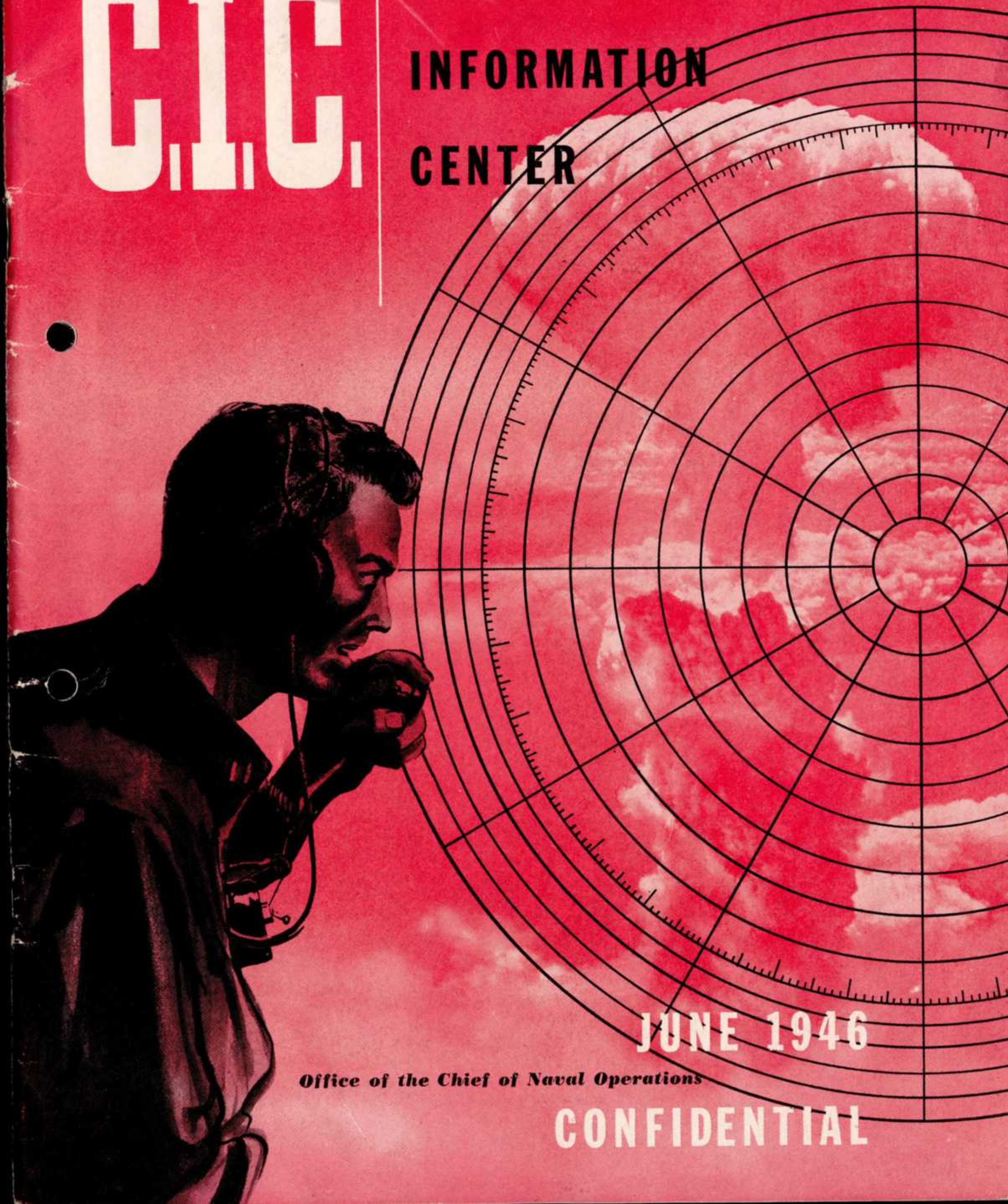
Declass, Declass in Full, March 1998, Per OPNAVIST 5513 16-02

C.I.C.

COMBAT INFORMATION CENTER



JUNE 1946

Office of the Chief of Naval Operations

CONFIDENTIAL

C.I.C.

the tactical use and operation of electronic and associated equipment.

VOL. III, NO. 6 JUNE 1946

■ *Published monthly by the Chief of Naval Operations (CNC) for the information of Military personnel whose duties are connected with the tactical and operational aspects of electronic equipment.*

■ *Include this publication with other confidential material which is to receive emergency destruction in the event of possible loss or capture. "C. I. C." shall not be carried for use in aircraft.*

■ *Material and photographs for publication in "C. I. C." should be submitted to Chief of Naval Operations, Editor of "C. I. C.", Washington 25, D. C. (Navy Department Telephone Extensions: 63334 and 62779.)*

United States

CONFIDENTIAL

British

■ *This document contains information affecting the national defense of the United States within the meaning of the Espionage Act, 50 U. S. C., 31 and 32 as amended. Its transmission or the revelation of its contents in any manner to an unauthorized person is prohibited by law.*

Editorial Office: CNC (OP—20—F—4)

Art and Layout: EXOS (Publications)

Declass, Declass in Full, March 1998, Per OPNAVIST 5513 16-02

Declass, Declass in Full, March 1998, Per OPNAVIST 5513 16-02

WANTED: 15,000 EXPERTS

EVERYWHERE in the Navy today you will find people scratching their heads over the lack of personnel, and scraping the bottom of the barrel to locate an officer or man to do a job that, a short while ago, was done by not one but several *experienced* people. Observing the situation and hearing the comments from many sources, we decided to round up a few figures (some call them statistics) on the subject of electronics personnel, and present them in an impartial manner for the information of the officers and men of the Navy.

It must be realized that some of what you will read here is based on estimates that might better be called mediocre guesses, but the figures and the pictures do show the trend and they do emphasize a grave problem. As we see it, that problem is to train men in a big hurry to keep our active fleet and aircraft—about one-quarter of what we had in operation a year ago—in running condition with some degree of efficiency.

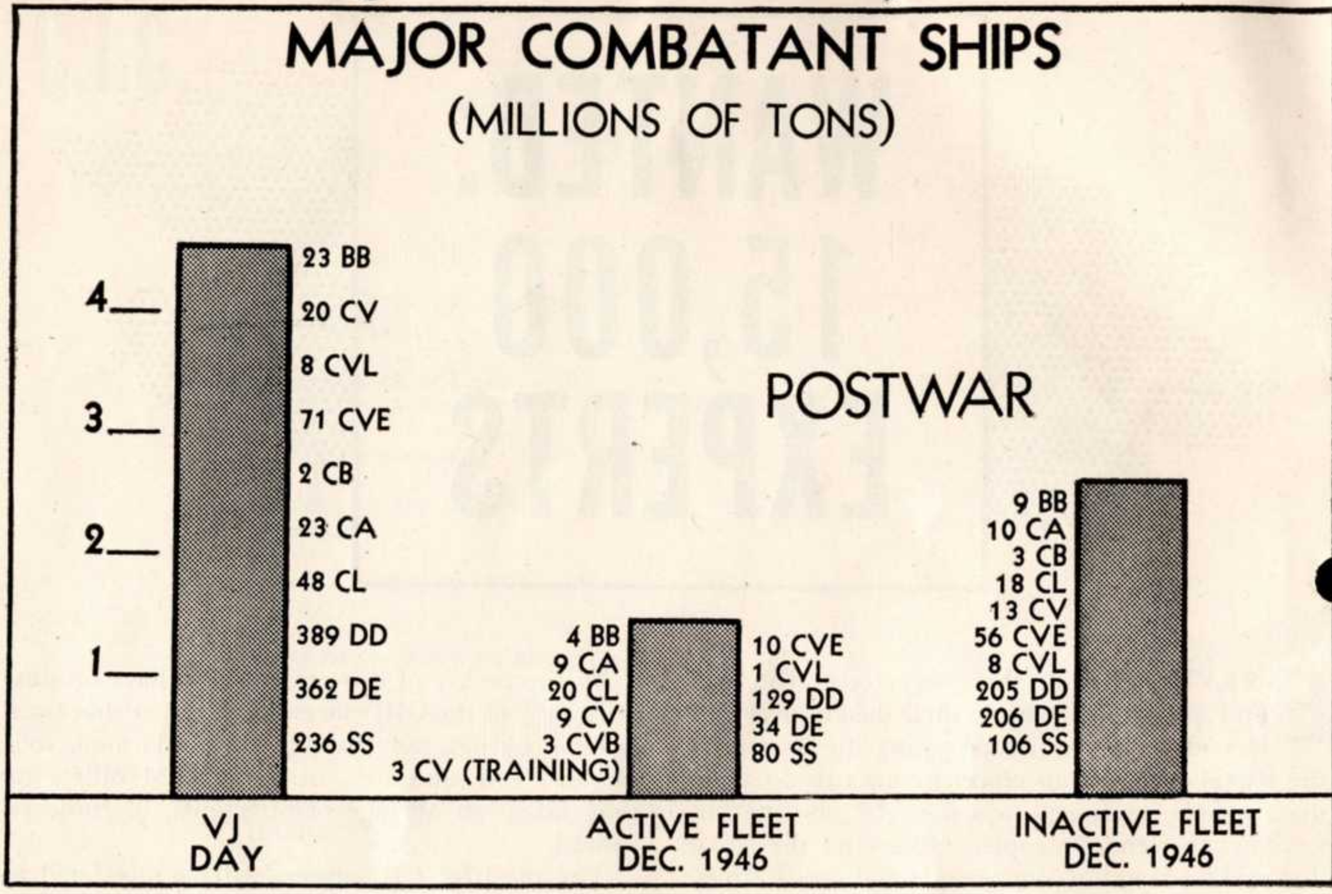
The basic factor, of course, is initial procurement. About this, the majority of us can do nothing. Although in this article we are primarily concerned with CIC and electronics personnel, the overall problem of procurement of personnel must be visualized.

There are billets right now for 750 CIC officers, 9,487 ETM's and AETM's, and 4,442 Radarmen. It is logical to suppose also that we will need a good many electronics officers—commissioned and warrant—but there are no requirements set up for these at this time although training of technical officers is proceeding through 1947.

By September of this year we will have on duty only 23% of the CIC officers required at that time. For the ratings, only 35% of the Radarmen, 10% of the ETM, and 26% of the AETM billets are now filled—an average of only 26% of those required.

The need for CIC officers will be alleviated by the continuance of St. Simons as a CIC officers training school (See "C.I.C." Vol. III, No. 5, p. 49). In addition, training at Oahu, T. H., San Diego, California, and Boston, Massachusetts, will aid in taking up the slack created by the rapid discharge of CIC officers. Of some 4000 CIC officers on V-J Day, only 58 were regular Navy. On 15 May 1946, 117 reserve CIC officers had requested transfer to the regular Navy. The Fleet has, now, a "deficit" of 575 CIC officers—77% of the billets to be filled. The ultimate aim, of course, is to have every junior line officer a qualified CIC watch officer (includes fighter direction) capable of both OOD and CIC duty by the time he is promoted to lieutenant, junior grade.

It is planned to have no commissioned electronics officers on regular duty afloat. The electronics maintenance duties, both in ships and aircraft, which during the war were the responsibility of the specialized reserve officer, will be assumed by appropriate warrant officers. The theory that every line officer will eventually succeed to command is incongruous with the war-time specialization of some of these officers in electronics maintenance. The exact requirement for warrant electronics officers for the Navy is not known. But it is assumed, because of the ever increasing quantity of



electronic equipment and the recent establishment of this policy (7 January 1946), that qualified men to fill these billets will be very scarce.

Radarmen, who actually operate radar sets, will be represented in the peacetime Navy by one-fifth the number present on V-J Day. Now on board are about one-third of the number ultimately required.

Sonar rates are in the best condition, so far as supply and demand are concerned, with more men on board as of 1 April than will be actually required for fleet operation.

The greatest need is for Electronic Technician's Mates—ETM's and AETM's. Less than one-fifth of these technical billets are filled. It is believed that ETM and AETM quotas of 400 recruits per month and 200 fleet men per month will be required to bring the Navy up to complement by the summer of 1949—three years from today. The reasons for the critical shortage in these rates are, in the main, two. First, the long course of 48 weeks[1] will take men from the fleet at a time when they are sorely needed to keep active ships going. Second, the attrition in these technical schools is very high. Recruit attrition is about 10% of the input, and fleet attrition about four times as great. This is due partly to lack of motivation and loss of study habits among the fleet men. Furthermore the directives to replace all electronic equipment in the fleet every five years will require further re-training plans for which BuPers is considering.

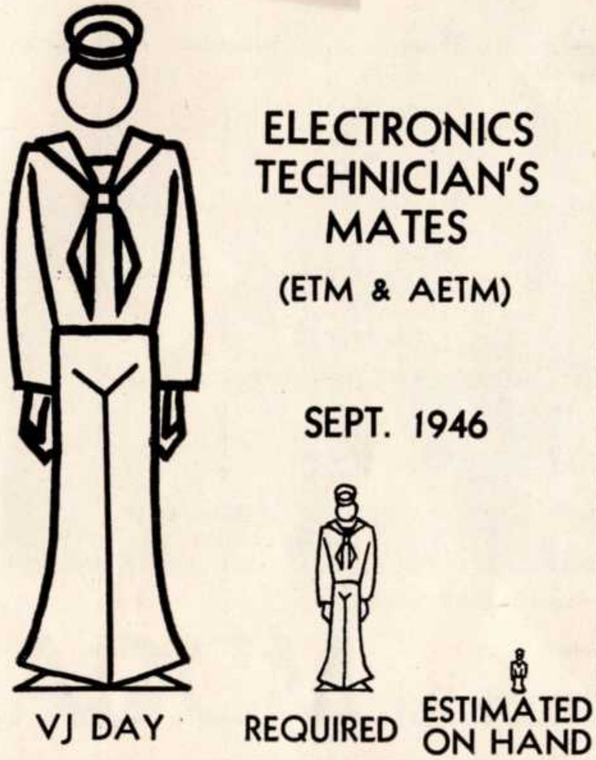
Some ships and activities are going to accept the challenge, train their officers and men and operate efficiently in spite of the predictions that it will be two to four years before we have enough well-trained men to call our complements adequately filled. Outside of personnel procurement, shipboard training will do more to solve this problem than anything else. And commanding officers can assist greatly by sending the *right* men back to school, thereby cutting the fleet attrition rate down to a sensible figure. The result of such a measure may not be apparent to the individual ship for a year or more, but it will decrease the "reconversion" time of *all* the ships by perhaps a full year.

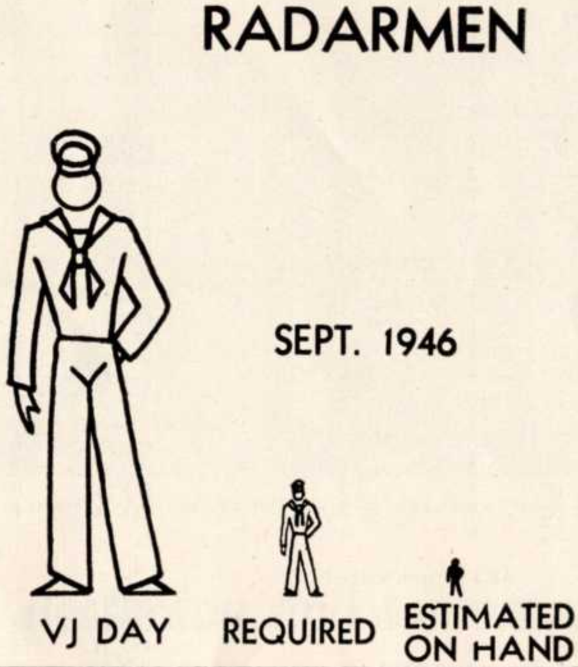
1 Presently being revised downward.

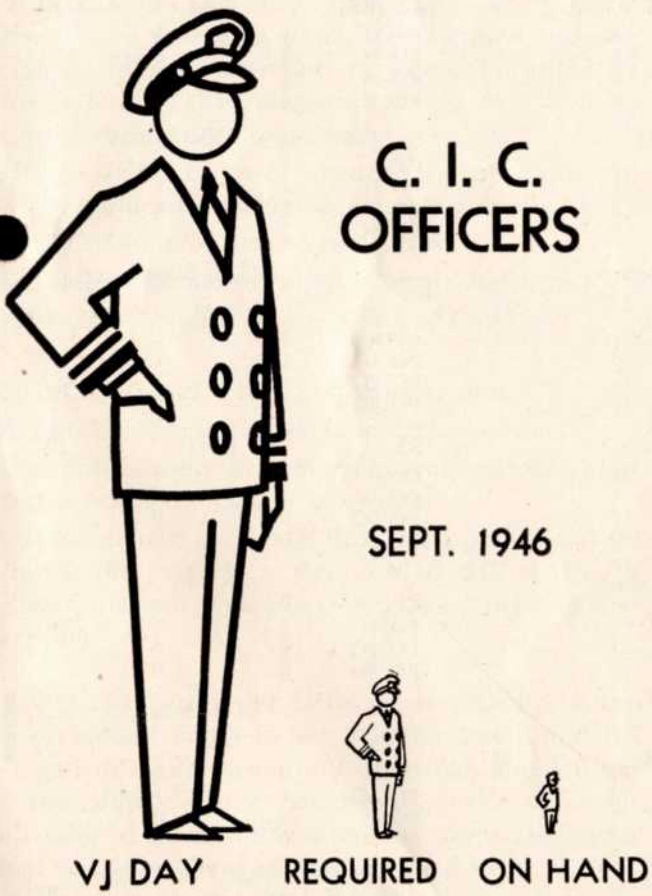
(See page 4 for a summary of electronics personnel allowances by types)

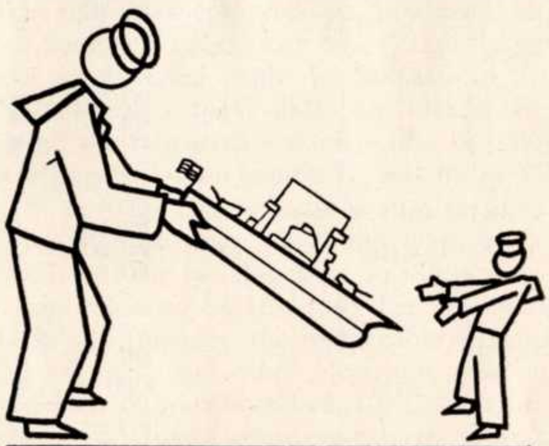
Declass, Declass in Full, March 1998, Per OPNAVIST 5513 16-02

Declass, Declass in Full, March 1998, Per OPNAVIST 5513 16-02









THE PEACETIME COMPLEMENT OF AN ACTIVE SHIP WILL BE, IN ROUND FIGURES, BUT 70%* OF THE WARTIME COMPLEMENT. THIS IS COMPLEMENT, ***NOT*** ALLOWANCE, SO WE WILL FIND OURSELVES WITH VERY FEW EXPERIENCED MEN FOR MANY JOBS ABOARD. PART ANSWER OF COURSE; GOOD SHIPBOARD TRAINING.

