of track 49, and finds it on his scope. Then turning to his assistant, he advises the position and asks for an altitude. Though intently watching the progress of an unknown track, he checks the vicinity of the aerodrome from time to time to look for his fighters, and anxiously awaits their call.

Before long he sees a blip. Seconds later he receives a call:

"Hello, Sausage—this is Whiskey Red."

"Hello, Whiskey Red, this is Sausage. Vector 350 for bogey. Angels 30. Over."

Whiskey Red acknowledges; then, a minute later, he says:

"Target twelve o'clock, three hundred miles, heading 180, airspeed four hundred."

As the gap decreases between the two tracks, the Intercept Controller continues to brief the fighter on his progress and that of the target:

"Whiskey Red, target now one o'clock, 80 miles, altitude 25,000, down 5,000."

His nerves tense, he reaches the crucial turning point, which may mean success or failure of the interception. He gives the order:

"Starboard 080. When steady, target ten-thirty, nine miles."

He watches closely. Nice. The fighter is closing quickly on the target. "Target eleven o'clock, five miles," he advises.

"Whiskey Red, tally-ho," comes back.

"Roger. Investigate target."

Seconds later, the fighter reports:

"Target one hostile, twenty-four thousand."

"Roger, Attack target," replies the controller.

He then informs the Duty Controller: "Whiskey Red, tally-ho at 360, one hundred, one hostile, attacking."

This information is passed immediately by the Ops "B" to the Air Defence Control Centre and the Combat Operations Centre.

Before long the fighter reports: "Attack completed. Target shot down."

The Intercept Controller heaves a sigh of relief. "Good show Whiskey Red. Head 180 for base."

SUCH (we hope) would be the fate of an enemy aircraft which tried to penetrate our defences.

The Fighter Control personnel are keenly aware of their responsibilities. No one who has ever visited a radar station can help but be impressed with the air of serious expectancy which prevails. Our airmen and airwomen know that we are living in the world with an enemy who may strike without warning. They know that an unknown track is a thing to be feared. For them there is no "peace".