C.I.C.

COMBAT INFORMATION CENTER

CONFIDENTIAL

C.I.C.

the tactical use and operation of electronic and associated equipment.

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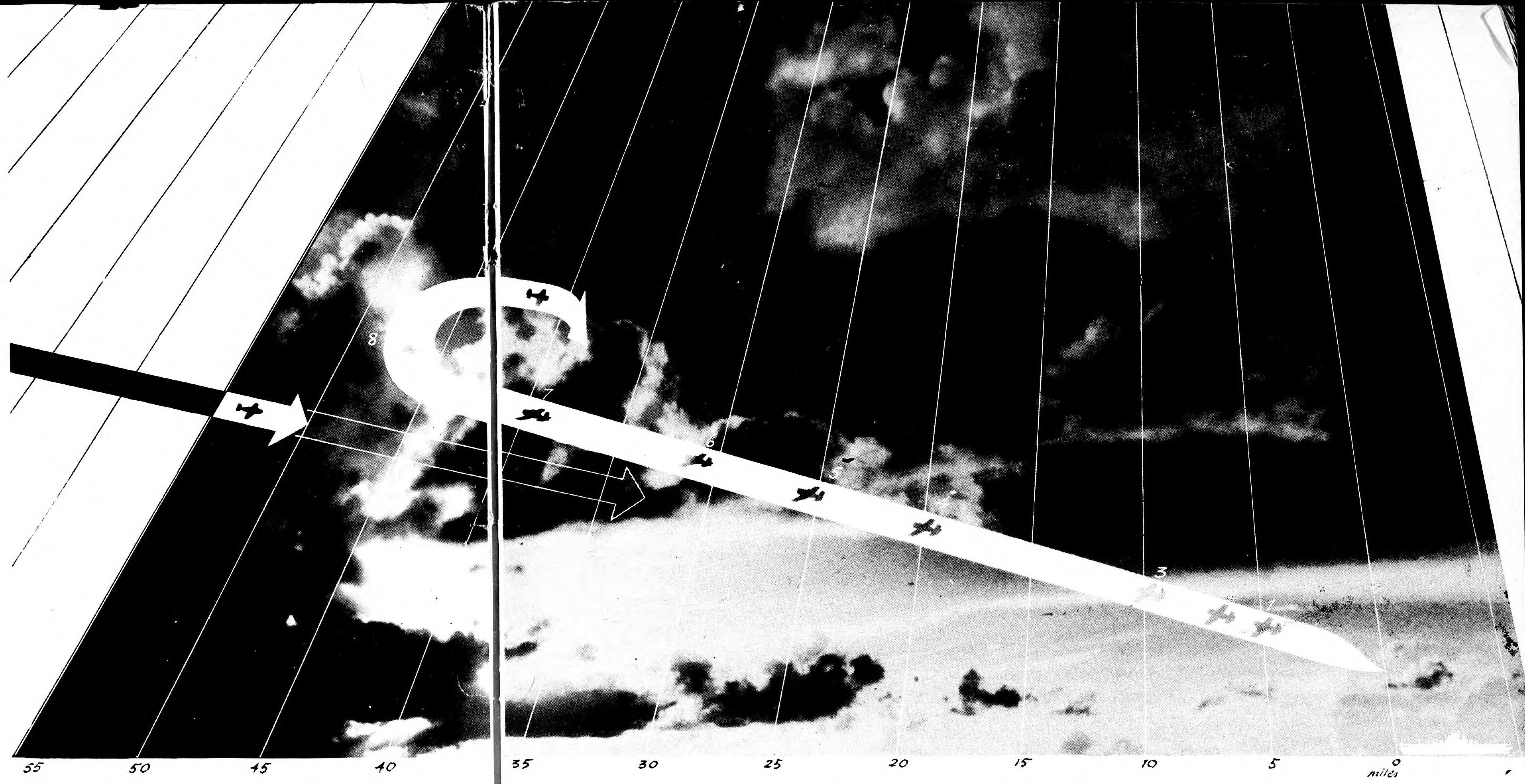


new intercept techniques

No subject in CIC operations is more controversial than the technique of interception. No subject is more important. The following brief review of new theories of interception is published to acquaint Fleet and shore-based personnel with what other Fleet and shore-based personnel believe are improved methods of snaring enemy aircraft. "C.I.C." will welcome comments, emendations, controversy.

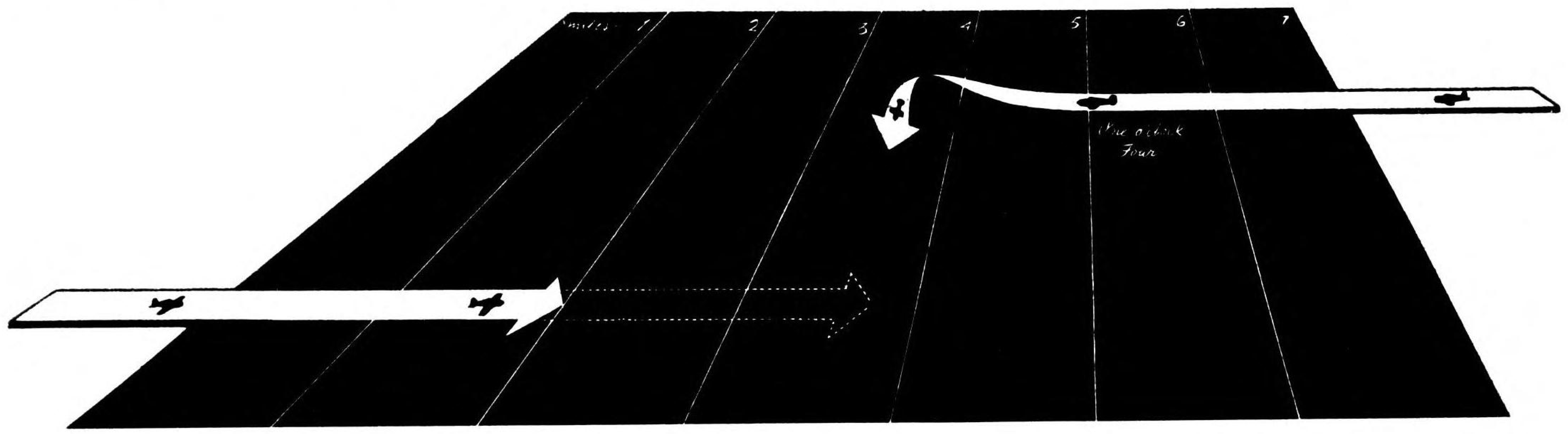
In the early, dim days of fighter direction when an intercept officer counted himself lucky if he owned a plot board and a couple of ex radio techs for operators, the general intercept technique was to send as many VF as possible out in the direction of a raid, pray and hope for the best.

Since the early Solomons, however, fighter direction has grown away up. Hundreds of CIC and radar officers, and thousands of enlisted operators, technicians, plotters now ply their trade in the Fleet and ashore; and a book on radar and associated gear looks like a pocket (?) edition of a Sears-Roebuck catalog.

Paralleling this growth has been a steady refinement of the technique of interception. Improved equipment, experimentation with new devices and methods, and the accumulated experience of literally hundreds of thousands of intercepts run against the enemy or in training have produced a spate of methods, some highly stylized as in night work, others, like many day intercepts, as simple and direct as the flight of a 40 mm bullet. Like all the other means and methods of waging war, fighter direction has had to adapt itself to constantly changing enemy tactics and to utilize every capability of our improved equipment.

The purpose of this article is to review some of the newer methods of interception. Because the techniques are constantly changing, it is impossible to be definitive. No one not on the scene can specify the exact type of intercept to use; and, as any intercept officer knows, academic refinements frequently are jettisoned in Fleet practice. The closely controlled intercept, however academic, does underline those principles of precision, accuracy in timing, and attention to detail which are the constant concern of the intercept officer.

What, then, is the latest opinion on daylight intercepts? On Visual fighter direction? On night work? What, in the opinion of pilots and intercept officers, is the ideal clock-code approach? What are the bases for current methods and conclusions?



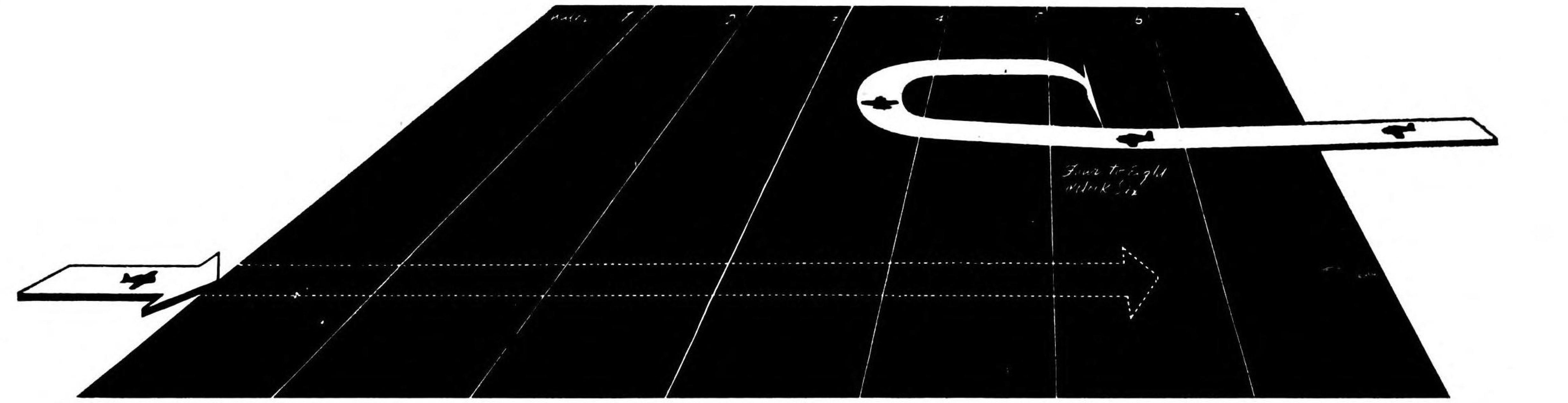
Head On Intercept

THE DAYLIGHT INTERCEPT

Newest and perhaps most radical departure from the old methods of orbit or beam approach is the practice now being followed at NRTS, St. Simon's: The head-on intercept with a turn into position for a 4 to 8 o'clock tallyho at within three miles. The principal reasoning behind the new method is that the high rate of closing is reduced, a position ahead of the attacking aircraft is insurance against a breakthrough and the interceptors are placed in the optimum attack position. The older method—an approach from forward of the beam at between 10 and 2 o'clock—so the argument runs—may throw the interceptor into a hopeless tail chase. Should the interception have to be made close to base with the attacker pushing over into his dive—suicidal or otherwise—the chances of catching him are negligible.

Rapid development by the Japanese of speedier aircraft and their likely employment in Kamikaze attacks made it essential that intercepting aircraft get all or the majority of the raiders—disrupting the approaches of those who do get through.

Chief arguments against the method center around the contention that in order to give the interceptor the advantage, the turn must be timed with a maximum accuracy—a feat not always possible because of radar limitations.



St. Simon's Intercept

tions. Moreover, the position ahead of the raid, unless an altitude advantage is maintained, temporarily lays the interceptor open to attack. Opponents of the "St. Simon's method" argue that until altitude determination is more reliable the risks involved are not worth taking. The fact that both SM and SP can give *relative* altitude with reasonable accuracy, of course, reduces the force of this argument.

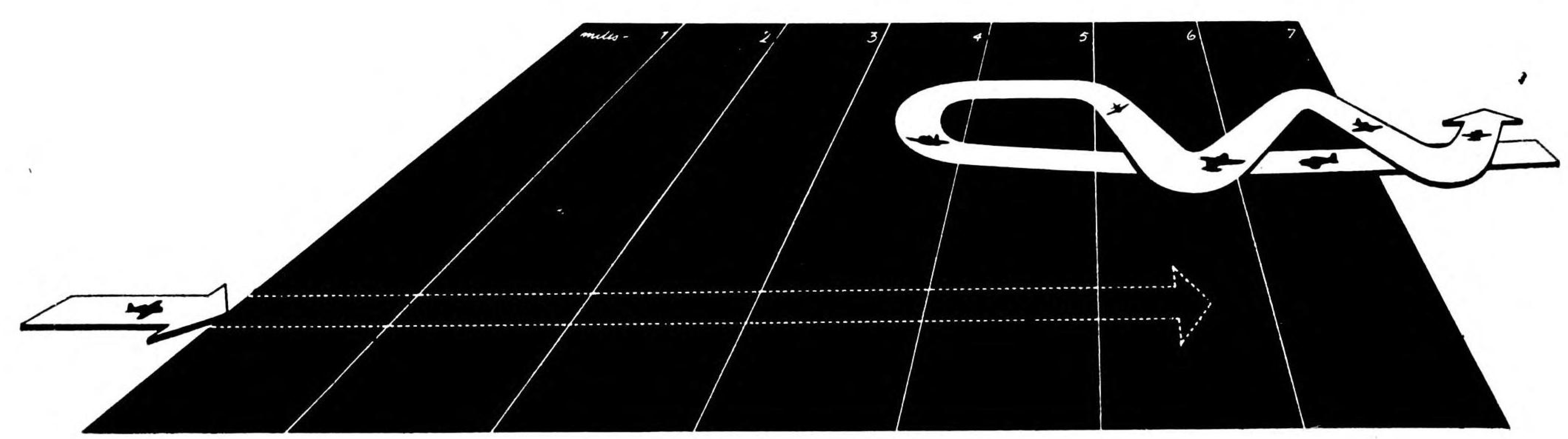
In controlling the intercepting division, generally speaking, from one to three basic vectors are necessary. First is a snap vector, usually at buster, to start the interceptors out. After the "On Vector" and position report from the division leader, the intercept officer locates his VF on the remote PPI and the plotters begin to DR. Second is usually a correction vector to place the VF on a more accurate heading. Third is the "safety vector" approximately to the bogey's course.

In the event that no tallyho is reported an immediate turn to the bandit's course is given, followed by subsequent vectors of from thirty to fifty degrees to port and starboard of his course. If the relative speed has been incorrectly estimated and the turn has been given too soon, this "weave" procedure slows the interceptor down until the raid zooms into sight. Further, and most importantly, the "weave" establishes a thorough, visual search of the area. The recent Jap practice of breaking up when tallyhoed, with some raiders diving for the deck and others scattering, made this search imperative. A method of procedure against the regrettable tendency of a clear, well-defined blip of either friendly or bogey to fade from the PPI scope is also thus established.

With an increased CAP, the practice of back-stopping or using stacked formations for additional protection can also be employed in conjunction with the St. Simon's method.

Minor but notable new notions in intercept techniques at St. Simon's include a standardized method of keeping pilots informed on the progress

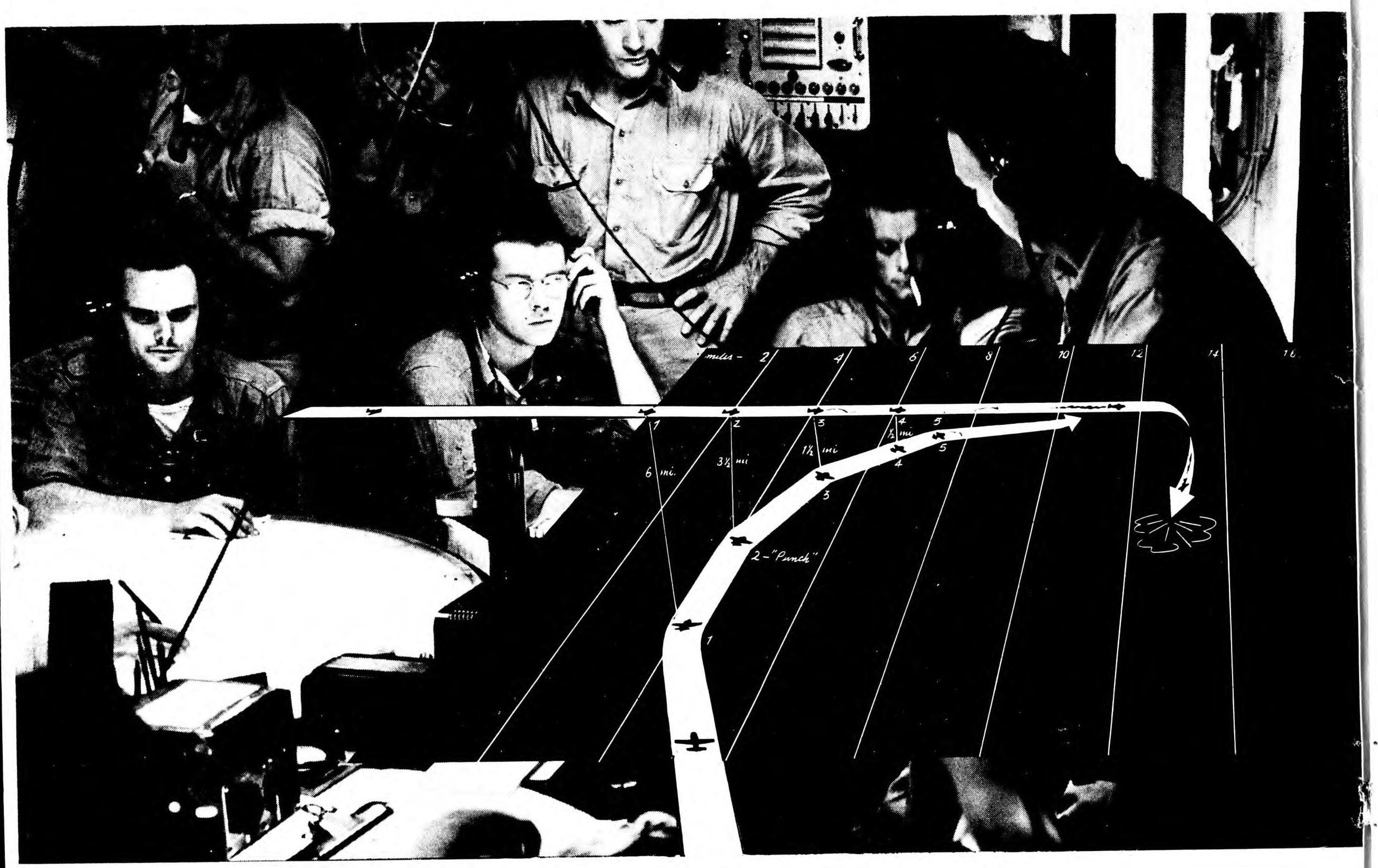
The Weave



of an interception. Out to twenty miles on an intercept, initiated for example when the bogey has popped up at seventy, information transmissions are generally limited to a simple: "Bogey ahead thirty or forty." During the next several miles information transmissions may include enemy altitude, course, speed and composition. Clock code is not employed in the first 20 miles, and then only when the information is useful to the pilot.

Whether or not the "St. Simon's method" will find many converts in the Fleet, its proponents point out that it effectively emphasizes the basic principles of the controlled intercept. The development of Jap evasive tactics and less favorable visibility in the areas near the home islands of the Empire indicated that the 10 to 20 mile tallyho might become more of a rarity than it was in the past.

Brigantine VF(N) Intercept



At Beavertail (Jamestown, R.I.) and Brigantine (N.J.)—to mention only two continental fighter direction centers—intercept methods follow a more generally established pattern. Beavertail staff members still teach four intercept methods: orbit, forward of the beam, four to eight o'clock (St. Simon's), and 11 to one o'clock (semi-headon). Generally preferred for good visibility as the speediest type for a closing raid is the 11 to one o'clock approach with an altitude advantage of 2000 feet. Less speedy but the best tactical position when visibility is not too good, the St. Simon's four to eight o'clock approach has the advantage of bringing the pilot in at the approach he himself will likely choose after the tallyho. Actually, according to Beavertail staff members—and for that matter, St. Simon's—a combination of the two preferred methods—the four to eight and 11 to one o'clock—is preferable with the intercept planned as semi-headon and the IO standing by to control the fighters into a four to eight o'clock approach if the radar information is sufficient. In effect, this is the method also taught at St. Simon's, since the four to eight o'clock position is reached by a turn through the other clock positions. Orbits are employed only when information is poor and the forward-of-the-beam approach only on crossing raids.

When there is insufficient time for a head-on, Brigantine intercept officers are advised to vector VF for an eleven to one o'clock tallyho with a 2000 foot altitude advantage. The too closely controlled intercept, according to Brigantine belief, leans too heavily on niceties of calculation. A slight error or miscalculation will place the fighter in an impossible position and lead to a fruitless tail chase. With new, high-speed Jap fighters appearing and likely to have been employed on suicide missions, it was of paramount importance to keep the VF between the bandit and base.

Because Beavertail is primarily a team training center and IO's have developed their own methods before they arrive, the staff concentrates on team training and advocates no special method which can be strictly called "Beavertail."

Should a tallyho be missed both Brigantine and Beavertail IO's, like St. Simon's students, are taught to turn the interceptors on the bogey's course and bring them at high speed. If a cloud layer exists, the division may sometimes be split for search above and below the clouds. Backstops are also used if they are available.

VF(N) INTERCEPTS

By nature the night intercept is a highly specialized technique. Although a day fighter may tallyho at ten or even fifteen miles, the night fighter must be so positioned as to be within two or three miles of his target. Moreover, he must be at a relatively exact—plus or minus 500 feet—altitude.

There have been two major handicaps in the development of the night intercept: The difficulty experienced by pilots who must fly their planes and operate their radars expertly at the same time, and the imperfections of the airborne gear itself. The evolution of night fighter direction—SCI (ship controlled interception) has been a constant effort to master these two handicaps.

Substantial technical progress has been made with the AP/APS-6A although as a recently returned Air Group Commander put it, "with the Japs getting so good at countermeasures and evasive action, we've got to have better night fighter radar in a hurry. The load on the night fighter is getting to be grave. He is going to need some help pretty soon."

Many action reports stressed the fact that Jap night flyers finally employed evasive tactics which have also materially increased the problems of the night fighter and the night controller.

Indeed, development of Jap evasive tactics noticeably approached the German degree of skill in night operations. Contrasted with the night-flying Jap of the Solomons in early 1943, who came in almost invariably at 6000 feet, the Okinawa Jap was clever and elusive. He came in to the attack, roller-coaster fashion, in spiraling orbits, changing heading and speed constantly. Moreover, he knew when he was being pursued.

The first and foremost answer to these tactics by intercept officers has been a general tightening of control. Instead of a series of hopeful vectors, VF (N) controllers have of necessity begun to exercise increased precision, acting more fully as the fighters' eyes up to the time either the pilot or his electronic eye can do the spotting.

Although the basic principles of SCI remain the same and are well known to CIC personnel[1], they may profitably be reviewed briefly to illustrate this principle.

There are according to NRTS, St. Simon's, three fundamental types of SCI interception: 1—Curve of Pursuit; 2—Cut-off Vector; 3—Head-on.

In the Curve of Pursuit method the fighter is kept on a heading directly toward the target. The VF (N) proceeds toward the target in a gradual curve of steady approach on a series of vectors which may come seconds apart. Because it is slow, the method is generally regarded as the least likely to succeed in intercepts against newer and speedier Jap aircraft.

The Cut-Off Vector method automatically takes into account the possibility of higher speeds since it is based on the general principle of an almost equal speed of target and fighter. The interception is planned by selecting a point on the target's projected track and vectoring the VF (N) out at a speed which will guarantee the simultaneous ar-

[1] "C.I.C.", June 1945, page 24.

rival of bogey and VF (N) at that point. Roughly three miles before the fighter reaches the bogey's projected track, the fighter is turned to a so-called safety vector which puts the fighter on a track which will intercept that of the bogey at an angle of 40 degrees. When the VF (N) has reached a point on that heading from one-half to three quarters of a mile distant from the target's projected track, he is given a turn to the bogey's course. Chief hazard of the Cut-Off method is the danger of bringing the VF (N) in too far astern. Close control of VF (N) speed and alertness to the necessity of correcting the vector, however, minimizes the danger of over-shooting.

The third fundamental SCI intercept—and the most difficult to handle—is the Head-on Interception. The approved method of executing this intercept is to send the fighter out on a vector but slightly off (i.e., roughly four miles) the reciprocal of the target's course. At a point approximately five miles from the target, the VF (N) is ordered to the safety vector and then to the target's course. Similar to the new St. Simon's daylight intercept, the night Head-on holds one similar hazard: The danger of missing the turn at the crucial point, through lack of radar information or communications failure.

With these three types of intercept regarded as basic, St. Simon's-trained SCI controllers are taught to utilize such variants as the tactical situation demands.

The speeds of newer Jap planes dictated modifications of these tactics. The effective range astern in interceptions has generally decreased—from three to one mile astern. Pilots training at fighter direction centers are thus indoctrinated to high overtaking speeds and controllers to more accurate positioning of the VF (N).

Although a small altitude differential *below* the target is still standard procedure, there are instances in which an altitude advantage *above* the target may be necessary and desirable. NRTS, St. Simon's SCI students thus sometimes position fighters above the target when a bright undercast can be used to silhouette the target. The principles which dictate the normal position *below* the target—the normal lightness of the sky in comparison with the sea, and the fact that the darkening of the stars as the bogey passes are valuable aids in visual spotting, and the ability to exercise Speed Control by reducing speed without changing throttle setting or flaming exhausts—likewise dictate the approach from down moon which is emphasized at NRTS, St. Simon's.

It is possible that the need for visual identification may be obviated by the future development of an electronic gunsight for blind firing and the development of more positive IFF. However, until these equipments become reality, the need for visual spotting will continue to demand close attention to light conditions.

For night or low visibility intercepts a new technique has been devised by the Beavertail staff. Beavertail IO's employ a modification of the British controlled turn. The intercept is initiated by placing the VF (N) 60 degrees off the bogey's course (i.e., at ten or two o'clock) from the bogey at a distance of six miles. At that point a thirty degree turn in the direction of the bogey's course is given. Two miles later another thirty degree turn is ordered, placing the VF (N) approximately 3½ miles, ten or two o'clock from the bogey, and in a "Punch" position. If the VF (N) fails to make contact after two miles on the second vector, another thirty degree turn is ordered. As this turn is made the VF (N) is off the beam of the bogey at about 1½ miles, and in the ten or two o'clock position. If a contact is still not forthcoming, an additional 30 degree turn brings the VF (N) to the bogey's course about one-half mile astern.

Advantages of the "Beavertail method", it is argued, revolve around the fact that a maximum number of effective contact positions are obtained, the intercept is conducted at high speed, and a better position is achieved in that the VF (N) is kept clear of the tail gunner and any possible tail warning devices which have been developed by the Japs. Moreover, the tendency on the part of night controllers to bring the VF (N) too far astern of the bogey is minimized.

Other recent suggestions for improving SCI have included recommendations that night intercepts be conducted at the highest feasible speed and that the practice of specifying fighter speeds be dropped since the relative position of both fighter and bogey are readily apparent on the PPI scope. Higher speed can be obtained by initially stationing VF (N) at altitudes well above the anticipated angels of the intercepts and losing altitude as it becomes necessary to increase speed. New, high-speed Jap reconnaissance planes found their advantage reduced—at least in the initial stages of the intercept. Another suggestion has been to allow the pilot to choose his own relative altitude as he nears the point of interception since he is the one fully informed on light and visibility conditions in the target area.

Not new but receiving added stress in training programs are such principles as keeping pilots—particularly night fighters—fully informed on the progress of an interception, avoiding hard turns unless they are very necessary, and keeping on the alert for enemy fighter cover over night raiders. Although the JAF did not use fighter cover for night raiders, there was always the possibility that they would do so. Returning dawn and dusk patrols of VF (N) should also be joined in sections or divisions for mutual protection whenever light conditions are adequate for day tactics, according to the newest SCI practice.

VISUAL FIGHTER DIRECTION

Wherever IO's gather, the subject of Visual Fighter Direction is sure to bob up. No subject in fighter direction is more controversial. Opinion—usually heated—ranges from the opinion that visual interception is relatively useless to the opposite opinion that it is essential. Recent experience with low-flying conventional Jap attacks and high or low-flying Kamikazes, some of whom have come in undetected by air search radar, would seem to vindicate the visual enthusiasts.

Late enemy tactics—splits and breakaways after the tallyho with singles weaving in on the force—indicated that the Japs were aware of the deficiencies of our search radar and of the difficulties experienced in separating the bogies from the large numbers of friendlies in the vicinity of our operations. In some instances visual fighter direction is thus effective and necessary.

Current trends, with the shift of control from CV's to screening DD's or BB's, have also answered the objection of carrier people that their position in the center of the force prevents them from making effective use of the visual station.

Chief development in visual intercepts has been toward simplification to save valuable time and to transfer the load from the pilot to the Visual Intercept Officer (VIO). Instead of the conventional "Port 30" or "Starboard 60" NRTS, St. Simon's—trained visual FDO's calculate the extent of the turn themselves. After the initial vector—"Mohawk 7. This Mohawk Snap. Vector Pronto 150."—directions are simply: "Starboard (or Port) Out." When the course has been sufficiently corrected, the VIO orders: "Steady. Out."

No acknowledgment is required from the pilot. Busy searching for the enemy, he need not take time out to watch the compass. A constant flow of information also goes out to the fighter. With the advantage of a full view of the intercept picture, the VIO can supply his fighter with the exact number and type of enemy planes, their altitude, relative motion, position and range.

Since sighting the enemy is the immediate objective and the lower the fighter the better the visibility, current visual fighter direction practice at St. Simon's does not stress either position or altitude advantage. Pacific Fleet Radar Center IO's are trained to intercept at a point about one mile inside and on the bow of the bogey; however, as at St. Simon's, speed in interception—full military power with most turns hard starboard or port—and quick sighting receive the most stress.

Most visual intercepts are normally conducted with the VF at 500 feet, and an altitude advantage of two or three hundred feet is desirable. Under low cloud cover conditions when visibility is exceptionally bad; the tallyho may be accomplished, however, from slightly below and behind the bogey. Care must be taken, as in all intercepts, to see that the intercept does not turn into a fatal tail chase.

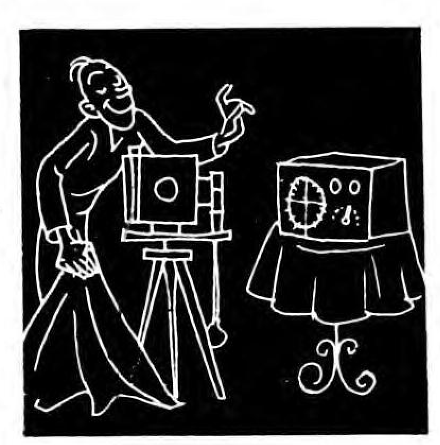
Pacific Fleet Radar Center's Visual course emphasizes the fact that the visual FDO must have good eye sight, especially with respect to depth perception and must be given ample opportunity for practice, with much emphasis on recognition.

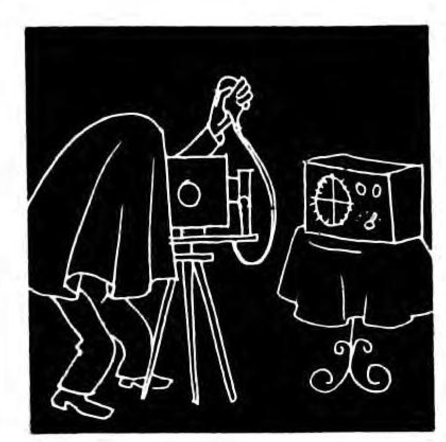
Two additions to the visual vocabulary have recently been recommended:

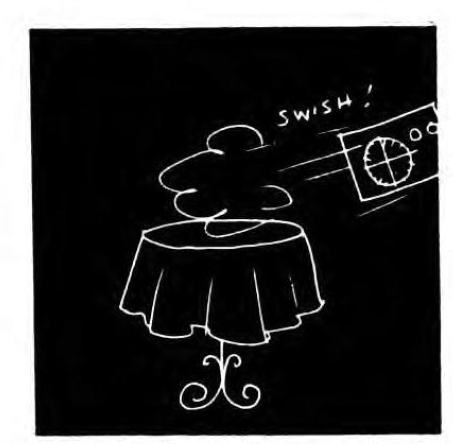
"Tallyho Pounce"—I see and will be able to bring the bandit under effective attack.

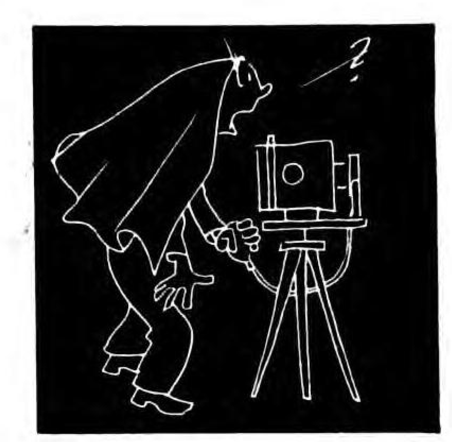
"Tallyho Heads-up"—I see bandit but will not be able to make an effective attack.

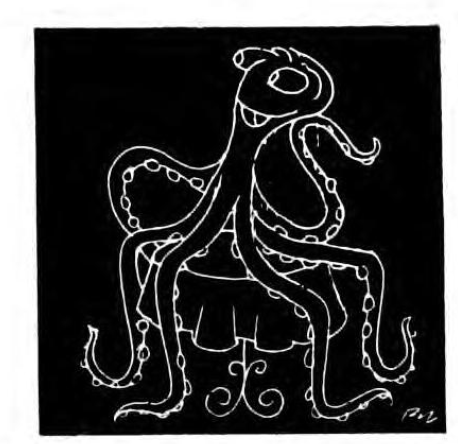
Briefly stated the foregoing represent the latest notions in fighter direction. As our radars are perfected, the intercept officers' technique will continue to change and improve. Perhaps for some years to come, fighter direction will continue to be the Fleet's long arm of defense.











You, in your airplane, are directly over the airfield because you are a good navigator, and your calculations show that's where you should be. Not that you can see the field! Your altimeter reads 5,000, and you are sitting on top of a fog bank whose bottom, as far as you can tell, rests squarely on the runways. You call the control tower located somewhere down in the soup, and they confirm what you have already surmised:

"Field closed in . . . ceiling one-hundred-fifty feet . . . visibility half a mile. . . ."

Fly on to the next field? (Sure, only this is a Pacific island airbase, and there's a helluva lot of water without bourbon between bases.) Bale out? (Same thing goes about the water.) But wait! The voice from the control tower has a suggestion:

"We are turning you over to GCA," says the voice from the tower, and then a new voice comes over your earphones:

"Hello Navy one-seven-two"—(that's you)—"this is Pelican. What is your altitude, heading and approximate position, over?"

And you answer: "This is one-seven-two. Angels 5, heading one-two-zero, somewhere over the field —I hope."

The voice comes back: "Roger, one-seven-two, we have you in sight five miles east of the field. This is the Ground Control Approach Director—do you understand?"

You don't understand. What the hell's this Ground Control Approach. It's not on your instrument panel—as far as you know. The voice, a quiet, reassuring voice, continues on Channel Baker:

"Please follow our directions and we will bring you down to the end of the runway where you can touch down visually. What is your aircraft type—over?"

You tell him.

"Continue on course one-two-zero," the voice continues. "You are now heading downwind. Make your cockpit check now."

Roger. You check.

"You are six miles east of airport. Steer right two-one-zero, over."

"Wilco—steer right two-one-zero," you answer.