*(*Average of all ships—some will be 55%, others more than 70%)*

TYPICAL SHIP'S ALLOWANCES BY TYPES OF RADARMEN, ETM'S, AETM'S, AND SoM (SONARMEN)

BB

	WAR TIME	POST WAR	% WAR TIME
RdM			62
CPO	1	1	
PO 1C	4	3	
PO 2C	10	6	
PO 3C	16	10	
ETM			
CPO	3	1	
PO 1C	4	3	
PO 2C	7	4	
PO 3C	9	5	

AETM and SoM—None

CA

	WAR TIME	POST WAR	% WAR TIME
RdM			55
CPO	1	1	
PO 1C	4	3	
PO 2C	8	5	
PO 3C	12	8	
ETM			
CPO	3	1	
PO 1C	4	3	
PO 2C	7	3	
PO 3C	9	4	

AETM and SoM—None

CL

	WAR TIME	POST WAR	% WAR TIME
RdM			55
CPO	1	1	
PO 1C	4	3	
PO 2C	8	5	
PO 3C	12	8	
ETM			
CPO	3	1	
PO 1C	4	3	
PO 2C	7	3	
PO 3C	9	4	

AETM and SoM—None

CV

	WAR TIME	POST WAR	% WAR TIME
RdM			62
CPO	3	1	
PO 1C	7	3	
PO 2C	11	7	
PO 3C	15	12	
ETM			
CPO	2	2	
PO 1C	5	4	
PO 2C	8	5	
PO 3C	10	6	
AETM			
CPO	2	1	
PO 1C	3	2	
PO 2C	5	3	
PO 3C	6	5	

SoM—None

CVB

	WAR TIME	POST WAR	% WAR TIME
RdM			81
CPO	3	2	
PO 1C	7	4	
PO 2C	11	8	
PO 3C	15	12	
ETM			
CPO	2	2	
PO 1C	5	5	
PO 2C	8	8	
PO 3C	10	10	
AETM			
CPO	2	1	
PO 1C	4	3	
PO 2C	6	5	
PO 3C	8	5	

SoM—None

CVE

	WAR TIME	POST WAR	% WAR TIME
RdM			46
CPO	1	1	
PO 1C	3	2	
PO 2C	4	4	
PO 3C	6	6	
ETM			
CPO	1	0	
PO 1C	2	1	
PO 2C	3	2	
PO 3C	5	2	
AETM			
CPO	0	1	
PO 1C	1	1	
PO 2C	0	2	
PO 3C	1	2	

SoM—None

CVL

	WAR TIME	POST WAR	% WAR TIME
RdM			55
CPO	2	1	
PO 1C	5	2	
PO 2C	7	3	
PO 3C	10	5	
ETM			
CPO	2	1	
PO 1C	4	2	
PO 2C	6	2	
PO 3C	9	3	
AETM			
CPO	1	1	
PO 1C	2	1	
PO 2C	2	2	
PO 3C	3	2	

SoM—None

DD

	WAR TIME	POST WAR	% WAR TIME
RdM			70
CPO	1	1	
PO 1C	1	2	
PO 2C	2	3	
PO 3C	4	3	
ETM			
CPO	1	1	
PO 1C	1	1	
PO 2C	1	0	
PO 3C	2	1	
AETM—None			
SoM			
CPO	1	1	
PO 1C	1	0	
PO 2C	1	1	
PO 3C	3	1	

DD (RP)[1]

	WAR TIME	POST WAR	% WAR TIME
RdM			67
CPO	1	1	
PO 1C	2	2	
PO 2C	4	3	
PO 3C	7	6	
ETM			
CPO	1	1	
PO 1C	1	1	
PO 2C	2	1	
PO 3C	2	1	
AETM—None			
SoM			
CPO	1	0	
PO 1C	1	1	
PO 2C	1	1	
PO 3C	3	1	

DE

	WAR TIME	POST WAR	% WAR TIME
RdM			83
CPO	1	1	
PO 1C	1	1	
PO 2C	1	2	
PO 3C	3	2	
ETM			
CPO	0	0	
PO 1C	1	1	
PO 2C	2	1	
PO 3C	1	1	
AETM—None			
SoM			
CPO	1	1	
PO 1C	1	0	
PO 2C	1	1	
PO 3C	3	1	

DE (RP)[1]

	WAR TIME	POST WAR	% WAR TIME
RdM			69
CPO	1	1	
PO 1C	2	2	
PO 2C	4	3	
PO 3C	6	4	
ETM			
CPO	1	1	
PO 1C	1	1	
PO 2C	1	1	
PO 3C	2	1	
AETM—None			
SoM			
CPO	1	0	
PO 1C	1	1	
PO 2C	1	1	
PO 3C	3	1	

SS

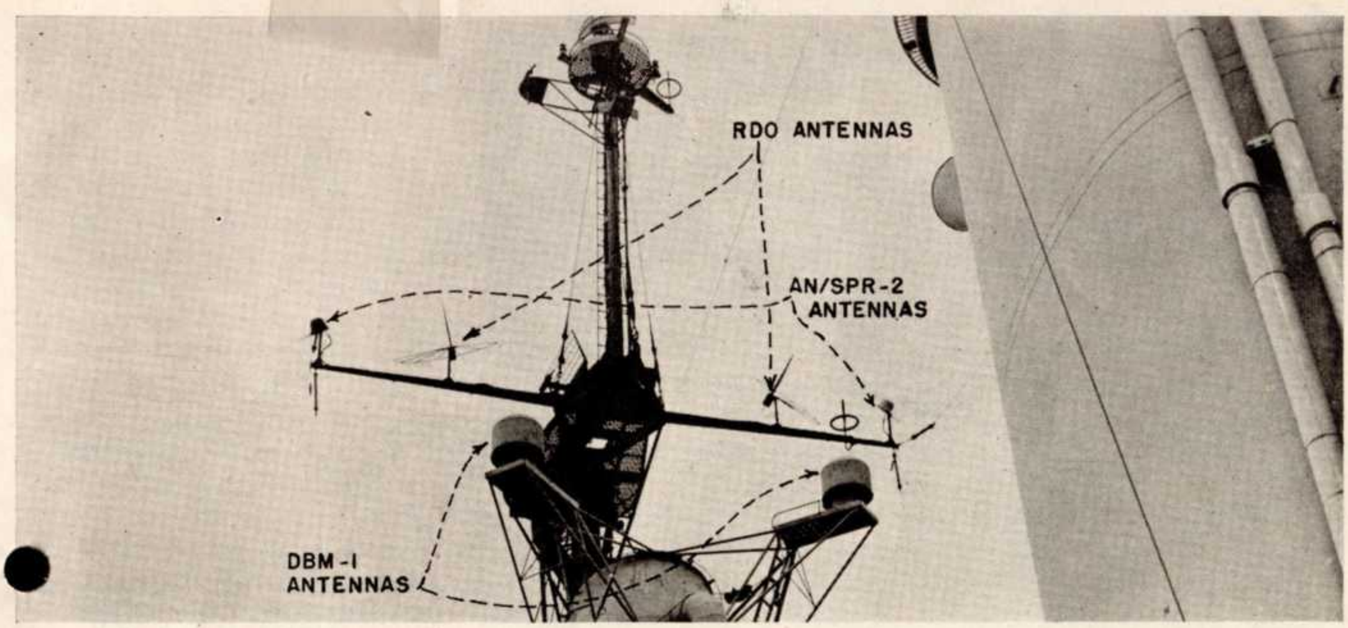
	WAR TIME	POST WAR	% WAR TIME
RdM			100
CPO	0	0	
PO 1C	1	1	
PO 2C	0	0	
PO 3C	0	0	
ETM			
CPO	0	0	
PO 1C	2	2	
PO 2C	0	0	
PO 3C	0	0	
AETM—None			
SoM			
CPO	0	0	
PO 1C	1	1	
PO 2C	0	0	
PO 3C	0	0	

Average Percentage Peace Time of War Time: 67

1 Radar Picket.

Declass, Declass in Full, March 1998, Per OPNAVIST 5513 16-02

Declass, Declass in Full, March 1998, Per OPNAVIST 5513 16-02



These RADCM search antennas intercept the enemy's tell-tale radar and radio emissions.

RADCM *interception yesterday and tomorrow*

Electronics countermeasures encompasses the entire frequency spectrum and many types of operations. The extent to which it has grown and specialized under the impact of war is indicated by the following abbreviations adopted by the Joint Countermeasures Committee:

RCM—Radio Countermeasures (covering the entire field and including all that follow):

RADCM—Radar Countermeasures;

COMCM—Communication Countermeasures;

ROCCM—Guided Missile Control Countermeasures;

SONCM—Sonar Countermeasures; and

NAVCM—Navigational Countermeasures.

Equipments may be either electronic or non-electronic (as in the case of window).

This article on RADCM Search and Interception is the first of a series. Others will deal with Electronic and Non-Electronic Jamming and Deception.

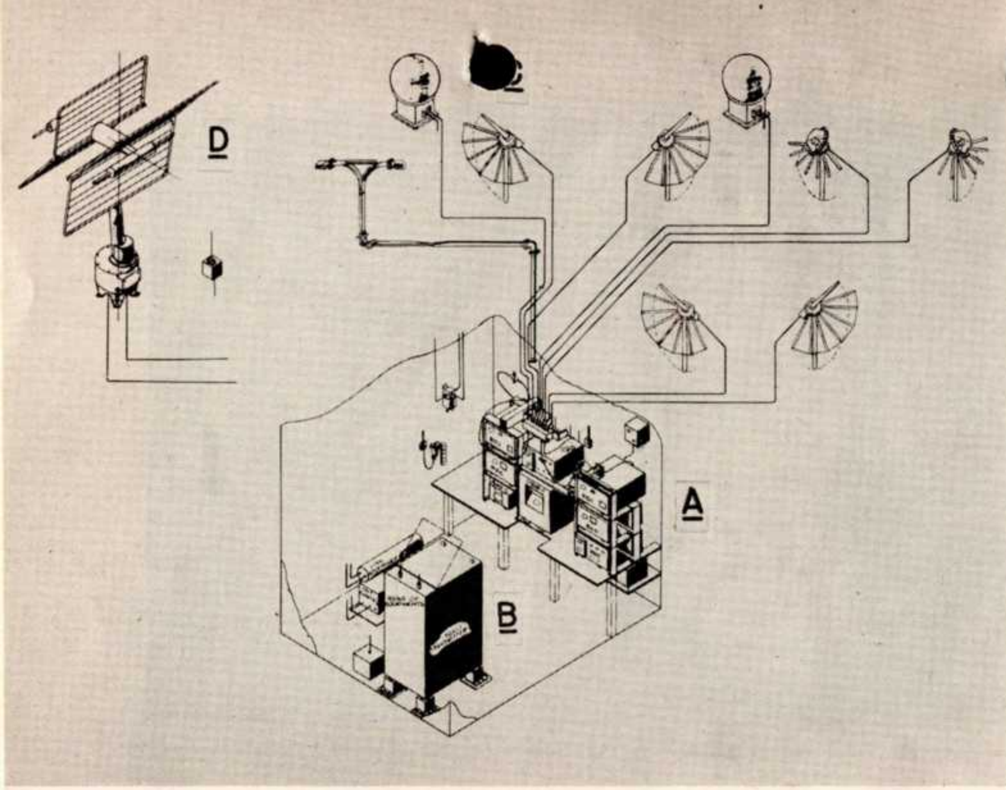
IN August 1943 the Germans unveiled a radio-controlled bomb in the Mediterranean and began to take a heavy toll of British and United States ships. After August 1944 the Germans abandoned use of the bombs. Our countermeasures had rendered them completely ineffective.

The key to our success was a pair of special search and intercept receivers produced by the Naval Research Laboratory by a "crash" program. These were rushed to the Mediterranean by two DE's in October 1943, and soon intercepted and revealed the frequencies used by the Germans in controlling the radio-bombs. It was by no means easy to develop jammers and tactics to repel the German bombs, once the frequencies were discovered; but the job was done, so thoroughly that the Japs made no effort to use this weapon.

As in this incident, the remarkable accomplishments of radar and other electronic weapons in World War II were matched, time and again, by the achievements of countermeasures equipments and tactics. The same process worked for the enemy, of course. Indeed, the Japs brought their countermeasures to a higher stage of development than their radars, and towards the end of the war were utilizing their search receivers in preference to their radars in spotting our radars and homing on our ships.

DEFENSIVE AND OFFENSIVE OPERATIONS

There are two phases in the employment of radar countermeasures, the defensive and the offensive. In the first phase, the RDO or AN/SPR-2 intercept receivers (which basically are simply radio receivers) are used to search for enemy signals and to intercept them. Once a signal has been



Search antennas (C) feed intercepted signals into receivers, pulse analyzers, and direction finders (A) in the RADCM space. (B) is the TDY-1 jamming transmitter, and (D) its antenna.

intercepted, the RDJ pulse analyzer, DBM-1 direction finder, and RDP panoramic adaptor can be used to determine the frequency employed by the enemy, the location of the enemy station, and the type of system being employed (air search radar, fire control radar, etc.).[2]

When we begin to make tactical use of the information gained to attack or mislead the enemy, we are in the second phase of countermeasures operations—the offensive. The primary object of offensive countermeasures equipments and tactics is to prevent the enemy from making profitable use of his electronic systems. This may be accomplished in three ways: One, by jamming the enemy's radar, radio, VT fuze, guided missiles, etc.; two, by homing on enemy radars, radios, or jammers; three, by deception (use of window or other false targets, use of jammers for decoy purposes, etc.).

CIC EXERCISES RADCM CONTROL

In the early days of the war, RADCM equipments were used primarily to locate enemy radars, to analyze enemy emissions for use in developing our jammers, direction finders, and deception devices, and for tactical use by planes and ships in approaching enemy areas without detection. There was no unified RADCM program or organization. But by the summer of 1944, a program was underway to standardize shipboard and airborne equipments, to make fleetwise RADCM installations, and to train the personnel to operate them. RADCM had reached a place of prominence among electronic weapons by the end of 1944, and the fact was signalized by its being fitted into shipboard organization. Responsibility for control of RADCM operations was logically delegated to CIC, by CentComTwo, Annex B, CTF Instructions and Part Six in Change 4 to USF-10A. RADSEVEN, "The Radar Countermeasures Manual," was soon to be published.

FLOW OF INFORMATION

The interception of enemy radar signals is one of the chief duties of the RADCM operator. He analyzes the intercepted signal as to its frequency, pulse characteristics, direction and its probable use (early warning, fire control, airborne search radar, etc.), and passes this information immediately to CIC by sound-power phone.[3] In CIC, this may be the first contact information received on the target, or it may confirm other information obtained from radars or other ships or planes. In the former case, the information becomes valuable in assisting our own radars in locating the target,

[2] The equipments mentioned constitute a typical shipborne Intercept System. A TDY-1 jamming transmitter completes the RADCM installation. Some units used in interim installations were really airborne equipments adopted during the war because of lack of sufficient development and production of shipboard equipments. In the field of Aeronautics, there is an aggressive RADCM program also, as will be indicated in this article, though the emphasis here is on the shipborne RADCM program.

[3] "CIC Takes on RCM," May 1945 "C.I.C.", Vol. II, No. 5, page 1, outlines the responsibilities of the CIC Evaluator and tactics to be employed in controlling RADCM.

Declass, Declass in Full, March 1998, Per OPNAVIST 5513 16-02

Declass, Declass in Full, March 1998, Per OPNAVIST 5513 16-02

by coaching them to search at the proper range and bearing. The CIC Evaluator may decide to use the target radar signal as an additional source of information for our own forces, or he may decide to jam it, thereby blinding the enemy's radars and screening our own ships. In either case, the work of the intercept operator is important, as it is necessary to keep the enemy signal monitored to observe the enemy's actions or to assure that the jamming signal is kept on frequency.

Combat experience has underlined many times the great value of RADCM intercept contacts. These contacts often out-ranged search radars. USS *South Dakota* reported that their intercept sets located radar-equipped enemy targets two to twelve minutes sooner than the air search radars, determined bearing with an accuracy of plus or minus ten degrees down to zero, and surpassed the detection range of air search radars (maximum about 100 miles) by tracking radar-equipped targets out to 130 to 140 miles. On many occasions, such information contributed to the destruction of the enemy planes and ships. "CIC-RADCM co-operation . . . proves that the enemy may be found and destroyed by his own use of radar."[4]

Lest any commander decided to throw overboard his search radars, however, it should be pointed out that (1) it is natural to pick up radar *emissions* at greater ranges than a mere echo from a lump of metal, and (2) results from search radars will vary with the degree of operating efficiency.