"You are on your crosswind leg six miles from the airfield. Fly at two-five hundred, over."

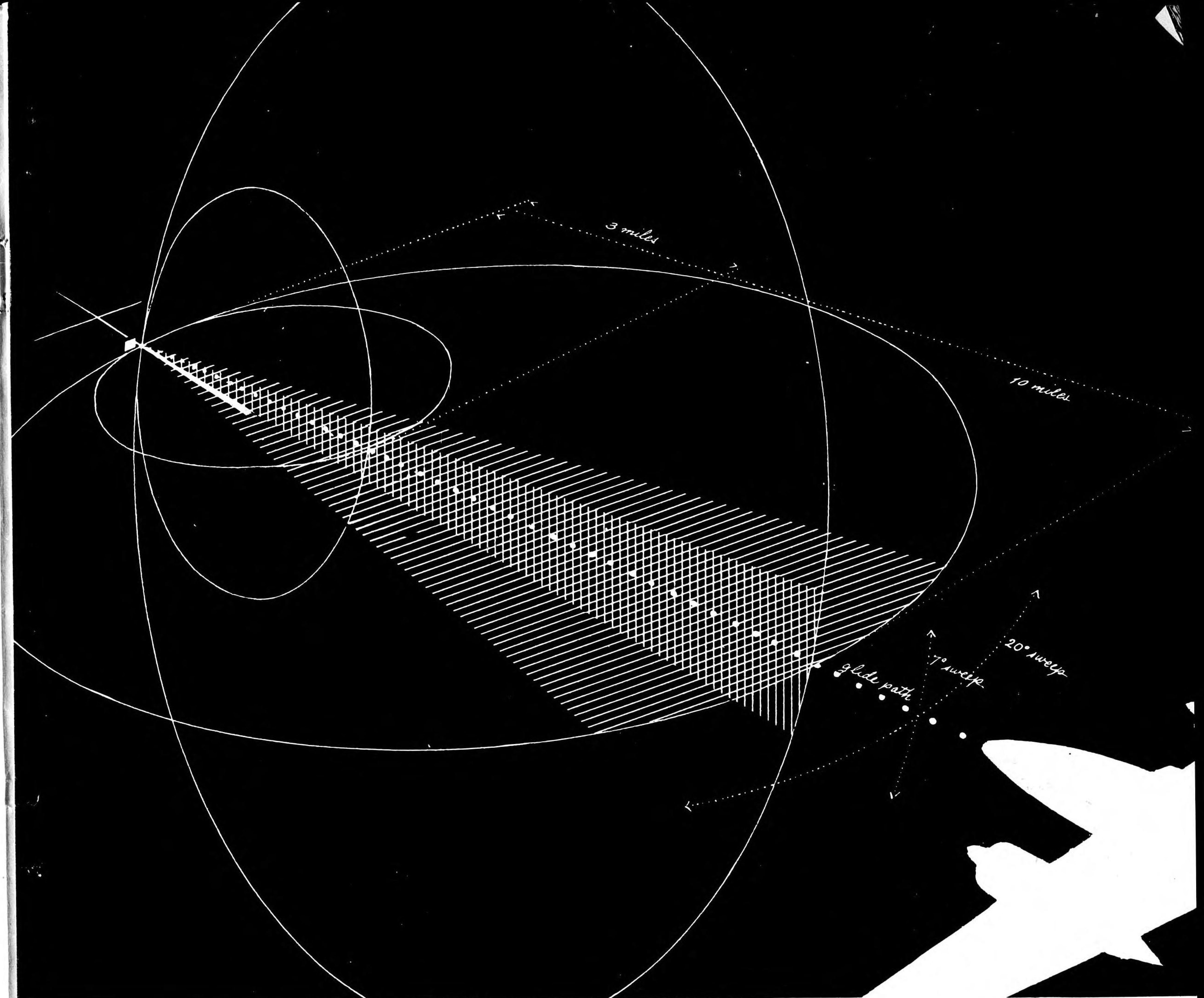
Nothing new about this. Just the conventional landing pattern so far. Downwind, then crosswind, then:

"The runway is 4000 feet long, 150 feet wide. You will make a right hand approach to the runway. Steer right two-nine-zero, over—"

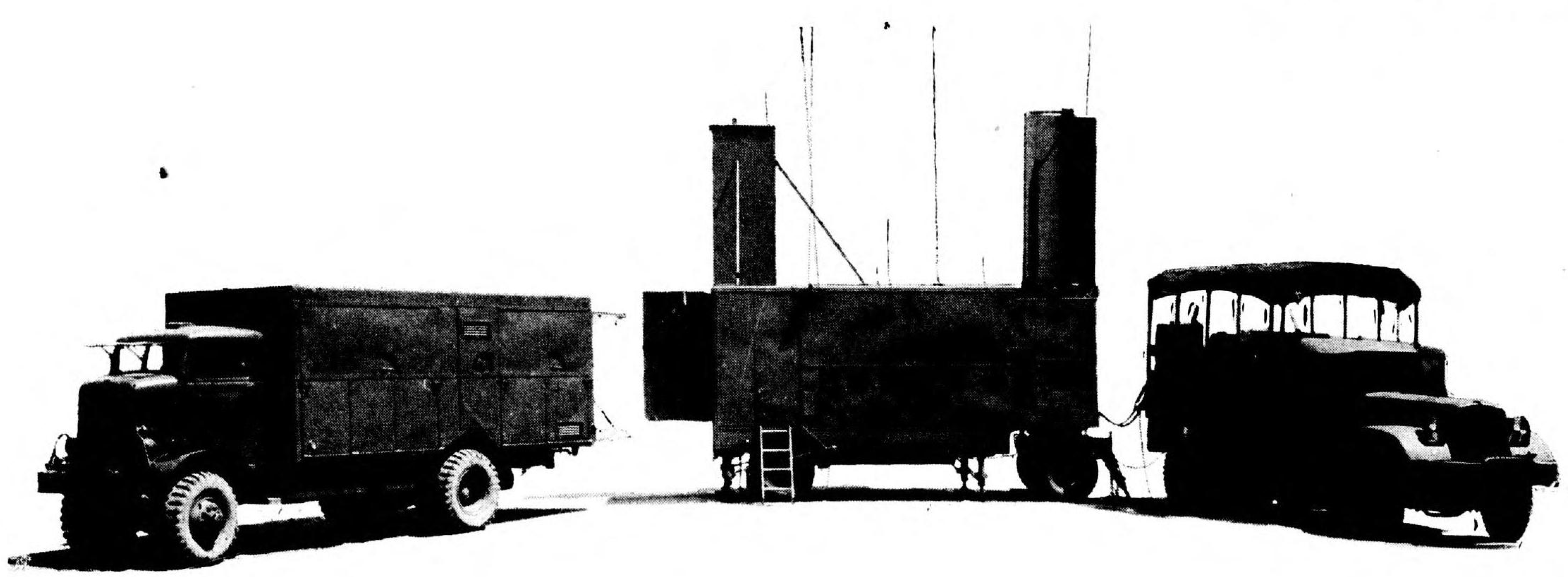
You guessed it. The final leg! A new voice comes over your earphones. A voice as smooth as an announcer giving out with commercials. A voice as relaxing as a Swedish massage:

"You are on your final leg . . . do not acknowledge further transmissions . . . two-nine-zero is your heading . . . two-nine-zero . . . five miles to end of runway . . . wind on the surface northwest five . . . lose altitude five hundred feet per minute . . . two-eight-five is your new heading . . . two-eight-five . . . "

Not hurried. Just a steady flow of directions, easy to understand. Losing altitude at the normal five hundred-feet-per-minute. Adjusting your course now. The voice continues, quietly, confidently:



GCA lands you with ceiling zero



"Four miles to runway . . . Drifting slightly above glide-path . . . Down fifty feet . . . forty . . . thirty . . . twenty . . . On glide-path now . . . that's correcting nicely . . . two-eight-five is your heading . . . "

Certainly you correct nicely. You're a good pilot.

"Three miles from runway . . . check landing gear down and locked . . . Steer two-nine-zero . . . two-nine-zero is your new heading . . . You're twenty feet below glide-path . . . Up a shade . . . You're holding ten feet above—bring it down just a little . . . that's fine . . . Glide-path very good . . . Still two-nine-zero . . . Your heading is two-nine-zero . . . two miles from end of runway . . . Glide-path good . . . Mile and a half from runway . . . "

Like scooting down a sliding board when you were a kid—that's this glide-path business! Just follow directions:

"One mile from runway . . . two-eight-eight is your heading . . . two-eight-eight . . . going above the glide-path twenty . . . ten . . . on glide-path one-half mile from end of runway . . . "

You're squinting now. What runway? You don't see—but wait. You do! There it is, directly ahead, looming out of an opaqueness that you know stretches from here up to there, five thousand feet up.

"Runway straight ahead. Take over visually. This is Pelican, out."

Almost at the same instant your wheels touch and you are down on the ground once more. Five thousand feet of soup, and you came through it to make a landing. You and your "co-pilot" . . . the GCA controller!

How did he do it—what brought you down? You did not line up crosshairs on an instrument face, nor did you switch gadgets on and off; in fact, you flew your plane as you would on any conventional landing, except that—shades of pre-commissioning days—you were given constant compass headings to follow, and coached on your rate of descent. Those directions came to you over your radio on a common frequency band that is standard in all airplanes. There was nothing new that you had to know, except, perhaps, how to have confidence in someone's judgment . . . and some "gear."

GCA USES THIS EQUIPMENT:

That "gear," according to the Instruction book, is the AN/MPN-1A: "A mobile ground radar system providing facilities for directing the movement of aircraft over a pre-determined glide-path for a safe approach to an airdrome runway under conditions approaching zero visibility."

This mobile ground radar system known as Ground Controlled Approach equipment, or GCA, is mounted in a specially designed trailer. The trailer is set up on the airfield approximately three hundred feet from the center line of the runway (to the pilot's left on an approach) and three thousand feet from the downwind end of the runway. It is easily recognizable by the large search antenna reflector which is mounted on top of the trailer.

As you enter the trailer you note that, similar to a CIC, the illumination is low, the only light coming from PPI scopes. What appears to be one giant radar console actually houses two radar sets: one a search system for directing aircraft into the narrow "glide-path" area which is scanned by the second set, a precision set that provides continuous range, azimuth and elevation information on the plane being controlled on the Final Leg.

Five men make up the crew in the trailer seated before the console, four radarmen reading scopes, and the final controller, usually a naval officer. In the air, you would hear the voices of three of these men, the two radarmen "directors" and the controller who "Talks-down" the plane along the glide-path during the Final Leg. All information is carried over an ordinary two-way communication system operating on either the HF or the VHF bands. In front of the controller and the directors are push-button arrangements giving them three HF and three VHF selections. Once frequencies are set up on the transmitters, all the director or controller has to do to switch channels is press one of the six buttons.

THE VOICES YOU HEAR

The voice of the No. 1 director, a radarman, is the first to be heard when you report to GCA for instructions on landing. He uses a **PPI** scope with a 30 mile maximum range. If you were a pilot familiar with GCA procedure at advanced base, say Okinawa, you would call in:

"Hello Pelican, this is Navy five-one-three-zero-nine. Request ground approach control, over."

And it would be No. 1 director who would answer: "Navy five-one-three-zero-nine—this is Pelican. What is your altitude, heading and approximate position, over?"

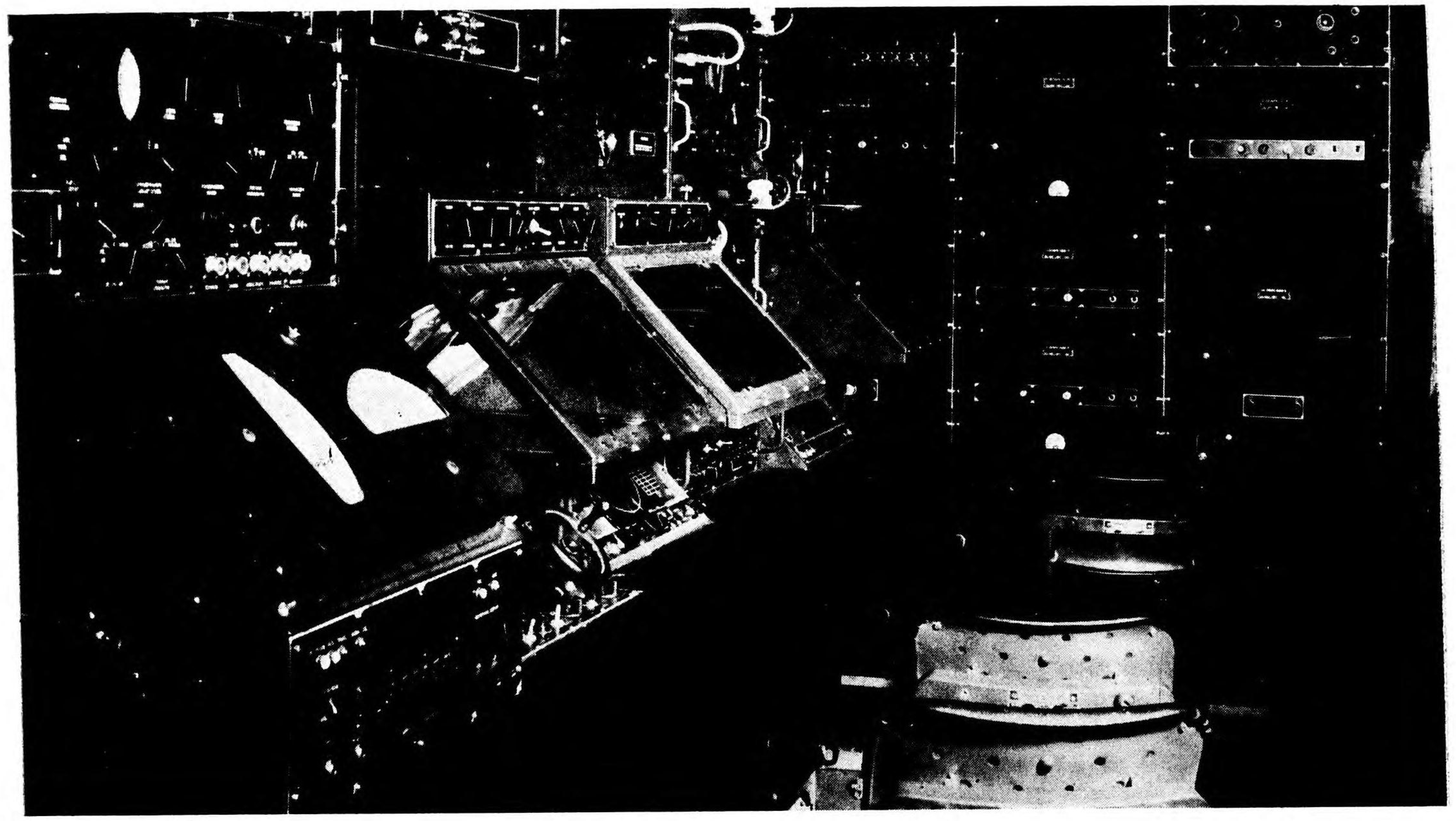
You would give him this information, and he would pick you out on the **PPI** scope. If he were doubtful just which blip represented you, he would give certain steers so you would be flying in a pattern he could recognize on his scope. Once you were identified he would report to you over the radio channel you are using:

"You are in sight."

No. 1 director assigns the altitude and heading to fly to start you, as a pilot, on your landing circuit. No. 1 director gives you the necessary information concerning altimeter setting, field elevation, runway dimensions, wind data. No. 1 directs you to perform your landing cockpit check; No. 1 is a combination "Information-please" and super-navigator who, by careful radar checks, brings you to a point where you begin your cross-wind leg of the landing pattern. At this point, No. 1 director, on intercom, calls No. 2 director who is the next man to his left and gives him your call, range, clock position, altitude, heading and channel.

On a PPI scope, identical to the 30-mile maximum range scope used by No. 1 director, No. 2 director picks you out on his scope and directs:

"Three-zero-nine—steer right one-six-zero, over." You follow directions.



Interior of GCA trailer. No. #1 Director's position is last "glass showcase" to rear of van. The panel between No. #1 and No. #2 radar sets is communication setup to tower. Note "error meter" in foreground and cursor crank directly under azimuth precision scope.

"You are on your crosswind leg seven miles from the airport. Fly at two thousand five hundred feet—over."

Thus the No. 2 director brings you to a point where you start your up wind approach along the "glide-path." Here the final controller takes over:

"Steer right two-nine-zero . . . you are on your final leg . . . "

Now you are within the precision system of GCA in both azimuth and elevation, a system so exacting that the original U. S. Navy specifications requiring that aircraft be brought in to within 150 feet above terrain have been exceeded every time in tests made in Gainesville, Georgia, where the elevation beam was proved to be accurate within six feet and the azimuth beam within twenty feet.

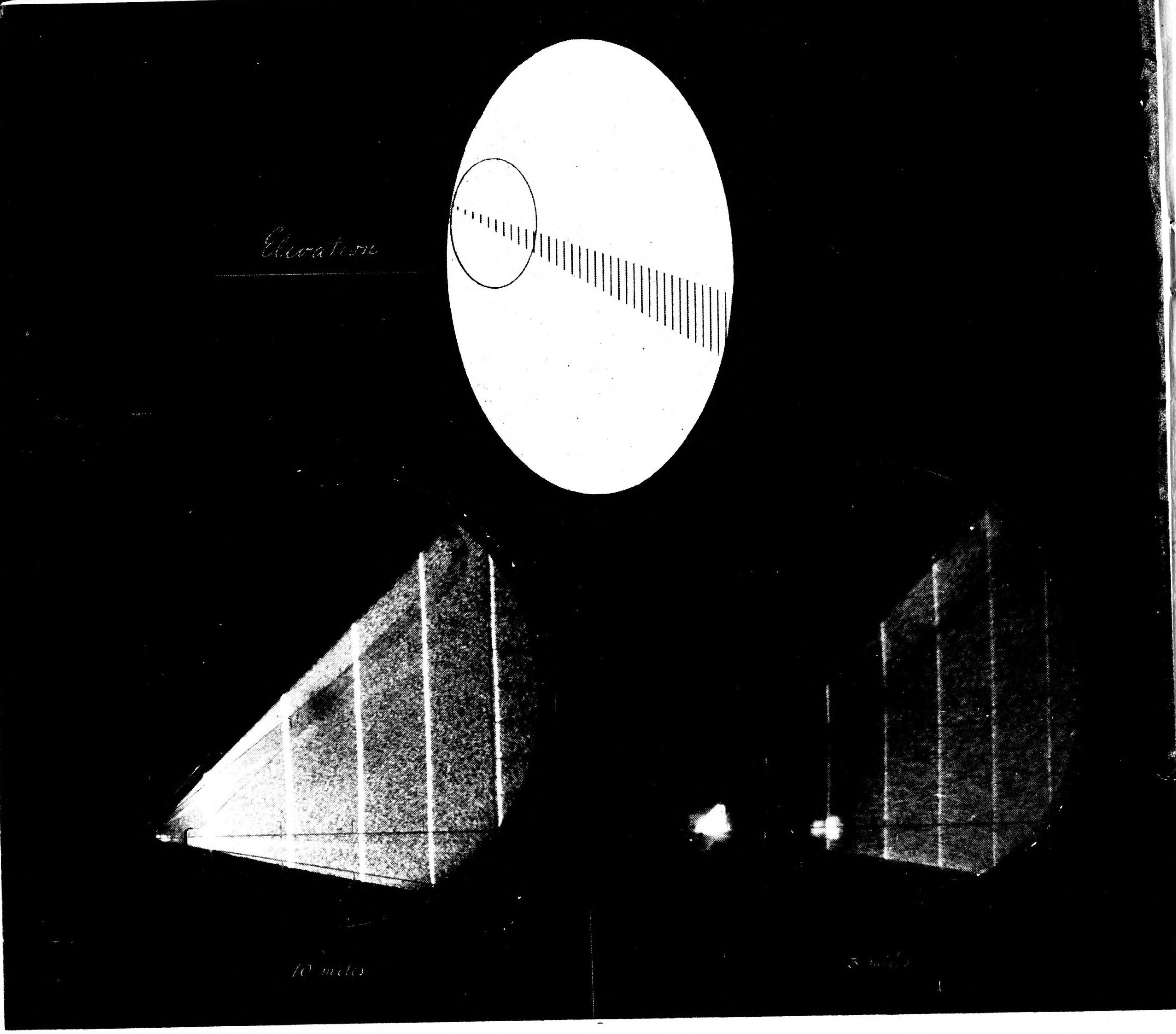
The controller sits before an Approach Controller Meter (see illustration). To his right is the radarman azimuth tracker, and at his left, the radarman elevation tracker. Each of these precision trackers has two scopes before him, one with a ten mile range, the other with a three mile range. Actually, the three mile scope is an enlarged presentation of the last three miles of the approach as shown on the ten mile scope.

THE FACTS OF GCA PRECISION

The precision system scans 20° in azimuth, sweeping across the end of the runway. Once a plane is picked up on the 10 mile range scope, an "on course" line is established, and the azimuth tracker follows the aircraft with a hairline or "cursor." The difference in feet between the cursor, representing the actual position of the aircraft, and the established "on course" line is automatically shown on the azimuth error-meter in front of the Final Controller. There is very little possibility of the "human error" element entering the picture; it is only necessary for the Controller to determine the compass heading that the plane should fly to correct for the error in feet. Controllers usually correct in five degrees only, out past the two mile range, to make it easier for the pilot. Once a plane is within two miles of the runway, the Controller will correct in exact compass headings:

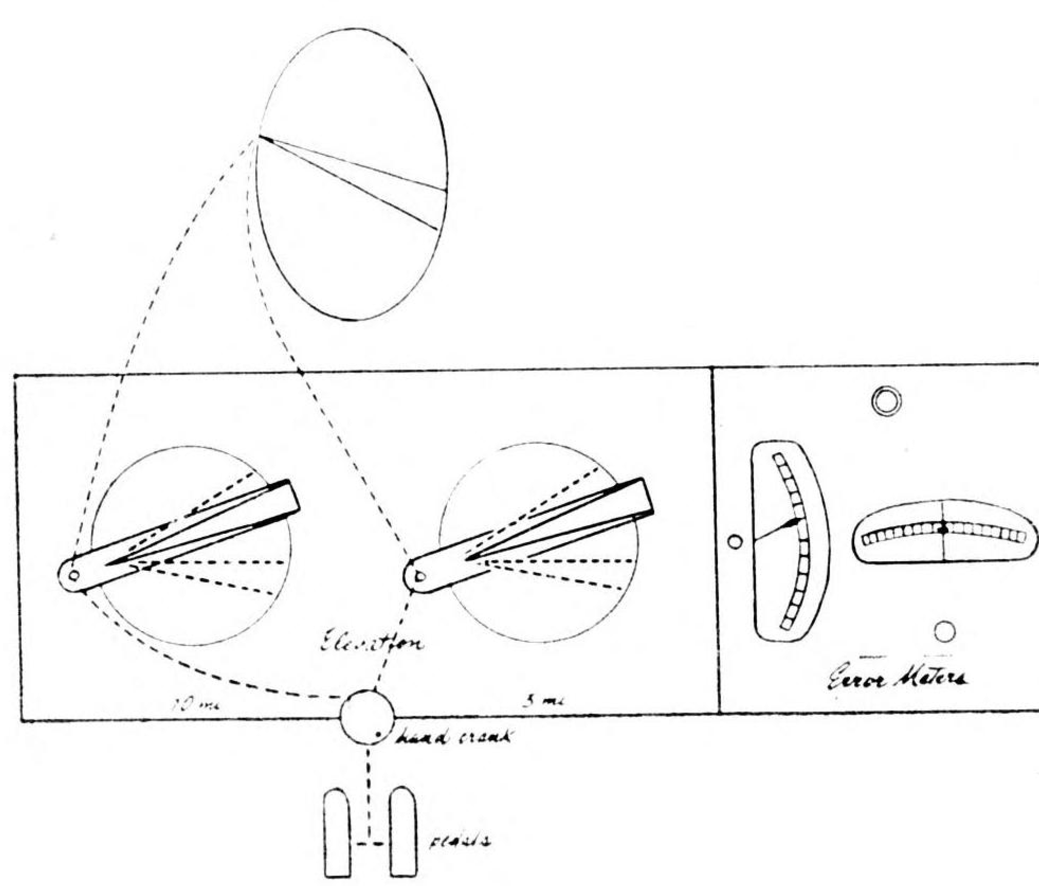
"Your new course is two-eight-eight . . . that's two-eight-eight . . . "

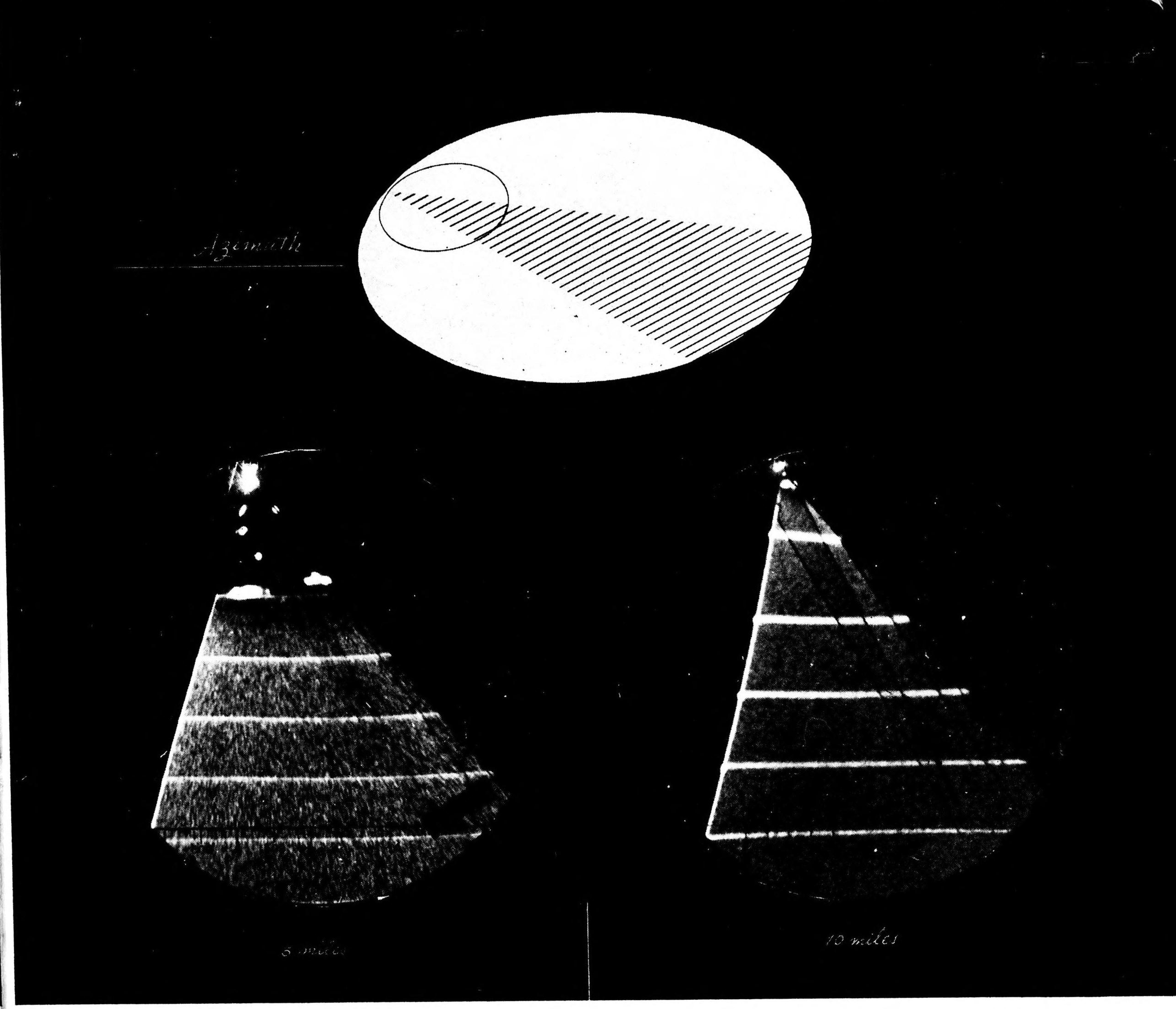
Most planes are "on course" almost immediately after making their turn from crosswind to the final leg, and there are few course changes necessary.

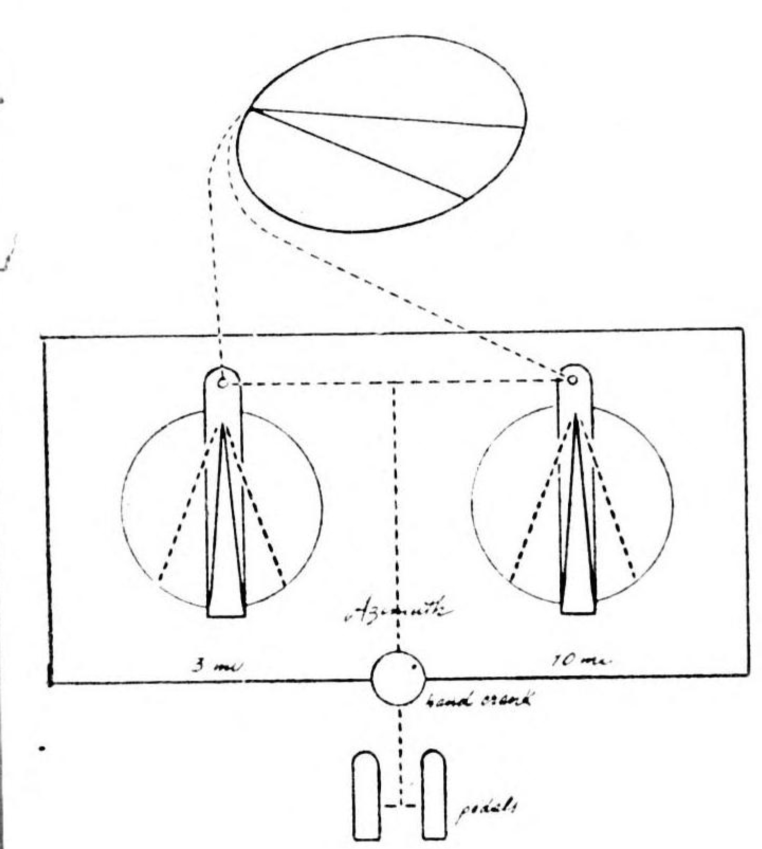


▲ *Both the three-mile range and the ten-mile range scopes are 7 inches in diameter. The "blip" on the three-mile range elevation scope is a house one mile from the GCA trailer. The corresponding "Blip" can be seen on the three-mile range azimuth scope.*

The precision system scans 7° in elevation, 6° above the ground and 1° into the ground. Thus a permanent radar ground line is established, and an accurate glide-path may be set up anywhere from a 2° to 5° angle from a definite touch down point. The glide-path, which is the angle the path of a descending plane makes to the ground, can be shifted for various types of planes.







◀ *A hand crank controls cursor for tracking target in elevation. Foot pedals control azimuth antenna in elevation.*

◀ *Twenty-degree sweep is controlled by the crank, the foot pedals controlling the elevation antenna in azimuth.*

Again, with the use of a cursor, the elevation tracker automatically cranks into the error meter information on the number of feet the aircraft is above or below the pre-determined "glide-path." The Controller reads these figures from the meter in giving instructions to the pilot:

"You are fifty feet above the glide-path . . . forty . . . thirty . . . twenty . . . on glide-path . . ."

On the three-mile range elevation scope, the picture of the terrain is so complete that houses, towers, radar vans and the like show up as permanent blips that take on characteristic shapes of these objects. For this reason, it is possible for the Controller to give useful information to pilots on possible hazards, such as:

"You are two hundred feet above Mount Surabachi . . . "

With two radarmen doing the actual tracking of the aircraft on the precision system and cranking in the errors on elevation and azimuth into the error-meter, the Approach Controller has all information necessary for a successful "talk-down" approach; he is not hampered in this performance by having to do the manual work of maneuvering the cursor to check the path of the incoming plane.

HOW GCA TEAMS ARE TRAINED

It is obvious that to pass control of the plane from No. 1 director to No. 2 director and finally to the Approach Controller who instructs the pilot on the last leg of the approach requires a good deal of teamwork. The question might arise: why not have one man do the talking to the pilot? Once you have watched a crew perform, the answer is simple: to have the controller shift from the search set to the precision system would in the small space provided mean considerable lost motion—and confusion. This shifting the aircraft from directors one and two to the Approach Controller makes each man a highly trained specialist, and the maneuver is performed as neatly as a championship basketball team passing the ball around. To reach this high degree of efficiency takes training, of course, and following a conference of representatives from BuAer, BuShips, and CNO, the Naval Air Technical Training Center was set up in Gainesville, Georgia, in October, 1943.

At the present time, three complete GCA units (Component 22) are being sent from the school each month. A unit consists of three officers and fifteen enlisted men with the officer-in-charge an active Naval aviator with a white or green instrument card who has had considerable experience in flying GCA. In addition to his administrative duties, he briefs pilots who have not flown GCA before, and can take over most positions in the GCA setup.

The approach controller must have "good microphone technique" and must have a thorough knowledge of the flight characteristics of all types of aircraft. A maintenance officer, (E) T, keeps the gear functioning properly at all times, which is no easy job considering there are two complete GCA mobile units to insure against possible breakdown.

Of the fifteen enlisted men, ten are radarmen, two motor mechanics, two radio technicians and one electrician. The radarmen are trained in all of the four "crew" positions, but eventually specialize in one of the spots, those with the best microphone techniques taking over the No. 1 and 2 directors' positions.

The GCA course lasts three months, with the last month devoted to working as a crew with actual aircraft approaches. An average of forty or more approaches are successfully completed each day so that a crew claims that with so much practical experience: "We can land anything from a Cub to a B-29."

At the present time, thirteen of these GCA units are overseas and are setting up, or have set up, Ground Control Approach Systems in Saipan, Guam, Palau, Okinawa, and presumably "points west."

HOW GCA ORIGINATED

The philosophy which started GCA on its way was this: If Microwave Radar can locate a plane from the ground precisely enough to shoot it down, it is capable of the more constructive task of guiding a plane to a safe landing in conditions of blind flying.

This basic idea was conceived in November, 1941, by Dr. Luis Alverez and was first tried at the Radiation Laboratory of the Massachusetts Institute of Technology. It was decided at this time that GCA would make a clean break from conventional blind landing systems; instead of putting the information on a meter in front of the pilot, it would be told to him verbally. This would eliminate the need of new equipment in the planes and the pilot would have most of his thinking done for him by someone on the ground.

The first experiments using aircraft were conducted at East Boston Airport and at NAS Quonset Point using gun-laying radar for the precision system. It was obvious from the beginning that this gear was not sufficiently accurate at low glide-path angles, to successfully bring planes in for an approach, but it did prove that the "talk-down" principle was good providing the controller had accurate information as to the elevation and azimuth of the aircraft at all times. The Radiation Laboratory at M.I.T. then developed special radar antennas and a presentation for high precision radar at low angle, combining this with a search system for traffic control. This was the Mark I GCA and was ready for a test a year later, November, 1942.

Mark I GCA was operationally a big success, but technically not practical for forward area use. This brought about the development of the Mark II GCA set which was exhaustively tested by the Navy operational personnel and was accepted in August, 1944. Six complete units per month are being manufactured at present.