ACTION REPORTS CITE MANY BENEFITS

RADCM search and intercept provided a wide variety of services to the fleet. "Task Force 54," says one report, "was under enemy aircraft torpedo attack. Upon interception of a radar signal of 157 megacycles, barrage jamming of the 150-160 megacycle band was ordered. Enemy planes remained in the area for about 30 minutes before retiring, but further attacks were not made." Aircraft, too, gained protection from RADCM. Commander Night Carrier Air Group NINETY reported, "During one flight over Kanoya airfield on Kyushu it was found that a 155 Mc. signal appeared on the RCM receiver just before the searchlights came on. The pilot permitted the lights to track until nearly on the plane before requesting jamming. In each case, as soon as jamming commenced, the tracking which had been well controlled became very inaccurate. The searchlight beams went wild and after a few seconds the searchlights were turned off and simultaneously the radar signal disappeared."

RADCM intercept spotted new enemy equipments, enabling the fleet to be forewarned against their use: "*Washington* and *The Sullivans* picked up the first new Jap radar signals at a frequency of 205-215 Mc. during a night raid on the 14-15th of April (1945). It is believed that this is the first time that this new Jap radar has been positively identified as being in use. . . . If the enemy continues to develop and use this frequency band it may have far reaching effects on the use of our air search radars during low visibilities. . . . It will be necessary for the CTG to be informed of all SC and SK frequencies in use by his ships in order to facilitate spot jamming this Jap radar without 100% loss of use of our own air search." Intercept also revealed Jap tactics: "This attack indicates that the radar (Jap Air Mark 6, Type 4, Modification 4) is used only intermittently to secure a bearing. This may be to prevent disclosure of the new frequency."

Commanding Officer, Patrol Bombing Squadron 100 declared, "RADCM gear, which was in all planes, was used to excellent tactical advantage as well as for information. The Privateers pioneered in Korea and Tsushima Strait and detected and located hundreds of radar positions. Antennas were pinpointed by the usual visual method to corroborate readings. . . . Normally, destroyers and escorts would be a constant threat in foul weather or concealed in deep coves, but the countermeasures gear acted as an early warning. . . . The equipment is worth its weight in gold."

INTELLIGENCE OF THE ENEMY

RADCM intercept reports, plus information from other sources, enabled CincPac to maintain a continual survey of the Japanese electronic situation with particular reference to Japanese radar locations, radar and operational efficiency, and tactical employment of electronics. The CincPac publication, "Japanese Shorebased Radar Locations," was invaluable to surface forces, aircraft, and submarines in planning operations and identifying Jap radars. Major fleet commands were kept informed by dispatch of all significant developments, and prior to every major operation were sent a list of enemy radar locations so that these could be destroyed or deceived.[5]

---

[4] "CIC RADCM Coordination Pays Dividends," October 1945 "C.I.C.", Vol. II, No. 10, page 34. The statement is substantiated by a number of incidents attested by action reports.

[5] "RADCM Intelligence Activities," October 1945 "C.I.C.", Vol. II, No. 10, page 56.

OBLIGATIONS TO THE FLEET

As long as radar remains an essential weapon, RADCM must not be neglected. Combat efficiency of the fleet requires a RADCM peacetime program which will: (1) Develop an integrated system permitting interception, signal analysis, directional determination, and jamming of any electromagnetic emission; (2) Completely train CIC and Command personnel in RADCM principles and tactical applications; and (3) Train operating personnel and technicians to operate and maintain the equipments at peak efficiency.

RADCM was a new weapon during World War II, and as such it became necessary in most instances to develop a series of equipments and rush them into use for specific tasks with little regard for the overall countermeasures job. This naturally permitted some types of equipment to reach the operating forces which were by no means desirable in all respects, but were forced into use for lack of anything better. For example, at the end of the war, we still did not have a satisfactory intercept direction finder which would cover all the frequencies desired. But now, during peacetime, new developments can be operationally tested and our research laboratories furnished with the information necessary for them to complete the development of more satisfactory equipments. This is, of course, a long term project. As progress continues in the techniques used to protect radars against direction finding and jamming, so must the development of RADCM equipment keep pace to be ready for any predictable radar development. An active peacetime RADCM program is our only means of maintaining our countermeasures supremacy—in the capacity of our equipments, efficiency of our operating personnel, and tactical skill and knowledge.

USES IN PEACETIME MANEUVERS

In addition to training CIC personnel and conducting development tests to improve equipments and tactics, there are a number of peacetime uses of RADCM equipments of value in ship and force exercises:

Early detection and identification of other fleet units and aircraft by interception of their radar signals.

Coaching radars onto units detected.

Assisting search radars in following aircraft at low altitudes and through fade zones, window, or weather clutter.

Analyzing intercepted signals in an effort to discover whether own ship has been detected by radar.

Obtaining navigational information by direction finding of known shorebased radars.

Monitoring radars of ships in company for detection of faulty operation or failure to observe current radar silence conditions.

Homing on intercepted signals such as those from submarines.

Setting jammers on frequency.

TOOL OF THE FUTURE

As any thoughtful CIC officer knows, and as every naval officer must realize, RADCM has immense potentialities. It will be one of our most significant weapons in countering the air missiles of the future, since the logical development of these missiles involves electronic guidance.

Note: *Further articles on other phases of RADCM will appear in later issues of "C.I.C."*

The scope at center reveals the enemy's direction, the receiver above picks up his beam, and units left and right disclose the type of radar he is using.

Declass, Declass in Full, March 1998, Per OPNAVIST 5513 16-02

Declass, Declass in Full, March 1998, Per OPNAVIST 5513 16-02

Naval War College is housed in three inter-connected buildings with the Naval Training Station, Newport. Physically small, its principal commodity is brainwork.

the Naval War College looks at new weapons

TIED up alongside the Naval War College at Newport, R. I., is the frigate *Constellation,* oldest warship in the world. Inside the gray stone walls of the College a portrait of bewhiskered Alfred Thayer Mahan dominates the library where he once wrote the lectures that make up his epochal *Influence of Sea Power Upon History.* In classrooms off the quiet corridors students may still study the lessons of previous wars.

But these relics of the past do not mean that the College at Newport is moribund; far from it. Brushing shoulders with textbooks on the genius of Nelson is a strange little giant called nuclear physics. In the problem rooms Army, Navy and Marine Corps officers are wrestling with the logistics of a full-scale amphibious operation, a la 1946. Not 500 yards from Mahan's portrait the Line School has in operation a life size mockup of a B-17 AEW (flying CIC) installation. Across the channel, at Beavertail, is the Navy's greatest concentration of operating radars. The War College has plans for an immense electronic maneuver board. And in the revised curriculum are lectures on many of our new weapons and what they mean to the students of command.

On 1 July of this year the War College resumes its full length course, after devoting the war period to short hurry-up courses for officers who had no time to lose. Eleven months of study will give both senior and junior classes a broad footing in the political and economic as well as the tactical and material aspects of the business of waging war.

LECTURES ON RADAR AND CIC

Of special interest to readers of "C.I.C." are those parts of the new course which involve radar or implicate the control functions of CIC. Most of the first month's schedule is in this general category, and may therefore be quoted, by lecture title (the lectures average two a day, and many are given by military or civilian experts from outside agencies):

Operation Crossroads; Future Trends in the Defense of Task Forces Against Air Attack; Application of the Probability Theory to Tactics; Employment of Ships' Weapons; Theory of Search; Atomic Bomb Post-Detonation Phenomena; The Navy in Research; Guided Missiles; Future Trends in AA Weapons; Anti-Submarine Warfare; Submarine Warfare; Nuclear Energy (four lectures); Employment of Fast Carrier Task Forces; Rockets; Naval Radar; Radar Countermeasures; Radar Weapons; Airborne Radar; Fighter Direction; CIC; Guided Missiles for Naval Operations.

Some of the highlights in the remainder of the course are a series of lectures on military strategy in World War II; a series on all important foreign countries by State Department experts; several lectures on atomic energy, fissionable material, the

Maneuver room where actions of surface forces are graphically represented. Checkerboard pattern determines scale. Movable curtains obscure opposing forces. Plans call for complex electronic maneuver system to permit commanders of the future to simulate the use of future weapons.

atomic bomb and national policy; the Navy as an instrument of national policy; military government and international law; selected analyses of outstanding actions of World War II; etc.

There are given as actual exercises a series of operational problems, strategical and tactical. In such problems opposing teams of students fight out on paper, complete with operation plans and orders and involving air, sea and land forces, an amphibious assault, or a naval-air engagement, or any of a dozen such combinations. Upon completion, critiques are held which analyze exhaustively every move made by the two teams.

ELECTRONIC MANEUVER SYSTEM

At present the War College employs for graphic representation of naval units in tactical problems the so-called "maneuver room"—a very large room on the floor of which naval actions may be diagrammed and ship models moved about in simulation of combat maneuvers. This room is no more capable of presenting to the student a concept of the high speed missile and remote control conflict of the future than is a drug store pin ball machine. Well aware of this, the staff of the War College has had in the plan stage for some time an electronic maneuver board.

Declass, Declass in Full, March 1998, Per OPNAVIST 5513 16-02

Declass, Declass in Full, March 1998, Per OPNAVIST 5513 16-02

This device, whose future is at this writing as uncertain as many things in the Navy, would realistically simulate the movement and control of ships, aircraft, submarines and guided missiles. Preliminary plans call for a total of 20 control stations, or flag plots (carrying out some of the functions of CIC from the standpoint of command), and an electronic generator and display system capable of producing and displaying 60 ship and air targets. This concept, actually an out-growth of the first CIC electronic trainer built by the University of California for the Navy, goes far beyond the matter of CIC training. In the 20 flag plots, opposing commanders would have before them the information, from electronic and all other sources, enabling them to fight an action developing over distances of thousands of miles and involving targets travelling at supersonic speeds.

The realization of the electronic maneuver system is something that may or may not occur within the next two or three years. It is, to begin with, an immense technical problem. But the suggestion that the Navy's highest institution of learning is planning to simulate the toughest kind of future warfare without waiting for it to reach the textbook stage, should be encouraging and vitalizing to all Naval personnel.

Enlarged library houses more than 75,000 volumes on every phase of war. War College was founded in 1884, was then looked upon by many as a wild innovation. During the past war it operated under many difficulties. Now, with one of the Navy's great fleet commanders as its new President, its curriculum is dynamic and forward-looking.

GROUND/AIR EMERGENCY CODE

TO BE USED TO AMPLIFY DISTRESS SIGNALS

INSTRUCTIONS

1. Lay out these symbols by using strips of fabric or parachutes, pieces of wood, stones, or any other available material.
2. Endeavor to provide as big a color contrast as posible between the material used for the symbols and the background against which the symbols are exposed.
3. Symbols should be at least 8 feet in height or larger, if possible. Care should be taken to lay out symbols exactly as depicted to avoid confusion with other symbols.
4. In addition to using these symbols, every effort is to be made to attract attention by means of radio, flares, smoke, or other available means.

1. REQUIRE DOCTOR SERIOUS INJURIES	I	7. REQUIRE SIGNAL LAMP WITH BATTERY AND RADIO	¦	13. REQUIRE FUEL AND OIL	L
2. REQUIRE MEDICAL SUPPLIES	II	8. INDICATE DIRECTION TO PROCEED	K	14. ALL WELL	LL
3. UNABLE TO PROCEED	X	9. AM PROCEEDING IN THIS DIRECTION	↑	15. NO	N
4. REQUIRE FOOD AND WATER	F	10. WILL ATTEMPT TAKE-OFF	|>	16. YES	Y
5. REQUIRE FIREARMS AND AMMUNITIONS	∨∨	11. AIRCRAFT SERIOUSLY DAMAGED	L⌝	17. NOT UNDERSTOOD	JL
6. REQUIRE MAP AND COMPASS	□	12. PROBABLY SAFE TO LAND HERE	△	18. REQUIRE ENGINEER	W

AIRCRAFT ACKNOWLEDGMENTS

MESSAGE RECEIVED AND UNDERSTOOD

An aircraft will indicate that ground signals have been seen and understood by:
1. Rocking from side to side OR
2. Making green flashes on signalling lamp.

MESSAGE *NOT* UNDERSTOOD

An aircraft will indicate that ground signals are not understood by:
1. Making a complete right-hand circuit OR
2. Making red flashes on signaling lamp.

C. I. C. JUNE 1946

Declass, Declass in Full, March 1998, Per OPNAVIST 5513 16-02

Declass, Declass in Full, March 1998, Per OPNAVIST 5513 16-02

GROUND/AIR EMERGENCY CODE

IN the war lots of people survived air crashes in various corners of the world, only to find that their troubles were just beginning. They might be wounded, sick or lost, but when (and if) a plane spotted them they often had no way of attracting attention or communicating their difficulties.

The panel code was one solution—a system of large markers by which a "crashee" could indicate to a searching aircraft that he was in trouble, and what he needed. This was used by the AAF and ATC boys flying the Hump in the CBI area, by the Marines in the Solomons, by the Navy at sea, and others. Trouble was, they were all different.

Now, after lengthy deliberation, an all-service, combined (British and American military) panel code has been approved and adopted. The official symbols are shown on the opposite page. The signals may be made with special strips of nylon or other cloth (that is up to the individual service), or they may be improvised with sticks and stones or scratched in the ground. Instructions for their meaning and use should be stencilled in all aircraft, and on parachutes, liferafts, dinghys and rescue packs. All flying personnel, *including passengers,* should be briefed in the use of the code.

The international application of the code is of interest to the military, as brought out in the CCB letter quoted on this page. Standardization in such a matter is basically desirable. For example, commercial airline crashes in the United States bring out military search planes, and a common system of signalling is of course essential.

On 8 May 1946 the Combined Communications Board, in a letter to the Chief of Naval Operations, announced that the Air/Ground Emergency Code described in this article had been adopted by the Board. This means that the code is now official for all services, U.S. and British.

A portion of this letter is paraphrased as follows:

"All services are requested to promulgate the information. . . . The Ground/Air Emergency Code should be given very wide circulation within the military services and be publicized through service bulletins and publications.

"The great value of this code to all aviation interests, military, civil and commercial, is evident. The military services of the United States and the British Commonwealth should therefore urge its universal international adoption. To this end, the U.S. military services are requested to recommend the matter of adoption to the Provisional International Civil Aviation Organization, Civil Aeronautics Administration, Civil Aeronautics Board, State Department and Treasury Department (Coast Guard)."

CIC's role in the atomic experiment

Embedded in the multitudinous pages comprising the Operation Plan of Commander Joint Task Force One is "Annex C," presenting the "Communication and Electronic Plan." Everyone in the fleet concerned with CIC must have wondered what role would be allotted to CIC at Bikini; here is the answer—in the subsection entitled "CIC and Radar Doctrine."

It is no surprise to learn that this role is a crucial one, assigning CIC responsibility for control of all aircraft in the area—launching, directing, homing, and rescuing downed pilots—tracking all participating planes continuously (precise positioning and split-second timing are essential), and making radar observations of the radioactive clouds following the atomic explosion.

In this greatest of all bombing experiments—largely an air operation—CIC has a problem as complex (and as potentially dangerous) as any it met in wartime.

CIC and Radar Doctrine stated herein is in accordance with:

(a) USF 10B.

(b) PAC 70B.

The following supplements the above:

1. Control.

The control of all aircraft traffic, air and surface search radars, VHF and Inter-fighter-director voice radio communications, and conditions of radar and IFF silence within the Task Force is the function of the OTC (normally CJTF-1 except when otherwise specifically indicated) and will be exercised and controlled through the Task Force Fighter Director Officer. The Task Force Fighter Director Officer will be stationed in, and exercise control from, the CIC of the flagship, unless otherwise directed.

2. Duties of the Task Force Fighter Director Officers.

The Task Force Fighter Director Officer will:

(a) Control all aircraft traffic in the air.

(b) Maintain radio discipline on all aircraft control and inter-fighter-director radio voice communications circuits.

(c) Coordinate the homing of lost aircraft.

(d) Coordinate and control Air Sea Rescue.

(e) Prescribe radar guards and radar guardships.

(f) Designate Fighter Director Ships.

(g) Assign IFF guard duties.

(h) Be responsible for the assignment of shipboard radar coverage.

(i) Brief all CIC officers prior to operation.

3. Duties of the Ship Fighter Directors Officers.

The Ship Fighter Director Officer will:

(a) Be responsible for carrying out all directives of the Force Fighter Director Officer and to function in accordance with prescribed CIC doctrines.

(b) Be responsible for carrying out all directives of CJTF-1 Operation Plan No. 1-46 as they apply to CIC.

4. Fighter Director Ships.

The Force Fighter Director Ship is the USS *Mt. McKinley*. The sequence of Task Force Fighter Director relief will be:

(a) USS *Shangri La.*

(b) USS *Saidor.*

(c) USS *Appalachian.*

(d) USS *Blue Ridge.*

(e) USS *Panamint.*

In case of radar, radio voice communications, or other materiel failure in the flagship the Task Force Fighter Director duties will be assumed by the relief ships in the order above.

5. Radar Guards and Radar Guardships.

The following ships are designated radar guardships:

(a) USS *Mt. McKinley.*

(b) USS *Shangri La.*

(c) USS *Saidor.*

(d) USS *Appalachian.*

(e) USS *Blue Ridge.*

(f) USS *Panamint.*

Declass, Declass in Full, March 1998, Per OPNAVIST 5513 16-02

Declass, Declass in Full, March 1998, Per OPNAVIST 5513 16-02

All radar guard ships will immediately report all failures of radar or communication equipment to the Force Fighter Director Officer over the Radar telling circuit. Reports will include the length of time equipment will be inoperative. A report will also be made when the equipment is back on the air. Radar guard ship duties are assigned as follows:

(a) USS *Mt. McKinley*

SK Radar—The master PPI will be set on the 75 mile range scale with a continuous 360 degree sweep at 4 rpm. All targets will be reported at least once each minute. Radar operators will report from the master PPI tube using a cursor with calibrated range markings.

SP Radar—Assigned to track the Bomb Carrying B-29 and the two B-29 pressure instrument aircraft. May be further assigned to track helicopters when designated by the Task Force FDO.

SCR 720 Radar—Will be assigned zenith search when and as directed by the Task Force Fighter Director Officer.

(b) USS *Shangri La*

SK Radar—The master PPI will be set on the 75 mile range scale with a continuous 360 degree sweep at 4 rpm. All targets will be reported at least once each minute. Radar operators will report from the master PPI tube using a cursor with calibrated range markings.

SM Radar—Assigned to track the four F6F drones, the four Primary Drone Control Sections Red, White, Blue, and Yellow and the four Secondary Drone Control Sections Red, White, Blue, and Yellow, when launched from the USS *Shangri La*. The radar track of these aircraft on the Main Display Board will be labeled with Mark III IFF codes as shown.

SC Radar—Maintains the IFF guard for the Task Force. Also maintains the emergency IFF guard duty. All emergency IFF will be reported immediately to the Task Force Fighter Director Officer via the Radar Telling circuit. IFF guard is to include the keeping of a record of all planes showing emergency IFF; giving position, track, and time. Only BL equipment on the USS *Shangri La* will be operated during this operation, unless otherwise directed by the Task Force FDO.

(c) USS *Saidor*

SK Radar—The master PPI will be set on the 75 mile range scale with a continuous 360 degree sweep at 4 rpm. All targets will be reported at least once each minute. Radar operators will report from the master PPI tube using a cursor with calibrated range markings. The *Saidor* will also act as standby IFF guard ship and be prepared to take over this duty when directed to do so by the Task Force Fighter Director Officer.

SP Radar—Assigned to track the one F6F aircraft designated "Roger" and the one TBM photographic aircraft designated "Nan." Will also track the 2 PBM aircraft designated "Tare" and "Uncle."

(d) USS *Appalachian*

SK Radar—The master PPI will be set on the 75 mile range scale with a continuous 360 degree sweep at 4 rpm. All targets will be reported at least once each minute. Radar operators will report from the master PPI tube using a cursor with calibrated range markings.

SP Radar—Assigned to track the two B-17 drone aircraft and the two B-17 Mother aircraft, "How" and "Love."

(e) USS *Blue Ridge*

SK Radar—The master PPI will be set on the 75 mile range scale with a continuout 360 degree sweep at 4 rpm. All targets will be reported at least once each minute. Radar operators will report from the master PPI tube using a cursor with calibrated range markings.

SP Radar—Assigned to track two B-17 Drone aircraft and the two B-17 Drone Control aircraft designated "Fox" and "George." Also the Master Drone Control aircraft designated "Mike."

SCR 720 Radar—Assigned zenith search when and as directed by the Task Force Fighter Director Officer.

(f) USS *Panamint*

SK Radar—The master PPI will be set on the 75 mile range scale with a continuous 360 degree sweep at 4 rpm. All targets will be reported at least once each minute. Radar operators will report from the master PPI tube using a cursor with calibrated range markings.

SP Radar—Assigned to track the four F-13 aircraft, Flight Able, and the four F-13 airborne spares, Flight Baker.

Note: The *Panamint* will also conduct certain radar observations of the explosion of the bomb in accordance with instruction to be issued separately.

6. Radar Silence and IFF.

Only those ships designated as Fighter Director Ships and/or Radar Guard Ships will operate their air search radars on "ABLE", "BAKER" and rehearsal days. All others will secure their air search radars, unless otherwise directed.

All Fighter Director Ships and Radar Guard Ships except those designated as IFF guard ships, will secure their BL equipments.

All ships present will secure their surface search and gunnery radars as later directed.

7. Radar Tracking.

All designated Fighter Director Ships will be responsible for maintaining a continuous track of all aircraft in addition to tracking any designated aircraft as assigned in this operation plan. No instructions contained in this appendix will be construed as relieving any Fighter Director Ship from the responsibility of maintaining a continuous track of all aircraft. To properly perform this function all air search radars will be placed at peak performance.

All Fighter Director Ships will be prepared to report position of any aircraft to the Task Force Fighter Director Officer when requested. All air contacts will be identified and labeled on the Main Display Board in accordance with their assigned radio voice calls.

Any ship launching aircraft is charged with the responsibility of keeping a constant track of those aircraft and being ready to give their position to the Task Force Fighter Director Officer when requested. To insure an accurate identified track it is suggested that two CIC Watch Officers maintain a running plot on the face of the PPI tubes (2) in addition to the Main Display Board.

The safety of this operation depends on knowing the exact whereabouts of each aircraft at all times. Tracking ships will make full use of the 20 mile range scale on the PPI tubes for close-in tracking. Carriers launching planes will commence PPI tube tracking on the 20 mile range scale in order to have each plane properly identified. A shift to the 75 mile range scale may be made when all launched aircraft are on the scope and can be identified.

It is suggested that lookouts be fully utilized to identify close-in visual contacts.

Supporting Fighter Director Ships will be prepared to assist in identifying any aircraft requested by the Task Force Fighter Officer by referencing their Main Display Board.

8. Radar Reporting.

All radar reports will be given via the Radar Telling Circuit using standard fighter direction vocabulary.

All aircraft contact reports made via the Radar Telling Circuit will be given as bearing and range from the Radar Reference Point designated "Automobile." This reference point is the center of Bikini Island, Bikini Atoll (11°37′15″ N. Lat. 165°32′50″ E. Long.). Each Radar Guard Ship will so set up their CIC that quick conversion plotting can be done.

All launching and landing reports will be made to the Task Force Fighter Director Officer over the Radar Telling circuit in accordance with the Standard Deck Condition Code. Condition Jig reports will be made simultaneously with each aircraft launched.

9. Communications.

The Task Force Air Guard channel and the Radar Telling Circuit will be carefully monitored and controlled by the Task Force Fighter Director Officer. Proper voice procedure and strict radio discipline will be maintained and rigidly enforced by the Task Force Fighter Director Officer on these circuits. All aircraft will maintain a constant guard on the Task Force Air Guard channel and be prepared to transmit on this channel at all times.

The Fighter Director Vocabulary, as published in the Combined Communications Board publication, CCBP-11-3, is to be used on the Radar Telling Circuit. No preliminary call ups or communication checks will be made after X-RAY hour minus three hours. It is assumed that all communications will have

Declass, Declass in Full, March 1998, Per OPNAVIST 5513 16-02

Declass, Declass in Full, March 1998, Per OPNAVIST 5513 16-02

been checked on this circuit prior to X-RAY hour minus three hours. Voice radio transmissions on this circuit will be kept down to an absolute minimum and no unnecessary transmissions will be made.

All voice radio transmissions will be made on their assigned and designated channels only.

All information messages should end with "out."

If routine reports, made from plane-to-base, are readable they will not be relayed to the Task Force Fighter Director Officer. However, the parent carrier will be prepared to give an amplifying report if requested. The Task Force Fighter Director Officer will monitor the Task Force Air Guard channel, Task Group 1.5 common, Task Group 1.6 common, and the Radar Telling Circuit assigned this Task Force.

All Fighter Director Ships will be prepared to log any aircraft control channel and/or the Radar Telling Circuit when directed to do so by the Task Force Fighter Director Officer.

The Fighter Director Vocabulary, CCBP-11-3, will also be used on the Task Force Air Guard channel. No preliminary call ups will be made after communications have been established. This applies to base-to-plane transmissions as well as plane-to-plane. However, communications should be re-established before the transmission of lengthy messages. This shall not be interpreted as prohibiting the parent base from establishing satisfactory communications with their aircraft.

All aircraft will report in to the Task Force Fighter Director Officer on the VHF Task Group Common channels when on assigned stations.

All aircraft will use only their assigned radio voice calls at all times. No nicknames will be used.

All aircraft will check their transmitter keys prior to take-off to insure that they are "off." If trouble develops while planes are airborne each plane will immediately exercise every means available to locate the defective radio and take remedial action.

All transmission to the Task Force Fighter Director Officer requiring action, or for information, will be addressed to the Task Force Commander.

All CIC's of the Destroyers assigned this Task Force as Surface Patrol will monitor the Task Force Air Guard channel and the Radar Telling circuit. All plane guard destroyers are designated Radar Guard Ships.

10. Lost Plane Procedure.

Lost plane procedure will be in accordance with PAC 70B.

Lost planes will usually be homed by the parent carrier. If landbased, the planes will be homed by a Fighter Director Ship designated by the Task Force Fighter Director Officer. If several planes are lost simultaneously the Task Force Fighter Director Officer will designate one Fighter Director Ship to coordinate and control the homing of all lost planes. During any period when there is a lost plane, no plane will show emergency IFF until directed to do so by the ship coordinating the lost plane procedure. This will alleviate the confusion of emergency IFF and the homing problem.

11. Air Sea Rescue.

Air Sea rescue will be in accordance with CinCPOA SOP-3A.

Air Sea rescue within the Bikini Atoll Objective Area (defined in paragraph 1 Annex Y to CJTF-1 Op-Plan No. 1-46) will be under the control of the OTC and exercised through the Task Force Fighter Director Officer.

All ships will be alert for reports of downed aircraft and relay such reports to the Task Force Fighter Director Officer for action.

All ships will keep a record of such downed planes, showing position and time.

All Fighter Director Ships shall be prepared to assist in Air Sea Rescue work.

12. Aerological and Radiological.

Ships designated to make weather reports in accordance with Annex T will use suitable radars to obtain RAWINS, except during the period "X-RAY" minus 1 hour to "X-RAY" plus 3 hours on "ABLE", "BAKER" and rehearsal days.

Starting at HOW plus 45 minutes all ships of DesRon 7 will attempt to track the bomb cloud using their air search radar. Any data obtained will be relayed by the Radiological Monitor in each ship, via the radiological net, to the Radiological Center in the USS *Mt. McKinley*.

electronic installations on AGC and DD

TO the aircraft carriers in the war went the big job of controlling, homing and landing hundreds of planes, during combat, in high seas, at night. Their islands bristled with complex electronics gear—the big search antennas, the beacons, the VHF dipoles—used for this purpose.[1]

Supplementing control from carriers in the fast task forces, and acting as radar pickets in amphibious operations, was the Navy's old standby, the destroyer; and carrying the brunt of control and communications duties around an assault beach was a type new in this war, the AGC (headquarters or command ship). The electronics installations on these two types are pictured for handy reference on the following pages.

The AGC grew out of a concept literally forced on the U. S. and British navies by the skyrocketing development of radar and radio—that of a commander directing huge operations on land, sea and in the air from a position where he could instantly control and communicate with all his forces. Large, roomy merchant ships, with accommodations for the big staffs, were converted for the purpose. Their topsides flowered in a profusion of radar and radio antennas of every description. Below decks was a maze of control rooms, radio and decoding rooms, intelligence rooms, photographic interpretation rooms, offices and conference rooms for flag and general officers and their subordinates. From these ships—the brains of an invasion armada—went the messages that brought together and maneuvered our great amphibious task forces into attack positions, that ordered gun and rocket fire support against the beaches, that put in motion the waves of landing craft at H-hour, that controlled the planes from distant ships and bases in air support and air intercept missions, that moved divisions of troops on the beaches and brought up reinforcements, that ordered ships to and fro with their enormous cargoes of supplies to support the invasion.

The destroyer, used early in the war in its historic role of torpedo carrier and escort, came to be more and more relied on as a fast-moving, ubiquitous and expendable picket/control station, equipped with the best radar and radio available and partially rebuilt for its revised mission. With the fast carriers the DD's gave early warning and advanced fighter direction, served as check-in and orbit points for outgoing and incoming air strikes and CAP. With the amphibious forces they were used far out on the perimeter of the defended area to warn the force and to detect, attract and destroy enemy air and surface units.

---

[1] See "Electronics Installation on Carrier Types," "C.I.C.", April 1946, page 5.

Declass, Declass in Full, March 1998, Per OPNAVIST 5513 16-02

Declass, Declass in Full, March 1998, Per OPNAVIST 5513 16-02

AGC

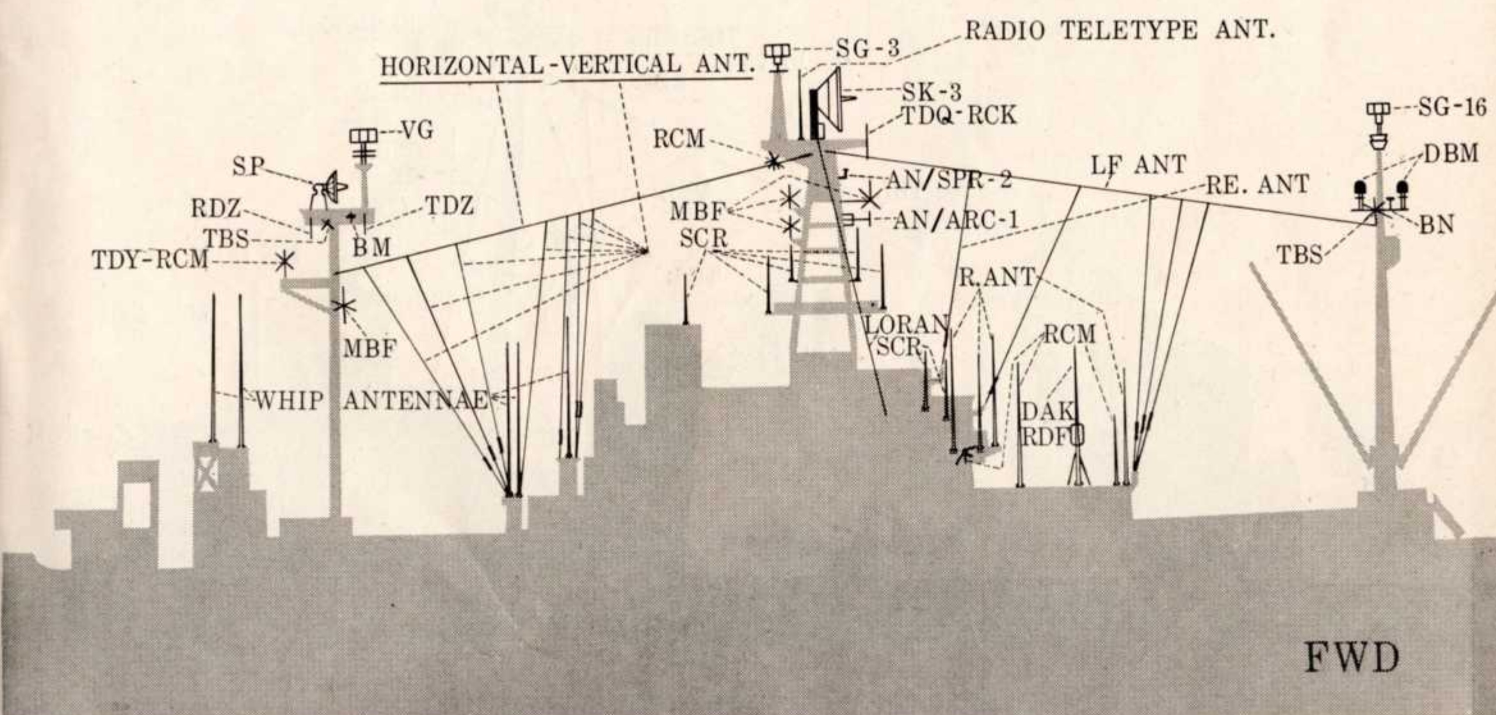
RADAR: Consists of 2 SG's, an SK, and an SP, the latter added to improve fighter direction capability.

RADIO: A veritable shipload of radio equipment serves flag communications, main radio and joint communication center, joint operations room, CIC, air support, etc. Some 112 receivers and 34 transmitters are provided, in addition to six SCR 608, five SCR 610, and two SCR 508, 4 MBF's, two TBS, teletypewriters, six TDQ-RCK, AN/ARC-1, and AN/TRC-1 designed to be carried ashore with a teletypewriter printer and telephone, and used with the Mod. 1498 Link transmitter/receiver equipment (being replaced by UHF). This array of communication equipment can be scarcely more than suggested on the accompanying sketch.

ELECTRONIC ACCESSORIES: Radio and radar intercept, countermeasures and jamming equiment are liberally supplied aboard an AGC. Radio intercept appears in the RAO-9, RBK, RDC, RDD and RDG; two panoramic adapters, the RCX-1 and RVW-2, and the Model PQ recorder. The Model UL modulator, the AN/ARQ-8 transmitter and the AN/33APT amplifier serve for radio jamming. Radar intercept is accomplished by the RDO and AN/SPR-2 receivers, DBM direction finder, RDJ pulse analyzer, RDP panoramic adapter, and the TDY-1 and 1A do the jamming. A number of PPI's are located in CIC, including 3 VK's or VJ's, a VF and VG (Projection PPI). A VF is provided for flag plot, along with a VG and VJ or VK, a VF for the pilot house, and a VD on the open bridge. DAS LORAN is carried.

BEACONS AND IFF: BM and BN interrogators, the BK transpondor, and the BO interrogator-responsor. The BN's are being removed and replaced by the BK. Aircraft may be homed on the YG directional beacon.

FIRE CONTROL RADAR: The highly vulnerable AGC must be protected by other ships having greater firepower than it is able to provide. Two 5″ guns and a battery of machine guns, which comprise its armament, are controlled by a Mk. 26 FC radar.