The first sets were set up in Gainesville, Georgia, Whidbey Island, Washington, Attu and in Africa. In six months, approximately 10,000 successful approaches were completed to conclusively prove the dependability of the system.

PILOTS NEED TO LEARN ABOUT IT NOW

One of the difficulties being experienced, both in the forward areas and in the states, is the logical problem that the secret and confidential nature of GCA during the development period has necessarily made it "little known" to the man who must use it . . . the pilot.

This article, for instance, is one of the first accounts to be given fleet-wide distribution.

An example of this is the pilot of the B-29 unable to land at Iwo Jima because of weather conditions. He had never heard of GCA, and when it was explained to him over the radio, he chose, instead, to attempt to land without the Ground Controlled Approach. Several passes over the field convinced him he could not find the runway—and Mount Suribachi was a mental hazard looming somewhere out in that soup. When the effective ceiling was only 100 feet and the visibility less than a mile, the GCA crew took over. Although this army GCA crew had worked only with P-61's, a B-29 pilot was brought in the trailer for consultation. The stage was set for GCA's greatest test: rain, strong crosswinds, severe turbulence near Mount Suribachi—the weather so bad that the pilot had to fly the rudder and the co-pilot the elevators. This alone made it extremely difficult in lining up the plane to accurately follow the glide-path. Finally the pilot called down to GCA: "Either get me down—or shoot me down . . . there isn't any more gas."

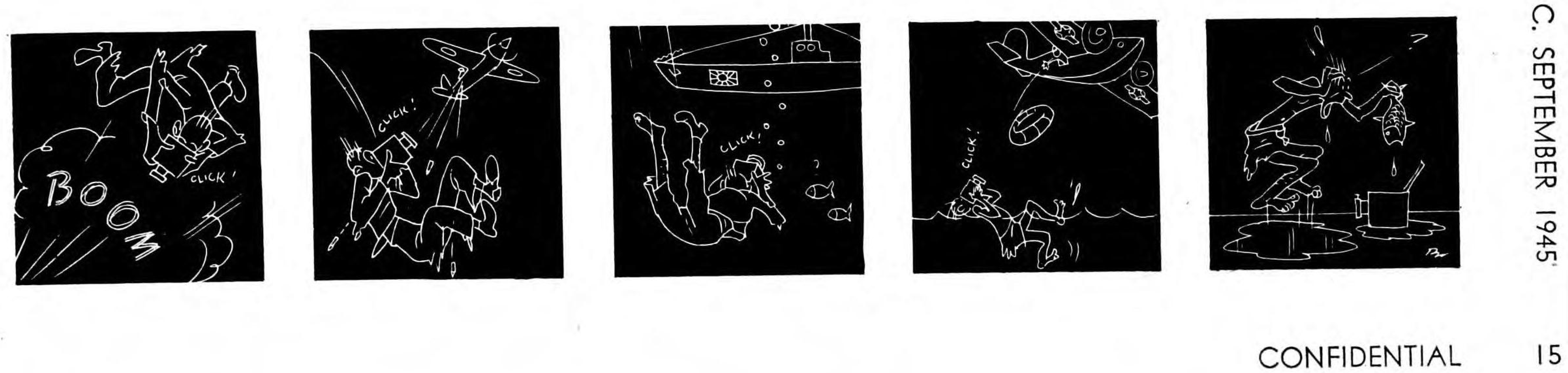
GCA did bring the big B-29 down, without shooting it down. A grateful plane crew wrote letters of thanks to all of the GCA crew. Since this incident of 4 April 1945, B-29's have been landing regularly on Iwo Jima—as high as twenty in one day. Now all B-29 pilots are being briefed in GCA and making test runs.

IT HAS A ROSY FUTURE

It is difficult, at this time, to predict the future of GCA and how far it can go. There have been several successful "Talk-down-to-touch" when pilots, under a hood, actually were brought down and landed without visual contact. This, of course, is not the claim of GCA—that Ground Controlled Approach can actually bring the plane down to touch, but rather that a plane can be brought down during almost zero conditions, and the pilot takes over visually within a hundred feet or so above the runway. No doubt when GCA units, now in the field, have had more experience, there will be more and more cases of "touch-downs" or near touch-downs being made.

Several commercial air-line officials have recently made trial runs at the Anderson, South Carolina, field and have expressed confidence in GCA as a post-war plan for all commercial lines.

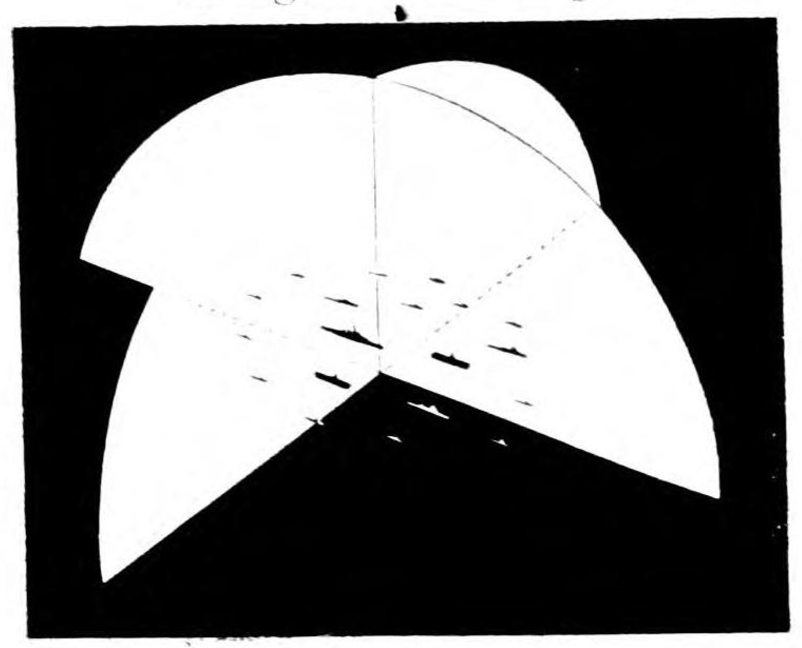
At this same field, in Anderson, the practicability of using a "stacking" system for traffic control was demonstrated when thirteen approaches were made in the elapsed time of 36 minutes, fifty-two seconds, or an average of 2.81 minutes per approach . . . . and preliminary tests, using a modification of the present GCA equipment, have demonstrated successful carrier controlled approaches for landing at night under blacked-out conditions—the birth of the CCA!



sector plan for AA coordination

Prior to the Okinawa operation the USS ESSEX originated a new sector plan of AA coordination which strikingly resembles the plan of task group fighter direction. Adopted experimentally by Task Group 58.3 and later taken by all groups of Task Force 58, the success of this plan in its first use is revealed by action reports of the USS NEW JERSEY and other participating ships. Fitting these together, here is the story which shows the effective use of CIC facilities in coordinating our defense against enemy air attacks on cruising formations.

Task Group 58.3 was divided into four sectors of responsibility for AA defense. All ships in each quadrant covered the same sector, (rather than assigning each ship an individual sector based on its bearing from the center of the disposition as was done previously). By thus creating four fire groups the AA coordinator in TG 58.3 was able to place the best situated fire power on a target while the remaining sectors were left free to investigate other targets or search in their immediate areas. One or more sectors may be ordered to hold fire to safeguard friendly planes while the batteries of other sectors are released to fire on known bandits. The importance of dividing the work load is particularly advantageous when numerous planes attack simultaneously, for no one bandit draws all the fire while others press home their attack without adequately being taken under fire. By setting up this small number of fire groups the communication traffic of the AA Coordination System can be much more expeditiously handled than when each ship is an independent firing unit. Every ship in the group has all pertinent gunnery information, can fire whenever desired, and can feel free to concentrate on its own targets with no responsibility to what is going on in other sectors.



The AA Coordination System was planned with attention to detail. This was particularly noticeable in regard to the special and efficient voice procedure for use on the VHF circuit in Task Group 58.3. A well defined and efficient search plan using fire control radars was placed in effect. The directors are not designed for constant training over a sector, and rotation of a director is quite a different thing from just rotating an antenna. But despite this limitation on continuous search by fire control radars, their use gives better coverage of the short range area out to 20 miles. Within 20 miles air search radar is often unreliable and visual sightings cannot always be depended upon. Lookouts, directing their reports to a single station, provide clearance of all friendly aircraft approaching the formation. As expressed by the Commanding Officer, USS HORNET: "Such close liaison between ships has the effect of 'pooling' all pertinent information as well as combining the AA batteries of all ships into one well organized and coordinated task group battery." The CO, USS ENTERPRISE adds: "Reporting ships must be positive of enemy identification, otherwise erroneous reports will clog the AA channel to the extent that the 'alarm effect' of a report on a real bandit may be nullified by the great number of cries 'wolf' ".

Another reason for the highly effective coordination achieved in 58.3 is that the anti-aircraft control officers of the ships of that group were well informed regarding the purpose and use of the system, having attended a conference aboard the USS ESSEX prior to the start of the operation.

FLAGSHIP OPERATIONAL TECHNIQUES

In this plan the Flagship should have as much information—in the nature of a complete track—on its own radars as possible to get maximum coordination with the AA Director. 58.3 Task Group AA Coordinator took station in CIC, USS ESSEX. Using a small plot, he coordinated the information on the Task Group FDO plot with his small AA gunnery plot and had the use of his ship's SC-2 radar when the bogies approached to within 20 miles of the task group. The ESSEX has constructed a special cover for the Master PPI Scope with 15 mile range markers for the use of the operators. Ranges and bearings are read directly from the PPI scope without the use of the cursor. In addition, the operators are required to track all contacts with a grease pencil on the Master PPI Scope. Any new contact picked up by the SC-2 is interrogated by the SK to determine identity. If the SK does not have the contact, supporting ship (and/or the SC-2) are requested to interrogate the contact.

In case of a multi-plane attack, an officer on a Remote PPI, using the 20 mile range scale, reads ranges and bearings on enemy contacts closing the disposition for purposes of coaching FD radars onto target and also for purposes of maneuvering. The small bearing and range errors resulting from such procedure are negligible in view of the speed and ease with which many contacts can be handled simultaneously.

Information is exchanged between the Coordinator, who personally uses the transmitter together with the headset during Conditions ONE and General Quarters, and gunnery personnel in ships in the group over VHF. It was at first believed that no separate VHF channel for AA coordination was necessary and that such use of the Tactical (Administrative) channel would not seriously impair the flow of administrative traffic for any appreciable period of time. However, experience has demonstrated that not only is a separate channel necessary to handle clearance reports on friendly aircraft and other coordinated information, but also it seems desirable to maintain a 24-hour gunnery watch on this circuit in CIC.

GROUP COORDINATION AT WORK

When enemy waters were entered, ships of the Task Group were kept advised of the progress of interceptions. The altitude and location of CAP were announced over the AA circuit, assisting ships in picking a bogey target instead of CAP when more than one target was picked up by fire control radar. This information also served to reduce the frequency of lookout reports of 'bogey, overhead, high'. In instances where some bandits evaded or broke through the intercepting aircraft, ships were warned whether our fighters were following the bandits in, or if they were breaking off interception. Prompt warning was given of the approach of all friendly aircraft as well as bogies. Individual ships were encouraged to aid in the identification of bogies and did so. It was clearly understood that the AA Coordinator would designate which sectors were to take which closing targets under fire. This free exchange of information has done much to eliminate uncertainty on the part of individual ships in certain situations regarding whether or not to open fire. Yet, when surprise attacks develop the initiative of each ship to open fire at will against an identified enemy plane remains undisturbed.

Even though most of the information that goes out over the AA circuit duplicates what goes over the Fighter Director Circuit, it is felt that everything is to be gained by the repetition and nothing lost. Recent enemy tactics were to disperse large formation flying just outside intercept range (50-60 miles), following erratic course changes for the remainder of their approach. The fighter director channels, of necessity, will provide information on dispersed groups involved in interception and may not be able to furnish information on small groups closing the formation but not being intercepted. The AA channel, coordinating spasmodic tracks and visual reports from all ships, fills in with information for gunnery concerning any dispersed groups that have evaded intercept which the other channel is too busy to adequately cover.

In the initial trial of this setup in action all bandits approaching the disposition were correctly evaluated. No bandit contacts approached the disposition within six miles from the center. All were taken under fire at extreme gun range. Altitudes of contacts varied from 1500 to 6000 feet. On one occasion the Task Group was under attack by four separate bandit aircraft between approximately 1900 and 2130. Two were destroyed. A heavy fire was delivered by the Task Group and warnings as to location of adjacent friendly Task Groups and pickets as well as care in regard to location of adjacent ships in own disposition contributed to lack of any damage by own AA fire.

Large ships in central positions in alert sectors were called to reinforce the fire of ships in action sectors. Response to this request was smooth, fast, and accurate. Copious use of window as well as evasion by radical changes in altitude on the part of the bandit planes was experienced. Nevertheless early contact by fire control radar was accomplished and maintained. Reports of contact and solution were not acknowledged for or relayed, thus enhancing circuit discipline and the immediate value of the information transmitted.

BB ADJUSTS TO AA PLAN

"USS NEW JERSEY anti-aircraft and CIC organizations took immediate steps to organize CIC and Secondary Battery Plotting Rooms to participate in receipt and distribution of target information under this plan. To achieve the closest possible cooperation with the task group commander and the other ships, an AA Coordination Team has been created and stationed in CIC. This team consists of two officers and one fire controlman. The members of this team are seated at a table below the Air Plot with the VHF radio and the anti-aircraft director range and bearing indicators before them. One officer mans the VHF. The second officer mans the ship's anti-aircraft control circuit for the purpose of disseminating information and control orders to the directors and Air Defense. The petty officer mans a special circuit, connecting with the anti-aircraft computers, which is used to collect information to be relayed to the Task Group AA Coordinator via VHF. Each telephone circuit is virtually a one-way circuit which greatly expedites the handling of traffic. This method has proved very efficient and it is believed that the information obtained by the anti-aircraft radars, directors, and computers (particularly in regard to altitude of target obtained by Mark 22 Radar) has been of assistance not only to the Task Group Coordinator, but also to the Task Group Fighter Director Officer in effecting interceptions near the formation. While it is realized that much remains to be done in the way of improvement, it is felt that great progress has already been made since the inception of the AA Coordination System toward obtaining more effective anti-aircraft defense in large formations.

"The special and continued effort made in this ship to improve the organization of its anti-aircraft defenses, in recognition training of lookouts and gunnery personnel, in indoctrination of gun crews and control parties in fire discipline, and in special training to obtain the rapid commencement of a large volume of accurately directed fire to defeat suicide attacks was repaid by the performance obtained during this operation. Recognition was prompt and accurate under trying circumstances. On two occasions when friendly planes were taken under fire by other ships, this ship held fire and warned the task group of the identity of the aircraft over the VHF coordination circuit. Fire discipline was excellent. In all cases fire was opened promptly, maintained at full volume as long as possible, and then checked before endangering other ships of the formation. In spite of continued attack, enemy aircraft failed to effect more than minor damage to any ships while the USS NEW JERSEY was in company. It is felt that this ship contributed in full measure to the excellent anti-aircraft results obtained by this plan of task group AA coordination".

A CRUISER REPORTS

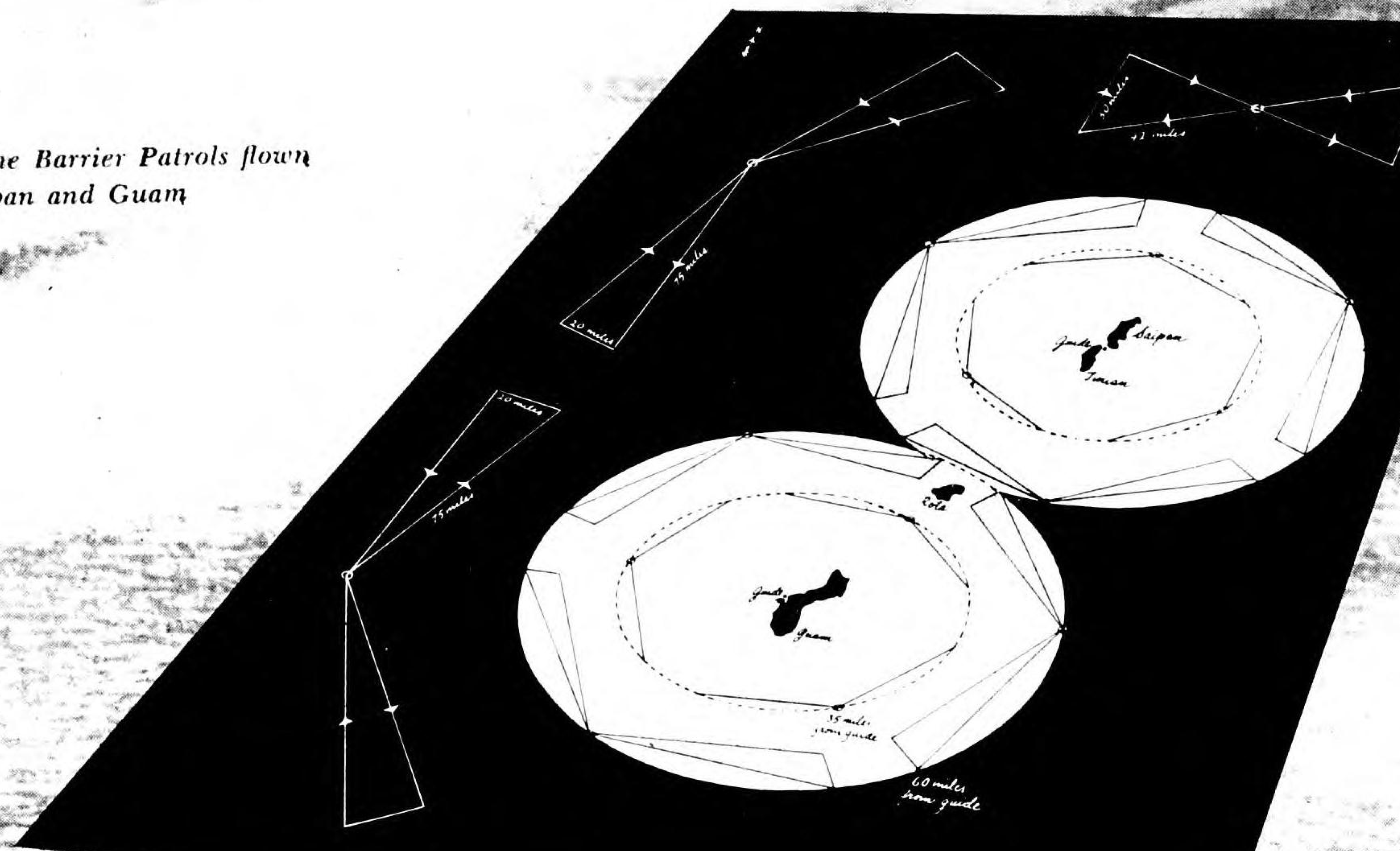
USS ASTORIA (CL-90) says, "It had been our experience that a cruiser CIC with a single SK (air search) radar cannot efficiently accomplish both of the following assignments at the same time: (a) conduct a normal radar Guard Baker, checking contacts as ordered by the Task Group CIC Officer and transmitting information obtained to him to assist in interception; (b) reduce gain to a minimum to check all close-in contacts to obtain data for own ship's gunnery. We found T.G. 58.3 AA Coordination plan, with its mutual interchange of target information, to be of great benefit in conducting effective AA defense against enemy air attacks. Frequently this ship has been alerted as to the presence of enemy aircraft in our sector which were not detected by our own CIC or had been lost within ten to fifteen miles of the formation. This has applied to reports of visual sightings as well as radar contacts. Until fire control radars are equipped with IFF, a single ship in each sector may be designated to conduct close-in air search and transmit resulting data over the AA Plan channel.

"Had this plan been in effect during this ship's operation with another task group which had not yet adopted the Coordinated AA plan, it is believed that a Hellcat, which was shot down after pursuing a Jap dive bomber into the formation, might not have been fired upon. Its identification as an F6F could and would have been reported over channel Tare."

CONCLUSIONS

The Task Group AA Coordinated Plan has enabled a task group to bring more guns to bear against suicide planes before they were in position to make their dives. Large and early volume of heavy AA fire appears to be the best defense against these planes, once they have eluded the CAP. The possibilities of this plan are logically summarized in the report from Commander Task Force 58: "Although the results of long range gunnery have not come up to expectations, it is believed that from the development of suitable procedures for the control of fire against maneuvering targets, a greatly increased percentage of planes shot down by five-inch fire *outside* the formation can be expected. The greatest drawback to vesting coordination of all five-inch AA fire in one ship and one man is the tendency for all hands to become too dependent on information received from the AA Coordinator. However, it is believed that if the initiative of each ship to open fire at will against an enemy plane can be maintained, the AA Coordination plan has excellent possibilities."

Daytime Barrier Patrols flown at Saipan and Guam



pilot—CIC teamwork in ASW

—*By Commander Air Force, Pacific Fleet*

The chief threat of Japanese submarines in the last stage of the war was their effort to attack and disrupt our amphibious operations. The dense shipping around an invasion beach was an attractive target for enemy submarines. During landing operations, transports and warships must often be "sitting ducks." The ambition of Jap sub commanders was to penetrate our defenses, torpedo our ships, and cripple our assault during the critical period before a beachhead and supply lines were powerfully established.

The barrier patrol was the major item in our Pacific anti-submarine warfare to protect our amphibious operations. Aircraft on the barrier patrol draw a circle of vigilance around the approach waters to detect, and if possible kill, enemy subs before they can filter in to a point of attack. This "air barrier" is closely co-ordinated with surface sub hunting via CIC.

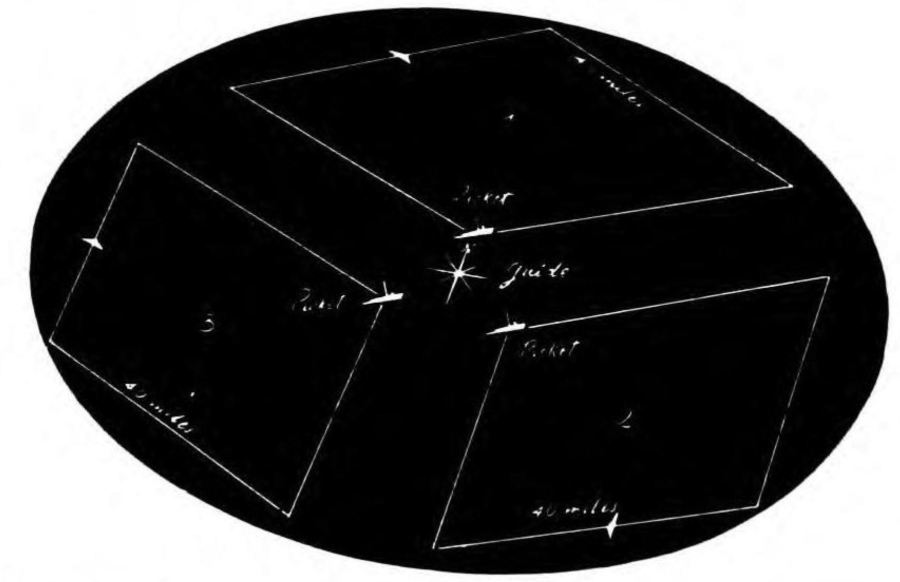
The plan of defense is fundamentally simple but viewed in detail is seen to be an impressive welding of various units. Over-all control is exercised from CIC aboard the command ship, and the CIC's of picket ships, supporting surface ships, and shore-based radar units all contribute to the search and attack, and must dove-tail their activities. It is essential, accordingly, that all CIC's be briefed on the barrier patrol plans before any amphibious operation and important that all CIC personnel understand the purpose and technique of the barrier patrol and anti-submarine warfare.

BARRIER PLAN—CATCH THEM ON THE SURFACE

The target so alluring to Jap subs was our landing force, usually several miles off shore. Protecting this force was a screen of surface craft stationed farther out at maximum torpedo range (at least 10,000 yards), with aircraft of the barrier patrol scanning the region beyond this screen.

It has been found that the aircraft should search at a considerable distance (30 to 60 miles) from the invasion beach. The reason is that at this distance the planes can probably catch the submarines on the surface. Since any submarine within visual or radar range of the surface craft screen will be submerged, there is little value in aircraft flying within 15 or 20 miles of the beach. On the other hand, the submarine would not attempt a submerged approach of more than 60 miles since this would leave just enough battery charge for a submerged attack. The submarine would then have to retire on the surface, making it virtually a suicide mission. Beyond 60 miles, nearly all attacking submarines are likely to be surfaced. A more conservative submarine would not be likely to submerge until about 30 miles away from the beach so as to be able to retire submerged. For these reasons the PBM Patrols fly at ranges of 60 or more miles from the invasion beach in order to deny undetected passage of all surfaced submarines (including suicide subs) into the shipping area. Carrier-based planes search the area closer to the beach.

The barrier patrols are carefully planned to give the best coverage on all possible approaches for submarines with the aircraft available. Planes relieve on station to insure maximum efficiency. The adjoining diagrams show the patrols which were actually flown about Guam and Saipan, day and night. (The outer sectors of the day barrier were not always covered.)



The Night Coverage

DETECT—REPORT—DESTROY

The plot of the anti-submarine barrier patrols is kept on the CIC board as the planes swing along their assigned routes. For the job in CIC to be smoothly carried out, all hands must have a clear idea of the task which the planes face. The primary objective of the aircraft is to DETECT; the second is to REPORT; the third is to DESTROY. The planes report to CASCU (Commander, Air Support Control Units) at regularly prescribed intervals in order to assist in plotting and in control. The planes guard the local air warning channel and report all enemy contacts on this channel, thereby alerting all CIC's in the area. Proper procedure is followed with respect to IFF and anti-submarine warfare as promulgated in FTP-223A. It is imperative that the patrol planes understand what shipping lanes friendly ships expect to use and any other pertinent information. CIC can be of valuable assistance in vectoring these patrols around friendly ships and in keeping the planes on station. In particular, the CIC's on board picket ships serve to assist the patrol planes in keeping on course and in passing on information. This cooperation has been very useful in keeping a tight screen and in easing the burden of the CIC on board the command ship.

The performance of the anti-submarine barrier has been highly satisfactory, according to all CASCU officers thus far interviewed. No ships were sunk off Okinawa by enemy submarine action. Two enemy submarines were sunk in the Okinawa vicinity, one of which was first sighted by a patrol plane. Small suicide craft were also detected by patrol planes on a number of occasions.

narrative of a typical hunter-killer attack

by USS CORREGIDOR (CVE-58)

"It was 0105 and the midnight ASP (anti-submarine patrol), consisting of two TBM's and one FM2, had been in the air about 30 minutes. The search plan consisted of one TBM conducting an 80 mile barrier search on each beam and one FM2 flying a relative sector search of 30° forward of the disposition. The barrier search was in conformity with the search shown on page 53 of the July, 1944, issue of the *Anti-Submarine Bulletin*. The cruising disposition of the carrier and five DE's as screen was in conformity with USF 10 B. One TBM was fully loaded and gassed and in position on the catapult and another was in the ready position aft and to starboard of the catapult. All aircraft were armed with 6 3½ in. solid head ARP, Mark 1 rockets, equipped with flares and ammunition lead into the guns. The TBM's were also loaded with six sono-buoys and bombs.

"At 0110 CIC received over VHF the transmission from Lt. Smith flying the starboard sector that he was investigating a disappearing blip. (At interrogation later he said that his radarman picked up a strong blip at 5½ miles and that it disappeared at 2 miles.) CIC immediately gave the bearing and position of the plane to the Bridge and entered on the DRT overlay position of plane, ship and time. Air Plot conveyed information to ready room over 19 MC. The next transmission from Lt. Smith was 'I am dropping ramrods.' The next transmission from Lt. Smith, 'Strong indications on orange ramrod. Am positive it is skunk.' (See FTP 223 A and ASW Bulletin for standard pattern for ramrods). Bombs away.

"The Commanding Officer then orders DE's 2 and 4 immediately to the spot, they are continuously tracked on the DRT, (the FM2 is vectored to the spot when contact is by day and far from disposition to get height and thereby maintain SK fix). Every three minutes the SG operator reports position of DE's and track is maintained on DRT. At this same time the Air Officer orders Flight Quarters sounded and Air Plot is told to brief the hunter-killer mission quickly and order 'Pilots man planes!' Ready room is given true bearing and distance and hunter-killer mission is launched.

"After launching aircraft the carrier and screen regroup and take a bearing toward the contact. The track of the ship is also put on the DRT. CIC continues to vector the DE's to contact #1 and, as shown by the dotted track, it is often necessary to give small changes in course.

"It will be noted that the carrier does not approach the spot of the contact within five miles. As the DE's approach, the planes continue to hear sounds on the sono-buoys. Lt. Smith then reports that he now has sounds on purple ramrod and none on orange indicating course of skunk to be ---- (shackle code). Hunter-killer planes have been tracked by CIC and are reported as on station to the Bridge. But now Lt. Smith reports no sounds are heard on ramrods and contact lost. Then one hunter-killer plane drops a second pattern along assumed course of the sub and pilot Jones reports strong indications on purple ramrod at contact #2. Bombs away. DE's are near contact #1 and are vectored to contact #2. Here is where the teamwork of aircraft, carrier and DE's is most closely interwoven and vital. When the DE's approach closely enough for the aircraft to vector them, the pilot reports that he is now taking charge of DE's as CIC continues to track ship, DE's and aircraft.

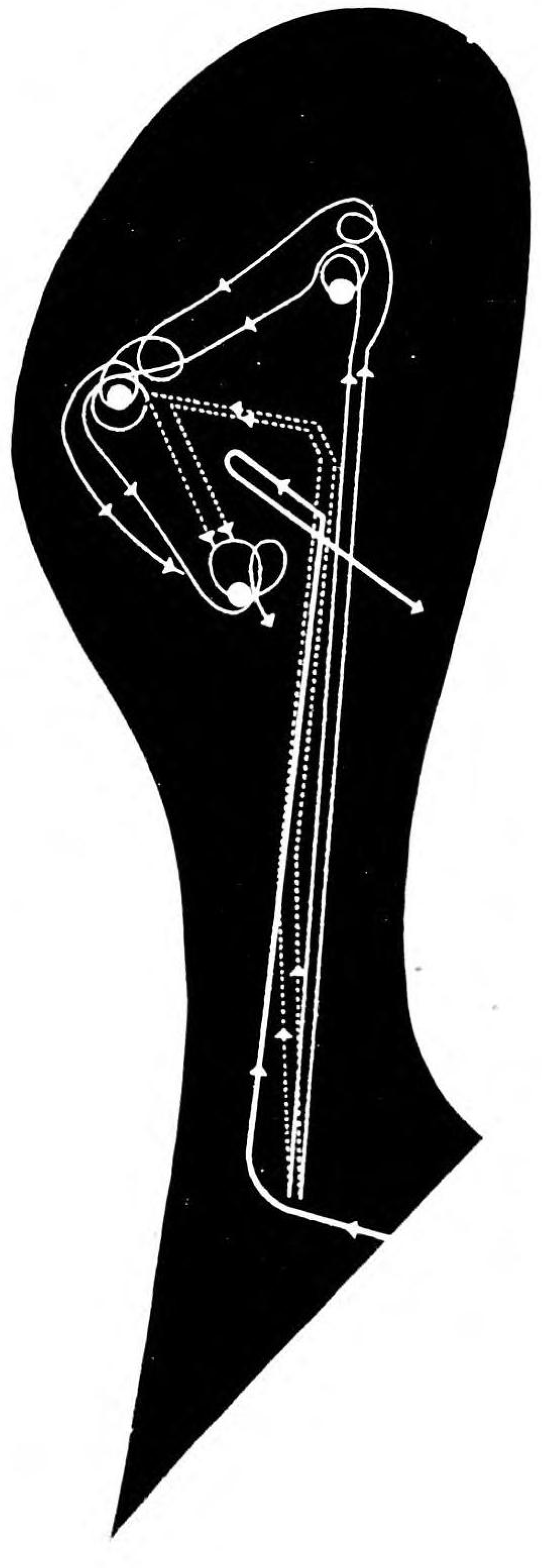
"As the DE's approach near enough for their engines to interfere with the sono-buoy reception, the pilot orders them to stop engines for two minutes. Sounds are still coming from the purple sono-buoy and pilot orders DE's to start engines again and gives vector.

"At this point another hunter-killer pair is launched and the original patrol TBM, Lt. Smith, is vectored back to base and Lt. Jones takes over. Contact is again lost at point 2 and another pattern is dropped and indications are heard on the most southerly of the sono-buoys in the pattern. Bombs away. And now the DE's report that they have the sub on their doppler gear and go in for the kill at which point the aircraft turn over the action and patrol around the spot of the contact.

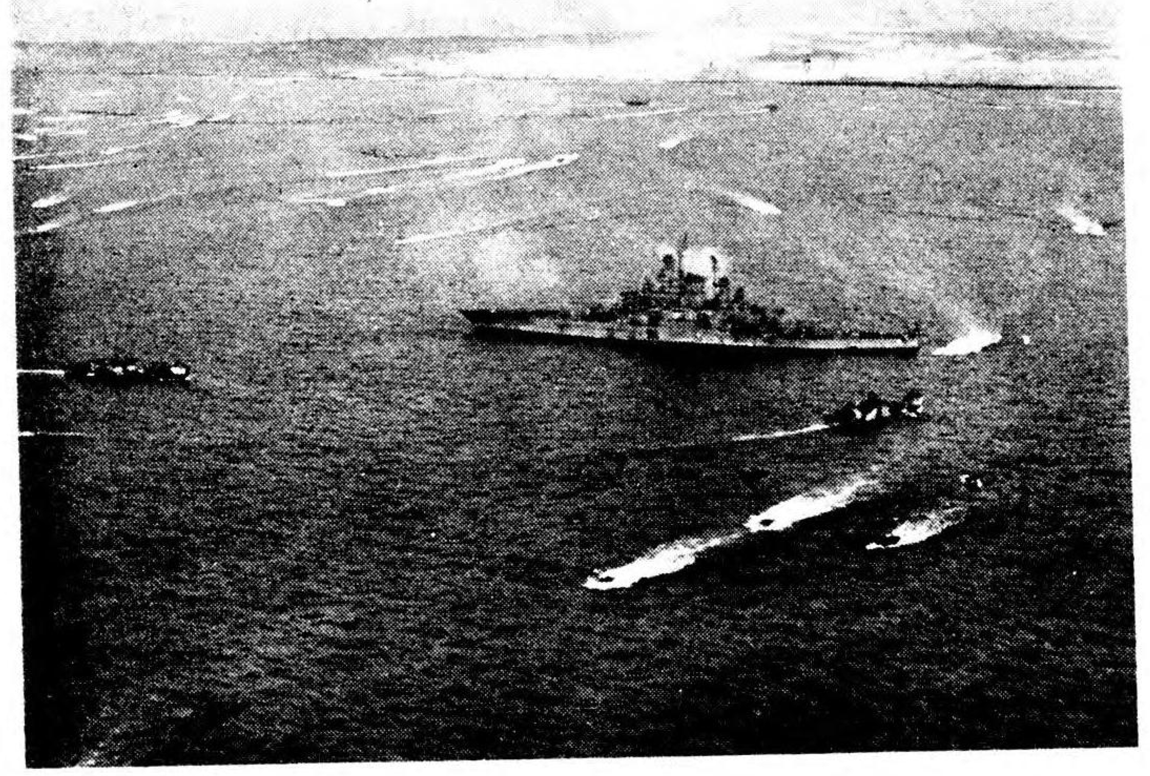
"If the DE's lose contact 'Observant' search is begun in accordance with patterns and time element as indicated in FTP 223 A.