DD

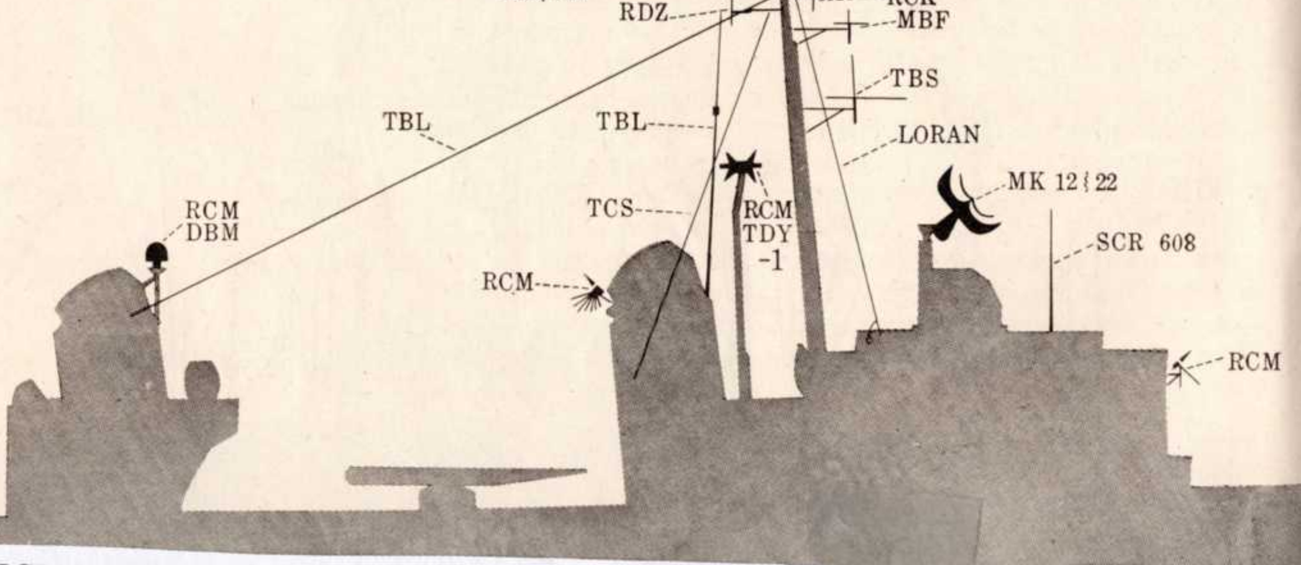
692 RADAR PICKET

RADAR: Any destroyer, or other vessel, can be a picket. But the radar pickets as developed by the Navy were highly specialized ships. The 692 class pickets, converted in early 1945 at the request of the Pacific fleet, had the forward torpedo mount removed and a tripod mast added to accommodate the SP radar, and CIC was enlarged. A height finding radar had become essential for effective control of fighters in clouds and darkness. The air search is SR, and surface search SG. IFF gear included two BM's, one BO for the SP, two BK and BN.

RADIO: Considerable communication equipment is standard. The TBS is backed up by MBF, TBL, TCS, MN (the interdestroyer maneuvering circuit), RBS, RAO, RAK/RAL; and the RBA, RBB and RBC. TDZ and RDZ are scheduled for pickets at next yard overhaul; meantime MAR are in use. AN/ARC-1 gives communication with aircraft.

ELECTRONIC ACCESSORIES: Full radar countermeasures are carried in the form of RDO and AN/SPR-2 receivers, RDJ pulse analyzer, RDP panoramic adapter, and DBM direction finder. A TDY-1 set is used to jam enemy radar. PPI scopes in CIC are a VF and VJ, the latter to be replaced by the VK when available. A VD is located on the open bridge, and a VJ (or VK) in the pilot house. Aircraft are guided by a YG homing beacon, while a DAS LORAN set provides long range navigation. Underwater sonar gear is the QGA equipment with a built-in BDI (bearing deviation indicator).

FIRE CONTROL: The exceptionally hazardous duty sometimes undertaken by picket destroyers demands a large degree of firepower and fire control for a vessel of that size. The reliable Mk. 12 and Mk. 22 secondary fire control radars give needed protection against either high or low-level attacks by enemy aircraft. The Mk. 32 interrogator, which is nothing more than a BN with a special antenna, provides IFF for the gun director. The Mk. 34 Mod. 2, or the Mk. 28 Mod. 2 F/C radars control the 40mm. guns, supplying immediate information on target location.



Declass, Declass in Full, March 1998, Per OPNAVIST 5513 16-02

Declass, Declass in Full, March 1998, Per OPNAVIST 5513 16-02

DD

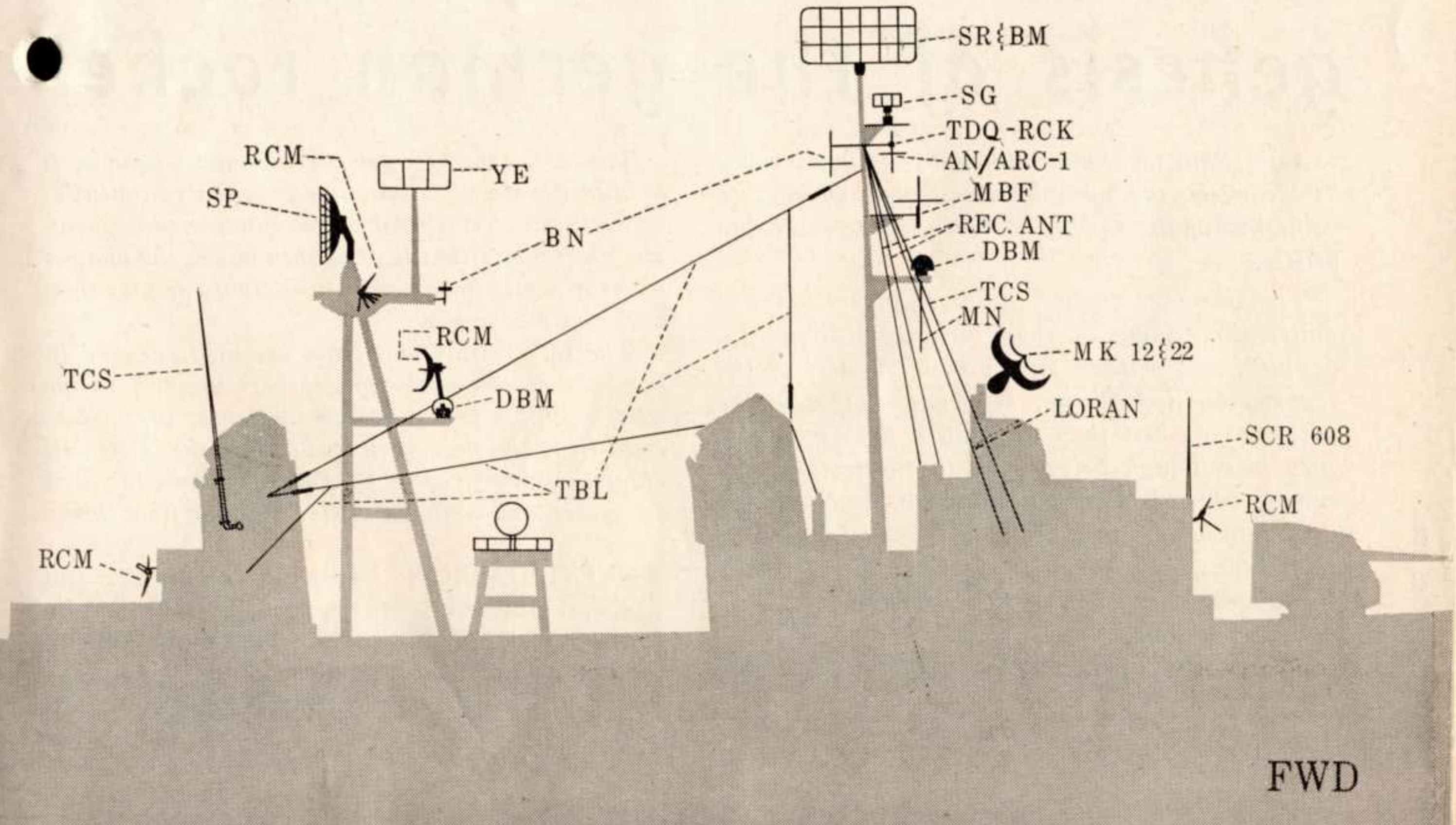
692 LONG HULL CLASS

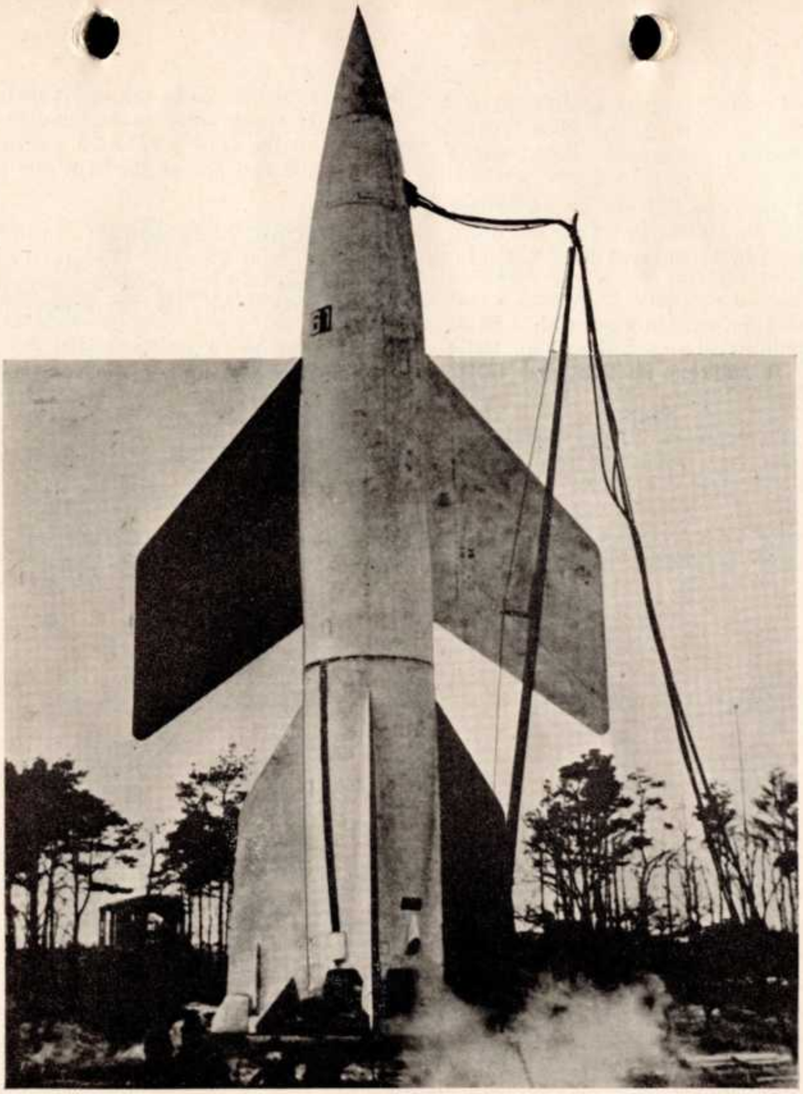
RADAR: Coverage is based upon two sets—the SG for surface search, and either SR or SC-4 for air search. Two BK transponders, and a BN interrogator, to be replaced by a BM, provide IFF.

RADIO: Similar to that of a picket destroyer, with TBS as the primary tactical and administrative circuit, and all radio equipments of a picket DD. In addition, an RBK and TDQ/RCK are carried. As in the picket destroyer, the new improved TDZ/RDZ is scheduled to be installed, with the MAR serving in the interim. The AN/ARC-1 gives communication with aircraft, while two sets of the SCR 608 provide liaison with the Army.

ELECTRONIC ACCESSORIES: Jamming system, Loran, sonar equipment and remote PPI's are the same as on picket destroyers, but no YG or other beacons are carried. Some of these vessels carry DAU HF/DF equipment, and all carry DAS LORAN.

FIRE CONTROL RADAR: Same as on picket DD's.





Winged version of V-2, launching site in Germany.

genesis of the german rocket

A sidelight on the development of the German "V" rockets, the second most vicious weapon to come out of the war, is set forth in the following article.[1]

The Germans devised hundreds of machines of destruction, some of them of extraordinary ingenuity, and worked on scores of models of the rocket-propelled missile. It is known that in the early days, when they still had a fleet in being, they placed high priority on the perfection of a remote controlled rocket which could be directed during at least part of its flight by naval units. By this means they hoped to beef up the comparatively weak fire power of their warships.

The ultimate German development (one step behind the space-station) was a trans-ocean missile, using internal controls; lacking intermediary control positions, either land or ship based, the margin of error would have been considerably greater than with the V-1 or V-2.

The U. S. Army and Navy are now engaged in operational test of V-type rockets under positive control. This is not now a matter of immediate concern to the fleet. But it is certain that CIC will enter the picture of rocket control within the next few years, and perhaps sooner than we now think.

INVESTIGATIONS by British Intelligence and Royal Air Force experts, recently published by the Royal Aero Club, have shed some light on the details and history of the German long-range rocket V-2, which constituted the most important

[1] Reprinted by permission of *The Technology Review*, edited at the Massachusetts Institute of Technology. Copyright, 1946, *The Technology Review*.

Declass, Declass in Full, March 1998, Per OPNAVIST 5513 16-02

Declass, Declass in Full, March 1998, Per OPNAVIST 5513 16-02

contribution of the Nazi war machine to scientific progress.

Most of the research and experimental work took place on the German island of Usedom, which is the westernmost of the two large islands separating the Bay of Stettin from the Baltic Sea. The experimental station was located in the immediate vicinity of the small fishing village of Peenemunde, which is located at the extreme northwest point of that island, and it was, for this reason, referred to as the "Peenemunde Institute." Founded in 1937, it became active in 1938, and experiments were carried on there until the institute was almost obliterated by the bomber command of the Royal Air Force during the night of August 17, 1943. One of the weapons developed at that institute was the German flying bomb V-1, and a subsection developed the army projectile rockets of the types Nebelwerfer and Schweres Wurfgerat.

However, the main activity of the institute was directed toward the development of large-size liquid-fuel rockets. This main section was under the command of General Dornberger, with Professor Wernher Freiherr von Braun in charge of construction and Professor Hermann Oberth doing the theoretical work. General Dornberger's rocket-projectile research group had existed as a part of the German army's weapon research before the Peenemunde Institute was founded.

THE FIRST ROCKET

In 1933 Dornberger and Count von Braun had developed a 330-pound liquid-fuel rocket, called A-1 (Aggregate No. 1), which was tested at the artillery proving ground at Kummersdorf, not far from Berlin. It had been about 4 feet 7 inches long and had had a largest diameter of one foot. The next design, A-2, was finished and tested in 1934; it was about the same size as A-1 but with important design changes. In the tests which took place from the German island of Berkum in the North Sea the A-2 rocket reached an altitude of 6500 feet, with a burning time of 16 seconds.

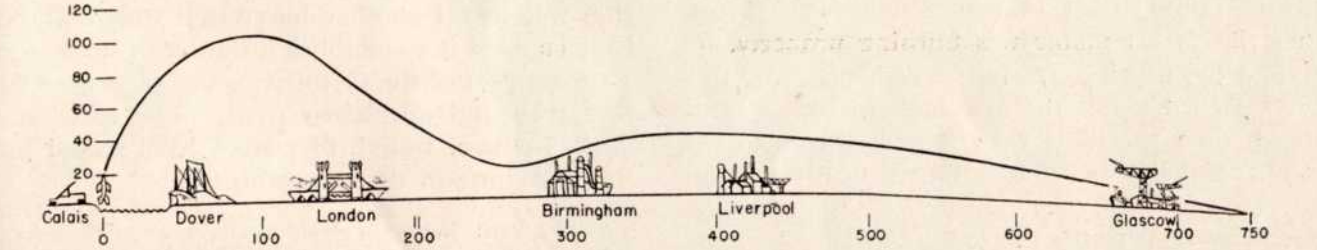
A-3, the first rocket developed at Peenemunde, was 25 feet long and 2.5 feet in diameter, tremendously large as compared to A-1 and A-2. Ready for take-off it weighed 1650 pounds; its rocket motor developed a thrust of 3300 pounds for 45 seconds. In 1938 it reached an altitude of 40,000 feet vertically and a maximum range of about 11 miles horizontally.

The next model was Fernrakete A-4 (long-distance rocket A-4), which later became known under the designation V-2. At first it looked as if the new model were going to be disappointing. The first A-4 rocket, fired on July 6, 1942, rose just three feet and then exploded, destroying the testing site. The second and third to be fired exploded at an altitude of about 16,000 feet. The fourth, fired in October, 1942, successfully covered a range of 170 miles, as did the fifth. Then a series of 13 disappointments followed—some of the rockets exploded, some just did not function, and many broke up in the air only a few seconds after take-off. However, the nineteenth was a success, as were most of the following. Among the subsequent hundred experimental firings only one out of five misperformed, in most cases dissolution being the cause for failure.

By then the order for mass production was given, and more than a hundred additional rockets were used for target practice. One of the practice rockets, fired in June 1944, exploded some 40 miles high over Swedish territory. Two tons of fragments were collected, and although the pieces were small, British experts succeeded in fitting them together so that they had a very good idea of the rocket's size and performance.

The first V-2 actually used crashed down in a suburb of London on September 8, 1944. By

German sketch entitled "Trajectory of long-range rocket with airplane wings—Range 750 kilometers." Similar sketches showed a two-step missile with range of 5,400 kilometers.



German scientific personnel work on German supersonic wind tunnel at Naval Ordnance Laboratory, Washington, D. C. Originally used at Peenemunde in V-2 development, the tunnel was captured by Americans in south Germany. At right, crew read data from bank of 120 manometers. Main valve at upper left.

Christmas of that year the Germans claimed to have fired the 1000th V-2, London and later Antwerp being the principal targets.

OPERATION OF THE V-2

V-2 consisted, from the top down, of the warhead, filled with amatol (a mixture of T.N.T. and ammonium nitrate), the instrument compartment, the alcohol tank, the oxygen tank, and the propulsion unit. The latter consisted of a steam turbine, operated by bringing hydrogen peroxide and calcium permanganate together, which drove two fuel pumps, delivering the oxygen and the alcohol to the rocket motor with a working pressure of about 350 pounds a square inch.

The rocket stood vertically on a concrete platform or hard ground, and the firing procedure was as follows: The valves controlling the alcohol and the liquid oxygen were turned on. Underneath the exhaust nozzle a special black-powder torch was blazing. The fuel caught fire, and the rocket motor began to work, although far too weakly to lift the 12-ton rocket. When the observer felt sure that the rocket motor was burning properly, he started the turbine by electric control. The turbine needed about three seconds to achieve full speed, then the fuels were fed forcibly into the motor, and the rocket took off, vertically. At an altitude of a little over eight miles, the gyroscopic controls began to tilt the longitudinal axis of the rocket in the proper direction; some 47 seconds after take-off, the angle was 45 degrees. The fuel supply lasted for 70 or 71 seconds, and by that time the rocket had reached a speed of about 3500 miles an hour. The whole trip, from take-off to crash, took about 5 minutes; the operational range was about 180 miles (maximum range observed was 220 miles); and the peak altitude along the trajectory was about 60 miles.