"It is important that the officer-in-charge of maintaining the DRT overlay put down the exact time of each position report obtained on the aircraft, the ship and the DE's.

"During the entire engagement after aircraft have been launched it has been found expeditious for the Air Officer to take his station in CIC where instantaneous decisions can be made and immediately transmitted into action by the FDO."



—— *CVE track*
– – *Hunter-Killer planes*
· *DE track*
● *Sound-contacts on subs*



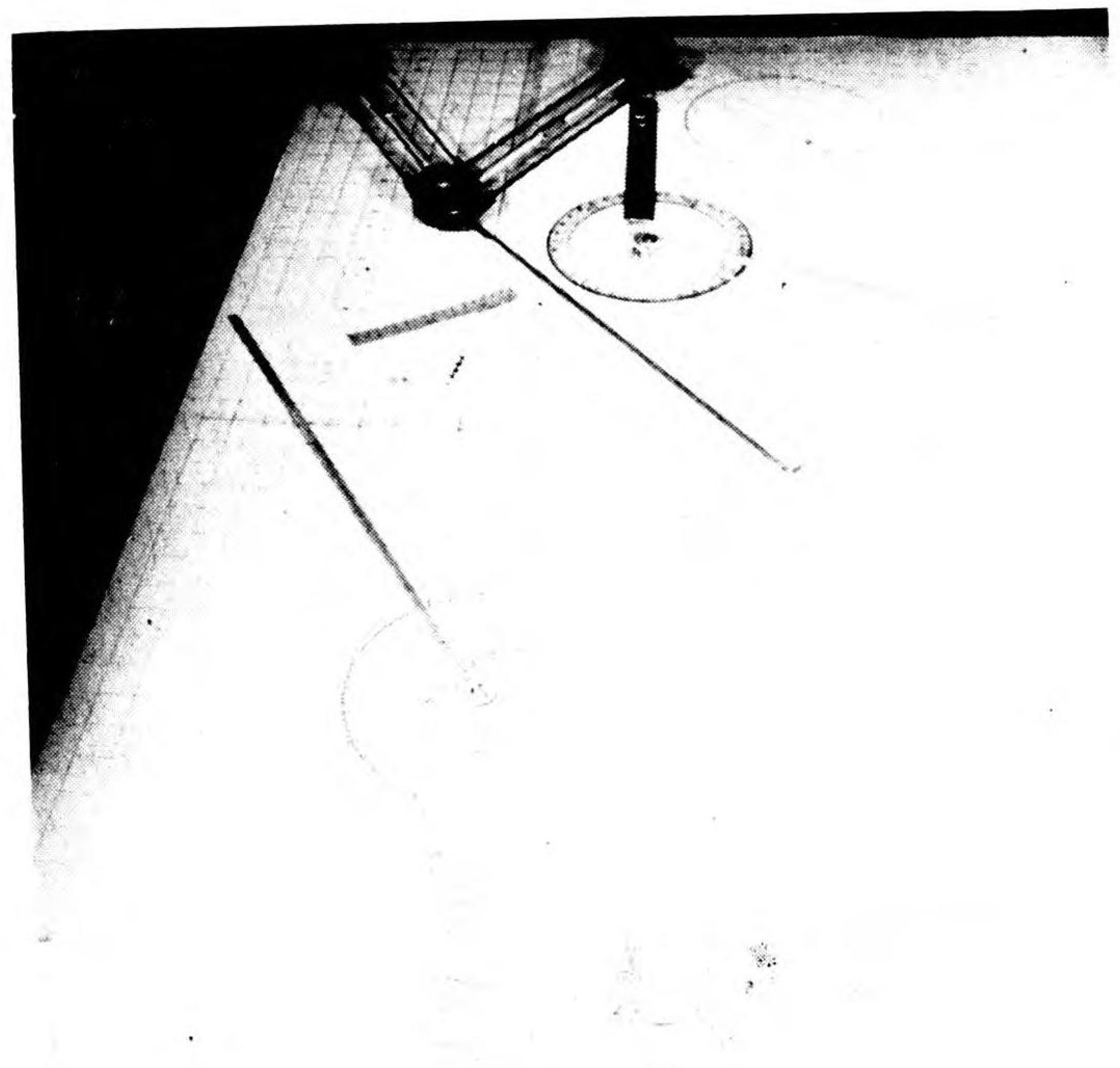
USF-10B says, in Part VI, paragraph 6750: "The problem of shore bombardment differs from normal gunnery procedure in that the target to be taken under fire is usually not seen. Because of this it is necessary that the geographic position of the target and the ship be known at all times." Here is a shore bombardment procedure developed by USS TENNESSEE during participation in nearly every amphibious operation in the Pacific, which successfully carries out the recommendation above. It differs from the procedure ordinarily used in that the DRT is not employed. Although their CIC acts only in a standby condition after "locating" the ship for Main Battery Plot preliminary to bombardment—(Mark 8 radar is thereafter used to position the ship, and the grid chart and track are maintained wholly in Main Battery Plot)—some of the techniques developed by the TENNESSEE can be of use to CIC personnel concerned with bombardment operations.

shore bombardment without DRT

With the increased employment of naval gunfire following an initial landing, indirect fire assumes a proportionately greater importance. The vast majority of TENNESSEE'S targets during the Okinawa bombardment were so located that it was impracticable to obtain direct bearings or ranges. In consequence, they used indirect fire in nearly all instances. The ship's position was plotted with the aid of the Mark 8 Mod 2 radar, using well defined points of land on which to take ranges and bearings. The methods of handling this type of radar fire control have functioned with great success in numerous amphibious operations, borne out by the fact that their first spot is often within 100 yards in either range or deflection when opening fire at ranges as great as 15,000 yards. These methods are described in detail for those who may find helpful suggestions for their own operations.

TENNESSEE DESCRIBES THE SYSTEM

Here is the TENNESSEE's explanation of their system: "This system eliminates the use of a DRT for two reasons. The size of DRT's now in service does not permit the use of the large scale charts which we have found are particularly desirable when fire will be distributed over a considerable area. In such operations the TENNESSEE feels that there is some loss of accuracy using the 1:36,000 scale in these instances, which warrants use of a larger scale." However, the recent CINCPAC-POA standardization of all bombardment charts (see "ABC's of Grids," page 26) probably makes charts of this scale the more desirable. "Second, and more important, the DRT depends upon a pitometer log input for its track. The inaccuracies of the pit log when the ship is engaged in frequent turns or steaming very slowly are sufficient to destroy precision. Unless a constant track from plotted ranges and bearings is maintained, there is no assurance of the accuracy of the ship's initial salvos. Even if the position were plotted before a range and bearing to target was given, there would be no guarantee of the accuracy of succeeding salvos. The unreliability of the pit log input to the rangekeeper would produce false generation and make final 'on target' adjustment impossible for all practical purposes. By employ-



The instruments used for shore bombardment solutions are prepared to the same scale as the chart being used. Two range arms are used to plot ship's position. A small hole at the zero index (the arm is graduated in length in range) is placed on a point (strong phonograph needles are ideal) which has been driven into the chart table at the tip of land to which ranges and bearings are taken. Bearing is read from the inked compass rose on the chart, range from the engraved scale. The arm can be lifted from the point when desired. A third range arm is designed to fit on the center of the celluloid rose to give range and bearing to a designated target. The speed scales used enable determination of speed to an accuracy of one-half knot.

ing a minute by minute plot, the pit log does not enter the picture. All ranges and bearings to target are furnished from an actual plot of ship's position. Any current is readily determined in a comparison of the track with the shaft revolutions and courses steered. This current can be applied reciprocally as target course and speed on the rangekeeper. Own ship's speed determined by use of speed scales can be entered manually to insure accurate rangekeeper generation. The inaccuracy introduced by the use of current and ship's speed from the same track is negligible."

CIC ON "STANDBY"

"Physical dimensions on the TENNESSEE make it possible to maintain the bombardment chart in Main Battery Plot. The plotting room officer has immediate access to information on targets, contours, line of fire, assigned positions and other elements he must consider. The Mark 8 Mod 2 radar has proved to be more accurate in both range and bearing than any surface search radar now in use. With present Mark 8 control established in the TENNESSEE's plotting room, and with accurate transmissions of range and bearing to the rangekeepers, the most accurate information is available at that station. After locating the ship preliminary to the bombardment operation CIC assumes standby status as far as bombardment procedures are concerned, concentrating on navigation, air search and other routine procedures that must be coordinated with this operation. Throughout the operation the 4JW circuit (ship control ranges) was of special value. It provides a convenient circuit for rapid dissemination to all gunnery stations of ranges and bearings of selected targets, and for the identification of grid locations of previously unreported targets. Wide use of the chart is thus facilitated by having this circuit tied in with the 5-6-7-8JW circuits as firing set-ups are given to Air Plot, areas and targets are identified for secondary battery control officers, and positions are sent to the Bridge over the tied circuit.

CHART PREPARATION

"An essential step in this system is the preparation of a good bombardment chart. Early experience found the 1:20,000 most satisfactory and the ship has employed this scale in all operations except those for the bombardment of Leyte and Okinawa. A large scale gives a detailed picture of topography and minimizes the inevitable errors in plotting. The chart is formed by joining the several sheets with strips of cellulose tape on the reverse side, removing as much of the charted sea area as practicable. It is then secured to linen tracing cloth which provides a durable surface from which navigational tracks can be erased easily at the conclusion of each day's firing. This continual plotting and erasure is not possible on present chart paper without rupturing the paper.

"Fire support areas are then marked; areas of responsibility are delineated; assigned firing positions are shown; and important contour lines are inked in for easy understanding of the topographical nature of the target. All targets reported since the printing of the chart are entered. The chart is further used for identification of a target's location through ranges and bearings and for transmission of accurate positions to ship control stations. The area identification enables spotting officers of both main and secondary batteries to orient themselves with minimum confusion and permits accurate reports of the location of new targets.

"Of paramount importance is the selection of points of land to be employed in the radar track. Obvious considerations are prominence and location enabling tracking directors to bear at all times while in the firing area. Not so obvious, but equally important, is the selection of points so sharply contoured that tidal changes exercise little effect on radar return. The points should be so located, with relation to the landing beaches, that minimum interference from small craft can be expected.

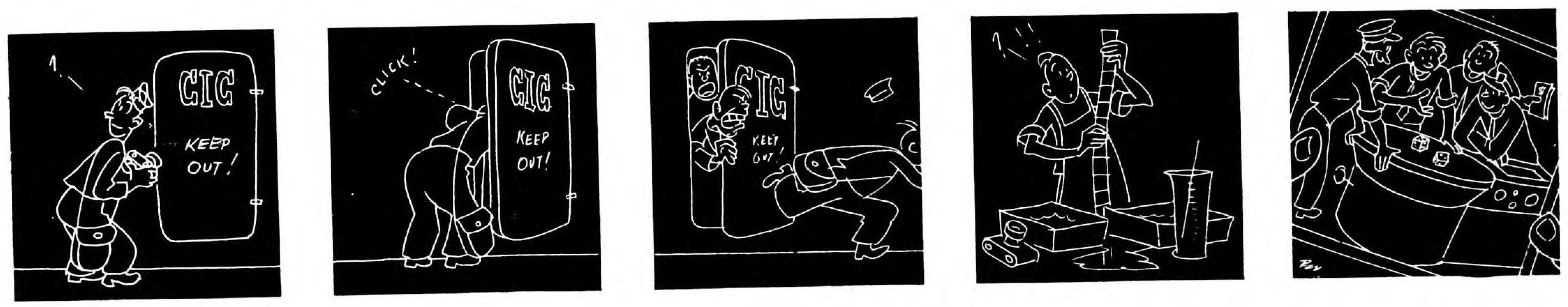
"A compass rose is inked around each tracking point and numbers are placed on this rose 180° opposite to the normal arrangement, so that the bearing of a point from the ship can be plotted immediately as the bearing of the ship from that point. The compass rose attached to the drafting machine has a short metal tube 7/16 inches in diameter in its center, fitted with cross hairs so that the rose can be oriented exactly around the advanced position.

RADAR TEAMWORK ESSENTIAL

"Excellent radar operation is essential in this type of tracking, and comprehensive study of radar presentation is indispensable for the operators. As the ship approaches a firing position at the objective, both Mark 34 directors and associated Mark 8 Mod 2 radars are trained out on tracking points. For several minutes, thereafter, positions are plotted simultaneously from each of the two units. Ranges and bearings are taken from Mark 8 Mod 14 rangekeepers. When it is clear from the conjunction of simultaneous plots that an accurate position has been attained, the foretop is freed from tracking to begin search of the objective for targets. The maintop maintains the fire control track.

"After a series of plots taken each minute, course and speed are readily apparent on this track and the ship's position can be advanced for a period of one minute with great accuracy. When range and bearing to a target are desired, the ship's position is plotted and advanced one minute. The celluloid compass rose on the drafting machine is centered on the advanced position, and the range and bearing to the designated target are given to rangekeeper #1 where the values are entered. The foretop matches the designation transmitted from range-keeper at a 'mark' on the advanced minute that the time motor is turned on. As a check, the position of the advanced minute is plotted and minor corrections are made as necessary. To check the accuracy of the plotted position the range to the nearest land in line of sight is compared from the chart and from Mark 8 radar on the forward antenna. The battery is ready to fire in all respects at 15 seconds after the advanced minute. In no case when the ship is steadied on a firing course should a delay greater than 2 minutes be necessary between the time a target is designated and the instant a battery opens using full indirect control."

Editor's Note: An article on shore bombardment utilizing the DRT will appear in the October "C.I.C."

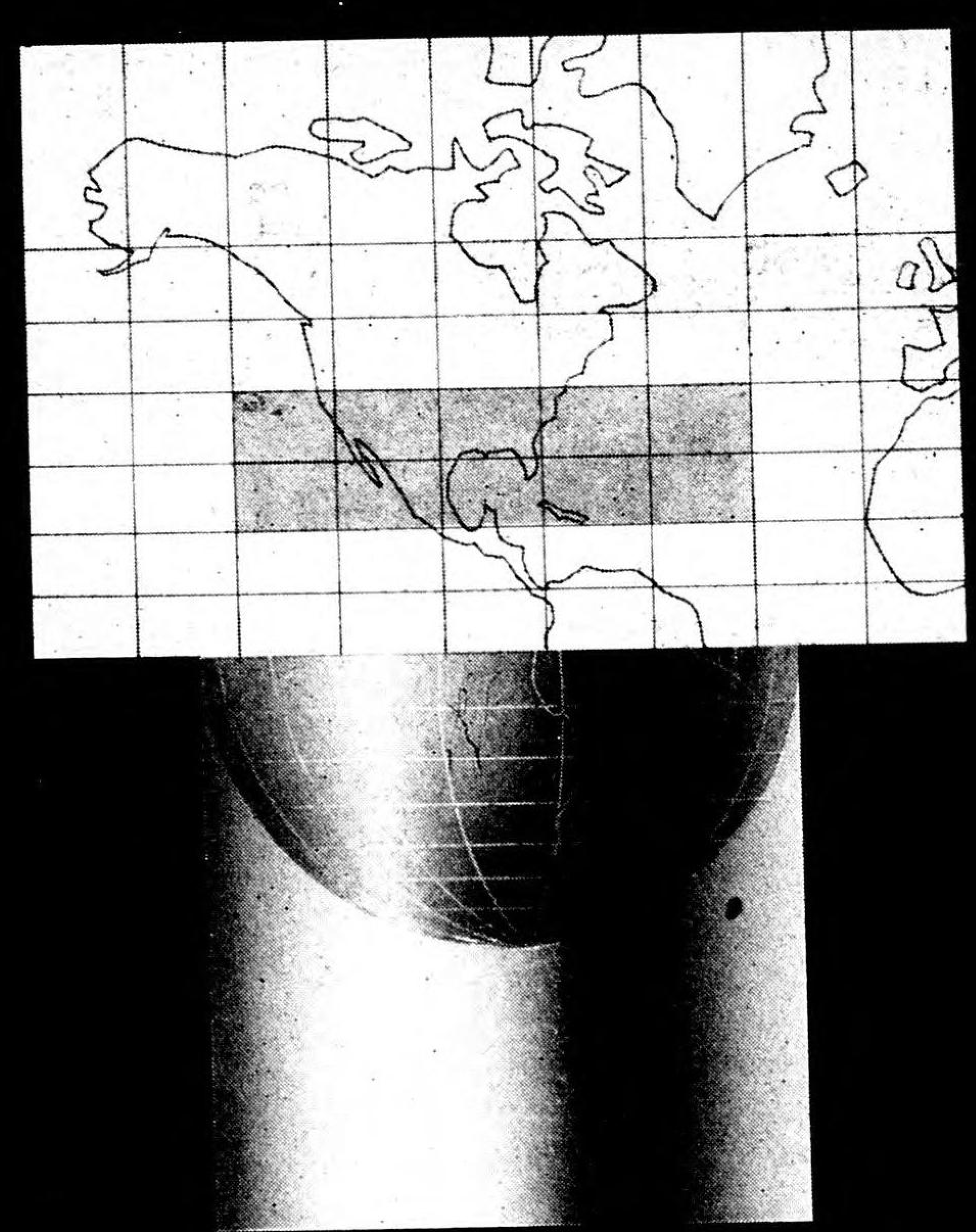


the ABC of grids

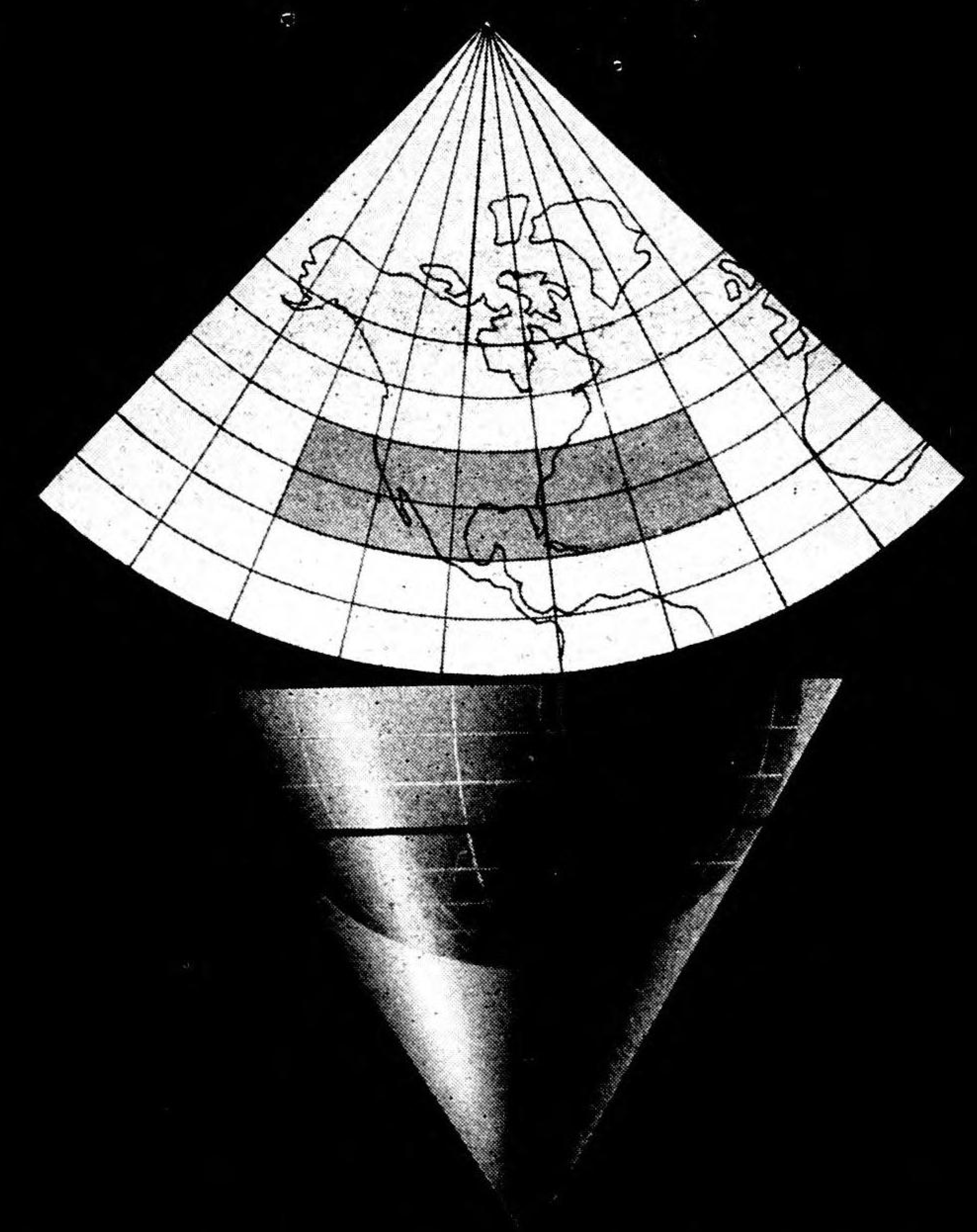
How to portray the earth's curved surface upon a flat map or chart has long been a scientific problem. For centuries men have tried to design a grid without introducing intolerable errors, and even from the earliest days of this war, grids of various types have appeared; however, the use of radar, the magnitude of island warfare, and the necessity for an increased amount of naval bombardment have created the need for standardization. The importance of a universal grid system to serve all military services alike has been realized.

This is the story of grids, how they work and their especial value to CIC and gunnery officers. Since most of the maps and charts prepared by CinCPac-CinCPOA authority for land, amphibious and air support will carry the World Polyconic Grid with target area designators,[1] an explanation of the polyconic system is given.

[1] Restricted enclosure (a) of 15 Dec. 1944 from CinCPOA top secret 0001172 to the Hydrographer of 26 Dec. 1944.



MERCATOR PROJECTION. This type is truly a navigator's projection because on it a straight line is a line of constant bearing. It is the only useful and practical projection developed from the cylinder.



CONIC PROJECTION. Similar to the Lambert Conic, this projection has the same geometric basis, but is not as perfectly conformal. It makes contact with the globe at only one point.

TYPES OF GRID PROJECTIONS

Three of the types of "map projections" that have been developed are the Mercator, the Transverse Mercator, the Lambert Conic and the Polyconic. Of these the polyconic takes its name from the fact that it is based on a large number of cones, each tangent to the earth at a parallel.

The scale on the polyconic projection is true on the central meridian and along each parallel, but the scale error on other meridians increases with increasing departure in an east and west direction from the center meridian to such an extent that the usefulness of the polyconic projection is confined to areas of narrow longitudinal extent.

A military grid is simply a network of 1000 yard lines (depending on scale of chart and area) superimposed on a map or chart sheet. In order to keep errors within practical limits, the limiting point has been established at four degrees east or west of the central meridian. Distances in an east and west direction are not distorted on the polyconic projection and therefore the lengths of the arcs of parallels are represented in their true lengths on the projection. Hence, the Pacific Ocean Areas are divided into vertical grid zones eight degrees wide, each spreading out four degrees east and west of the central meridian.

In order to assure greater accuracy when giving true bearings from grid readings, the following factors must be taken into account: The grid constitutes a complete system of geometric lettered squares. And, to the east and to the west of the central meridian an angular difference appears between the converging meridians and the rigidly parallel grid lines. This angular difference is called "Grid Declination." All bearings measured from the lines or co-ordinates are grid bearings; to obtain true bearings Grid Declination must be applied. (This is always indicated on the margin of AMS maps). Hence, grid north and true north

LAMBERT CONIC. This projection is conformal; that is, shapes of small areas are not distorted and maintain their correct proportions. It is especially good for aero-navigation.

POLYCONIC PROJECTION. Its scale is true on the central meridian and each parallel, but errors increase in an east and west direction on the other meridians. Therefore, its usefulness is confined to areas of narrow longitudinal extent.

are not the same. Until "Grid Declination" is computed, general directions but not true bearings can be taken from grid reports at first glance. In all grid systems, the "longitudinal" co-ordinates (eastings) are always reported before the "latitudinal" co-ordinates (northings.)

PROBLEMS OF STANDARDIZATION

There are very definite principles involved in designing a grid to satisfy the various forces. In an assault group, where the ground troops are supported by naval and air units, a single, common point-referencing system is necessary, and for clarity's sake there must also be a common method for recognizing topographic signs. While differences in scale and density of detail may appear, all graphics must tell the same story. Universal signs are employed, but in some charts they are necessarily more exaggerated than in others and variations in scale require that the amount of detail differs. Thus a 1:25,000 (one inch equals 694-4/9 yards) ground map will show nearly every house and hedge, while the 1:36,000 naval bombardment chart will omit such precise details.

AREA DESIGNATORS AID REPORTING

Target-area designators, carried on the World Polyconic Grid, simplify the calling off of military grid positions. For example, a grid reading of 625-820 with the new Navy area designation system becomes 6282 FOX when the 25-letter squares are used in place of the 100-yard digits. Cutting down the numerals from six to four facilitates reporting as well as plotting, minimizes the possibility of error in transmission, and cuts the length of transmission, particularly if shackled.

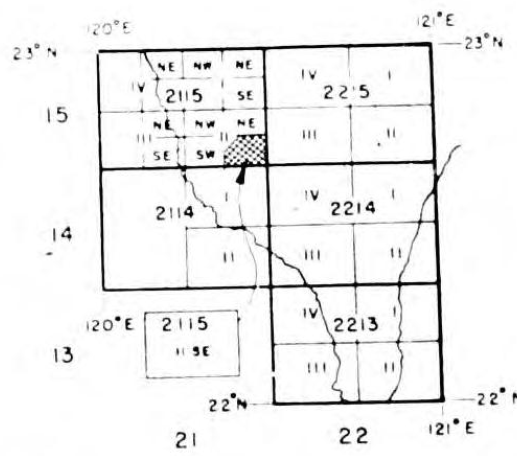
In most instances operational charts will be printed so as to include the benefits of the latest photographic intelligence. For this reason a clear method of edition and issue identification has been employed in Army maps to distinguish the old from new reports. The majority of ground maps issued for operations in POA will be Army Map Service products, identified by the AMS issue number, such as, "First Edition, AMS 3" or "Type B, AMS 3". Edition numbers and type letters are largely academic, but issue numbers are highly important, and serve to differentiate current maps and charts from obsolete ones. Thus a map marked First Edition AMS 3 is to be preferred over a First Edition AMS 2.

The CinCPac-CinCPOA authentication on an Army field map is the official stamp by which you can determine its dependability, and only those so labeled are guaranteed to be in factual agreement. This authentication is provided for your protection, and if any weaknesses are present, they will be acknowledged on the map.

For Navy charts, reference should be made to topographic and hydrographic coverage diagrams which indicate reliability of the source material used in their compilation by CinCPac-CinCPOA. After the chart has been issued, all corrections are handled by H.O.'s Notice to Mariners.

SHEET NUMBERING SYSTEM

In order to simplify the indexing of the thousands of Army maps stocked by POA agencies, a definite sheet designation system has been set up. Each map is assigned a number based on a co-ordinate system instead of employing consecutive



A definite sheet designation system has been set up to simplify the indexing of maps stocked by POA agencies. The whole area above is a 1:100,000 map and is broken down into various panels to specify smaller sections, namely, 1:50,000 and 1:25,000 map. The cross-hatched area represents the 1:25,000 sheet 2115 II SE.

numbers within a series as the Navy does. For example, in the adjoining diagram each one-degree square is broken down into three horizontal bands each 20 minutes (20 nautical miles) high, and into two vertical stripes each 30 minutes wide. These panels are numbered in order from west to east (see 2115-2215) and from south to north (2114, 2115 and 2213, 2214, 2215). For the 1:50,000 sheets, the 1:100,000 area shown is broken down into four quadrants I, II, III, and IV, numbered clockwise beginning in the northeast corner. For the 1:25,000 sheets the same map is further cut down into NE, NW, SE and SW quadrants. In the illustration the cross-hatched area represents the 1:25,000 sheet 2115 II SE.

This method of sheet numbering applies to all standard AMS and POA series maps. Some preliminary reprints of native maps originally designed on local sheet lines may retain old numbers pending recompilation, as emergency items.

The Hydrographic Office uses chronological miscellaneous numbers following the coastline of any given island. For example, the Ryukyu's are known as the 11557 series, the Phillipines are the 11601 series. Indices of all approach and bombardment charts are available to facilitate ordering specific charts. In later charts a differentiation has been made between the approach and bombardment with Prefix A preceding the number for 1:72,000 charts and Prefix B for 1:36,000.

USES OF GRIDS

Working near land has created the necessity for providing adequate warning for air and surface contacts, and a means of coordinating land operations with naval activities off shore. Grids answer this need. They also play an important role in evaluating aircraft warning information for fighter interception and control, for homing lost aircraft, and for locating enemy surface vessels. All of these functions are of importance to CIC.

During operations a ground commander may wish to call for naval gunfire at a specified target which appears on his map. Since his and the naval gunnery officer's chart, which goes 16 miles to sea and 10 miles inland, are based on identical cartography, the bombardment can be applied by co-ordinates, with the knowledge that it can be effectively rendered.

Two CinCPac-CinCPOA charts have been authorized for Navy use. The 1:36,000 naval bombardment chart is the principal firing aid for naval gunnery support of shore operations. It is complete with a military grid and with target-area designators. The 1:72,000 naval approach charts assist naval navigation and gunnery officers in maneuvering ships into position for precision gunnery support of shore operations. It too carries the military grid and area designators.

Four portfolios (Nos. 1, 40, 41, 49) have been tentatively drawn up by the Hydrographer for all Pacific Fleet vessels having CIC's. These may be obtained from the Hydrographic Office, Washington, if time permits, the area Hydrographic Distributing Office, or a U.S. Navy Chart Depot upon request submitted on Form NHO 754. It is recommended that all units draw their allowances, which are issued in addition to the regular charts and publications for use of navigators. The Pacific Fleet CIC School suggests that the series of authorized charts of the Japanese Islands at scales varying from 11 to 14 nautical miles per inch be used on the DRT and for a strategic summary plot.

CIC's will also be interested in the V-3 series of aviation charts which may also be obtained from the Hydrographer, Washington. These charts have a scale of three nautical miles per inch and show both land contours and fathom curves. The series includes the areas of Chosen and Formosa.

Since 1 April 1945 the Hydrographic Office has been making automatic distribution of the Restricted issue of all bombardment and approach charts printed after that date. This eliminates the necessity of a requisition being forwarded to the Washington Office from ships at sea. These gridded charts cover large coastal areas of enemy-held territory at scales of 1 inch equals 1000 yards (1:36,000) and 1 inch equals 2000 yards (1:72,000), and show land contours and fathom curves.

CINCPAC ADOPTS AIR DEFENSE GRID

On 1 September, CinCPac ordered the adoption of the standard Army Air Force Air Defense Grid (now employed by CinCAFPac) by naval forces in the Pacific areas. Whenever a grid is used, the Air Defense Grid, which supersedes the Jan Grid, is to be utilized for the exchange of air warning information, radar reporting and telling and fighter direction. The following exceptions, however, are particularly important. The AMS World Polyconic Grids are still to be used for gunfire and air support, and both the Polar Coordinate System used by ships at sea and the Polar Coordinate System for local reporting from a fixed reference point at the scene of an operation are to be retained.

CIC library and POL

"Combat from Conn"—it's the Captain on the 21MC—"They've been talking about pigeons over the VHF. What are pigeons?"

Simple. "Pigeons" obviously must be part of the Fighter Director Vocabulary. Now, to find that vocabulary pamphlet . . . it's not on the radio bench where you remember seeing it last week . . . the radarman on the SG remembers the SK radarman reading it yesterday . . . no, the SK operator hasn't seen it since yesterday. Frantic searching, then finally you find it. You check through it hurriedly: "Pancake—pancake ammo—pancake fuel—pancake hurt—pillow—whoa, back up. What, no pigeons?"

"Combat from Conn," the Captain booms out again and the only answer you have for him:

" . . . no pigeons, sir!"

This is an incident that happens too frequently on a ship where no adequate library has been set up in CIC, and where there is no regularly assigned CIC petty officer librarian.

Consider your own library and see how it fits the dictionary definition: a library is a collection of books, pamphlets, etc., kept for reading and consultation; especially such a collection arranged to facilitate reference, as by classification and indexing. Consider especially "Arranged to facilitate reference"; here is where many CIC libraries fall down drastically.

A good CIC POL (Petty Officer Librarian) can, in short order, win the most-valuable-man title by simply making information readily available. Unfortunately, the complement set up for CIC does not include a POL whose duties would involve only publications; the petty officer must be drawn from the list of watchstanders who, during periods of inactivity, would completely familiarize himself with every pamphlet, publication and book that should be in CIC and make up a filing system.

His routine runs something like this:

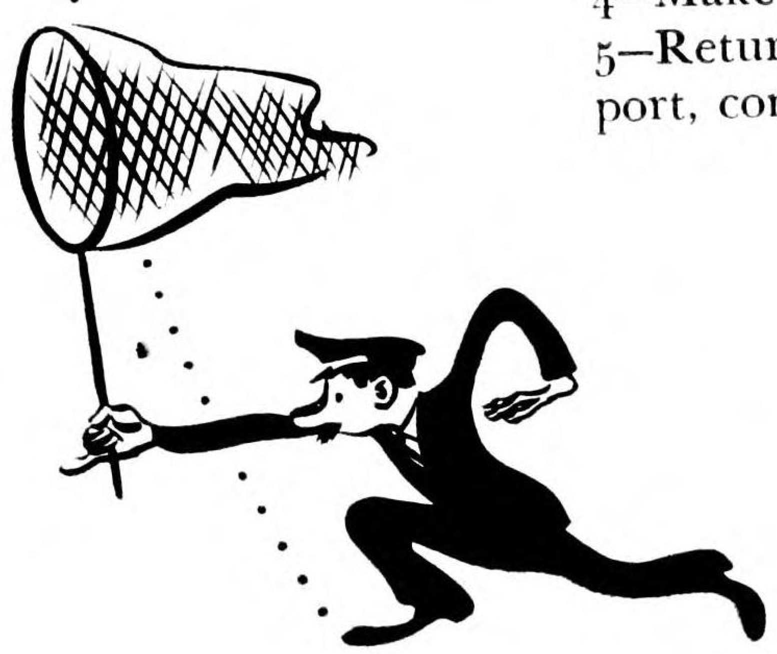
1—List all publications in the CIC library on a handy card index, keeping this constantly up to date.

2—Insert changes and additions into standard publications when these changes and additions are announced. (A good example: the word "pigeons" added to the *revised* Fighter Director Vocabulary.)

3—Cross-index subjects that may be found in several different sources. (Example: "WINDOW—USF-10-B, Part 6, Para.6660. "C.I.C." Magazine, July '44 pg. 1, etc.)"

4—Make routing slips and see that all concerned read the material.

5—Return all material to the ship's custodian or lock it up in CIC when in port, complying with the ship's existing security regulations.