THE SPACESHIP

The development envisaged by the Germans called A-9 was an A-4 rocket with highly sweptback wings, which would have added a hundred miles or so to the range. Development A-10 was an 85-ton rocket designed to serve as a lower step for an A-9, and the combination of the two was for the bombardment of American cities; the trip would have taken about half an hour over a 3500 mile range. Later on, the A-9 and A-10 combination was to get another lower step which would have enabled it to establish a station in space, the ultimate goal of the German rocket experts as far as earthbound operations went. The space stations, in turn, would, of course, have served for the launching of true spaceships.

Editor's Note: Reference should also be made to the article, "Guided Missiles" in the April 1946 ONI Review, *for a further discussion of German rocket development.*

Declass, Declass in Full, March 1998, Per OPNAVIST 5513 16-02

Declass, Declass in Full, March 1998, Per OPNAVIST 5513 16-02

banana river MEW

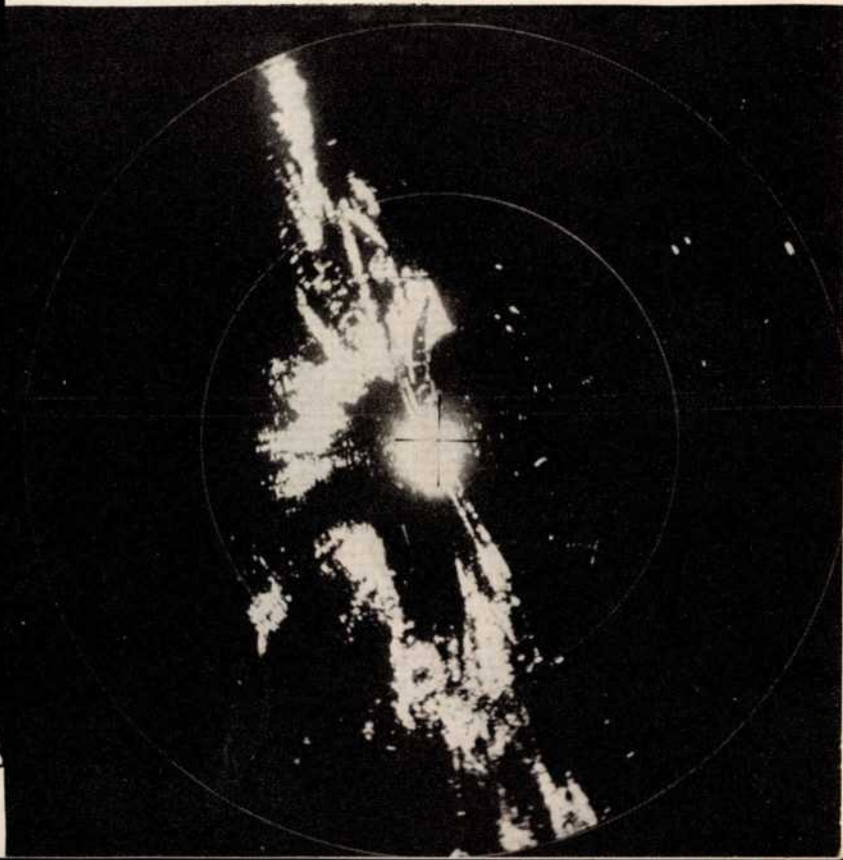
One of the great radars to come out of the war was the Army's AN/CPS-1, commonly called the MEW (Microwave Early Warning). Its high frequency, great power and multi-PPI and B scope presentations made it the first operational radar with truly enormous raid-handling capacity. It got into some of the Pacific islands (though rather late in the game), and followed the tactical air forces' sweep across France in a mobile version.

The Navy now has a few of these sets for training. Beavertail CIC Training Facility has one in operation on Jamestown Island in Narragansett Bay. Another is at NAS, Banana River, Florida.

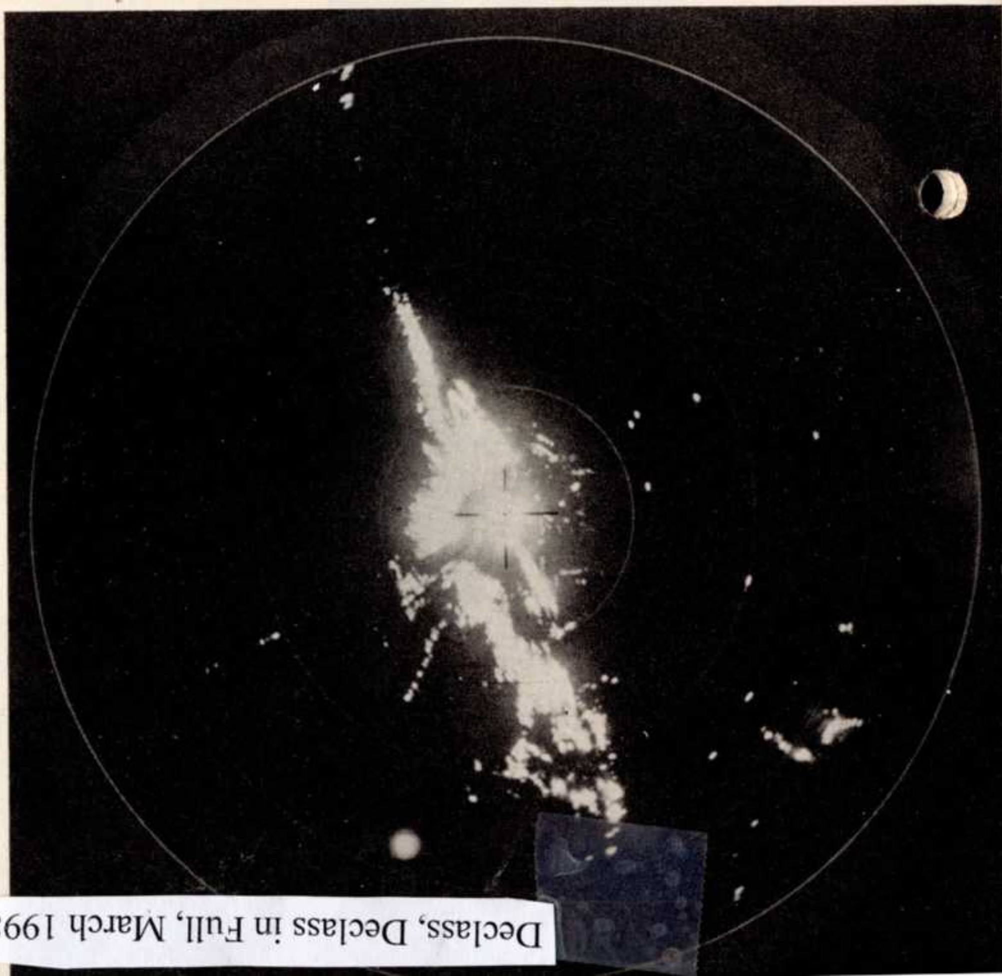
From the Naval Air Advanced Training Command at Jacksonville come the Banana River scope photographs shown here. They are reproduced as being of interest because of *unusual ranges noted.* The MEW's massive antenna has a back-to-back arrangement, one side emitting a low angle beam and the other a high beam. These pictures were made during routine operation of the set on the night of 11 April 1946, using low beam. The exposures were 1½ minutes duration, which accounts for the track of air targets visible, notably the night intercepts in progress at the time. The set is at virtual sea level.

Many CIC officers, on first seeing an MEW scope, have said, "Oh boy, if we only had a set like that aboard ship!" To such a comment, there is one good answer: Take a look at the MEW antenna. It is 25 feet long, and weighs a great deal more than you'd care to put topside on any ship afloat.

MEW PPI scope, 90-mi. range, low beam antenna. Exceptional mapping of Banana River, Indian River and associated land masses (compared with chart). Surface targets in NE quadrant from 62 to 82 miles, others inside 50-mi. range marker. A night interception exercise at 125°, 40 miles has been completed and fighter is seen breaking away in a port turn during exposure time (1½ minutes for all photos).



MEW PPI on 45-mi. range, low beam. Note fine discrimination of single plane targets at 110°, 30 miles (night intercept in progress).



MEW PPI on 200-mi. range, low beam. Presumable surface target at 110°, 150 miles. Large indication at 125°, 150 miles checks in range, bearing and shape with Grand Bahama Island. Series of indications at 340°, 190 miles does not check with any logical target, but is on the coast line, near Jacksonville.

Declass, Declass in Full, March 1998, Per OPNAVIST 5513 16-02

Declass, Declass in Full, March 1998, Per OPNAVIST 5513 16-02

NEW RADS

FROM the experience of battle and the backlog of knowledge accumulated in the testing and evaluating of warborn radar equipment, the series of radar publications known as the RADS make available the current BEST PRACTICES in the operation and tactical use of radar. Because they are constantly being revised to give the Navy's views on best practices, the Rad Series constitutes the primary requirement of a CIC library.

Newly completed and soon to be distributed are RADTWELVE and change 2 to RADTHREE. Change 2 brings RADTHREE—the Radar Operators Manual—up to date on the comparatively new equipment, such as the SX, SP and SG-4 radars which have been put into use since the original bulletin was published. RADTWELVE is the Airborne Radar Countermeasures Operators Manual. A portion of the preface to this newest bulletin follows:

"This manual is intended for operators. It is not a maintenance manual nor does it assume a knowledge of the mysteries of electronics. The gear is approached face to face and only those controls on the front panels (operating controls) are considered. The details of operation are avoided so that pilots, navigators and CIC officers may also find this manual of value in providing an introduction to the field of RCM.

"The effectiveness of radar countermeasures demands a knowledge of enemy radar equipment, our own and the enemy's tactics, and a certain philosophy or 'savvy.' Part I of this manual is aimed at providing this background to the RCM operator. These first chapters deal with the overall problems of RCM. Particular emphasis is placed on the need for and problem involved in carrying out RCM reconnaissance. Part II explains the best method of operating the gear. It presents tips from operators and simple explanations to some of the perplexing problems the RCM operator has to face. Of particular interest to navigators is a section in chapter 7 describing the use of RCM direction finders as an aid to navigators. Principles and techniques of offensive countermeasures including Jammers and Window are discussed from the operator's viewpoint in Part III."

The status of the remaining undistributed bulletins is as follows: Completed and being distributed are RADTWO-A, RADEIGHT, RADNINE, and RADELEVEN. Still being prepared are RADSEVEN—The Radar Countermeasures Manual, and RADTEN—The Airborne Radar Operators Manual. Their completion will be announced in subsequent issues of "C.I.C."

Initial distribution of the bulletins which comprise the RAD series is to those who are considered to be primarily concerned with the material contained, however requests for additional copies will be filled. These should be forwarded to CNO (Operational Readiness).

• • • • • • • • • • • • • • • •

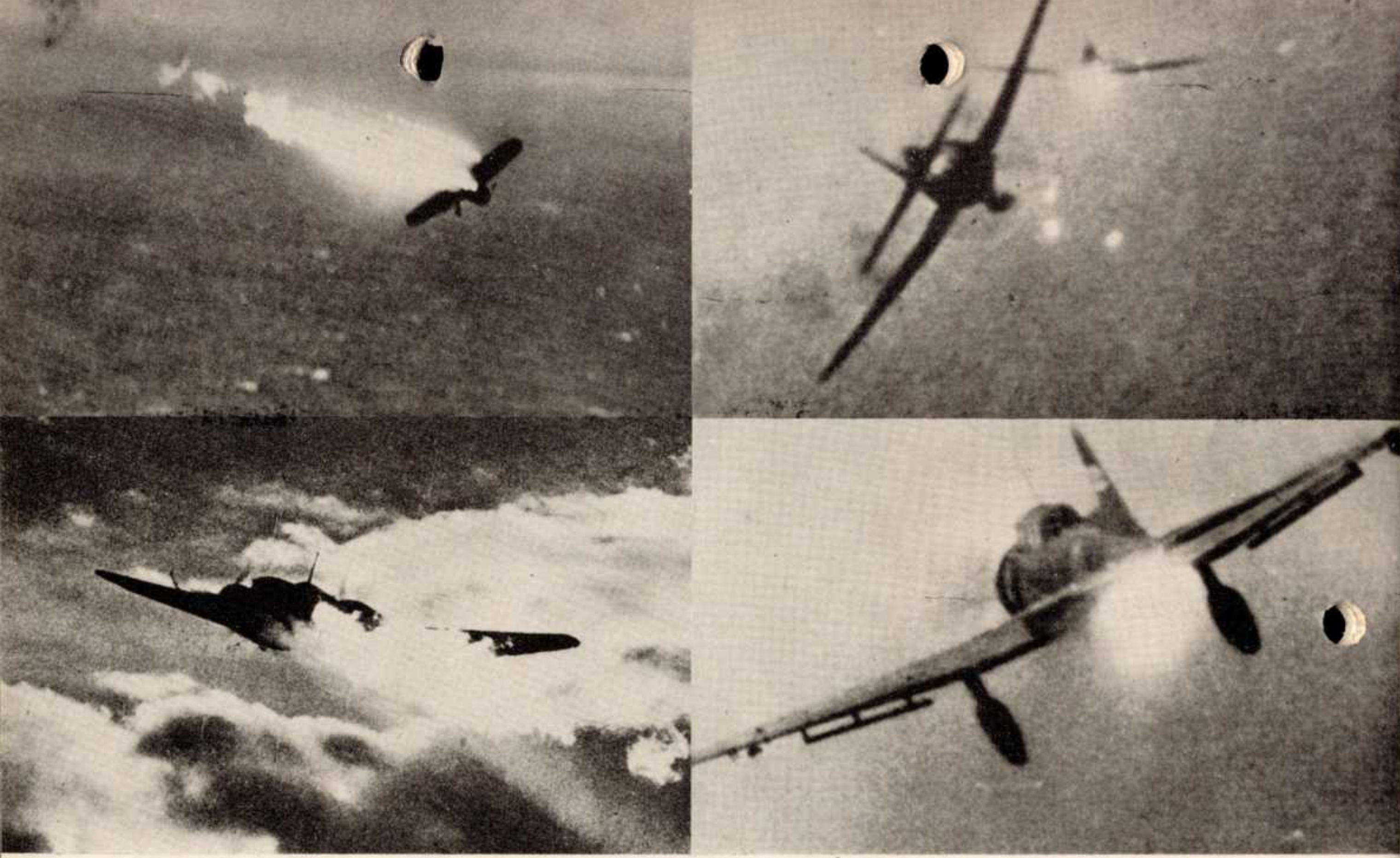
typhoons and surface winds ... a correction

As pointed out in a letter from the Naval Training School (Aerographer's Mates), NAS Lakehurst, N. J., the "rule of thumb" for determining the direction of movement of typhoons set forth in an action report excerpt in "C.I.C." (February 1946, p. 34) has no validity.

This report from T.G. 38.1 drew the erroneous conclusion that "typhoon images in the northern hemisphere will appear to be moving in a direction between 60° and 90° to the right of the surface wind direction . . ."

It will be quickly seen that this rule applies only when the observer is in the path of the advancing typhoon. In other quadrants there appears to be no connection between typhoon's course and surface wind direction.

• • • • • • • • • • • • • • • •



Shoot-downs like these . . .

history of naval fighter direction

(Part III of three parts)[1]

Chapter 4

FINAL PHASE—MASS OFFENSIVE

LATE in 1943 the steady westward march of American forces developed into a great leap-frogging offensive aimed at the Japanese homeland itself. The final phase of the war was highlighted, so far as fighter direction was concerned, by four things: (1) the picket destroyer, (2) the amphibious command ship, (3) night fighter direction at sea, and (4) visual fighter direction.

To inaugurate the big push, the Navy tried out its newest, biggest weapon: the fast carrier task force. In the summer the new CV's *Yorktown, Lexington,* and *Essex* joined the fleet. The first CVL's *Independence, Princeton, Cowpens,* and *Belleau Wood* had joined. Others were to follow early in 1944.

These carriers were all equipped with two air search radars, as earlier recommended: the new SK, with the SC-2 as a supplement. The *Lexington* brought the SM, also known as Model CXBL, an accurate altitude-determining radar. This gear, in addition to giving altitudes, permitted more accurate determination of the composition and vertical formation of the attacking forces. Aboard these vessels, the fighter director operated in a large CIC equipped with a large plotting board for a summary of all radar information, two smaller plotting tables for individual interceptions, re-

1 Written by Lieutenants William C. Bryant and Heith I. Hermans, USNR, as a section of the World War II history of Naval Aviation, in preparation by BuAer. Part II appeared in the May "C.I.C."

Declass, Declass in Full, March 1998, Per OPNAVIST 5513 16-02

Declass, Declass in Full, March 1998, Per OPNAVIST 5513 16-02

by pilots like this . . .

made scores like this.

mote PPI scopes which would reproduce any of the receiving scopes so that they could be examined without interfering with the operator, large boards for posting pertinent information, and the DRT (Dead Reckoning Tracer) for navigation and surface tracking.

After considerable argument, it had been decided to locate the CIC below decks and not in the island, and this was done in most of the new carriers and in the older ones when they were remodelled. In new battleships, cruisers and destroyers, the CIC was removed from the vicinity of the bridge. It was thus shielded to a greater extent from battle damage, noises and unnecessary visitation that added to the congestion of a place that, no matter how large, was at crucial moments crowded and busy.

Also introduced into the fleet in the late summer of 1943 was the long-awaited, four-channel VHF radio. Separate channels could now be assigned for communication between CIC's in the ships of a task force, between the FDO and his pilots, and between Air Plot and other patrol and strike groups; continuous contact with CAP and anti-submarine patrols and frequent practice at sea were possible even while a task force was steaming secretly to attack.

These improvements were tried out in the raids on Marcus Island and Wake Atoll.