To start an adequate CIC library requires a good deal of initiative, but once the basic setup is completed the "upkeep" is not too great. Listed here are books, pamphlets and bulletins that would be useful in every CIC library. One word of caution. Many of these publications can be included in the CIC library only if the ship's allowance permits and if the ship's custodian authorizes such use of the publications. It will be necessary for the OinC of CIC to sign for registered publication. The assigning of a petty officer as a librarian does not shift the responsibility for these publications from the OinC or the watch officer on duty. Therefore it is suggested that registered publications be checked every watch.

This is by no means an all-inclusive list; different type ships will require additional publications, such as the "CIC Handbook" for Destroyers, put out by Commander Destroyers, Pacific Fleet, which would be an essential pamphlet in a DD CIC library.

* USF-10 (Current Edition)
* Pac 71 (Current Edition)
* Pac 70 (Current Edition)
Op-Orders
Task Force Instructions
1 RAD Publications
2 "C.I.C." Magazines
2 "Electron" Magazines
3 FD and CIC Advanced Training Manual
* 4 FD Vocabulary (CCBP11-3)
* 4 General Signal Book

* *Indicates a registered publication.*

May be obtained from:
1 *Commander-in-Chief, U. S. Fleet, Readiness Division, Navy Department, Washington, D.C.*
2 *Office of the Chief of Naval Operations, Navy Department, Washington, D.C.*
3 *Pacific Fleet Radar Center, Fleet Post Office, San Francisco, California.*
4 *Ship's custodian (if the ship's allowance list permits).*

In addition to these basic publications, periodicals, such as Naval Aviation News, Recognition Journal and the like, plus bulletins released from time to time, should be circulated freely. A general information bulletin board should be the responsibility of the POL. Concerning Op plans, it is vital that all tactical information be supplied to CIC for ready reference as follows: own operation orders, plans and objectives; battle plans; tactical orders and instructions for types in company; effective communication plans, voice calls, and authenticators; general strategical situation; general information on logistical support; own and enemy, ship and plane, recognition characteristics; assumed enemy objectives; enemy tactics based on intelligence reports and past performances; enemy radar and radio countermeasures; hydrographical and geographical information; weather information and reports; other pertinent information. This collection of combat and tactical information requires the most classifying and indexing. It must be disseminated quickly, oftentimes during action.

enemy use of anti-radar coatings

The first development of anti-radar coatings in Germany began sometime in June 1943 at which time Admiral Doenitz called a number of high frequency experts to a meeting in Berlin. At this time it had become apparent to the Germans that Allied radar was largely responsible for increased submarine losses. This conference resulted in widespread research on this subject and a little later the first practical work began. This work was along the line of a high frequency selective coating. At first the Navy High Command wanted a coating that would give a reduction in reflection to a value of 10 per cent for all wave lengths below two meters (150 Mc.). However, at a second meeting at Frankfurt in the autumn of 1943 the High Command decided to concentrate on the band of 6 cm. (5000 Mc.) to 30 cm. (1000 Mc.). As a result of these experiments it now appears that two types of coatings were in operational use at the time of Germany's surrender.

IT WORKED FOR THE GERMANS

The first type, developed by the I. G. Farben plant and known as I. G.-Jaumann absorber, was used for the protection of Schnorchel[1] on U-boats. Employees of this firm asserted that these coatings were effective to the point that reflections were reduced to a value less than 10 percent of the value obtained from an uncoated surface over the band from 6 to 20 cm. This is substantiated by test curves and results of a test in which the range of detection on a U-boat with coated Schnorchel was 15 to 30 percent of the value obtained with an uncoated Schnorchel. A centimeter airborne radar was used in this experiment.

It now appears that the I. G.-Jaumann absorber was being replaced at centimeter wave lengths by a frequency selective one-layer coating developed by a Prof. Wesch. This type coating is known as "Tarnamatte" or Camouflage mat. Its thickness is 20 mm., and it is highly selective as to frequency and designed to operate at 9.3 cm. The latest information indicates that in spite of its selectivity the Tarnamatte had been chosen by the High Command to supersede the I. G.-Jaumann absorber for all future applications.

JAPANESE EXPERIMENTS

It appears that the Japanese have given much thought to the development of anti-radar coating and paints, but their work most probably reached only the research stage. Information from reliable sources states that the I. G.-Jaumann absorber process had been given to the Japanese by the Germans. Captured Japanese documents also substantiate the fact that the Japanese know the Germans were using a type of anti-radar coating on submarines. A captured undated document discusses the problems which must be met before practical use can be made of a paint to absorb radar radiation. The chief difficulty encountered was that of devising a paint which would be capable of giving protection over a wide band of radar frequencies. Also they felt that the additional weight which this paint would add to a plane must be given consideration.

This document also describes an absorbing material made of a layer of titanium oxide and a layer of a saline solution backed by a metallic plate of copper, iron or aluminum. The theory is that the incoming wave strikes this material and a portion of the radiation is directly reflected from the top layer of absorbing material while at the same time some of the radiation is reflected by the metallic plate. Through the interaction of these two reflected waves theoretically all radiation would be cancelled out. However, it is doubtful that this material could have much practical use due to the fact that the amount of energy absorbed depends upon the relationship between the thickness and quality of the absorbing material and the angle at which the radiation strikes it. Another argument against its use is its highly selective frequency characteristics.

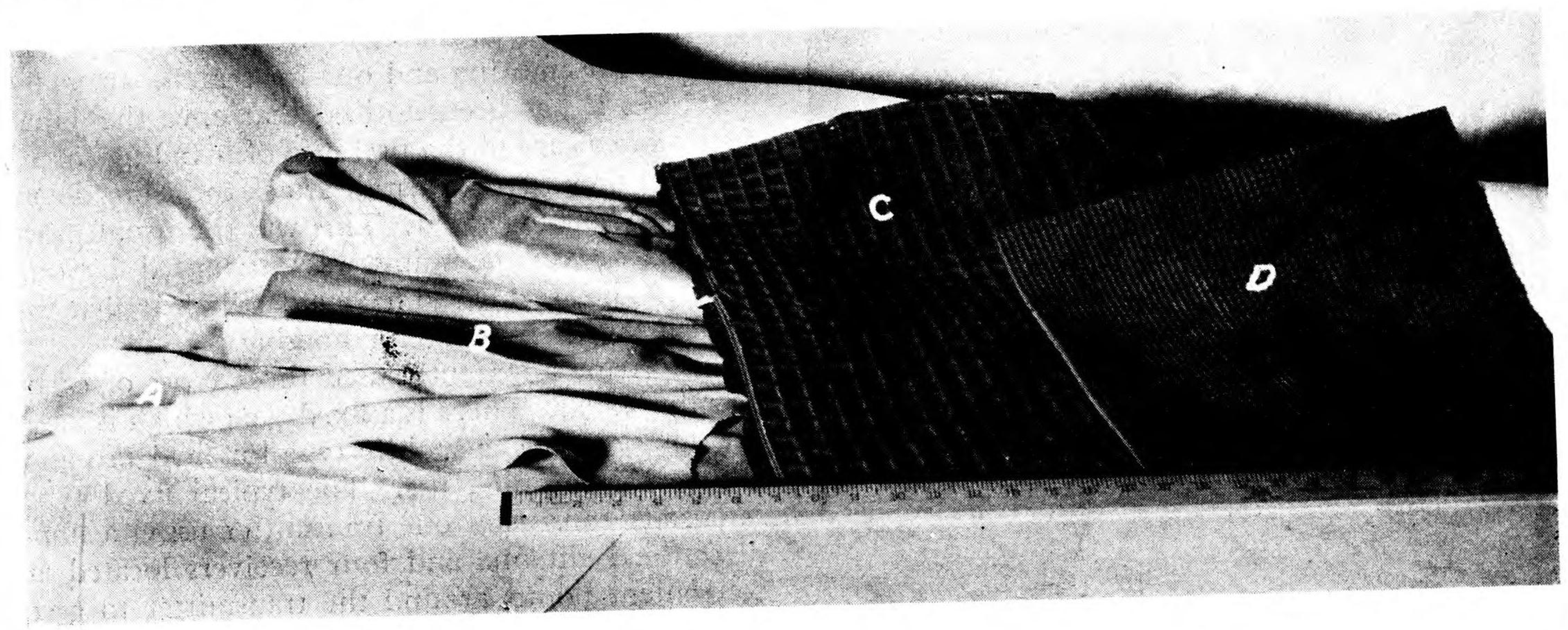
The document also describes a wave absorbing body which is cut in an irregular saw tooth fashion. It was assumed that the incoming wave would be reflected back and forth between adjoining teeth, and that the amount of wave absorption depended upon the number of times the wave was reflected from the body. The limitations of this method are the same as the other type absorber and it appears to be just as impractical. Another type absorber which the Japanese have worked on utilizes a metal plate on which metal rods less than one half wave length are fixed. These rods may be either parallel with the plate or perpendicular to it. This absorber also was considered to be impractical by the Japanese.

When the war ended, the Japs were seeking a fuselage material with a low wave-reflecting ratio. Wooden aircraft had been considered and radar wave-absorbing paints were being worked on.

Although the Japanese had met with but little success at the time this captured document was written, they spent much time on this subject and considered it highly important to continue research.

[1] A vertical exhaust tube which enabled the U-boats to cruise submerged for long periods.

Schnorchel's anti-radar covering



The Wesch "Radar-Pulse Absorber"

Japanese radar and tactics

The first radar with which the Japanese had any degree of success was perfected in October 1941. This was a land-based early warning radar which was used quite extensively for air search and surface search. After the development of this equipment the Japanese began work on shipborne equipment for air search and surface search. Tests on a 150 Mc. air search and a 3000 Mc. surface equipment were made in March and April of 1942. The air search equipment was fairly successful but considerable difficulty was experienced with the surface search equipment. By the end of 1943 sixty of the 3000 Mc. surface search sets were manufactured, but only five or six operated satisfactorily.

Meanwhile the Japanese Army had developed fire control radars copied from American and British sets captured at Corregidor and Singapore. Later the Army also developed mobile equipment which was of original Japanese design. The Japanese Navy also developed a search light control radar copied from captured British sets for shipboard use, but as far as known this equipment was never used as such; however, it has been used quite extensively on land. It was not until late 1943 that a suitable airborne equipment was put into operational use, this being a Navy equipment. This equipment was not extensively used until the latter part of 1944, probably due to production difficulties. The Army came out with a 200 Mc. set in 1944.

EARLY WARNING RADARS IN PAIRS

The Japanese early warning radar system for outlying possessions has in most instances been under Naval control. Early warning radars were located on the highest points of the island and faced seaward. Two of these sets were usually located at one site probably in order that one might be used for tracking and one for search. In many instances it has been noticed that once the Japanese were aware of the presence of invading forces or when they were under air attack they shut down all early warning radar. This was the usual practice before any jamming was attempted by our forces. They seemed to have a deadly fear that we were using their radar for homing.

The Army apparently used three types of early warning radar. There is a fixed type which is used for key positions, a mobile type for field use and a type for shipping use. The typical fixed type radar site consists of one transmitter using a non-directional antenna and four receivers located at convenient points around the transmitter to give the maximum possible coverage. The mobile radar set-up usually consists of two complete mobile sets separated by a distance of 500 meters. The two radars may be used to give more complete coverage. It has also been observed that two sets on a site may operate on different frequencies, and while it is believed that the Japanese appreciate the possibilities of this arrangement for reducing the effectiveness of countermeasures, it is possible that the object is to reduce mutual interference. Reports are made to a headquarters located equidistant from each radar.

Little is known of the radar for shipping use except that it was possibly being used on picket boats. (Two sets were found land-based in the Philippines). Picket boats patrolling off the coast and equipped with early warning radar are an important part of the Japanese early warning system. An early warning system using a continuous wave transmitter at a central point and receivers at strategic points approximately 200 miles away was also being used. This was the first type of early warning used by the Japanese.

FIRE CONTROL CHIEFLY LAND-BASED

There is very little evidence that the Japanese have ever perfected a shipborne AA fire control radar. Some sets were built for shipborne use but difficulties arose and some were later converted for land use. Information from POWs and captured documents indicate that the Japanese were using air search and surface search equipment for fire control in the early part of 1944. Captured documents describe a shipborne AA fire control radar but there is little evidence that it was ever put into use. Radar equipment for control of landbased AA batteries and search lights appeared to be in widespread use. Both the Army and Navy have sets for this purpose which are quite similar in construction and operation. A typical Army radar controlled AA battery usually has one radar for a battery of six guns. A group of search lights is controlled by one radar which is mounted on a master search light. The master search light is put on the target by radar thereby illuminating it for the other lights. Changes in tactics in the use of gun laying radars have been noticed recently, and may be enemy reaction to jamming. It has been reported that fire control radars in some areas came on the air only when the first wave of bombers were about to start their bomb run. Formerly these gun laying signals were heard 40 to 60 miles from the target area and operators had plenty of time to analyze the signals and prepare to jam before coming within radar range.

AIRBORNE RADAR HAD VARIETY OF USES

Only two Japanese airborne radars were being used extensively at the war's end. One is a 150 Mc. Navy equipment and the other is a 200 Mc. Army set. Although these are ASV (Air to Surface Vessel) sets they may be used with some effect for AI (Air Intercept). Both types are equipped with antennas for search and homing and the Army equipment uses a motor driven antenna lobe switching mechanism to give a 60° search area ahead of the plane. It appears that the general procedure for the use of the Navy equipment is as follows: the operator switches back and forth on the search antennas until a target is located. Then he maneuvers the plane in the right direction and heads toward the target using the homing antenna.

The Army sets are equipped with a switch by means of which the pilot can shut off his transmitter and then start it up again within a few seconds. This permits him to take a quick look at the target and then shut his equipment down again. Therefore, his chances of detection by search receivers are lessened. It is also probable that due to the shortage of radar equipment only one or two planes of an attack group were equipped with radar. These planes might either lead the group to the target or orbit some distance from the target and vector the attack planes in.

The Navy equipment has been used widely, particularly against submarines, and appears to have achieved results which were encouraging to

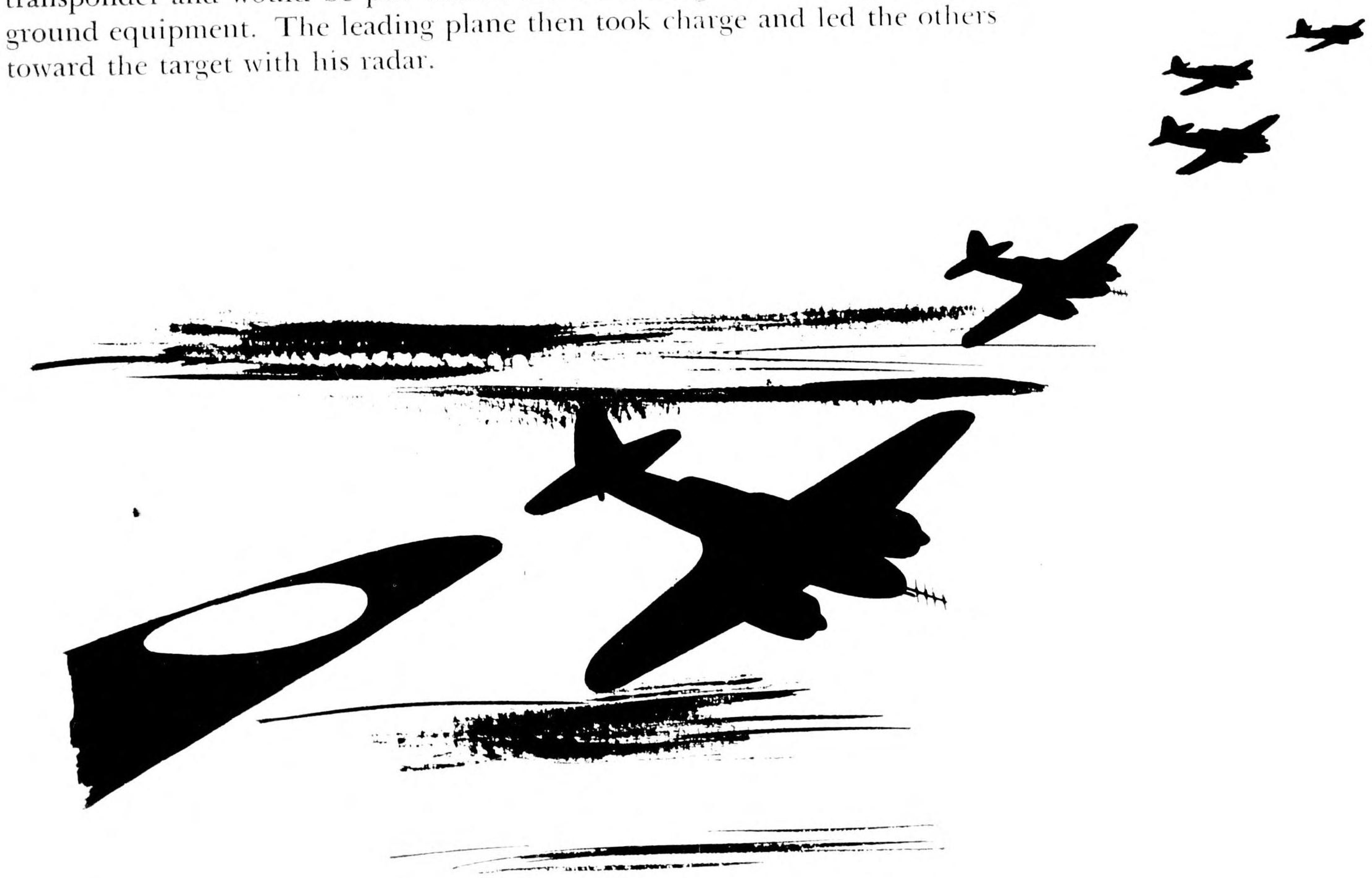
them. The equipment has also been used as a navigational aid in identification of islands and coast lines. Widespread use of the Army equipment was being expected before hostilities ceased.

SEARCH RECEIVERS IN FAVOR

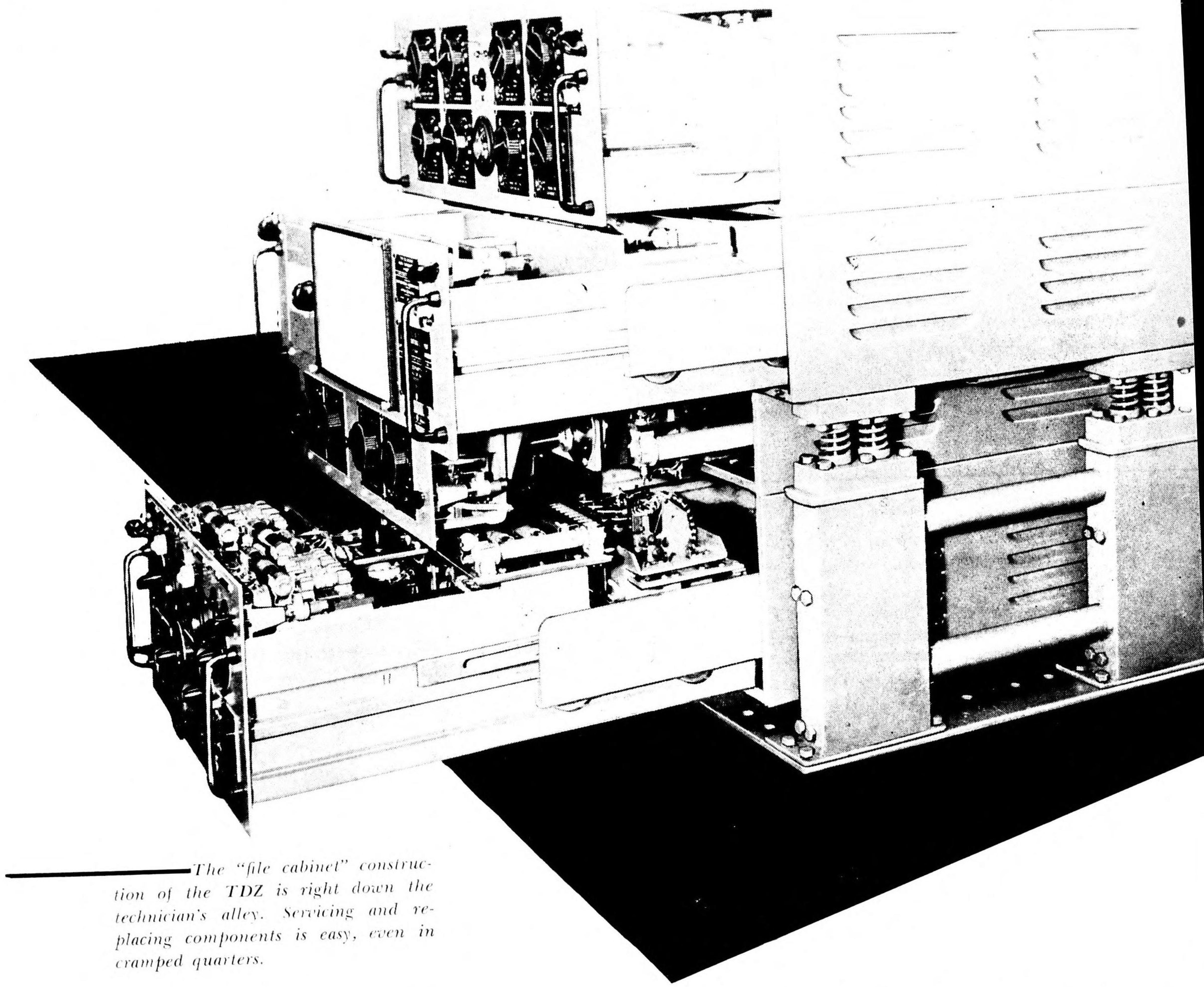
It is also known that the Japanese made extensive use of radar search receivers. Nearly all fleet units were equipped with a receiver capable of covering from 75 Mc. to 420 Mc. and a receiver that will tune from 2500 Mc. to 3300 Mc. In fact, it appears that they preferred to use search receivers for early warning instead of radar. During the past few months some early warning radars have been captured with search receiver antennas mounted on them. They also have developed three airborne search receivers. One type tunes from 42 Mc. to 400 Mc. and is used for determining frequency characteristics. The other two tune from 75 Mc. to 400 Mc. One of these is equipped with D/F antennas and a means for determining pulse rate.

STILL NO IFF

The Japanese so far as is known, did not have an electronic IFF system in operational use. Captured documents describe tests of an electronic identification system consisting of a ground interrogator operating in conjunction with an airborne transponder. They have also conducted experiments with similar equipment for fighter control. This is known as "F" device or "guide radar" and consists of a ground radar unit that operates in conjunction with a transponder installed in the aircraft being controlled. One plane of an attack group would be equipped with the "guide radar" transponder and would be put within the radar range of the target by the ground equipment. The leading plane then took charge and led the others toward the target with his radar.



TDZ/RDZ—new UFH radio



The "file cabinet" construction of the TDZ is right down the technician's alley. Servicing and replacing components is easy, even in cramped quarters.

The new TDZ/RDZ ten channel radio equipments for surface communications were designed to meet exacting demands. A recent survey in the Pacific Ocean Areas disclosed that about 700 channels may be required to provide fully adequate short-range communications for large fleet and amphibious operations. Of these, 300 would be for surface communications (fleet and ship-shore), 400 for air and for surface communications directly supporting air operations. For this system, equipments should be extremely flexible—easily installed interchangeable units—with instant availability of channels.

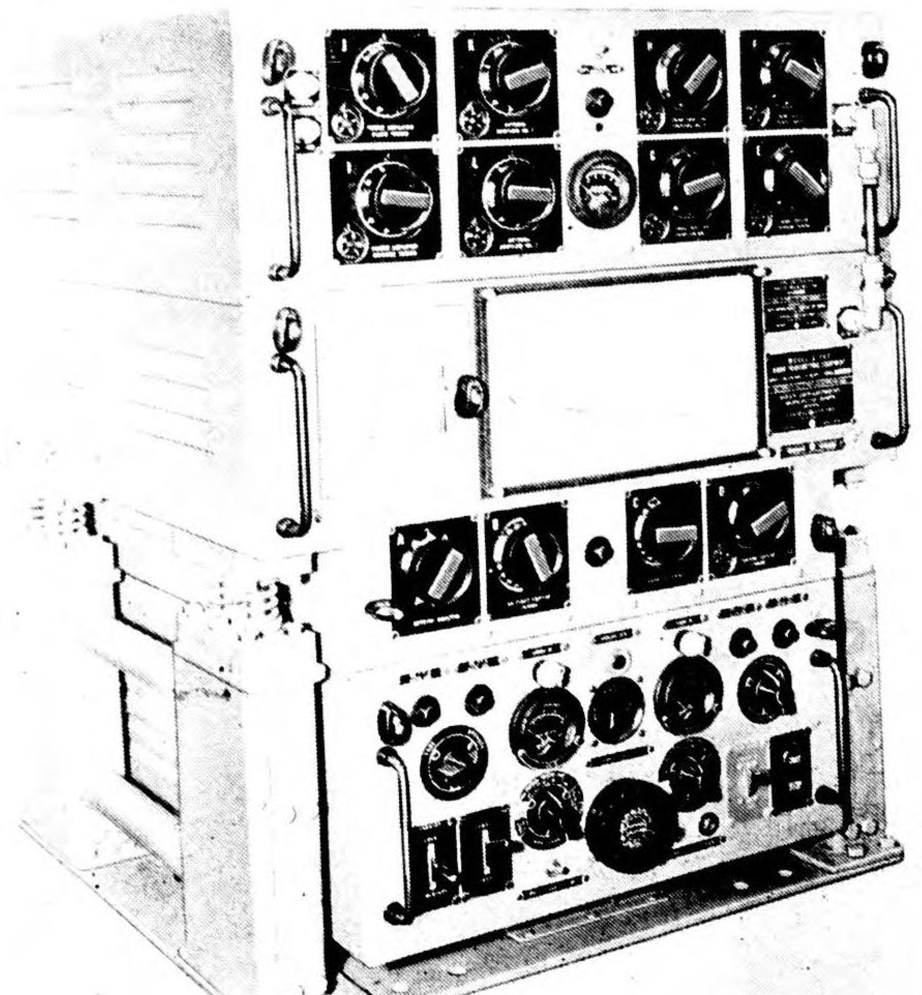
The 225-400 Mc. band was chosen for the new TDZ/RDZ sets for several reasons:

1—This frequency range is the only one available allowing current techniques and components to be utilized in arriving at a satisfactory production design.

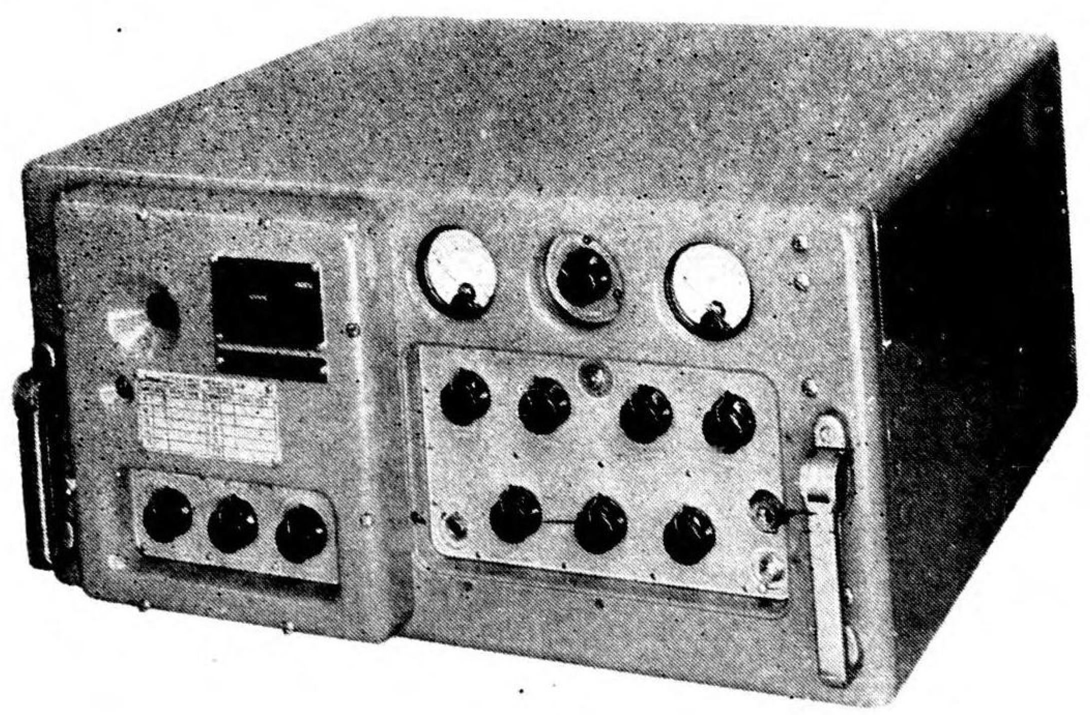
2—Since this range is completely free from sporadic long range sky wave propagation, it offers comparative security from interception outside a limited area.

3—The band contains sufficient channels to provide a flexible co-ordinated communications system adapted to the extremely fluid movements of large task forces.

The TDZ is a ship-and-shore transmitter. Its autotune mechanism provides ten pre-set, crystal-controlled channels anywhere in the 225-400 Mc. band.



The RDZ is compact, with knobs recessed to prevent accidental movement.



EASY TO OPERATE AND SERVICE

The RDZ is a superheterodyne-type receiver, employing crystal frequency control and having an Autotune mechanism providing ten pre-set channels within the band 225-400 Mc., any one of which can be selected in 10 seconds or less. A remote control unit permits channel selection, volume control and silencer on and off. Other receiver adjustments are normally pre-set at the receiver itself. The cabinet has been streamlined. There are no sharp edges or corners on the receiver enclosures, and all control knobs are recessed to prevent accidental movement.

The TDZ, a crystal-controlled, general-purpose, ship-and-shore transmitter, also utilizes an Autotune mechanism to provide ten pre-set channels anywhere in the 225-400 Mc. band, and can be shifted to any one of these channels in approximately 30 seconds from either a local or remote indicator unit. Its file cabinet design is designed to permit servicing from the front, thus avoiding the contortions often required to reach some inaccessible part of the equipment around the sides or back.

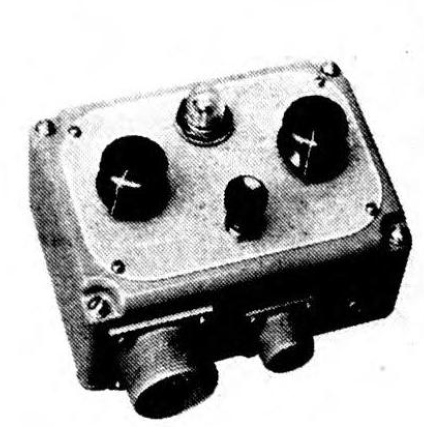
TENTATIVE DISTRIBUTION OF TDZ/RDZ's

The TDZ/RDZ gear is now being distributed to training schools and some fleet activities. Initial deliveries in quantity will be made to the fleet for installation at the disposition of fleet commanders. Tentative allowances provide for one TDZ and two RDZ's in each ship having a CIC, with additional units for certain flagships. It is expected that when installations have progressed sufficiently, this equipment will be used first to supplement, then to supplant present IFD and TBS nets, and eventually to replace all present VHF and FM equipments.

SOURCES OF ADDITIONAL INFORMATION

Further information concerning the technical aspects of the TDZ/RDZ and other nets in the new UHF series will be published in the BuShips "ELECTRON" Magazine which will run detailed articles, beginning with the August 1945 issue.

RDZ frequencies are remotely controlled with this unit.



REQUESTS FOR "C. I. C." *should be addressed:*

(issues prior to July 1944 are no longer available)

NAVY—*The Chief of Naval Operations, Editor of "C. I. C.", Washington 25, D. C.*

ARMY—*Adjutant General's Office, Operations Branch, Room 2B939, Pentagon Building, Washington 25, D. C.*

air plotting and the Kamikaze

Good air plotting is not advertised as a cure-all for the now defunct Kamikaze, but may help considerably in eliminating the possibility of your catching same in superstructure or points forward and aft. There are certain A-K (Anti-Kamikaze) features about air plotting that are neglected when the following symptoms show up in the air plotter:

1 FORGETTING-THE-BOGEY

What is the most serious mistake a plotter can make? Answer: Forget a bogey. What is the easiest mistake a plotter can make? Again—forget a bogey. It is easy to forget bogies when the plotter relies on radar reports only. There are at least five sources of contact information that can be plotted other than radar reports. Could you name them?[1]

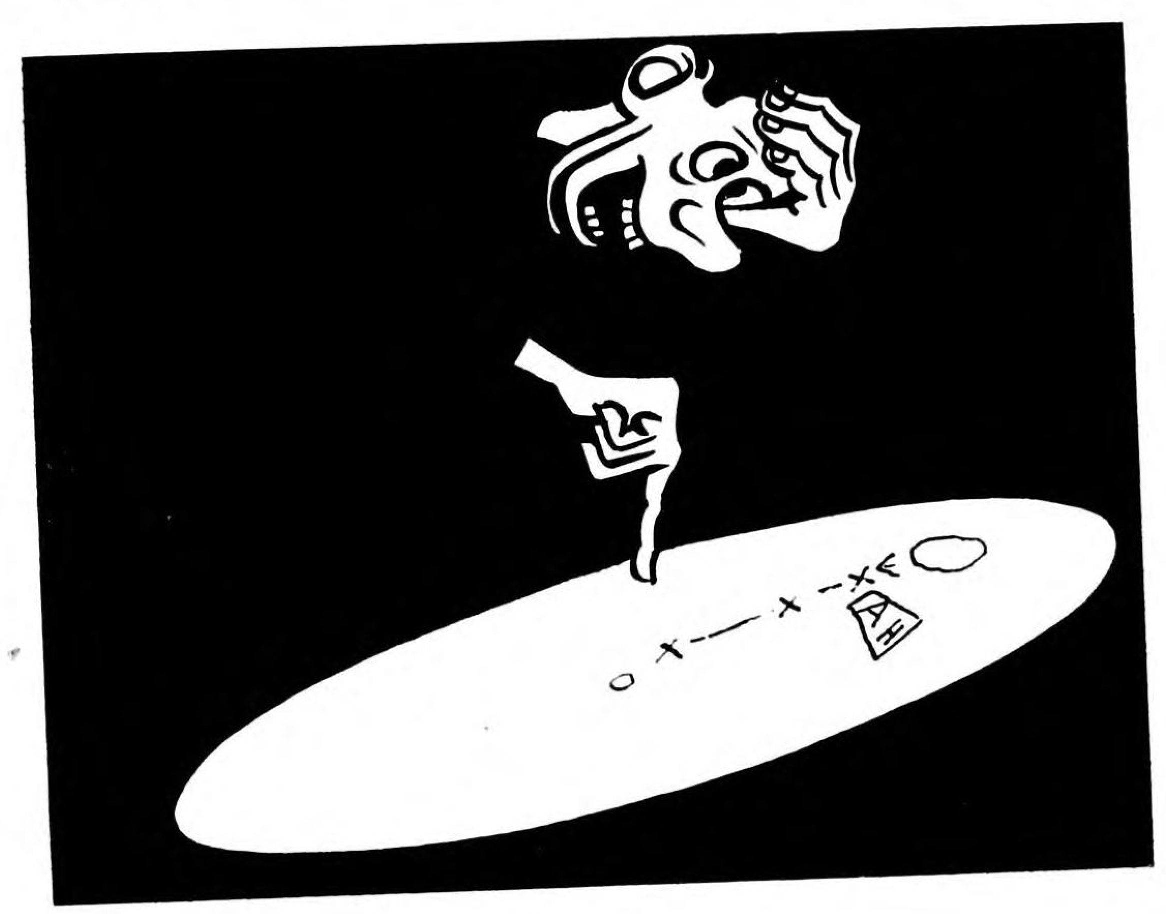
One minute after the last known radar fix has been given on a bogey, an Estimated Position Arc (EPA) should be plotted on the board. Every minute thereafter a new EPA goes down, and EPA's are plotted until it has been definitely established that the bogey is not in the area, that it has been identified as friendly, or radar reports are again received.

One ship recently took a suicide plane that had been tracked and plotted to within thirty miles of the force before it disappeared from the radar screen. Nine minutes later the plane was exploding on the deck of the ship. Could it have been avoided? It's difficult to say, but it would have been possible, with accurate, up-to-the-minute estimated position arcs, to give more pertinent data to the lookouts and to gunnery.

A partial solution: Running "canned" problems involving many fades within twenty miles of the ship. Learning to plot EPA's automatically comes only through hours of practice.

2 NEGLECTING COURSE AND SPEED

Again with no radarman to rely on, the plotter falls down on determining the course and speed of a bogey. It is possible for an excellent plotter to anticipate the movements of a bogey, and deter-



[1] Warning net reports, Lookout reports, Fighter net reports, Coast watcher reports, Intelligence data.

mine whether the plane is flying level, climbing or diving. Every single plot within twenty miles of the ship may indicate a new course or speed. Excessive speed within twenty miles can invariably be classified as "plane diving," and should be brought to the attention of everyone concerned.

3 "ANY OLD" TIMING

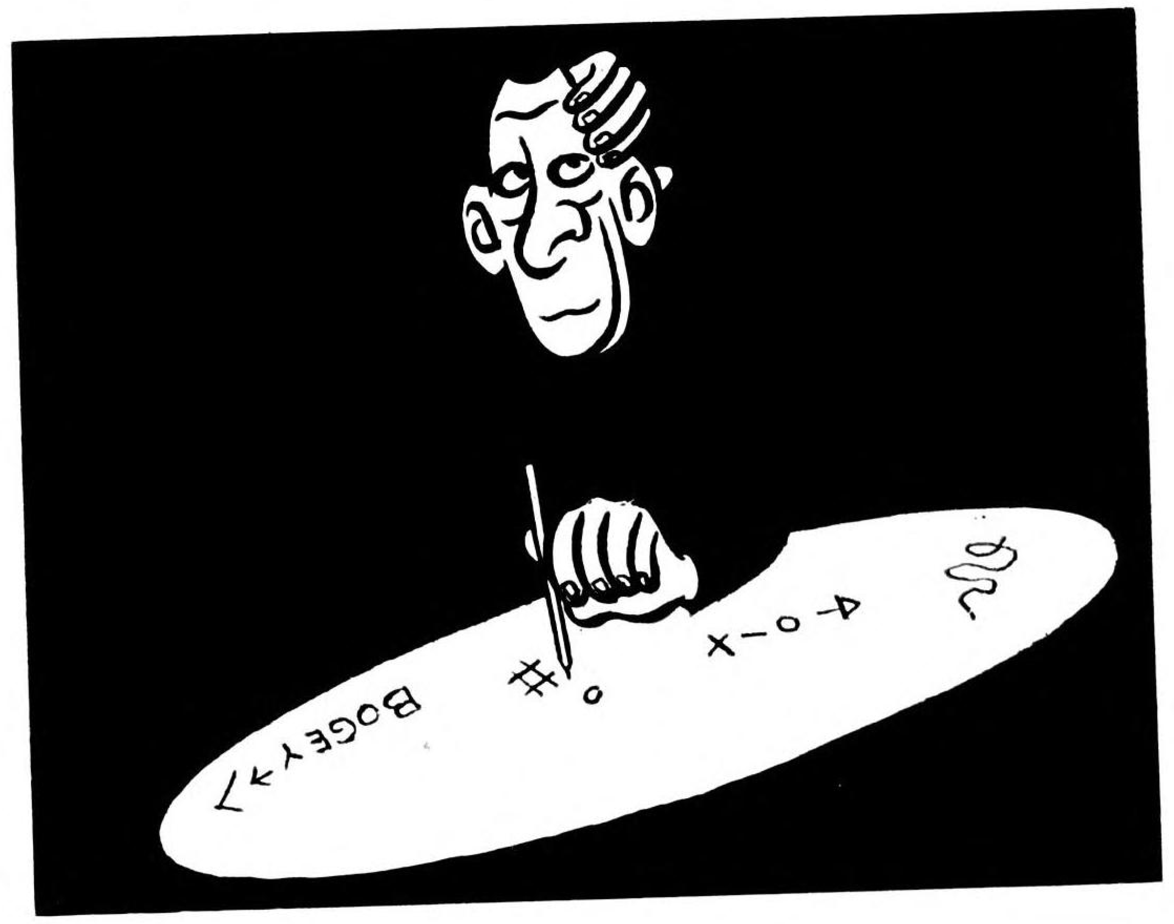
Although some ships have not adopted the quarter minute timing, for A-K plotting it is essential due to the terrific speed of these planes during the final leg. Speeds up to eight miles per minute are common; thus, under the old system of 30 second timing, an error of two miles or more is possible. Most important factor in the timing element for A-K air plotting is to determine accurately the speed of the attacking plane.

4 FACTS-IN-THE-HEAD

To combat enemy raids successfully, all known information about bogies must appear on the plotting board. If information is not volunteered by the radarman, the plotter should, for every new contact, ask for size and angels of bogey and plot this information. Almost all recent bulletins involving Anti-Kamikaze tactics stressed the necessity for knowing the exact number of attacking planes whenever possible. This is especially important when interceptor planes report "Grand Slam." If the number of planes in the initial contact report is greater than the tallied "Splashes," don't hide this fact. Unless it's plotted, your information is worthless.

5 NON-SYMBOLITIS

Plotting the wrong symbol, or worse, none at all, should be a mistake of the novice only. Most frequent serious omission: the circle-with-arrow Raid Symbol! This symbol, placed at the beginning of a raid track primarily for inserting the



subsequent raid number, should be the largest symbol on the board—a large warning sign to point up the bogey cross. It should be plotted immediately after the first contact.

An old chestnut but one that bears repeating: bogies are plotted as bogies until they are identified either as bandit or friendly. When identified as friendly—by IFF, visual or other methods—the friendly symbol should be plotted. A malpractice is plotting every contact as bogey with the word "friendly" written out beside those tracks identified as friendly.

6 NON DR-ING

Again, the complete dependence on radar reports has lulled certain plotters into "never-dead-reckon" state of mind. Dead Reckoning is insurance against the time when fades, land echoes, jamming, radar interference or failure of operators to report, results in an incomplete track of controlled friendly aircraft. When plotting for an Intercept Officer controlling intercepting aircraft, dead reckoning is essential for split-second decisions needed to forestall a successful suicide attack.

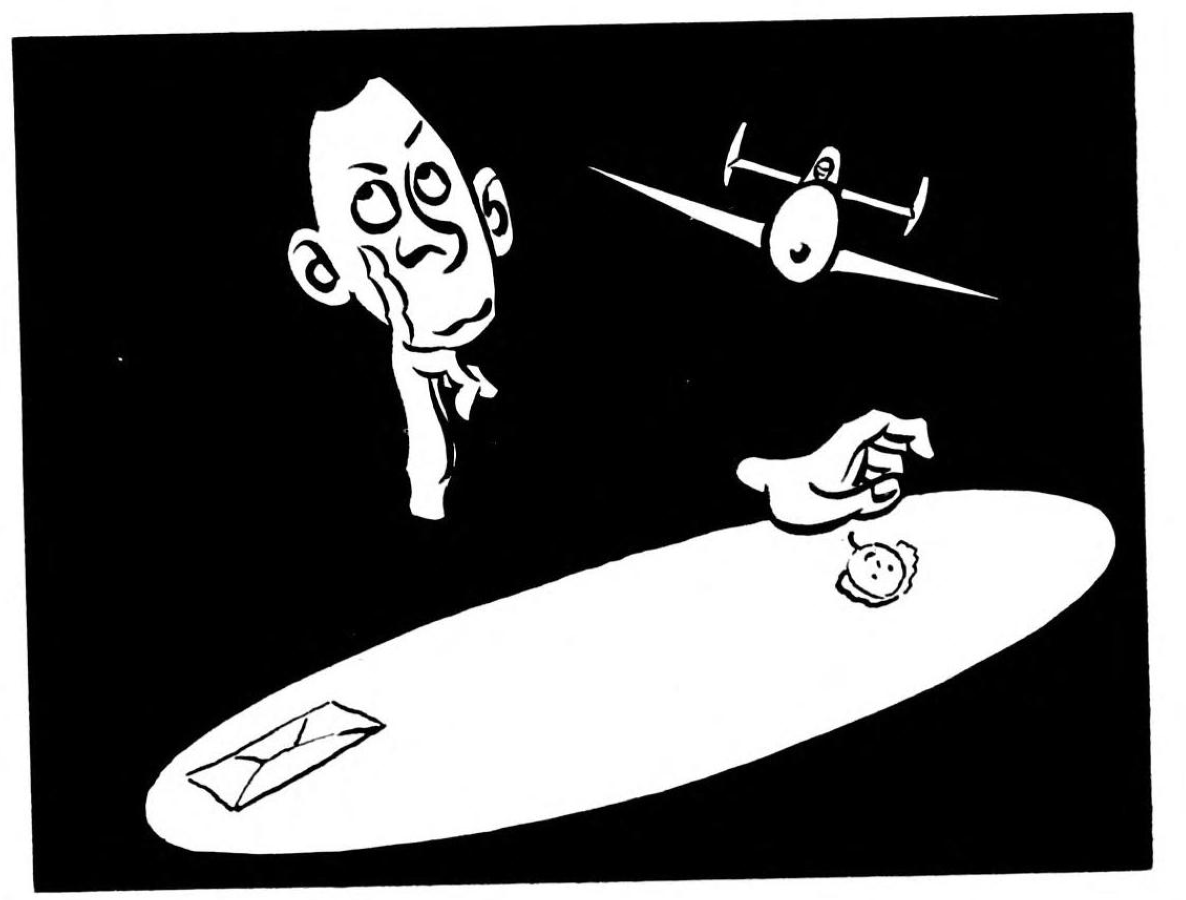
7 SLOUGHING OFF

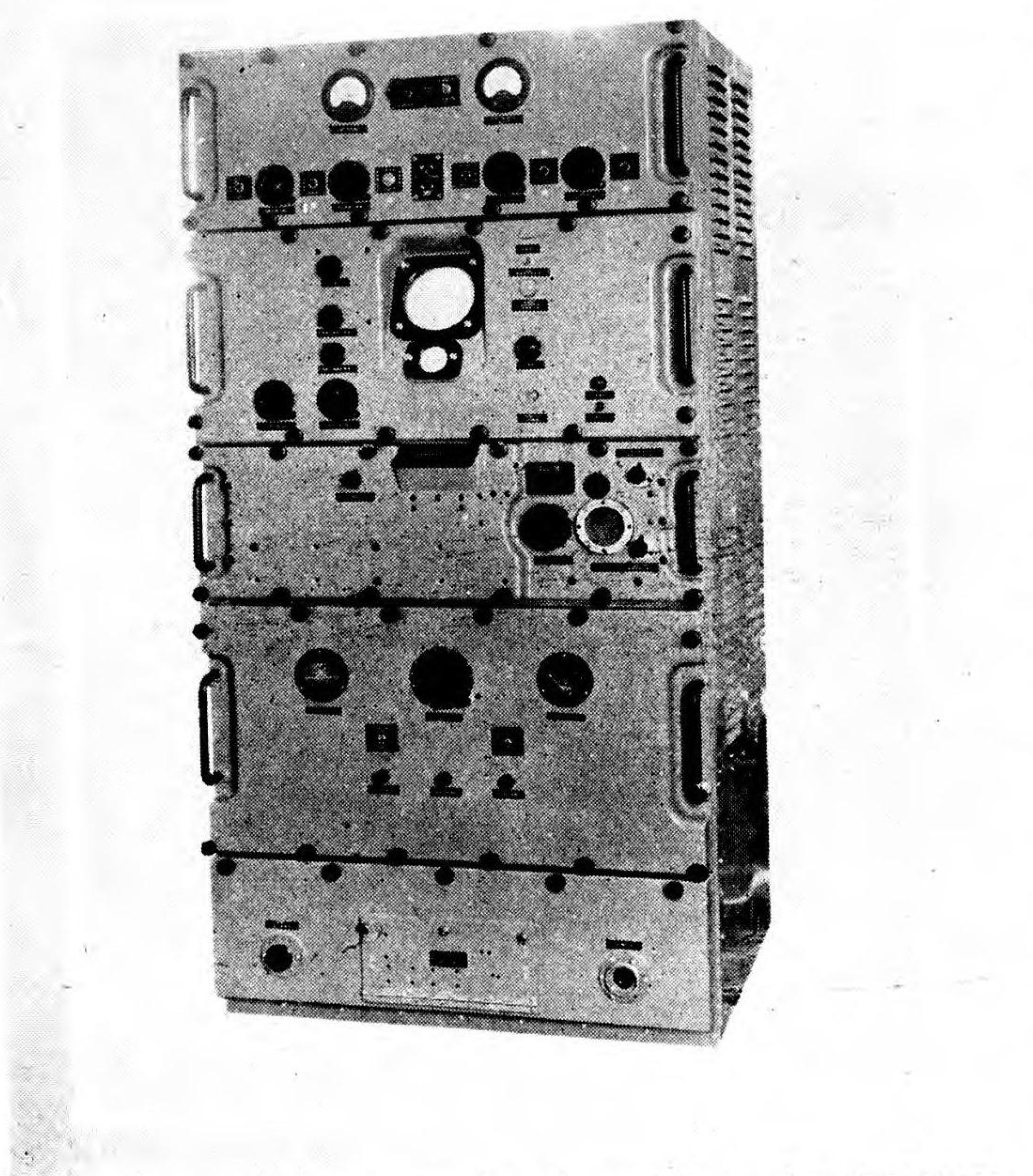
Plotter fatigue comes about not from too much plotting but from sloppy plotting. The solution is for the plotter to adopt a more realistic view of the board—visualizing each symbol, friendly and bogey, not as a quickly plotted circle or course but rather as a "live" plane, with a live pilot—a pilot either protecting you, or one—with his funeral ceremony behind him—preparing to destroy you. Although it is difficult to keep mentally alert all the time, whenever a bogey appears on the screen don't assume it must be friendly; instead, adopt the negative attitude that it is not friendly unless proved as such.

Two excellent examples of non-sloughing off:

(a) Not assuming all planes in a returning strike are friendly simply because a few show IFF, and

(b) not assuming a bogey is friendly because it apparently came over other ships that did not report "bogey approaching" over TBS.





The improved Mk 39 console aids servicing and maintenance.

new radars for heavy machine guns

The original radar equipment for Gun Fire Control System Mk 57 (heavy machine gun) was Radar Mk 29 Mod 2 which was produced in limited quantities largely from components of other radars already in production. The total production of approximately 100 such radars has been completed and the equipments have been installed on cruisers, battleships and carriers. The performance of this fire control radar has been adequate but it is no longer in production. Two new types of radar equipment are now being installed—or are about to be—with GFC System Mark 57. They are Mk 34 Mod 3 or 4 and Mk 39 Mod 1.

Both the Mk 34 Mod 3 and Mod 4 are X-band conical scan types with an ST transmitter and a 30″ dish-reflector. The Mod 3 utilizes components of Radar Equipment Mk 19 and Mod O; the Mod 4 is identical mechanically and electrically, but all units are newly manufactured. Both employ presentations similar to Mk 29 Mod 2, that is, a type A range presentation with a step, and type F or target spot presentation for angular tracking. In addition to target spot presentation the director pointer also views simultaneously through his eye piece a range presentation covering the first 20,000 yards shown on the below deck A scope.

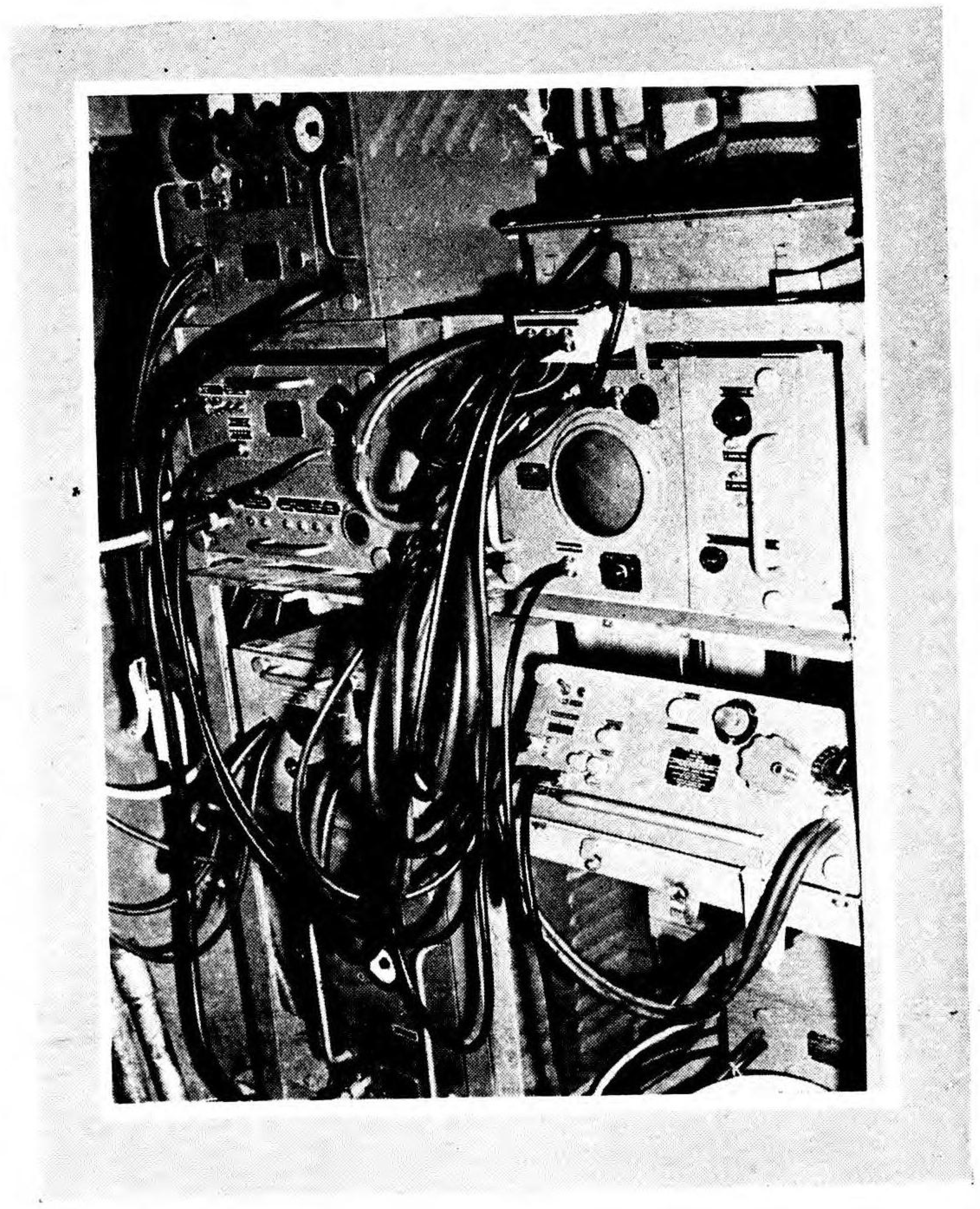
The beam is extremely narrow—three degrees plus—and its axis is offset only .75° in conical scan, thus giving a field of view of only about 5°. This equipment therefore has excellent angular discrimination (2.25°) and accuracy (plus or minus 2 mils) but because of its narrow coverage requires a high degree of coordination between CIC, gunnery control, the range operator below deck and the director pointer in target acquisition. A unit designed to facilitate target acquisition is now under development.

A total of 250 equipments are being produced and production will be completed early in 1946. Approximately 100 are now being installed.

Mk 39 radar has been designed as the ultimate standard equipment for the Mark 57 system. It is an X-band conical scan radar, using an SU transmitter and having the same beam characteristics as the Mark 29 Mod 2 and the Mark 34 Mod 3 or 4. However, an E-scope, showing range versus elevation, replaces the range scope in the director indicator. Below deck range scope gives simultaneous presentation of main and precision sweeps.

Below deck components perform the same functions as those of the Mk 29 Mod 2 and the Mk 34 Mod 3 and 4, but are combined into an operating console with greatly improved features for maintenance and servicing. The console packaging results in reduced weight as compared with the other radars used with the Mk 57 system. Deliveries are expected to begin in September.

Mark 34 as installed in the ALABAMA.



standard air plot tables in fleet

Over twelve hundred of the new standard Mark 1 Mod. 1 air plot tables (see "C.I.C.", September 1944) are now in the fleet, and one thousand more are being manufactured as replacements for ships having obsolete, non-standard tables at the present time.

The Navy Department Semi-Monthly Bulletin of 15 May 1945 (page 85) describes in detail how this new type of plotting table can be obtained.

The Mark 1 Mod. 1 was designed after consultation with fleet representatives as to the type of air plotting table that would best fit the needs of the fleet in the forward areas. One of the latest features is the sliding-type plotters' stool that can be folded when not in use. This is especially convenient during GQ when CIC is overcrowded.

The new Herculite "pencil-finish" plotting surface is superior to the plotting top of the first models. In recent tests made at the Bureau of Ships, lead pencils worked perfectly even with the plotting surface completely covered with water. Grease pencils work well when the surface is dry. The smooth or "Boston-type" tops on the first Mark 1 Mod. 1 tables that were manufactured (less than a hundred in all) are being replaced immediately with the new, proven "pencil-finish" Herculite top.

the recorder . . . mechanical memory

Today's Naval voice communications are a far cry from the days when John Paul Jones fought the Bon Homme Richard with leather lungs, speaking trumpets and messengers. Voice channels from sound power to VHF have paced the development of equipment and procedures necessary to the complicated business of ship handling and the control of large formations. As the tempo of Naval warfare has increased, voice transmissions of tactical information, commands, orders, reports and routine messages have at times seemed to approach the saturation point. The need came for a supplementary equipment to pinch-hit when inter and intra ship voice traffic became too heavy to log. Thus the sound recorder entered upon a Naval career.

The sound recorder has many uses. For training, the recorder enables the Evaluator, TBS talkers, CIC officers and telephone talkers to hear themselves as others hear them. Talkers with not the vaguest idea of how their voices sound on the air can study and improve upon the manner in which they deliver voice transmissions. For analysis of circuit discipline, the recorder can be cut in at will on any circuit for a "post mortem" on message content, intelligibility of talkers and standardization of orders and terminology. For garbled messages, when conditions of silence or overcrowded channels prohibit a "say again," several repeats of the recorder may make sense out of vocal sediment. For action reports, recorders monitoring the IFD, Tactical, AA Coordination and other nets will serve to fill in the hazy details that usually evade the log during action periods. After the action subsides the "whodunit" answers can be found embossed on a little disk or on a small strand of magnetized wire.

TYPES OF RECORDERS

Sound recorders, insofar as the Navy is concerned, are divided into three general classifications: disk, wire and film. Knowledge of the characteristics, limitations and allowance list for these equipments is of value to CIC officers.

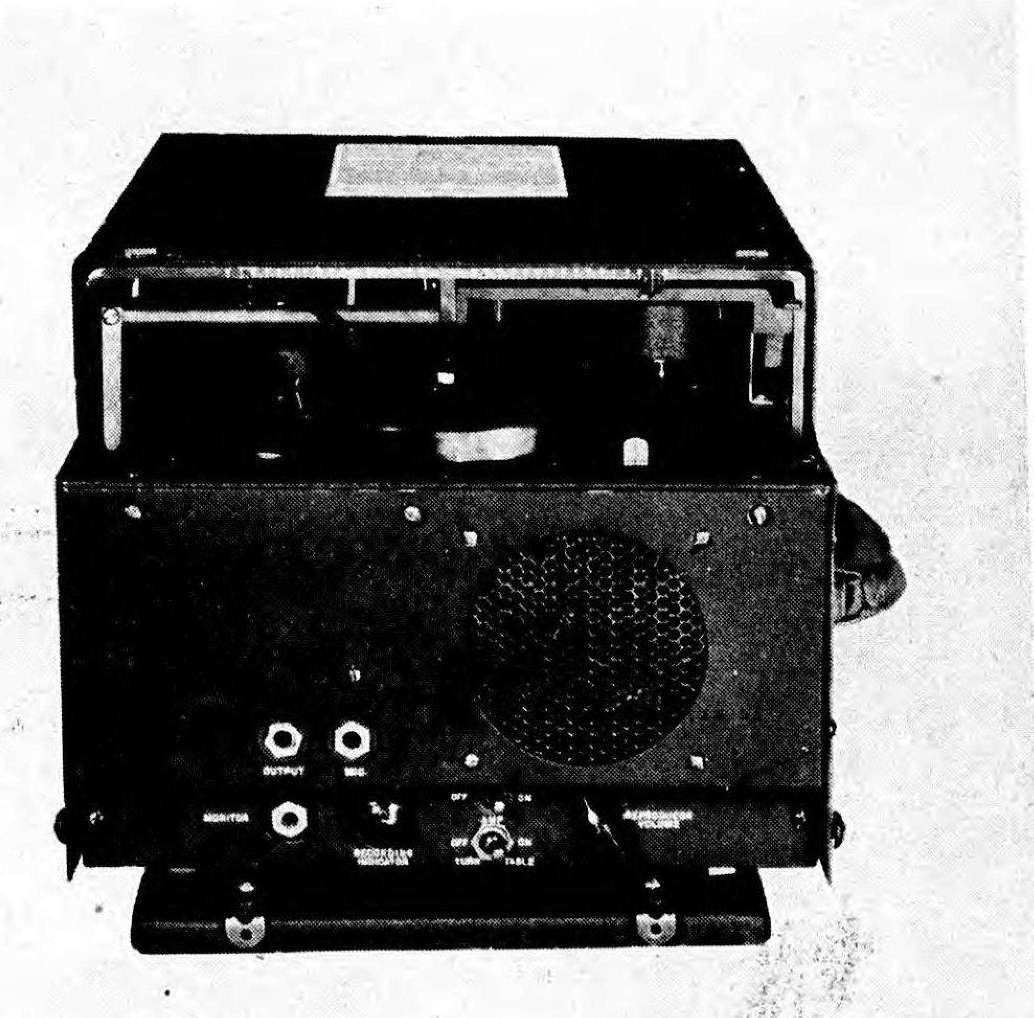
The following wire recorders are now approved for use: The *Mirrorphone* which records on magnetic tape for one minute and repeats back the recorded message ad nauseum. Its only function is speech training for telephone talkers and personnel involved with ship-to-ship and ship-to-plane communication. These are being gradually replaced by the multi-purpose spool and magazine type wire recorders. The *Armour Wire Spool Recorder* (the *G. E. Recorder Model 50A* is a similar machine) records for one hour on a magnetic wire four or six mils in diameter. By rewinding the spool, recorded transmissions can be played back, and they can be retained indefinitely or the wire demagnetized for use again. The *Brush Magazine Loaded Recorder* is similar to the Armour equipment in basic operation and use, but incorporates several improved features including components specified by the Bureau of Ships. Wire type recorders are subject to easy breakage of the wire, a discouraging occurrence that requires intricate rethreading which means loss of recording time.

Type Recorder	Navy Type	Time Length of Recording	Number Procured	Allowance List
Wire Armour—G. E.	50 50—A 51	One hour	380	CVB—2 CB—2 CV—2 CA—2 CVL—2 CL—2 CVE—2 AGC—2 BB—2 DD—1 DE—1
Wire Brush	VRW—1	One hour	1500	
Disk Sound Scriber	NRC—1 NRC—2 NRV—1	Fifteen minutes	700	CVB—3 BB—1 CV—3 CB—1 CVL—3 CA—1 CVE—1 CL—1 AGC—2

This allowance list for wire and disk type recorders has been recommended by the Ship Characteristic Board and has been approved for forces afloat. Recorders are to be obtained through ComServPac pools.

This spool type of wire recorder was developed by Armour Research Laboratory and produced for Navy by various contractors. It gives fair quality of speech intelligibility on playbacks. The fact that it is not shock mounted somewhat limits its utility afloat. Four spools of one hour recording duration come with each machine. A demagnetizing head erases previous recordings when it is desired to use the spool over again. For playbacks the spool must be rewound, an operation which consumes one-half the time it takes to record.

This disk recorder handles 7" disks which will hold fifteen minutes of recording per side. It can be used to record playbacks from wire recordings prior to demagnetizing the wire for re-use, providing a permanent record of such transmissions. A slight modification attached to some machines permits instantaneous playback, thus a garbled or misunderstood message can be heard again without tying up traffic for a repeat. This machine is shock mounted. The plastic disks can be obtained in any quantity.



The *Sound Scriber Disk Recorder* is built to standard Navy specifications. It records transmissions of fifteen minute duration on small plastic disks and has been used primarily for ACI officers' Ready Room interviews with returning pilots. It has also been used to record TBS messages in order to play back any transmissions that may be garbled.

Recording on film is something for the future as far as Navy procurement is concerned. The Navy has a *Recordograph* under development which provides two hours of recording on a 35mm film. It will boast mechanical advantages not available in the present wire and disk equipment.

Comparatively light in weight and designed to plug into any phone or radio jack, the utility of available recording equipment in training, action analysis, and message repeats is dependent upon the imagination of the officers using it. As equipment improves and is simplified, the range of its use can increase to the extent that all principal command circuits can be monitored to provide a permanent ship record.

This magazine type of wire recorder, manufactured by the Brush Company, presents some improvements over its predecessor. It is shock mounted, which improves the recording quality and reduces the possibility of the wire breaking. The wire spools are loaded in a magazine. Rapid change to a new spool is a matter of seconds. Five magazines come with each machine. Rewinding takes one-third the recording time.

Jap aircraft performance

As the U. S. Fleet and Army moved in closer to the heart of the Japs' embattled Empire, newer and more various types of Jap aircraft were encountered. Some new—the fruit of research, design and experience during the war years; some old—hastily outfitted for Kamikaze attacks—they were being marshalled for the final violent and desperate attempt of the JAF to beat off the approaching last stage of the Pacific war.

FDO's, IO's, and Gunnery Liaison Officers, charged with a major share of responsibility for repelling air attacks, are familiar with the performance characteristics of the Zekes, Bettys, Oscars, and Frances' which they have met in past months. They are not all aware of the newest types or of the latest developments in older types. The following data were prepared with the assistance of TAIC[1].

In considering aircraft performance one notable fact must be kept in mind: Much information must necessarily be derived not from observed combat operations but from flight tests, engineering calculations, captured documents, and the word of POW's. The figures, therefore, should be scanned with caution and allowances should be made for discrepancies between them and observed data.

Several rough generalizations may be made on the basis of available information. The emphasis in new Jap fighters, for example, was on increased speed and high altitude performance. Two examples are JACK and GEORGE, both now in service, both designed for top speeds in excess of 403 mph and capable of effective performance at from 25 to 32,000 feet, well above the former, rated altitude of 20,000 feet. Other notable performers are FRANK, a fighter with an estimated speed of 427 mph at 20,000 feet and a service ceiling of 38,800; RANDY, with a calculated speed of 437 mph at 32,000 feet in the high altitude fighter version, and GRACE 11, latest Jap torpedo and dive bomber, with a speed of 350 mph at 19,686 feet. Re-engined models of both TONY and TOGO are reputedly operational in limited numbers.

Figures for improved versions of older models illustrate the same high speed, high altitude trend in fighters. Zeke 52, latest in the long series, is reported to have a service ceiling of 35,100 feet and a speed of 358 mph at 22,000 feet.

Other notable trends were toward increased armament and better protection for pilots, the latter somewhat ironic in view of the continued suicidal missions. Zeke 52, for example, is reported to have a 20mm and a 13mm cannon in each wing with one or two 13mms in the fuselage. Like claimed speed data, however, any information on armament is subject to change without notice. Jap armament characteristically varies widely.

An additional new development of the JAF which possibly was to be encountered was the use of rockets as a means of gaining speed. At Iwo Jima, according to an AAF report, a bogey being chased by a night-flying P61 suddenly accelerated tremendously. Two flame-colored jets, appearing along the fuselage, indicated that some type of rocket had been used. Frances also has been reported as equipped with rockets to gain speed in low altitude torpedo attacks.

The extent to which the Japs may have been able to employ jet-propelled planes or variants of rockets is not completely known. In addition to the now familiar Baka, German types of the V bomb might soon have been employed. It has also been confirmed that plans for both the German Me 262, a high speed, high altitude, jet-propelled fighter and the Me 163, a liquid, rocket-propelled fighter, had reached the Japanese.

[1] Technical Air Intelligence Center, NAS, Anacostia, Washington, D. C.

navy fighters

ZEKE 52

Single engine, carrier-based.
Speed (mph) Sea Level—295
23,000′—358.
Climb—3.6 mins.—10,000′
7.8 mins.—20,000′
Service ceiling—35,100′
Range—380 sm. at 270 mph.
1844 sm. at 146
Notes: Still the backbone of the carrier force, Zeke was also being used as a night fighter.

JACK 21

Single engine, land-based.
Speed (mph) Sea Level—359
16,600′—417.
Climb—2.3 mins.—10,000′
5.1 mins.—20,000′
Service ceiling—38,800′
Range—205 sm. at 318 mph.
1300 sm. at 171
Notes: TAI pilots who have flown Jack state it is an excellent aircraft and easy to fly. A version with a turbo supercharger unit and Kasei 23 engine is believed to have been in production.

GEORGE 11

Single engine, land-based.
Speed (mph) Sea Level—358
19,000′—416.
Climb—6.1 mins.—20,000′
2.8 mins.—10,000′
Service ceiling—39,100′
Range—350 sm. at 333 mph.
1730 sm. at 176
Notes: Found in quantity at Clark Field, George was fully operational. High performance but more difficult to handle and land than Jack.

SAM (Provisional)

Single engine, carrier-based.
Speed (mph) Sea Level—349
19,700′—397.
Climb—6 mins.—19,700′
Service ceiling—35,700′
Range—666 sm. at 317 mph.
2130 sm. at 173
Notes: Expected successor to Zeke, Sam was not fully operational; and indications were that it would be abandoned.

REX 11 (Provisional)

Single engine, seaplane.
Speed (mph) Sea Level—320
18,800′—373.
Climb—7.0 mins.—20,000′
14 mins.—30,000′
Service ceiling—35,300′
Range—362 sm. at 305 mph.
1205 sm. at 177
Notes: Described as George on floats, Rex is an excellent performer.

TENRAI (Provisional)

Twin-engine, single place.
Speed (mph) Sea Level—372
16,600′—418.
Climb—11 mins., 20 secs.—32,810′
Service ceiling—36,700′
Range—unknown
1875 sm. at 187
Notes: Regarded as a type which was to be encountered in late 1945, Tenrai's trials were scheduled for completion in 1944 with production beginning in the spring of 1945.