In his report on Marcus, the OTC asserted, "VHF radio frequencies . . . are very valuable for important immediate communications such as maneuvering signals, combat information and fighter direction." The assignment of channels, however, was not entirely fortunate; the Inter-Fighter Director Net for communications between CIC's and the inter-plane frequency were the same, and this channel was, therefore, greatly overcrowded. The same condition was noted again after the attack on Wake, and the OTC recommended the procurement of new equipment providing more than four channels. Nevertheless, he pointed out, "In spite of the almost constant transmissions on these circuits each bogey approaching any surface formation was successfully intercepted. No enemy plane approached within range of surface gunfire. With this in view Task Force VHF communications were considered on this mission satisfactory." Another shortcoming was the lack of equipment on other surface ships. Fighter direction for the bombardment force reverted to the cruisers in which VHF radio had been hastily installed; it worked fairly well on most of them, and interceptions were made, but on the USS *Santa Fe* it was

Fast carrier task force assembled at Ulithi. In anchorages like this, ship, group and force fighter director officers meet to iron out procedures, codes and tactical details before putting to sea.

unworkable. "If any value is to be obtained by surface ships from the Combat Patrols furnished them," CTF 14 recommended, "these ships (including transports) must be equipped with VHF radio; they must have qualified Fighter Directors on board and their CIC organization, space and equipment must be enlarged to handle this function."

Another innovation in communications was a Deck Condition Code for exchanging information over VHF of carrier flight deck conditions and operations. It was recommended for inclusion in the Pacific Fleet Supplement to USF 70.

The new radar was a success. The *Lexington* reported, "The CXBL radar performance, aside from the material breakdown suffered, was good. It consistently picked up targets to its maximum range. Detection of low flying aircraft was excellent. The weakest part in this type radar is the identification feature. . . . Extremely high flying aircraft are difficult to pick up because of the searchlight type of detection. . . . Close coordination is necessary between this type radar and the standard air search radar."

The USS *Independence* with twenty-four fighters and nine torpedo planes aboard had acted as duty carrier providing most of the CAP for the Marcus raid, thus approximating the defensive fighter carrier recommended a year earlier. CTF 15 recommended that the CVL carry a full group of fighters.

After the Gilberts invasion the fleet received a new radar and fighter direction doctrine. USF 10A and its Pacific Fleet Supplement charged the Officer in Tactical Command with responsibility for air support operations, fighter direction and radar control. The commanding officers of combatant ships were made accountable for the proper organization and training of CIC's. The doctrine included much more detailed instructions for the combat air patrol and fighter director to follow. The flight leader was instructed to stack his planes when given an estimate of the enemy altitude "in such a way as to insure visual contact at the earliest moment and to provide a high cover if deemed necessary." The standard methods of vectoring the CAP to an interception in daytime and nighttime were outlined and diagrammed. Fighter direction ships were instructed to locate a visual intercept officer in the superstructure where he could coordinate lookout reports, plot all aircraft within visual range, and take over interceptions

Declass, Declass in Full, March 1998, Per OPNAVIST 5513 16-02

Declass, Declass in Full, March 1998, Per OPNAVIST 5513 16-02

close to the formation where the usual method of controlled interception was too slow and complicated to be effective.

Use of the orbit in effecting interceptions was recommended by the Fighter Director School on Oahu but it was not exempt from criticism. Since the fighters were usually told to orbit about ten or fifteen miles inside the raid, the interception was not effected at a maximum distance and the fighters had less time to work over the enemy before he reached his point of attack. Furthermore, the orbitting planes might find themselves in an awkward position from which to intercept, and finally, if they failed to tally-ho, they might, depending on their heading at the moment, take an appreciable amount of time turning onto the bogey's tail. Some FDO's recommended a different method of interception, which was approved by the new Fighter Director School at St. Simon's Island, Georgia. This method required the FDO to vector his planes to a position a little to one side or the other of the estimated point of interception and by a series of short vectors bring them around onto the bogey's course so that they would hit the raid from the side with an altitude advantage. This method obviously required much more precise estimates of enemy altitude, course, speed, close allowances for the effect of wind and altitude on the course and speed of the CAP, and exact timing.

USF 10A recognized both methods. It said, "Attacks will be intercepted by fighters vectored into the enemy . . . or by fighters put in an orbit, preferably a figure-of-eight, several miles ahead of the raid. The choice will depend upon whether these conditions—adequate radar information, trained personnel, and freedom from the distraction of too many other intercepts—permit the FD to use the second method."

This doctrine had been largely anticipated in the operations plans for the invasion of the Gilberts, and it was incorporated also in Commander Fifth Fleet's plan for the capture of the Marshalls.

(1) THE PICKET DESTROYER

The picket destroyer combined the duties of the fighter director destroyer, evolved in the Solomons, and the radar picket.

In the Gilberts invasion, destroyer-based FDO's again directed the CAP at the objective and were fairly successful, especially in the early interception of Japanese patrol planes. The amphibious force fighter director was in the headquarters ship, USS *Pennsylvania*. A similar arrangement was used at Kwajalein Atoll in the Marshalls. The fighter director teams were furnished by the Pacific Fleet Radar Center, Oahu, and the force fighter directors and later some of the destroyer teams were supplied from a pool maintained by Commander Air Support Control Units, PhibsPac.

The radar picket, as distinguished from the fighter director destroyer, was any ship detached from the main force and given special radar guardship duties. Enroute to the Gilberts a fighter director destroyer was used for this purpose; its station was 30,000 yards in the van. At Kwajalein a radar screen was stationed ten miles outside the sound screen, and cruising instructions enroute to the Marianas provided for radar pickets at night ten miles from fleet center for early detection of aircraft and surface targets. None of the radars, except the SM and its successor, the SP, was able to detect low-flying aircraft at any appreciable range, and only the fast carrier forces were equipped with these sets at the time. Use of the picket thus extended the margin of safety.

The two functions of early warning and fighter direction had been combined in the *Kimberly* enroute to the Gilberts. They were combined again at Saipan. At night a destroyer with a fighter direction team aboard was stationed west of the northern part of the island, another was stationed west of Tinian Harbor to the southwest of the transport area, and for a time a third operated east of Saipan. Most of the attacks approached from the direction of Guam and Rota to the south, and the destroyer west of Tinian was about twenty miles closer to those islands than were the transports and the force flagship with the force fighter director aboard. Although the flagships, the USS *Rocky Mount* and the USS *Cambria*, had SK radars and higher antennas that gave them a greater radar range, they were so close to rugged Saipan Island that the radar scopes were partially taken up by land echoes. The picket destroyers to the southwest sometimes detected bogies from the direction of Guam and Rota before the flagships and initiated interceptions. In addition, the destroyer was able with its fire control radar to furnish an accurate estimate of the bogey's altitude when it was still about thirty miles from the force and thus assist the night fighters which, for the first time in an amphibious operation, protected the invasion force.

There was another important advantage in using picket destroyers. The force fighter director was delegated responsibility not only for fighter direction but also for broadcasting warnings and alerts, and the flagship CIC was required to give the OTC a running picture of the attack. The destroyer team, except for supplying information over the warning and inter-fighter director nets, was free to concentrate on the interception.

Before the first carrier strike on Tokyo, a radar patrol line of two pickets and six other destroyers was established forty miles from Task Force 58 in the direction of the objective. A CAP of sixteen fighters was stationed over this force, and eight enemy planes were shot down. Four of these were trying to sneak in behind the returning strike group and might otherwise have been undetected. The OTC reported that the patrol line's "performance of duty under most difficult conditions was outstanding, and of great benefit to the Task Force as a whole."

First Carrier Task Force Instructions issued in April, 1945 made the use of picket destroyers and radar patrol lines a routine procedure for Task Force 58, and similar instructions were issued for the Second Carrier Task Force in July.

Pickets were used extensively at Okinawa and in supporting operations for that invasion. They were often attacked as primary targets although it was not definitely known that the Japanese had learned of their mission. The success of fighter interception against the heavy Japanese attacks on TF 58 in June, 1944 had forced the Japanese to adopt radically different tactics; they had introduced Kamikaze attacks in October against the next major U. S. offensive. Against such opposition fighter direction had to do more than break up the enemy raid; the enemy had to be stopped completely. Commander Fifth Fleet reported in his chronology:

"16 April 1945 . . . Attacks on ships at Okinawa were concentrated on pickets and outlying ships. At least 270 planes were shot down or crashed."

"22 April 1945 . . . Suicide attacks . . . damaged seven destroyer types in picket stations."

"9 May 1945 . . . Dusk suicide air attacks damaged *Oberender* (DE) and *England* (DE) in radar picket stations."

Many other destroyers and destroyer escorts were damaged or sunk in this operation while on picket duty. To protect the pickets by fire power, when the CAP failed, a second destroyer and four LCS types were added to make a picket unit.

In spite of their troubles and the failures of fighter direction to protect the forces from serious damage, the admiral concluded, "The effectiveness of radar pickets in protecting an amphibious operation against enemy air attacks was demonstrated. They provided air warning service, shot down many planes by AA fire, and by controlling their own CAP's, contributed to the destruction of many more. Although the radar picket ships suffered heavy losses from these attacks, it is believed that the enemy committed a serious error in concentrating on them instead of avoiding or ignoring them in favor of the transports."

One of the pickets, the USS *Cassin Young*, reported that the greatest difficulty was the old one of determining the enemy's altitude for purposes of interception. The destroyers had to rely on the SC-2 with its fade chart and on the fire control radar which had a relatively short range. "Many good interceptions failed to result in sighting the enemy due to poor altitude information during cloudy weather," the commanding officer noted. "There was often a great variation in altitude estimation on the same raid even with fire control radar, and even if the FD altitudes are good on attacking planes, it is usually too late to make a successful interception before the bandit is overhead. If certain fighter director destroyers were equipped with a fairly reliable altitude determining radar, such as the SP, they could handle any type of interception or fighter direction duties." This equipment was being installed at the end of the war on certain destroyers.

(2) THE AMPHIBIOUS COMMAND SHIP

The need for a specially equipped vessel to house the commander of an amphibious invasion force and provide him with adequate radio and radar facilities was apparent at Guadalcanal. Such a ship was provided for the Commander Central Attack Force in the invasion of Sicily in July, 1943. It was the USS *Ancon*, formerly a troop transport, but remodelled to provide operations and plotting spaces for the staff. Fighter direction, however, was done by Army controllers on the USS *Monrovia*, and Army planes were used for CAP. During the invasion of Salerno in September, direction of land-based planes was done in the *Ancon's* CIC by Army controllers; HMS *Ulster Queen* directed carrier planes. It was recommended that special fighter control ships be provided for future operations and that they be equipped with GCI radar for night interceptions. The ships should have their own fighter director teams permanently stationed on board, it was said.

The first ships specially constructed for this pur-

Declass, Declass in Full, March 1998, Per OPNAVIST 5513 16-02

Declass, Declass in Full, March 1998, Per OPNAVIST 5513 16-02

pose were the USS *Appalachian*, USS *Blue Ridge* and USS *Rocky Mount*, classed as AGC's. Their original complement included a full CIC team of radar operators and nine officers; all of the latter were qualified in fighter direction. They were equipped with an SK radar for air search, two SG's for surface search, and a small portable radar for emergency use. The *Appalachian* and the *Rocky Mount* were first used for fighter direction when they carried amphibious commands to the invasion of Kwajalein Atoll in January, 1944. First actual fighter direction against enemy planes was done on the *Rock Mount* during the invasion of Saipan.

The importance of this development from the standpoint of fighter direction lay in the fact that it provided the force fighter director with a CIC devoted almost exclusively to his and the OTC's requirements and supplied the transport convoy and the amphibious beachhead with radar equal in performance to that available in the carrier task force. The function of the flagship CIC was not primarily fighter direction but the coordination and evaluation of reports from its own radars, from other ships and from dispatches. Although interceptions were sometimes handled directly by the force fighter director or the intercept officers of ship's company, the force fighter director and his CIC were concerned mainly with positioning picket destroyers and coordinating their activities, initiating air warnings, and supplying the OTC with a running commentary whenever a bogey was detected and an interception was in progress.

Radar facilities on the AGC's went through approximately the same evolution as on the carriers. The first three were equipped with small Radar Plots on the Flag Bridge level of the superstructure. Two ordinary tables, not even regular plotting tables, were provided, and a remote PPI. The SK receiver was in an adjacent control room.

In November before heading for the Pacific the *Rocky Mount* was remodelled with a fairly large but cluttered CIC on the main deck level adjacent to the Joint Operations Room. It was equipped with regular intercept tables, a vertical summary plot, remote PPI and DRT. The SK receiver and one SG indicator were in the small closed-off corner, the Radar Control Room.

Experience in the Marshalls and the Marianas demonstrated the need for an altitude determining radar, especially for night fighter direction.

In later AGC's the CIC was rearranged to provide more room, greater blackboard and status board space, and better plotting tables and boards.

Giant eye. On this edge-lit lucite plot in an Essex class carrier CIC was displayed the air picture as told by reports from own and other ships' radar.

In November, 1944 the USS *Eldorado* equipped with an SP radar joined the amphibious forces and in February, 1945 carried the amphibious commander for the invasion of Iwo Jima.

Magnitude of the problem handled by the force fighter director and the CIC personnel of AGC's increased greatly during the invasion of Okinawa. Combat air patrols over the objective area varied from fifty-six to seventy-six planes plus five two-plane CAP's for the picket destroyers. Of 657 night fighters launched during a forty-seven night period, 252 had to be vectored on interceptions. Daytime sorties totalled over 17,000 for the target area. The larger number of fighter divisions used and the interception of several simultaneous raids necessitated the use of a multi-channel fighter net, and new ten-channel equipment had been partially installed for this purpose.

Fighter skipper briefs his squadron in a carrier ready room.

(3) NIGHT FIGHTER DIRECTION AT SEA

"The principal tactical problem confronting the carrier task force is defense against night aerial torpedo attacks. During December over 90 per cent of all Japanese offensive aerial effort in the South and Central Pacific occurred at night," CincPac reported on operations in December, 1943.

The first attempt to solve this problem was made on the night of 24 November 1943 when a radar-equipped TBF and two fighters took off from the USS *Enterprise*. No interception was made that night, but on the 26th the same combination shot down two or three Japanese planes and broke up a torpedo plane attack. Commander Fifth Amphibious Force urged that "every attempt should be made to furnish at least a minimum requisite of night fighters to all carriers."

The first detachments of night fighters were placed on the USS *Enterprise* and USS *Intrepid* in January, 1944. On 16 February the *Enterprise* vectored a night fighter from the USS *Yorktown* to radar contact on a bogey, but the contact was lost, and the *Intrepid* was torpedoed by the elusive enemy. *Yorktown* night fighters failed again to intercept near the Marianas on 22 February.

Greater success was had during the invasion of the Marianas when the amphibious and supporting forces were subject to many night attacks. "The performance of night fighters was most gratifying," CTF 58 concluded. "Our VF (N) made 10 successful interceptions resulting in kills. Particularly outstanding was the work of the VF (N) unit attached to the *Enterprise* in that they accounted for three enemy planes during one night." The large carriers were operating west of Guam and Rota, stopping off points for Japanese planes headed for Saipan from bases to the south. At Saipan itself, picket destroyers, the *Rocky Mount* and the Army controllers ashore directed the land-based night fighters. Radar contact was made several times and the Army controllers made one successful interception.

The enemy appeared to have found a partial answer to the night fighter in the form of a radar countermeasures device known as "Window," consisting of strips of paper coated with metal foil that will reflect a radar pulse. CTF 51 called attention to its use "possibly to prevent interception by our night fighters." Several times the Japanese bogies dropped "Window" while the night fighters were in pursuit and flew repeatedly through the same areas. The night fighter, depending on radar for interception, sometimes mistook the echo of the "Window" for the plane and was thus eluded.

During the summer it was decided to form two types of night fighter groups (1) the four-plane section to operate as a unit of the regular daytime squadron, and (2) a squadron composed entirely of night fighters and torpedo planes to be based on special carriers.

The USS *Independence* was the first carrier designated exclusively for night operations. On the night of 12 October 1944, its night fighters destroyed three Japanese planes near Formosa, and from 10-31 October, they shot down seven out of fifteen contacts at night.

While the fast carrier forces were operating in Formosan waters, the Japanese attacked repeatedly during evening twilight and at night. They used considerable numbers of bombers and torpedo

Declass, Declass in Full, March 1998, Per OPNAVIST 5513 16-02

Declass, Declass in Full, March 1998, Per OPNAVIST 5513 16-02

planes escorted at times by fighters. The Third Fleet Fighter Director Officer called attention to these attacks as "the worst problem of all." They were pressed regardless of weather conditions. One or two planes by turning on running lights or dropping flares homed the rest, and a coordinated attack followed. On 13 October the USS *Canberra* was torpedoed, and on the 14th USS *Houston* was torpedoed and USS *Reno* was hit by a damaged enemy plane. In none of these instances was there a CAP on duty.

Day fighters were used for interceptions if it was not too late, and an enlarged sunset CAP of four to six divisions, including about eight night fighters, was used. The *Independence* operated apart from the main group so as to be free to launch and recover her planes. After the daylight CAP had landed, one VHF channel was assigned to each pair of night fighters; a separate base controlled each pair. The same officer recommended that two destroyer pickets be stationed forty to fifty miles from the main force in the two directions from which an attack was most likely and be given control of two pairs of night fighters. It was hoped that they could give early warning to the force, initiate interceptions and perhaps decoy the attackers from their primary target.

At the end of 1943, the emphasis had been on land-based fighter direction in the Solomons; in December land-based planes had destroyed eight enemy planes at night. By October, 1944, the balance was reversed. One plane was accounted for by land-based night fighters, seven by carrier-based. In the year from November, 1943 through October, 1944, the average distance at which the night fighters contacted their bogies by radar increased from 1.7 miles in the first six months to 2.8 in the last six. Navy and Marine night fighters had destroyed a total of thirty-nine enemy planes in controlled interceptions during the year.