JIMPU (Provisional)

Experimental, single engine.
Speed (mph) Sea Level—unknown
30,000′—415.
Climb—11 mins., 30 secs.—30,000′
Service ceiling—unknown
Range—unknown
1440 sm. at 285
Notes: A single place, experimental plane with one radial engine, Jimpu was a developmental possibility for late 1945.

DENKO (Provisional)

Experimental, two place, single engine.
Speed (mph) Sea Level—unknown
30,000′—420.
Climb—8 mins., 50 secs.—19,686′
Service ceiling—39,400′
Range—unknown
1440 sm. at 285
Notes: The first Jap aircraft to be designed as VF(N), Denko is not as strong a developmental possibility as Tenrai.

SHINDEN (Provisional)

Experimental, single engine.
Speed (mph) Sea Level—462
(estimated)
Climb—unknown
Service ceiling—39,400′
Range—unknown
Notes: Captured German documents indicate that this unorthodox Jap fighter (maybe canard type wings or possibly tailless) was scheduled for production in April of this year.

IRVING 11

Twin engine, land-based.
Speed (mph) Sea Level—279
19,900′—329.
Climb—10.9 mins.—20,000′
24.2 mins.—30,000′
Service ceiling—32,500′
Range—648 sm. at 267 mph.
1982 sm. at 177
Notes: Primary duty is as VF (N). It may be out of production because of its ordinary performance. Its failure has apparently caused some Zekes and Judys to be converted to VF (N)'s.

Definition of Performance terms employed:
Maximum Speed—War Emergency Power (WEP), if available; Military Power (Mil. Pow.), if unavailable.
Range (1st figure listed)—Range at combat cruising; i.e., at maximum continuous power and with internal fuel only.
Range (2nd figure listed)—Maximum range; i.e., of economical cruising and with external and/or removable fuel.
Aircraft names of Jap origin; i.e., those not as yet coded by TAIC are printed in lower case type.

army fighters

NICK I

Twin engine, two place.
Speed (mph) Sea Level—302
18,500′—353.
Climb—3.5 mins.—9,200′
7.8 mins.—19,000′
Service ceiling—35,800′
Range—335 sm. at 270 mph.
1909 sm. at 151
Notes: Nick, first operational twin engine Jap VF, has been encountered by B-29's over the Empire.

FRANK I

Single engine.
Speed (mph) Sea Level—363
20,000′—427.
Climb—2.6 mins.—10,000′
5.8 mins.—20,000′
Service ceiling—38,800′
Range—303 sm. at 338 mph.
1815 sm. at 173
Notes: Sometimes mistaken for Oscar, Zeke, and possibly even Tojo. Frank was expected to be backbone of Army fighter defense.

TONY 2 (Provisional)

Single engine.
Speed (mph) Sea Level—335
28,000′—423.
Climb—6.6 mins.—20,000′
3.2 mins.—10,000′
Service ceiling—43,300′
Range—520 sm. at 305 mph.
2120—sm. at 160
Notes: Tony 2 was regarded as a strong JAF possibility for the future. Higher critical altitude than Tony 1 is reported.

TONY I

Single engine.
Speed (mph) Sea Level—302
15,800′—361.
Climb—4.0 mins.—10,000′
8.45 mins.—20,000′
Service ceiling—35,100′
Range—554 sm. at 287 mph.
2010 sm. at 148

OSCAR 3

Single engine.
Speed (mph) Sea Level—303
21,900′—358.
Climb—3.4 mins.—10,000′
7.4 mins.—20,000′
Service ceiling—37,400′
Range—395 sm. at 275 mph.
1995 sm, at 145
Notes: Oscar 3 is about 15 mph faster than Oscar 2 at sea level and has a service ceiling some 1500′ higher.

TOJO 2

Single engine.
Speed (mph) Sea Level—335
17,400′—383.
Climb—2.8 mins.—10,000′
6.0 mins.—20,000′
Service ceiling—36,350′
Range—294 sm. at 314 mph.
1206 sm. at 188
Notes: Tojo has a high rate of climb. Frank is successor to Tojo in design.

RANDY (Ki. 102) (Provisional)

Twin engine.
Speed (mph) Sea Level—340
32,400′—437.
Climb—9.1 mins.—19,700′
18.5 mins.—36,100′
Service ceiling—40,750′
Range—445 sm. at 296 mph.
1373 sm. at 170
Notes: Randy, successor to and a dead ringer for Nick, comes in two versions: High altitude VF, Ground Attack. Data is not complete on this fighter, although it was sighted with fair frequency. Very heavy firepower in both versions.

navy bombers

JUDY 12

Single inline engine, dive bomber.
Speed (mph) Sea Level—319
19,300′—377.
Climb—3.6 mins.—10,000′
7.5 mins.—20,000′
Service ceiling—36,400′
Range—420 sm. at 286 mph.
2445 sm. at 160
Notes: After a long period of evolution, Judy 12 began appearing early in 1944. It became the Jap Navy's principal dive bomber, but was gradually being replaced by Judy 33 (radial engine version).

JUDY 33

Single engine torpedo and dive bomber.
Speed (mph) Sea Level—325
18,500′—376.
Climb—3.6 mins.—10,000′
7.8 mins.—20,000′
Service ceiling—38,300′
Range—355 sm. at 281 mph.
2505 sm. at 157
Notes: Comparable to Judy 12, these new types have the same airframe. Judy has been used as suicide aircraft. The change to a radial engine is probably due to difficulties with inline engine. Judy 33 was reportedly used as a nightfighter.

GRACE 11

Single engine torped and dive bomber.
Speed (mph) Sea Level—303
19,686′—350.
Climb—7.5 mins.—13,125′
Service ceiling—34,850′
Range—2075 sm. at 153 mph.
1695 sm. at 153 mph.
Notes: Grace, with a four blade propeller and inverted gull wings, has been sighted occasionally. The extent to which it was operational is unknown.

BETTY 24

Twin engine.
Speed (mph) Sea Level—257
13,800′—283.
Climb—7.2 mins.—10,000′
17.4 mins.—20,000′
Service ceiling—30,400′
Range—1170 sm. at 226 mph.
3075 sm. at 136
Notes: Latest in the series of operational Bettys, performance is about the same as for Betty 22. It has been modified to carry Baka.

FRANCES 11

Twin engine.
Speed (mph) Sea Level—325
17,000′—367.
Climb—6.1 mins.—10,000′
14.0 mins.—20,000′
Service ceiling—35,530′
Range—887 sm. at 279 mph.
3737 sm. at 165
Notes: Used mainly as a torpedo bomber or recce. A night fighter version was in limited production.

EMILY 22

Four engine flying boat.
Speed (mph) Sea Level—262
16,800′—305.
Climb—5.2 mins.—10,000′
11.1 mins.—20,000′
Service ceiling—34,500′
Range—1246 sm. at 225 mph.
4190 sm. at 135
Notes: An outstanding patrol bomber of the early war, Emily is the successor of Mavis. Was being used primarily as a transport.

JILL 12

Single engine torpedo bomber.
Speed (mph) Sea Level—297
15,100′—327.
Climb—5.6 mins.—10,000′
13.7 mins.—20,000′
Service ceiling—35,400′
Range—575 sm. at 255 mph.
2010 sm. at 147
Notes: Jill, with a four-blade prop, is a standard Jap torpedo bomber. It was expected to be replaced operationally, however, by the superior Grace 11.

VAL 22

Single engine dive bomber.
Speed (mph) Sea Level—230
20,300′—281.
Climb—4.5 mins.—10,000′
9.5 mins.—20,000′
Service ceiling—33,600′
Range—310 sm. at 223 mph.
1580 sm. at 126
Notes: Obsolete, Val is still operational in limited numbers.

NELL 23

Twin engine bomber.
Speed (mph) Sea Level—228
19,600′—270
Climb—6.2 mins.—10,000′
13.5 mins.—20,000′
Service ceiling—34,250′
Range—590 sm. at 210 mph.
2050 sm. at 157
Notes: Like Sally, verging on obsolescence, Nell was still in limited production and service. Some were equipped with Magnetic Airborne Detectors.

army bombers

PEGGY 1

Twin engine.
Speed (mph) Sea Level—294
18,700′—346.
Climb—5.9 mins.—10,000′
13.0 mins.—20,000′
Service ceiling—30,100′
Range—750 sm. at 264 mph.
2040 sm. at 156

HELEN 2

Twin engine.
Speed (mph) Sea Level—274
16,900′—312.
Climb—6.6 mins.—10,000′
15.2 mins.—20,000′
Service ceiling—30,930′
Range—580 sm. at 245 mph.
2220 sm. at 145
Notes: Widely advertised by the Japs as the aircraft to win the Pacific War, Helen has not lived up to promises. It is among the most heavily armed of Jap aircraft.

SALLY 2

Twin engine.
Speed (mph) Sea Level—258
15,400′—294.
Climb—5.8 mins.—10,000′
12.6 mins.—20,000′
Service ceiling—30,500′
Range—550 sm. at 235 mph.
1945 sm. at 132
Notes: Verging on obsolescence, Sally was still in limited service, largely as a transport.

MARY 1

Single engine.
Speed (mph) Sea Level—unknown
16,500′—232.
Climb—unknown
Service ceiling—Maximum dive speed 302 mph. (Structural limitation)
Range—640 sm. at 111 mph.
Notes: Obsolete; inline engine, low wing monoplane. Chiefly a trainer.

LILY 2

Twin engine.
Speed (mph) Sea Level—268
20,000′—313.
Climb—4.6 mins.—10,000′
10.0 mins.—20,000′
Service ceiling—34,300′
Range—500 sm. at 246 mph.
1750 sm. at 246
Notes: With a short range, small bomb capacity and unimpressive speed, Lily has been a Jap disappointment. POW's call it a "flying coffin."

navy reconnaissance

PAUL 11

Single engine seaplane.
Speed (mph) Sea Level—245
17,900′—285.
Climb—5.2 mins.—10,000′
11.2 mins.—20,000′
Service ceiling—33,350′
Range—630 sm. at 219 mph.
1690 sm. at 130
Notes: Normally a recce plane, Paul was sometimes used as a dive bomber. It has not been found in large numbers.

MYRT 11

Single engine, carrier-based, three place.
Speed (mph) Sea Level—347
16,600′—396.
Climb—3.8 mins.—10,000′
8.4 mins—20,000′
Service ceiling—34,100′
Range—560 sm. at 324 mph.
2640 sm. at 178
Notes: Two cameras, one mounted vertically shooting through belly hatch, one hand supported, shooting through ports on either side of center canopy are fairly standard equipment on Myrt which is mainly a fast photo recce.

JAKE 11

Single engine seaplane.
Speed (mph) Sea Level—201
7600′—222.
Climb—5.4 mins.—10,000′
12.9 mins.—20,000′
Service ceiling—29,800′
Range—280 sm. at 198 mph.
1375 sm. at 119
Notes: Still the Japs' principal recce seaplane. Jake is continually associated with convoy anti-sub duty.

NORM (Provisional)

Recce, seaplane.
Speed (mph) Sea Level—unknown
19,686′—319.
Climb—10 mins., 30 secs.—19,686′
Service ceiling—unknown
Range—unknown
2465 sm. at unknown mph.
Notes: Norm was thought to be operational, but POW reports indicate that it was probably abandoned.

PETE 11

Float-biplane.
Speed (mph) Sea Level—199
13,000′—236.
Climb—5.0 mins.—10,000′
10.4 mins.—20,000′
Service ceiling—30,900′
Range—180 sm. at 190 mph.
1025 sm. at 111
Notes: There are some indications that Pete was to be replaced by Paul. Occasionally confused with our SOC, it was still operational.

GLEN 11 (Provisional)

Submarine-borne, twin float-monoplane.
Speed (mph) Sea Level—unknown
Climb—unknown
Service ceiling—unknown
Range—500 sm. at 92 mph.
Notes: Used principally in the first year of the war, little use has been made of Glen recently. Glen can be assembled in 15 minutes, stowed in less than 30.

army reconnaissance

SONIA

Single engine, Attack and Recce.
Speed (mph) Sea Level—228
9000′—254.
Climb—5.5 mins.—10,000′
13.4 mins.—20,000′
Service ceiling—27,200′
Range—490 sm. at 224 mph.
1540 sm. at 126
Notes: Sonia, although an older aircraft, was still being produced, in two versions, viz. "recce" and "assault."

DINAH 3

Twin engine, Army and Navy.
Speed (mph) Sea Level—366
16,700′—420.
Climb—3.8 mins.—10,000′
6.8 mins.—20,000′
Service ceiling—40,600′
Range—572 sm. at 318 mph.
1910 sm. at 170
Notes: With increased armament, Dinah could be utilized as VF(N); however, to date it has been used for recce only. According to documents Dinah 4 may be developed for high speed (400 mph at 32,000′) unarmed reconnaissance. Only known operational type used in substantial quantities by both Army and Navy.

navy transports

MAVIS 22

Four engine, flying boat.
Speed (mph) Sea Level—198
6200′—217.
Climb—9.9 mins.—10,000′
25.8 mins.—20,000′
Service ceiling—24,700′
Range—1080 sm. at 190 mph.
3980 sm. at 112
Notes: Mavis has been largely replaced by Emily except for transport purposes.

TESS 11

Twin engine.
Speed (mph) Sea Level—220.
8000′—240.
Climb—4.0 mins.—6400′
Service ceiling—28,500′
Range—1785 sm. at 110 mph.
Notes: Basically Tess is a Jap-produced DC-2 with slight modifications.

army transports

TABBY 22

Speed (mph) Sea Level—219
6400′—220.
Climb—9.4 mins.—10,000′
29.7 mins.—20,000′
Service ceiling—24,450′
Range—755 sm. at 192 mph.
2080 sm. at 113
Notes: Tabby is a Jap-produced DC-3 with minor modifications.

TOPSY 1

Two engine.
Speed (mph) Sea Level—233
19,000′—278.
Climb—5.9 mins.—10,000′
12.8 mins.—20,000′
Service ceiling—31,600′
Range—680 sm. at 221 mph.
1909 sm. at 120
Notes: Commercial version and forebear of Sally, Topsy is also known as MC-20.

BAKA

Suicide rocket-propelled aircraft bomb.
Speed (mph) Sea Level—unknown
540 mph level flight with rockets.
620 mph in dive (Terminal velocity).
230 mph in glide without rockets.
Climb—unknown
Service ceiling—unknown
Range—55 sm. when released at 27,000′
Notes: Baka, normally carried by Betty, although capable of attachment to Helen, Peggy, Sally, and Rita normally finishes its dive in a torpedo run.

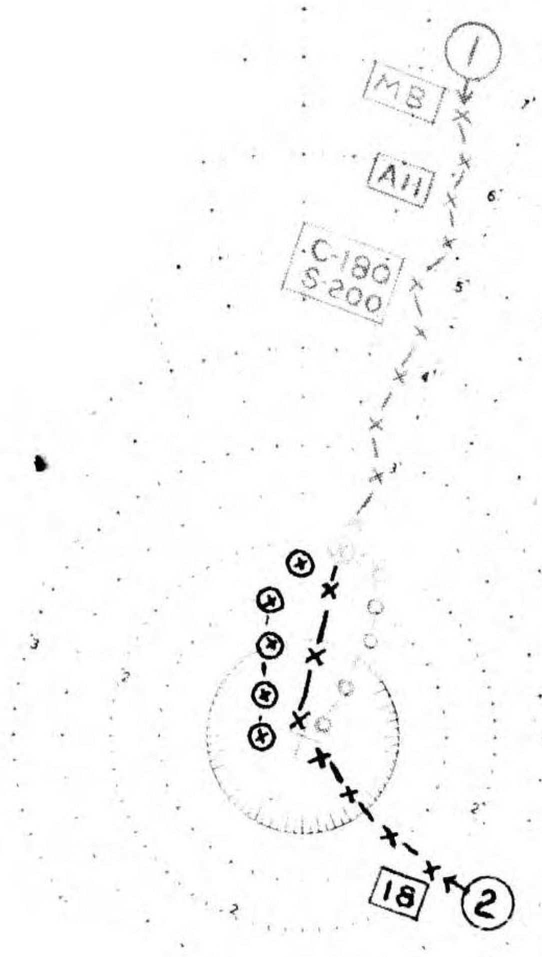
"CR" tracking must be improved

Beware of neglecting the "CR" content of your "canned" problems. "CR" is your Close-Range ingredient in canned problems—the part of the training program that deals with bogies in close . . . what to do about these bogies in general, how to disseminate information quickly, and particularly how to transfer smoothly the responsibility for these "Close-Range" potential Kamikazes from Fighter Direction to Anti-Aircraft weapons.

Running "canned problems" may be a daily occurrence in your CIC, but recent action reports indicate a definite deficiency in the training of CIC personnel in handling close-in targets. Check your own training methods in this art of tracking attacking aircraft! You may be using canned problems you made up yourself, or the training problems in Annex A of RADFOUR, the Air Plotting Manual, but in either case it's a safe bet you terminate your canned problems in this manner:

"Merged plot . . . two-eight-five, sixteen . . . end of problem."

You've—ideally—made an interception; therefore you end the problem while the planes are still ten to twenty miles from your ship. This defeats the very purpose for which the training was set up—to learn to act quickly with complete confidence under any circumstances. As a matter of record—from action reports—the common "circumstance" today involves the enemy plane practically on top of you, and that plane is a far greater threat than the plane tallyhoed sixteen miles away.

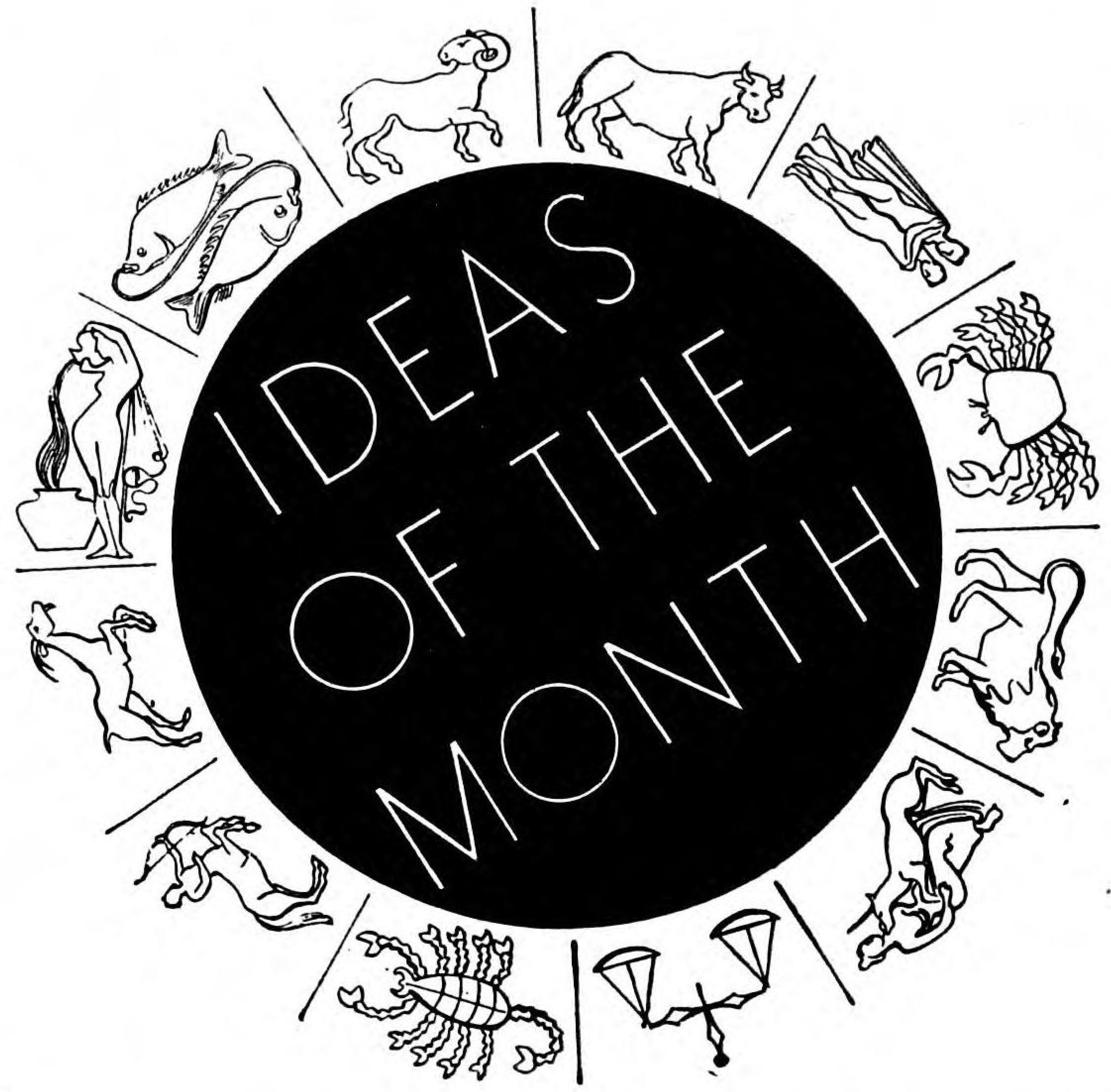


WHAT TO DO ABOUT IT

The remedy is simple. In your training problems continue to track targets after interception. Introduce "break throughs" with "heads up" to everyone concerned. Introduce bogies suddenly appearing within the twenty mile range circle flying at such tremendous speeds that it is obvious the planes are using diving tactics. This is excellent training for quickly determining course and speed of a Kamikaze, and for anticipating exactly when and where the suicide plane is expecting to strike. Normal fades, sea return and the cone of silence should be considered in the problems with special emphasis on plotting Estimated Position Arcs. Multiple targets should be no excuse for losing track of any single bogey. No problems can be considered satisfactorily completed until all bogies have been tracked into the attack position over the target and have been adequately taken under fire by automatic weapons.

Whenever live intercepts with actual planes are being run, in order not to reduce the number of air intercept problems, it is suggested that intercepting planes be used to simulate an attack on the ship or base while enroute back to the base to assume a CAP status for the next problem.

It is not enough simply to run "Close-Range" problems as training for plotters. These problems should bring out the part CIC plays not only in the shipboard organization but the responsibility of CIC to other ships as well. Intimate familiarity with intra-ship communications must be stressed to achieve optimum smoothness in the transfer of primary responsibility from fighter direction to AA weapons as the attacking planes close our forces. Lookouts and gun director crews must be considered an integral part of every canned problem. Simulated passing-of-bogey-dope—"keeping the Commanding Officer and higher commands embarked informed of the location, identity, and movement of friendly and/or enemy aircraft," quoting USF-10B—must also be included if the training is to be effective.



Items printed in "Ideas of the Month" are not doctrine or standard practice, but are suggestions from Fleet units which you may use or reject as you see fit.

If your ship has worked out tactics or techniques which have helped you, then the quickest way to pass the aid to others is via this column. Airmail contributions to "C. I. C." They will soon be in print (if deemed sufficiently new and helpful) and on the way to the entire Fleet by airmail.

the poor man's VG

—By Lt. (jg) W. A. Clark, USN,

USS KENNETH WHITING (AV)

The experience of our ship as Fighter Director ship and Radar Guard ship at Kossol Passage, Ulithi, Saipan and more recently at Kerama Retto in the Ryukyus, has proved it is necessary to keep continuous track on all targets at ranges from minimum to at least 75 miles, to obtain the IFF code on every target, and to get positive visual identification of every target within visual range.

Our ship has one SK air search radar, located several decks below CIC, communications are carried on by sound powered telephone only, and we have one VD-1 RPPI in CIC. However, the VD-1 cannot use the 12 inch PPI tube without extensive modification. A VG would be of considerable assistance but we have none. Our problem is complicated by the fact that it is impossible to keep track of both short and long range targets with one search radar. This is especially true when the ship is anchored near a seaplane operating area or an air field, with large numbers of planes in landing circles, and in orbits in the immediate vicinity. When short range targets are read from the medium range scale, bearings may be off as much as 15 degrees due to the difficulty of keeping the PPI sweep and cursor centered on the SK, and ranges may be off 2 or 3 miles on targets under 15 miles.

Shifting range scales is slow and has proved impracticable, the operators tending to concentrate on targets on one range scale to the neglect of those on the other.

One other result of the usual systems is that all plots are behind the actual target position by an appreciable length of time. This is not so important at long ranges but it becomes so when the target is only a few miles away and an interception is being attempted.

We solved the problem by developing a special plotting board which approximates the VG "expanded" presentation when mounted on the VD-1. It gives more accurate tracks and courses on aircraft at short ranges than the usual air plot board, and permits rapid plotting of more air contacts.

The board consists of 3/8" Lucite, engraved (very lightly) on the bottom side with bearing lines every ten degrees and with five-degree points indicated by a short line at the 16 mile range circle. Range circles are one inch apart. The size of our board is 20 inches, and its shape was determined by the location of our VD-1. A larger board might be desirable.

The edge of the board is lighted by two 115-volt, 15-watt lamps in metal cases. A slit 1/16" by 3/4" gives sufficient light to illuminate all plots and no light is reflected on the face of the PPI tube. When the lighting is turned off the engraving is invisible, but for better visibility when in use, do not engrave the middle six inches except for center markings.

The board is supported, mainly, by the face of the VD-1 and adjusted to the center by three sheet metal brackets slotted to fit under the studs on the VD-1 top casting.

In operation it has the effect of giving us a second air search radar and enables an accurate plot of all air targets under 20 miles without interfering with the usual medium range plotting set-up.

The VD-1 is set on the 20-mile scale with range marks turned on. All planes under 20 miles are plotted on this board directly from the RPPI at a scale of 1 inch equals 2 miles. The SK operator and the operator on the standard air plot table plot only those targets over 20 miles.

When a target closes to 20 miles the VD-1 plotter picks up the track, checking with air plot for the IFF code. On targets opening from the center, the VD-1 plotter obtains an IFF check from the SK operator and when the target opens to 20 miles, it is picked up by the SK operator and the air plotter on the big board. Visual identification is obtained from lookouts on all targets reaching visual range. All identification data is kept in boxes alongside the track.

This system has proved unusually successful in plotting short range targets, and particularly in tracking planes through a maze of echoes and side lobes from islands surrounding the anchorage. A few minutes of plotting on the VD-1 acquaints the plotter with the location and shape of all permanent echoes and moving targets are easily picked out.

Bearing accuracy is much better than that of plots from the SK PPI and range is accurate to within ½ mile. Approximately three times as many targets may be plotted in the same length of time as from the SK itself.

compass to true at a glance

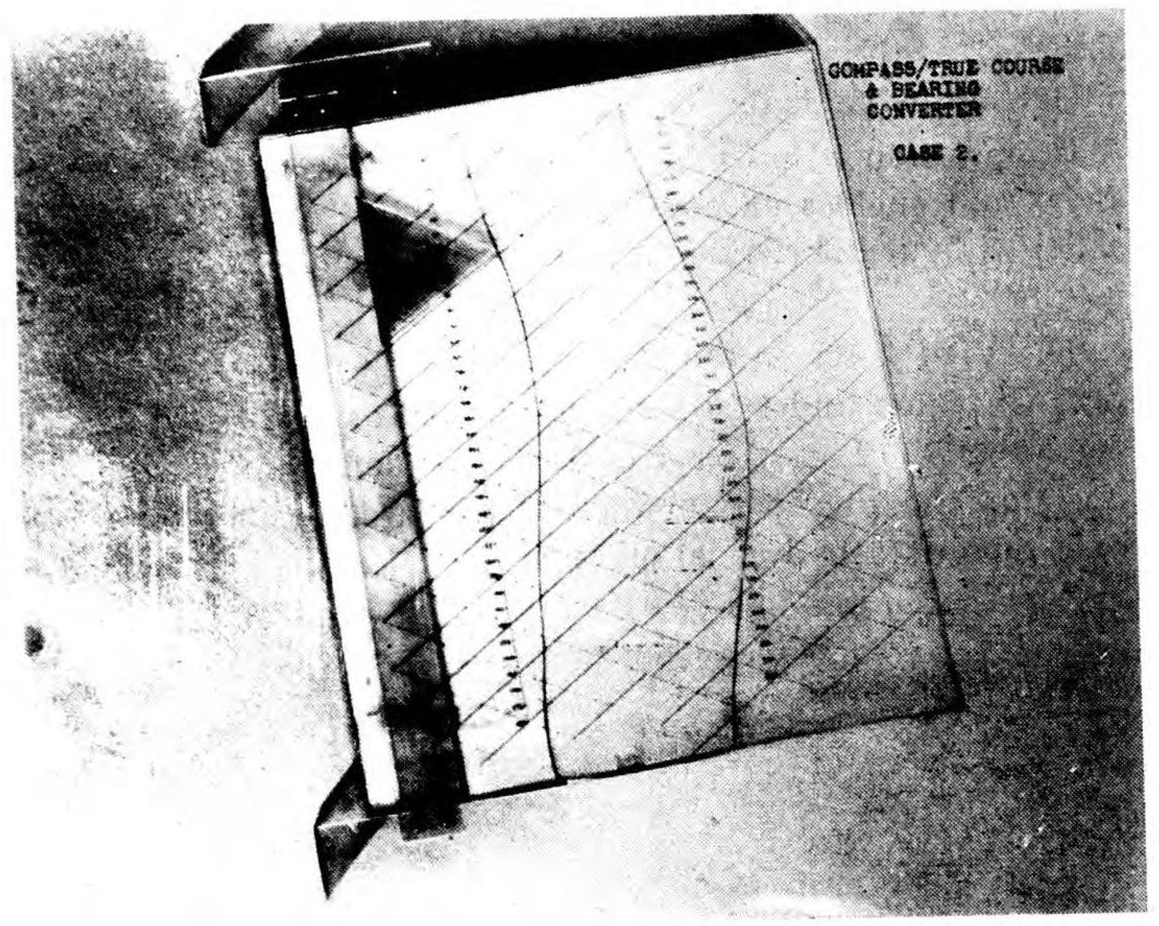
—By Gerald Ellis Foreman, CQM (AA), USN
U. S. Naval Training and Distribution Center, Camp Elliott, San Diego, Calif.

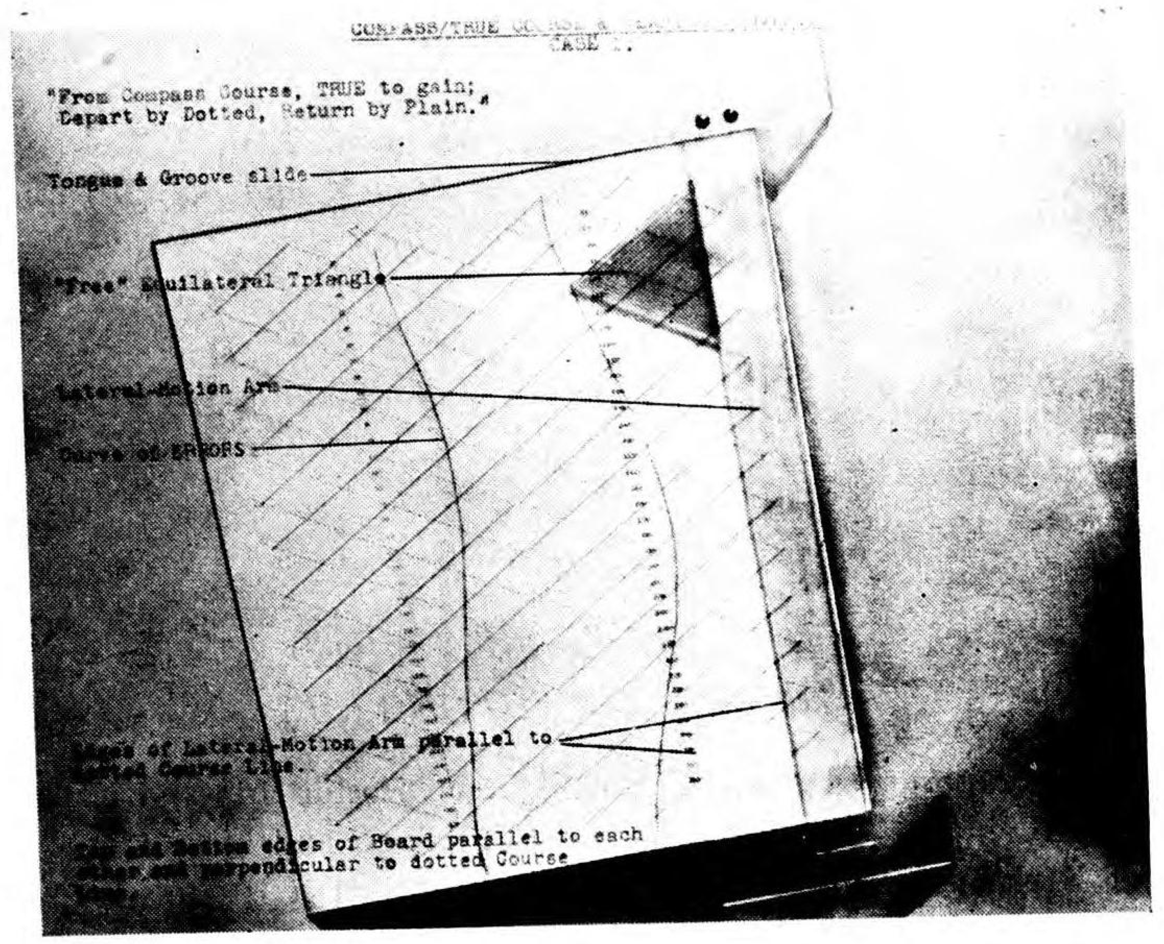
It has been noticed that the flow of information from CIC to the bridge is seriously impaired by a gyro casualty, especially under battle conditions. At times mistakes have been made in converting true course to compass and vice versa. With a variation of 10° or 15°, such a mistake can assume serious proportions.

A device based on the Napier diagram on which is drawn a curve of total error (variation and deviation combined) will automatically give either compass or true course when the other is known.

The device is composed of a board of plexi-glass or some suitable material on which is engraved the conventional Napier diagram, the surface of which is rough to facilitate drawing of the curve of *errors.* The top and bottom edges of the board are perpendicular to the dotted course lines so that an arm on the principle of the T-square may be moved laterally across the board and maintain parallelism. This arm or straight-edge assures orientation of the equilateral triangle whose base slides along its perpendicular edge. This function of the arm and triangle enables the operator to determine the true bearing of any object when the compass-head is known by the simple placement of the apex of the triangle against the curve corresponding to the ship's head, and then moving it down to any desired bearing. It can readily be seen that the entire computation is all purely mechanical and that a solution is obtained at a glance. The chance of large errors thus becomes very unlikely.

Since the curve of total error changes from day to day due to the change in variation, a new curve should be drawn each time the ship goes to general quarters or when battle is imminent.





BUPERS ANNOUNCEMENT

BuPers is revising allowances to conform in general to table on Radio Specialist Officer and CIC Personnel Allowances, established by CominCh Serial 01387 of 15 May and published on page 36 "C.I.C." Magazine of July, *subject to changes in, and installation of, electronic equipment.* CominCh Serial 01387 of 15 May 1945 and BuPers confidential letter Pers-2141-LN of 27 January 1945 are inter-Navy Department documents concerning detailed and voluminous studies of electronic personnel requirements and are *not available for distribution.*

By direction of Chief of Naval Personnel.
R. M. SCRUGGS, Captain, USN.

Action

EXCERPTS FROM RECENT REPORTS

CIC

Stationing CAP

USS INTREPID (CV): "The practice of stationing all CAP in various sectors ten to thirty miles from base and at varying altitudes has at times been found by this ship to present difficulties in control. This method has been particularly troublesome when trying to control divisions in widely separated sectors, while all transmissions are being made by three or four controlling bases on one intercept channel, or on a channel being used by Group's own strikes or for landing instructions to planes in trouble.

"The advantage of having a head start can be lost by having planes on wrong side of base if bogey comes in from an unsuspected bearing. The advantage of knowing where friendlies are located does not work out in practice as various divisions drift and control is lost at times. The situation can be met by sending out divisions from overhead or from sectors nearby as soon as any bogey appears and resuming if bogey shows IFF late. Ordinarily it takes from three to five minutes before bases can confirm bogey reports or make positive friendly identifications, by which time the CAP divisions are breaking out into the clear on the PPI.

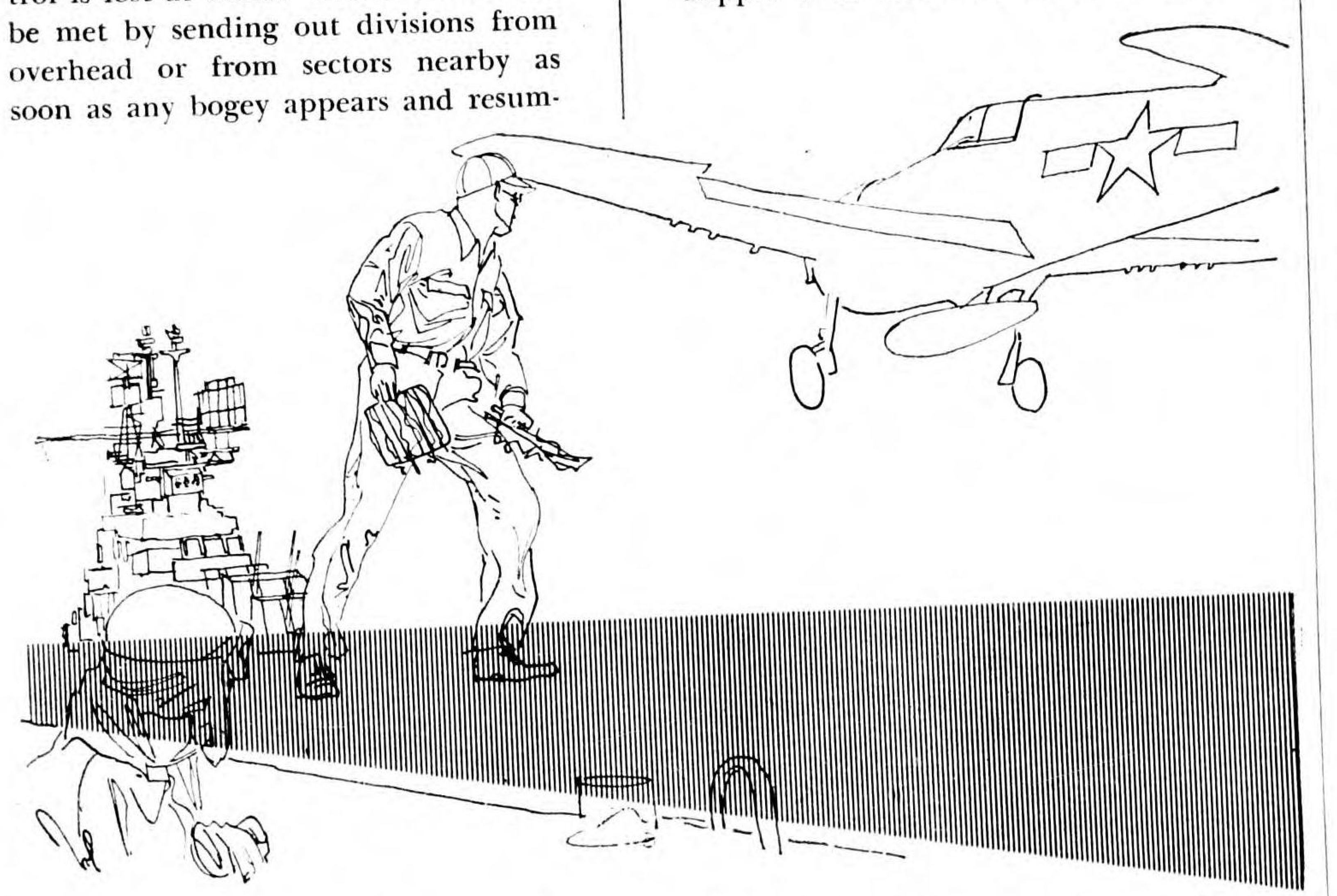
"There is a definite advantage in having CAP away from overhead when opening fire by ship's guns, but those divisions are usually already vectored toward raid to back up first divisions in case part of raid breaks through. There are a number of disadvantages which result from stationing CAP away from base:

1—You are sometimes compelled to use divisions at poor angels in view of bogeys known altitude.

2—Bases are being constantly alerted because planes are seen on horizon ducking in and out of clouds.

3—It is difficult to join up divisions to intercept large raids, and this actually results in conducting another interception on a channel which is already being used for an intercept.

4—There is a tendency to compromise VF sector letters by constant use of instruction oven channels such as 'Put Ripper 7 in sector G north of base.'



5—Confusion always exists as to location of CAP, thereby causing constant checking of status boards and this on busy IFD circuits.

6—The PPI is already overloaded with targets and keeping CAP overhead eliminates this as well as keeping all strength together.

"We believe a fair compromise would be to station CAP over picket destroyers during daylight hours (not radar picket line) twelve miles from base. These pickets are usually on three sides of base away from adjoining Task Groups. They are usually near the approach sectors and lost sheep circle. A known orbit point would prevent drifting and keep them clear of ship's gunfire."

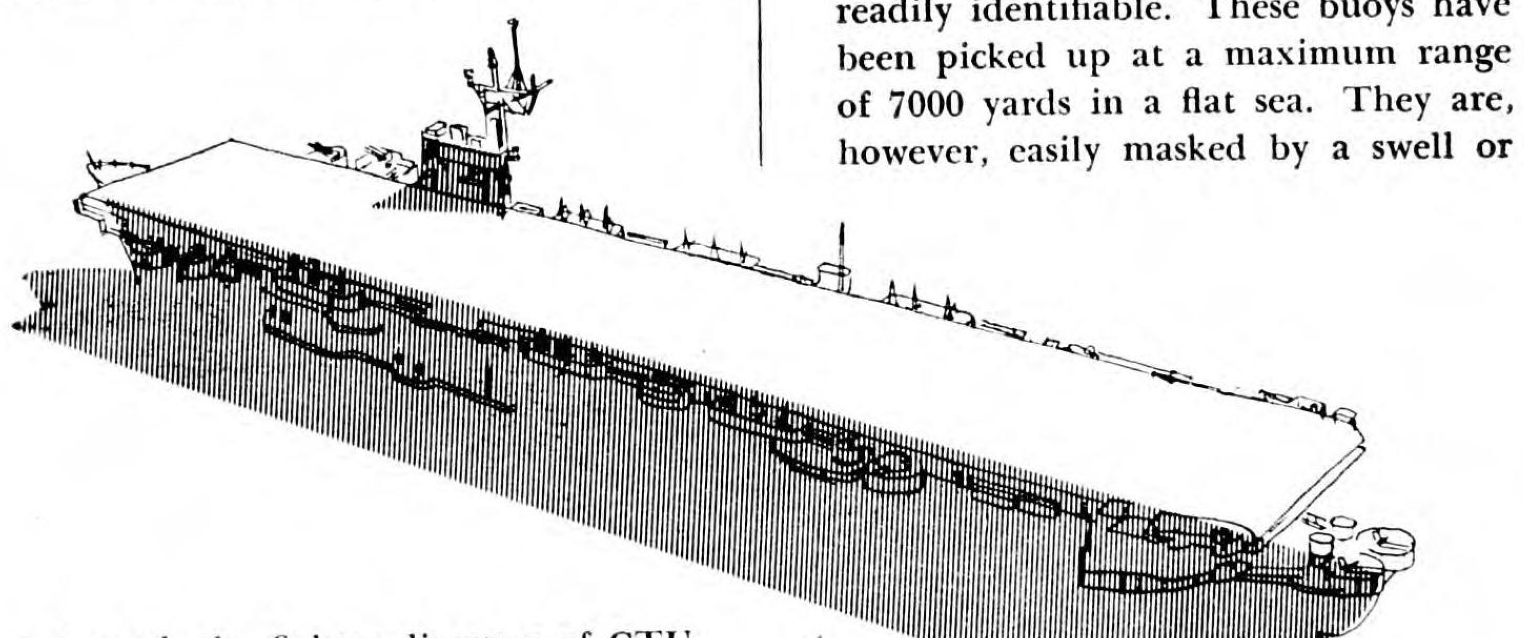
High Cover

USS ENTERPRISE (CV) (Okinawa): "The increase in speed and maneuverability attained by the enemy through use of fast planes and single plane approaches can be compensated for in part by initial stationing of CAP at higher altitudes and using the altitude to gain speed on vector. The unsuccessful interceptions attempted on 11 April failed, it is believed, largely because nearly all vectors were started with CAP below the clouds (about 3500 feet) and by the time the VF got into a clear area on the radar screen not enough time remained for completion of the interception. It is also considered that two or three divisions should be stationed far enough out on the bearings of possible attack that they may be controlled positively (different ships assigned the duty of keeping VF on station by radar positionings) at all times and identified without question. A division 'over base' is too often 10 miles on the wrong side of base and the intercept officer cannot be aware of this fact if there is cloud cover, nor can he do anything about it when he discovers his predicament. Fighter direction results in this operation were discouraging to say the least. It is believed that greater success may be attained in future operations if the foregoing considerations are given greater weight."

◆

Vector on First Plot

COMCARDIV (Okinawa): "CVE Carrier Task Groups are not passing sufficient information between their Fighter Director Officers. In this operation 2096 kcs was the high frequency inter-fighter director net but often the fighter director of CTU 52.1.2 could



not reach the fighter directors of CTU 52.1.1 and CTU 52.1.3. It is true that the circuit was often heavily used by the task force fighter director and by the fast carrier groups, but to prevent repetition of interceptions it must also be constantly employed by CVE Task Groups. If that crowds the IFD circuit too much, another frequency should be assigned.

"Control is generally retained in the flagship, being passed to another carrier if they first have the track. It has worked well and there is now little difference in the quality of control in CVE's. The need for starting the interception on the first plot was illustrated by the fact that enemy planes in this area often come in under low cloud cover and are consequently within thirty miles of the formation when first picked up."

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Follow the Buoys

USS FINNEGAN (DE) (Okinawa): "During this operation, CIC has been invaluable in tracking of enemy air raids. Sometimes as many as 40 raids a day were tracked. The excellent plotting has permitted this ship to be fully cognizant of the air raid situation at all times. Common practice has been to go to general quarters at any time that a raid penetrated to within 20 miles of this ship, or at any time when heavy raids plotted to pass over our position. CIC was also especially helpful at night for maintaining sector patrol and for movements into, out of and around the transport screen. The surface search radar was constantly used for navigation, not only at night and in periods of low visibility, but when on stations where good visual bearings were difficult to obtain. Radar reflector buoys were found to be very useful when they could be located. This is particularly true when two or more were in a pattern so as to be readily identifiable. These buoys have been picked up at a maximum range of 7000 yards in a flat sea. They are, however, easily masked by a swell or choppy sea, and we have frequently passed between them without their being picked up. An experimental buoy was also located south of Kerama Retto, which gave reliable ranges of 3000 yards, despite a choppy sea. It may be of interest that during the rehearsal for the Iwo Jima operation which was conducted in the vicinity of Lahaina Roads, an object, believed to be a radar reflector buoy, gave reliable ranges up to 10,000 yards, and was of indispensable value in maintaining an accurate patrol.

◆

Train—or Else

USS SHEA (DM 30) (Okinawa):

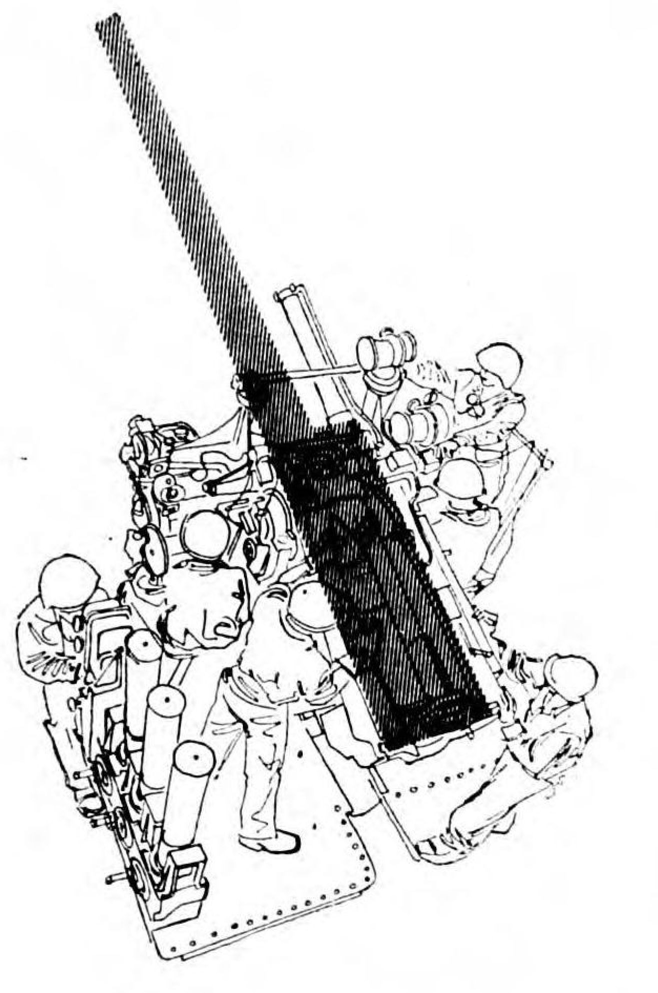
"(a) Drill CIC and Main Battery personnel to obtain rapidity at getting director 'On Target.' Use Target Designator and telephones for coaching, and remember that problem is simplified if Director has any information as to altitude.

(b) Train Radar Operators to follow targets through 'window' and over land. On one occasion Combat insisted for ten minutes that an enemy plane was in window—finally the enemy started his run out of the window.

(c) Radar Operators must be alert for peculiar IFF.

(d) Whenever possible track all planes—friendly and enemy.

(e) Emphasize and become efficient in use of Mark 22 Radar.



(f) Surface Radar Operators must be proficient in immediately recognizing planes on SG Radar. On one occasion during a sustained two and one-half hour night attack, practically all enemy planes were first detected by SG Radar.

(g) Air and Surface Radar must freely interchange information."

◆

Tracking Over Land

USS ARKANSAS (BB) (Okinawa): "Okinawa, unlike Iwo Jima, has brought the problem of tracking overland with SK radar to the fore. This vessel prefers to shift to the 20 mile scale on the 'A' scope leaving the PPI on the 75 mile scale, when tracking close in over land. This method does not disturb the PPI presentation. For a brief period as a radar guard ship on medium range search this vessel was ordered to follow the reverse of the above procedure, i.e., 'A' scope on 75 mile scale and PPI on 20 mile scale. This is considered to be impracticable and dangerous in searching and maintaining an accurate plot of the air picture.

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COMMUNICATIONS

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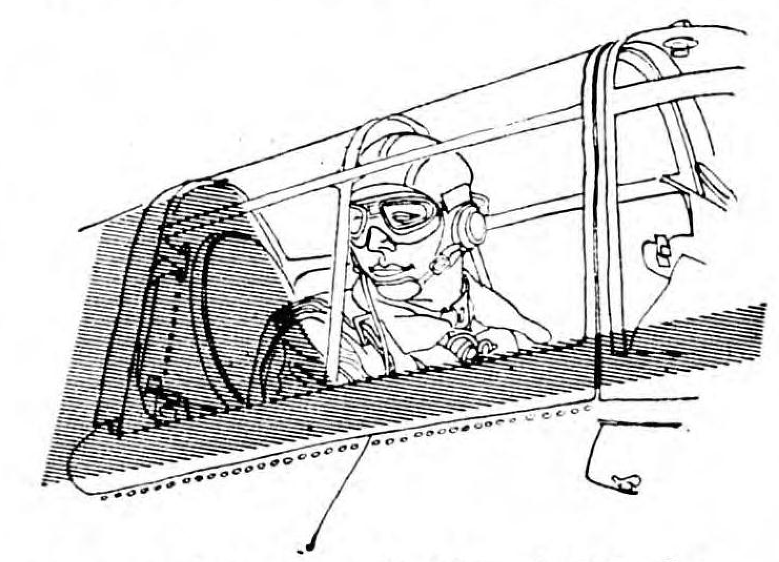
Party Line Taboo

USS HANCOCK (CV): "Aircraft VHF and Fighter Director circuits during this part of the operations were generally confused and inefficient. With an intercept being conducted on a bogey 20 miles from the group and the intercepting fighter about to make contacts, the FDO of another ship called one of its CAP divisions and asked for a radio check, thus tying up



the circuit for a valuable minute. Instances similar to this one have been occurring with increasing regularity. It is too late to tell the offender to stay off the circuit as the damage has been done. If the intercepting fighter does not receive, or is delayed in receiving a new vector, the enemy plane may get through to attack the Task Group. The pilots of the planes have also been guilty of this. Either breaking in on an important report for a radio check, or transmitting without listening, the pilots have often interrupted and delayed many contact and flash reports from communication relay planes. Indiscriminate and unnecessary transmissions are prevalent every day in which any appreciable number of aircraft are in the air. With a large number of planes airborne, the circuits are most inefficient. The solution to this problem is believed to be in the training of the pilots and CIC officers in proper communication procedure. Pilots and CIC officers should be instructed to think before they talk, say no more than is necessary, and never break in on communication circuits which are conducting urgent or emergency communications. These circuits must be cleared up. The use of Task Group frequencies for the Task Group CAP and the Task Group strike is a step along the road, but it is not quite enough. When a search plane has made a contact and planes from all the groups are sent out to attack the target all using the same frequency, measures must be taken to insure that only vital communications are maintained on this channel and that anything not pertaining to that circuit be shifted to another circuit where possible. Intercepts should not be run on a strike channel if at all possible. With all the transmissions that occur on such a channel, neither intercept nor contact report could be made with any degree of efficiency. The fighter director is having enough trouble these days without having to worry about whether or not the planes he is controlling receive the vectors and messages that he sends.

◆

Unhealthy Habits

USS VAN VALKENBURGH (DD-656), (Okinawa): "The lack of discipline on channel four caused considerable interference in getting urgent bogey reports to the support landing craft on the Roger Peter stations. This usually commenced during the midwatch when many thoughtless unofficial broadcasts were originated by what were apparently the enlisted operators of the small ships in the anchorage areas. A frequent example of these broadcasts would commence with an initial call for any one from a certain city or state. This usually brought a response, followed by an effort to establish a knowledge of mutual acquaintances and general talk about the home town or school days. The unofficial broadcasts lessened when news was broadcast during the midwatch.

"It is believed that this could be stopped completely if the necessity for discipline on this circuit was explained to the personnel of the smaller ships.

"The shackle code was frequently compromised. The following are examples of common every day occurrences:

"(a) 'Completed drinking Baker fuel shackle X-ray George unshackle' The X-ray is obviously a nine.

"(b) 'Transfer all shackle Able unshackle shackle Mike King unshackle illuminating projectiles.' Since the largest percentage of our illuminating ammunition is 5"/38 caliber, the 5, 3, and 8 had been compromised.

"(c) 'The storm will pass to the east on shackle Peter unshackle June.' Since the enemy probably, also, plots the same storm, the day is known and the number compromised.'"

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Nancy Shows the Way

USS SCRIBNER (APD) (Kume Shima): "The performance of Nan communications between ships, LCVP, and beachhead was of great assistance and naturally speeded up the operation. Marine personnel returning from the beach reported no difficulty in locating Nan-beacons in LCVP's thus greatly facilitating the rendezvous problem. LCVP's also experienced no difficulty in locating Nan lights from ships, when they commenced their trip back to their ships. This is the most favorable experience the SCRIBNER has had with new equipment to date. Improvement in results from Nan equipment is believed to be due to increased experience with the gear, and, secondly a more sincere employment of the gear. Successful employment created confidence and reliance on the gear."

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Double Duty Transmitter

USS LITTLE (DD) (Okinawa): "Many voice transmitters are required on a destroyer and usually more than are installed. To partially alleviate this condition, the TBK transmitter was altered to transmit either CW or voice. The alteration does not affect the efficiency of this transmitter when used for its designed purpose. The output is about 150 watts, which is far superior to the TCS equipment. It is recommended that all destroyers perform this alteration. The details of the circuit, and equipment required were made the subject of a special report to ComDesRon 58."

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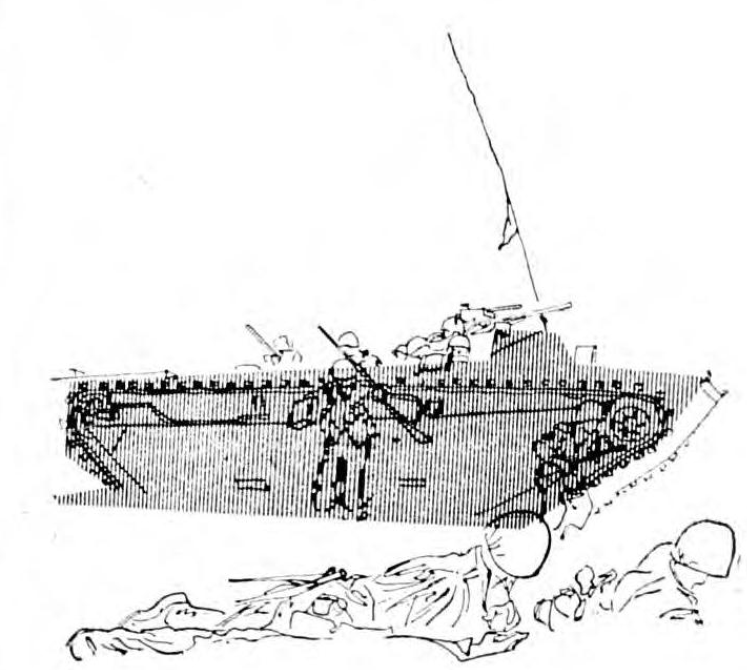

Japs Hear You 5 by 5

USS GREGORY (DD) (Okinawa): "It must be borne in mind while operating in close proximity to Japanese islands that all our voice circuits, the frequencies of which have been unchanged for months, are undoubtedly being well guarded by the Japanese. It is firmly believed that our TBS, MN, MAN, and fighter director circuits provide the Japanese with excellent tactical information.

"From the time this ship departed Okinawa until its arrival at Ulithi, a number of transmissions on MN between ships in the Okinawa area could be clearly heard. While off Okinawa, one or two transmissions on MN between ships in the Ulithi area were heard.

"It did not take the Japanese long to discover the times of departure of CAP from station to return to base, and the evening attacks on pickets usually occurred shortly after the CAP departed, with the usual preliminaries over voice radio circuits of 'I must return to base.' 'Can remain on station only thirty minutes longer,' etc."

GUNNERY

Long Range Pickups

USS SPRINGFIELD (CL) (Okinawa): "Gunnery communications were satisfactory, consisting only of sound powered communications within the ship. Consistently excellent results were obtained from the Mark 12 and Mark 22 Radars during this period. Targets were easily picked up in nearly all cases and were seldom lost once they were on the screen. No difficulty was experienced in tracking targets through window, large quantities of which were dropped in many instances. Incoming targets were usually picked up by fire control radars at ranges between 25 and 28 miles when warning was given by the air search radar in sufficient time. Radar fire control methods varied with the diffrent types of attack. In most cases partial radar control was employed. Full radar control was used in all instances of night firing, but results were not observed. In two daylight attacks, however, it was necessary to use full radar control due to the target's being obscured by clouds, and in both cases director optics were found to be dead on when the target emerged from the clouds."

RADAR COUNTERMEASURES

Jap Radars Detected

COMCRUDIV (Okinawa): "Shortly after arrival in Okinawa area and during the entire period in which ComCruDiv-4 remained in that vicinity, enemy radar signals were intercepted. As shown by WICHITA RCM Log (WICHITA Serial 001, 31 May 1945) the bearing or reciprocal from which these signals came was determined in a number of cases. Thus, the probable existence of the following radars was shown:

AGUNI SHIMA
Type CHI, Model AA.
MOTOBU PENINSULA
Mk B (Army), Mk 11.
NAHA Airport
Mk 11.
IE SHIMA
Mk 11, Type CHI.

"In addition, Mk B radar was detected in the vicinity of Machinato, Shuri, and in northern Okinawa, when these areas were still in enemy hands.

"It is believed that the radar on Aguni tracked our covering force on its nightly retirements. And, there is no doubt that the Japanese used the radars as homing beacons for their air attacks at night.

"It is suggested that once the existence and approximate geographical location of enemy radar transmitter is known, every effort should be made to pinpoint the installation and to destroy it by Naval gunfire or aerial bombardment."

Dinah Throws a Block

COMDESDIV (Okinawa): "At 0008 (I) on 15 April, at Latitude 25-13.3 N and Longitude 132-01.5 E spot jamming Japanese Type 3 air Mark VI Mod 4 for a period of 20 minutes, upon orders from CTU 58.3.2; jamming 149 Mcs with 'Dinah' using port antenna. A Japanese plane had closed to within 40 miles of formation, his radar having been detected by AN/SPR-1. Combined jamming of task group succeeded in turning plane away from task group."

Jap Trickery Evaluated

USS ELDORADO (Okinawa): "The enemy tried everything in the book to deceive our radar operators, except jamming. Violent course changes, jinking in altitude, raid splitting, dropping window, coming in very low, and at other times very high, were utilized too frequently by the enemy. However seldom did these methods fool the operators.

"Window proved to be quite a nuisance at times. Generally the SK operators spotted the plane before it began dropping window. Occasionally the operators mistakenly called in bogies for particles of window. It was dropped in very large quantities on occasions.

"The enemy did not obtain the maximum effective use of their window however, generally using it so that its position was determined by the operators prior to the enemy attempting to utilize it for deception. Enemy timing was poor, attacking planes coming in too long after the window was dropped and after it had been identified as such and plotted.

"A common practice of the enemy was to close to 10 miles or closer then open distance sowing window. After opening to about 20 miles the bandit would turn in again attempting to hide in its own window.

"During the Okinawa operation, the ELDORADO was assigned overall RCM intercept guard. In addition, as RCM control ship, all enemy signals reported to the RCM Control Officer were evaluated by RCM and when jamming was ordered by the OTC, the jamming signal was monitored by this ship.

"Between 1 April and 18 May, the following shore-based enemy radar signals were intercepted by this ship; Mk 13, 158/550/7; Mk B, 100/700-750/13-30; Mk 11, 92-95/300-350/30-40; Mk CHI, 69-75/400-450/40-60. The Mk 13 was not intercepted after the L-Day pre-invasion bombardment. The Mk B was intercepted intermittently with varying pulse widths until 12 April after which it was no longer intercepted. The Mk 11 was intercepted intermittently throughout the operation, most frequently at night. Although the Mk CHI was observed at one time to operate satisfactorily while changing frequency between 69 and 75 Mc, this radar was kept accurately centered on one of our TBS frequencies, indicating that the enemy was more interested in jamming our TBS than getting interference-free radar reception: the Mk CHI was at most only a nuisance to TBS reception.

"Enemy airborne radar has been scarce, due, perhaps, to the fact that enemy planes had little difficulty finding their target area by simple navigation. On 3 April during an air raid a signal with the characteristics 210/1000/17.5 was intercepted and believed to be the ASV type radar described in CinCPac's dispatch of 122332; by plotting all eight raids in the vicinity at the time and comparing times of maximum signal strength of the enemy radar, it was possible to determine the probable raid using the radar. During an air raid on 6 April similar air-borne radar was detected with the characteristics 200/1000/16. On 11 May, during an air raid, the Japanese Mk VI was intercepted with the characteristics 149/900-1000/10. Although other signals were reported in the general range of Japanese airborne radar, the above are the only ones which were evaluated by this ship to be positively of Japanese origin.

"During the operation on several occasions IFF transpondors were intercepted transmitting continuously and in an erratic manner in a sweep from 157 to 187 Mc; this was believed to be faulty operation of the transpondors caused by over-sensitivity of their receiver tubes. With no low frequency direction finders, this ship could get no bearings on the signals.

"Although several suicide boat attacks were attempted on the transport area during the operation, no enemy radar was intercepted during these attacks.

"Although fighter directors believed that Japanese planes were somehow warned of the approach of night fighters, there was no radar intercept evidence of Japanese use of the radar tail warning device. It is firmly believed that any warning device in Japanese planes is of the radar intercept receiver type, tuned possibly to transpondor frequencies, with directional antennas in the tails of the planes.

"The following recommendations are submitted in view of recent Okinawa experiences:

"(a) The Army Signal Corps should furnish the OTC prior to each amphibious operation with a complete list of all radars and their characteristics which are to be landed during the operation. Considerable confusion was caused by the fact that Army radars on Okinawa were similar to Japanese radars in all characteristics. Complete information on this subject was not available to this ship until two weeks after L Day.

"(b) A radar direction finder for the range of from 90 to 300 Mc should be installed on this ship. It is impossible to locate Japanese radars, most of which are in the 90 to 300 Mc band, with the type CAGA direction finder now installed in this ship."

RADAR PERFORMANCE

Orchids and Onions

COMBATDIV (Okinawa): "Excessive radar ranges caused by 'trapping' were reported by INDIANA on 14 and 17 May, when the SK Radar picked up land at 368 miles, and a single plane at 135 miles. PITTSBURGH picked up land on the SK on 17 May at 370 miles, while her BM IFF reached out 250 miles. A much debated problem in this Task Unit is the value of the VG PPI. VICKSBURG reported it indispensable for both air and surface plotting, but ALABAMA has had little success in using it as an air plot. The value of the VG as a surface summary plot is already well established. The general feeling concerning its use in air work has been that although it has some value as an air summary plot, it is inferior to the VC PPI equipped with a twelve-inch scope for fighter direction. In view of this controversy, the strong support given the VG by QUINCY is quite interesting. QUINCY is satisfied with the VG for both air and surface plotting and has used it with success to designate targets within limiting safety bearings during night torpedo plane attack. The QUINCY's ability to perceive AA patterns on the VG is noteworthy.

"New radars in the Task Group include the Mark 13 fire-control radar, reported by the ALABAMA as superior to the Mark 8; the SR, which has not yet measured up to the SK and for which replacement tubes are scarcer than the scarce standard types; the SG1b and the SG1c, as yet unassessed."

Evaluations

USS MANILA BAY (CVE) (Okinawa):

"When operating with a large group of planes airborne, over a wide area, the non-directional antenna attached to the BM Interrogator proved very ineffective for recognition purposes. The directional antenna of the BO was then substituted, operating off the BM and excellent results were obtained on air IFF indicators to a range of forty miles. It is believed that a directional antenna especially built for the BM Interrogator will lengthen the range considerably and will perform very efficiently.

"The performance of the SC radar was very disappointing but may be attributed somewhat to the fact that CIC personnel were accustomed to the long range pick-up obtained with the SK, and expected similar results from the SC. It was generally observed that unless the SP picked up a target itself, it was almost always coached on by reports of other ships which possessed SK radar.

"Results obtained with the VG/VG1 equipment was better than expected and improved as the CIC personnel became more familiar with its operation."

Ghost Gives Trouble

USS BATAAN (CVL 29): "During the period covered by this action report all radar sets of the BATAAN performed in a normal manner. On 25 March the SP radar first picked up a target that proved to be a puzzle and a hazard during the entire Okinawa support period. This target could be differentiated from an aircraft showing no IFF only by the fact that it tracked with a variable speed. The speed ranged from 20 to 70 knots. Having once become accustomed to seeing the now famous 'Ghost of Nansei Shoto' the BATAAN radar operators found it little trouble except when it appeared suddenly close in, especially when the Task Group was under attack.

"On 18 and 19 May phenomenal ranges were possible on all radar sets. The SK had land 250 miles away. The SP plainly showed TG 50.1 95 miles south. The BATAAN aerology officer reported a marked inversion at about 15,000 feet during this same period. This weather condition is considered the probable cause of the unusual ranges."

Maintenance Pays Dividends

USS WALKER (DD) (Okinawa): "The performance of the newly installed Mark 12 Radar equipment exceeded all expectations. It required constant tuning and adjustment and the technician's watch established for that purpose adequately handled this requirement. Little trouble was experienced in picking up targets from CIC information although when bogies and friendlies were close together differentiation was difficult. It is recommended that IFF equipment be included in

Mark 12 Radar installations as soon as possible.

"The Mark 22 Radar equipment was disappointing. When it worked it was very accurate but it was seldom operating properly when it was needed. Much of this is believed due to the unfamiliarity of personnel concerned with proper methods of maintenance and adjustment. Adjustment of the Receiver-Transmitter unit was difficult due to its position in the weather. During the last weeks of the operation, its performance has improved and personnel involved are able to tune it properly. The future should bring a more favorable report on the Mark 22 Radar.

"During the period covered by this report, the ship's search radars were maintained at a high level of operating efficiency. There were no major material or maintenance difficulties encountered. *This is thought to be due principally to the fact that the ship, for the first time since it was placed in commission, has had a sufficient number of technically trained personnel to permit the standing of a technician's condition watch with the technicians having no duties other than the maintenance of radar, sonar and radio equipment.* We have been enabled to institute and maintain a program of preventive maintenance which has paid dividends in continuous operation with a minimum of interruptions by material breakdown.

"The SG—a radar has been kept in operation 24 hours a day except for short periods when it has been secured for routine preventive maintenance. The greatest single aid to detection and early correction of incipient troubles has been the OBU-3 Echo-Box which was installed by the Navy Yard, Mare Island in January 1945. Use of the echo-box has clearly demonstrated that the radar's operating efficiency cannot be accurately determined by viewing the oscilloscopes or noting maximum ranges obtained on various targets. External factors such as weather sometimes cut down the ranges which can be obtained even though the radar is at the peak of its efficiency."

electronic releases

CNO (Op-25-3) is the Navy Department coordinating agency for the distribution of the Commander in Chief, U. S. Pacific Fleet, electronic releases to activities not in the Pacific Ocean Area or Southwest Pacific Area. All requests for copies of CinPac's electronic releases (included among others are the CMandD bulletins for RCM publications) should be addressed to CNO (Op-25-3).

correction

On the maps illustrating "Trapping in Empire Waters" p. 40-41, August "C.I.C.", two lines mentioned in the text were inadvertently omitted. The line RS, Zone C', referred to in the text, runs from Cape Hatteras to Portland, Maine. The equivalent line XY, Zone C, runs from Shanghai to Vladivostok.

be careful

That attention of all training activities that conduct or participate in Window demonstrations and exercises is drawn to the fact that Window, and particularly Rope, falling overland may come in contact with high tension electric cables causing power failures and possible danger to life. Activities using Window and Rope for training purposes should give due consideration to the direction and force of the wind at the time of the drop to assure that the material falls in the water and does not drift over the land when there is danger of coming in contact with high tension wires.

☆ U. S. Government Printing Office: 1945