The *Enterprise* added to its good record on the night of 14 December 1944 before an attack on Luzon. An enemy search plane was shot down within seventeen minutes of the first radar contact, apparently before it could report to its base, thus permitting the force to approach Luzon unobserved. On 24 December the *Enterprise* became the first large carrier detailed exclusively to night duties, as a night air group came aboard. In January, 1945 the *Enterprise* and the *Independence* were joined to form the first night carrier task group.

The *Independence* was responsible in January, 1945 for safeguarding the carrier task force from enemy detection. Night fighters shot down three enemy search planes in one night while the task force was passing through Bashi Channel enroute to strike enemy targets in the South China Sea.

CTF 38 approved the night carriers. "When the number of carriers permits the assignment of one carrier to exclusive night duties," he said, "the results have been exceptional. The relief of other carriers from night duties, plus the use of the specially trained night groups for special night tactical and defense missions are very advantageous."

Dusk attacks became a problem again in January, 1945, at Lingayen Gulf, Luzon, and enroute to that objective. Commander Seventh Fleet noted that "thirty percent of the damaging suicide attacks occurred between the hours of 1700 and 1800. . . . Sunset for this period was at 1740. This shows the Jap's preference for attacking a half hour before sunset when he can use the sun's glare to cover up his approach, and when our combat air patrol is being recovered." Army night fighters covered the task groups during morning and evening twilight, but the fighter direction ships were not equipped with altitude-determining radar.

The night carrier group disbanded in February when the *Independence* took on a regular air group and the USS *Saratoga* was assigned to close support duty. The night fighters continued to be more effective against snoopers than against determined attacks. On the night of 17-18 March the *Enterprise* night fighters shot down two snoopers. However, on the night of the twentieth, the Japanese again resorted to the use of "Window" to confuse the fighters and a number of snoopers eluded interception. An unsuccessful torpedo plane attack followed.

Meanwhile, the day carriers continued to operate night fighter divisions. The *Enterprise* with its night air group was out of operation due to battle damage from 21 March to 8 April, 11 April to 6 May, and 14 May to 28 May. CTF 58 concluded, "A single night carrier such as the *Enterprise* is not dependable to protect the whole force. A night carried assigned to each task force would be a solution, but such an employment of carriers would result in a decrease in the overall offensive potential of the Fast Carrier Task Forces. Therefore, it is recommended that each CV be equipped with 6VF (N) and 6VT (N) type aircraft, and that consideration be given to the discontinuation of the night carrier program as such."

The enemy was now attacking heavily by day. He continued his night attacks, but they were smaller and not always as well coordinated as be-

They did "get the carriers" in the first battle of the ***Philippines,*** *June 1944. They also got the Jap planes in the famous Marianas turkey-shoot—some 400 of them.*

fore. On 11 April ". . . attacks were mainly single or small groups of aircraft and were badly executed and presented little threat to a well-maneuvered force." Eleven were shot down by the night fighters. In all, the night fighters of Task Force 58 accounted for ninety-one enemy planes from 18 March through 25 May.

This success, CTF 58 pointed out, was achieved mostly by the night fighter divisions on the day carriers and not by the night carrier groups. He attributed the success to:

"(a) A rigid force control of the number of VF (N) airborne (not more than 4).

"(b) Shifting of control (oftentimes control was passed to 2 or 3 bases before interception resulted in a kill).

"(c) Excellent maintenance on the part of all carriers.

"(d) Good night controlling."

In the target area at Okinawa were three AGC's equipped with SP radars and five GCI sets ashore that could determine altitudes. In addition, the fighter direction destroyers often assumed control of the night CAP. Of 252 night interceptions attempted from 30 March through 17 May, 116 resulted in radar contact by the fighter, but only eighteen resulted in shoot-downs. The task force fighter director explained that many attempted interceptions and contacts had to be broken off to protect the night fighter as he chased the raid into ship and shore AA range during Control Yellow.

The technique used by night fighters throughout the last phase of the war was basically that developed by the British and employed by the Navy and Marines in the Solomons.

(4) VISUAL FIGHTER DIRECTION

Fighter direction before radar was based on visual information. At Guadalcanal the fighter directors sometimes relayed to fighters in combat over the field the locations of enemy planes spotted from their communications truck or fox-hole. But the use of visual fighter direction as a back-stop when radar control had failed was not emphasized until the summer of 1944. The beatings administered to large, high raids in the Solomons forced the Japanese to try new tactics. The result was the low-flying torpedo attack against which American radar was least effective. True, the SM and SP radars were more effective than others in detecting low planes, but these were fighter director sets designed primarily to check the altitudes of planes picked up by the air search radars and they were often too busy doing this to maintain a careful search for low-flying planes. Damaging raids

Declass, Declass in Full, March 1998, Per OPNAVIST 5513 16-02

Declass, Declass in Full, March 1998, Per OPNAVIST 5513 16-02

were sometimes undetected until lookouts sighted them, and by that time, fighter direction by radar control with accurate vectors and orbits was impossible. There was time to give the fighters, if any were close enough, only the briefest kind of order indicating the direction from which the bogey approached and his approximate height. This could best be done, not by acting in CIC on reports from lookouts, but by having a fighter director officer keeping a lookout topside, assisted by enlisted plotters and talkers, and equipped with a radio microphone and earphones so that he could initiate the interception of low-flying planes and give the fighter frequent changes in heading to bring them directly to the enemy.

USF 10A required the fighter direction ships to station a visual fighter director topside, who, with enlisted help, would keep a constant plot of all planes visible, coordinate lookout reports and keep CIC informed, and be ready to take control of the CAP when necessary. Similar instructions were incorporated in Commander Fifth Fleet's operations plan for the capture of the Marshalls.

USF 10A suggested that planes on the Anti-Submarine Patrol might best be vectored by the visual FDO against low-flying bogies. While supporting the invasion of Hollandia in April, 1944 the Anti-Submarine Patrol for Task Force 58 was augmented "with one fighter designated the Anti-Snooper Patrol. These Anti-Snooper Anti-Submarine teams accounted for two low-flying Bettys, one of which had not been previously detected." Whether the visual fighter directors controlled these interceptions is not mentioned. However, CTF 58.1 in his report on the bombardment of Satawan and Ponape, 30 April-1 May, 1944 mentions that "a visual defense procedure was set up for defense against low-flying enemy aircraft. . . . Four search planes were shot down by patrols assisted by visual control."

The Anti-Snooper Patrol was employed by the Third Fleet in its support of the landings on the Palaus, Morotai, and Leyte. CTF 38 recommended that fighter planes could be used for all routine patrols.

In September, 1944 a new Fighter Director Vocabulary was issued which included a voice code for visual fighter direction. The visual station on the fighter directing ship was known as "Snap", and a few brief, common terms were given specific meanings. "Up," for example, meant to climb and "Pronto" meant to go into a tight turn in the direction indicated. The vocabulary also provided needed terms for reporting weather conditions.

The persistence of Japanese suiciders in availing themselves of land masses and low altitudes to escape detection made visual control still more urgently needed in the Philippines.

Methods of visual fighter directing were not entirely standardized at this time. The doctrine was that there should be an intercept officer topside and that he should direct his planes "by simply telling the location of the attacking planes by magnetic bearing and distance from the directing ship. . . ." But not all ships had compasses and radio equipment available in a position topside from which the visual FDO could scan the entire horizon, and not all those who tried out the official method found it satisfactory.

Enroute to the invasion of Mindoro, reports on three enemy planes were received from destroyer lookouts, and the FDO in CIC ordered his fighters to dive in the bogies' direction, which he indicated by a clock code with force's heading at 12 o"clock. The CAP was at 5000 feet. All three planes were shot down, the commanding officer of the USS *Natoma Bay* noted, "indicating the value of this method over the Visual Fighter Direction method which had been previously used without success." CTU 77.12.7 reported, "Enroute to the objective Visual Fighter Direction exercises were conducted with very little success. During the two days in the Mindanao Sea it was expected that visual fighter direction would 'come into its own,' but, contrarily, it proved most disappointing. Although in the Mindanao Sea most of the information on the bogies was visual, it came from the bridges and lookouts of various ships, mostly from screening destroyers, and was acted upon to best advantage by the controlling FDO's in CIC."

In Lingayen Gulf in January, 1945 the pre-invasion bombardment force also used lookout reports in directing the CAP from CIC instead of using a topside visual fighter director. This kind of control was credited with 90 percent of the interceptions effected by the force.

The transport groups enroute to Luzon had visual controllers stationed topside in radio communication with a section of fighters circling at about 1000 feet around each group. The clock code with the group's heading at 12 o'clock was used to indicate the direction of the bogey, the direction to be taken by the CAP. This procedure was ineffective, and report said, because "clock code was used during a period of radical course changes caused by the approach of bogies. Twice the CAP, unaware of the course changes of the surface units far below, started on vectors in the opposite direc-

Fighter skipper in Task Force 58 describes an action in the first battle of the Philippines to his carrier's captain.

tion from that of the bogies they were supposed to intercept." Apparently in these instances a relatively high CAP was being used.

Still another group attempted to meet the threat by stationing each of four divisions of fighters in a 90 degree sector at a maximum range of twenty-five miles from the formation. This "Snap" patrol was later flown by two-plane sections at a maximum range of fifteen miles.

During the invasion of Okinawa, the First Carrier Task Force used either the combination Anti-Snooper Anti-Submarine Patrol or a special fighter patrol known as "Jacks." A Jack was a section or division of fighters which orbited at low altitude within visual range of the outer screen or radar picket. One of these units was assigned to each quadrant. CTF 58 noted that "visual fighter direction was stressed, and in each Task Group visual stations were maintained at all times during daylight."

Reports on the effectiveness of visual direction at Okinawa are few. The forces were operating in more open waters where the SP radar could often pick up the low-flying planes at twenty-five or thirty miles, and the use of destroyer pickets encouraged the Japanese, if they were intent on striking the main force, to come in at a greater altitude. In addition, it appeared that the Japanese had discovered that American radar was not only relatively ineffective in detecting low-flying planes but also in detecting single planes or small groups at very high altitudes. As a result, the enemy's snoopers often flew high instead of low, thus avoiding the "Jacks" and the Anti-Snooper Patrols.

SUMMARY

The First Battle of the Philippine Sea in June, 1944 was a triumph for fighter direction as it had been conceived at the beginning of the war when the primary threat was a mass attack delivered at a considerable altitude, with a minimum of evasion, at the most from several different angles of approach. CTF 58 summarized this phase of the battle as follows: "The four major attacks were each hit at ranges of some 50-60 miles from the carriers, and each time with sufficient altitude advantage to our fighters. It was the first time that a major enemy air blow has been made on our forces without the loss of or serious damage to at least one of our carriers. It proved that the long and costly efforts in research, training, and the practical application of radar have not been in vain." He listed two principles followed by the Task Force Fighter Director:

"(1) Every effort was made to insure that an adequate number of fighters were being vectored out against each raid. . . .

"(2) Insofar as possible every effort was made to insure that an adequate supply of fresh fighters was available for any subsequent raids . . ."

"Of 33 interceptions initiated as a result of radar or visual contact, 28 were completed successfully, resulting in the destruction of 141 enemy planes. One of the most important factors in the success of fighter direction during this phase was the instantaneous reinforcement of standing combat air patrols. Whenever one division of the standing two division combat air patrol was committed to an interception, eight more fighters were immedi-

Declass, Declass in Full, March 1998, Per OPNAVIST 5513 16-02

Declass, Declass in Full, March 1998, Per OPNAVIST 5513 16-02

ately launched if another bogey contact appeared on the radars," the reports said.

Not only had fighter direction improved, the radar and radio equipment was better than it had been in the major battles of 1942 and 1943; the F6F was a great improvement over the F4F and superior in most respects to the Japanese; and the addition of new aircraft carriers with larger complements of planes made more fighters available for defense. (Later, when the Third Fleet was blanketing fields on Luzon with its fighters, the USS *Wasp* and USS *Essex* each had ninety-one fighters aboard to the exclusion of other types.)

In addition to a large CAP overhead, a considerable number of fighters had been sent over the airfields of Guam where, without the aid of fighter direction, they intercepted numerous enemy planes that by-possed the carriers, intending to refuel, rearm, and take off again to attack TF 58 or the amphibious beachhead at Saipan. Twenty-nine enemy planes were shot down. This use of fighter blanket over the enemy fields was not fighter direction, but its result was to immobilize the enemy air forces and lighten the fighter director's task. A similar result was achieved by the fighter sweeps that were initiated, according to CTF 58, in this operation against enemy fields throughout the Marianas before the landings. Similar also was the use of night fighters as intruders over fields from which the enemy's harassing attacks were staged. These tactics were repeated again and again.

It has been necessary to retrogress to the First Battle of the Philippine Sea in order to see possibly why the Japanese adopted the mass suicide attack and why, as a result of it, fighter direction and tactical radar were in greater flux towards the end of the war than they had been at any time since Guadalcanal.

The success of our fighter defense in this battle and the attrition suffered by the Japanese air forces on land and sea forced them to find a new kind of attack. The traditional type of attack had been decimated in the Solomons, and had now suffered its worst defeat. Coordinated attacks by low-flying torpedo planes continued with some effect, but they were not sufficiently successful to threaten or retard the American offensive, and they were costly. The new SP radar made it a little harder for them to approach undetected, and the night fighter made it harder for them to attack unopposed.

The mass attack by suicide planes was first tested in the Second Battle of the Philippine Sea and its apotheosis came in the air battles around Okinawa. The high level bombers and dive bombers had to attack in large groups in order to obtain sufficient hits to insure serious damage, but the lone suicider, if he held his aim and hit solidly, was almost certain to do a great deal. The "Kamikazes," though many of them attacked at once, came singly or in small groups at various altitudes and from different directions. They could be much more evasive than any large group of planes, and the number of sections and divisions of fighters that had to be sent separately to intercept them was greatly increased. The problem of fighter direction, with its attendant communications and radar operation, became that much more complicated. At the same time, fighter direction had to be even more effective against this kind of attack than any other. It was not sufficient to shoot down most of the attackers to prevent the raid from being effective. Those who escaped the CAP, though few in number, were a major threat.

Another report by CTF 58 illustrates the magnitude of this change. "Fighter direction met its most strenuous test in the present Kyushu-Okinawa operations," the report said. "Rarely have the enemy attacks been so cleverly executed and made with such reckless determination. These attacks were generally by single or few aircraft making their approach with radical changes in course and altitude, dispersing when intercepted and using cloud cover to every advantage. They tailed our friendlies home, used decoy planes, and came in at any altitude or on the water. Only once during the entire present operation did the enemy attack in the old orthodox fashion. Here a raid of 32 Bettys with 16 fighters as cover stacked 14-18,000 feet was annihilated 60 miles from this force. Fighter Director teams and radar personnel operating in this task force were well trained and experienced and every effort was made to increase efficiency by practice and experience. Never before, however, have the limitations of our present equipment become so pronounced, and the enemy, fully aware of these limitations gained by experience and other means, made every effort to attack this force under the cloak of these limitations and with quite effective results."

The report lists the following limitations on effective fighter defense against this type of attack:

"(a) The human element. . . .

"(b) . . . no consistent radar protection against low-flying aircraft, particularly against single or small groups. . . . It is equally important to realize that although it is sometimes possible to detect the presence of this type of attack, it is extremely dif-

End of a Kamikaze, shot down by AA off Okinawa.

ficult to intercept and to get fighters on. At best the fighters probably have an opportunity to make only one pass against this type of attack.

"(c) A plus or minus two degree bearing error in the SC-2 and SK makes possible a seven mile error in position at 100 mile range. This, as well as the difficulty in obtaining accurate altitude estimate beyond fifty mile range accounts in part for the uncompleted long range interceptions on a single or few aircraft. . . .

"(d) It is pertinent that single or small groups of aircraft making radical changes in *course, speed* and *altitude* are very difficult to track with our present equipment and operator technique. This condition may be further aggravated if there are other groups of friendly planes in the general area and by use of 'window.' . . .

"(e) The use of 'window' itself, contrary to the general impression heretofore prevailing, can be quite effective. . . ."

In several other ways the Japanese had taken advantage of our weaknesses and were endeavoring to overcome their own. They had effectively used radar countermeasures to confuse our night fighters and our anti-aircraft control radars. They had learned that a snooper may avoid detection at a very high altitude almost as well as at a low one, and thus elude our patrol planes. They were beginning to use piloted missiles, the Baka bombs, which were less expensive, in materials at least, than the suicide plane. Successful day and night interceptions by allied fighters, which could not have been made without fighter direction, had greatly impressed the Japanese and they were making continuous efforts to improve their own procedure. A set of instructions issued by the Imperial GHQ commented on the need for early interceptions, good communications, and altitude advantage. An excellent Jap manual on radar evasion for pilots was also extant.

American fighter direction was made more effective near the end of the war by the installation of new radio equipment affording a greater number of channels for fighter control and inter-fighter director communications. A new IFF system, the Mark IV, was ready for experimental try-outs to replace the Mark III which was not sufficiently directional and appeared compromised. Still another type of identification equipment was being designed. A radar was being designed to search overhead where the SC-2 and SK were blind. A new type of precision PPI, the VF, had been installed in some CIC's and from it accurate ranges and bearings could be obtained in the CIC on ranges up to 25 miles without waiting for the operator. A prime need was a radar to give accurate altitude readings at greater range, with greater speed, and without stopping the antenna and thus interrupting the search for other contacts.

Vocabulary and doctrine were revised again be-

Declass, Declass in Full, March 1998, Per OPNAVIST 5513 16-02

Declass, Declass in Full, March 1998, Per OPNAVIST 5513 16-02

fore the end of the war. So far as fighter direction was concerned, the principal change in the new doctrine, issued in May 1945, was that it made no attempt to prescribe how the fighter director should guide his fighters to their target under various types of control. The new vocabulary differed very little from the old.

In the era of aircraft and atomic missiles travelling through the stratosphere at supersonic speeds, "Radar will undoubtedly be called upon to control friendly aircraft and missiles and to intercept those of enemy," predicted the Chief of Naval Operations. "It is believed that long range planning and development of radar must be with the view to meet this future situation." After describing the three stages of aircraft interception at the end of the war—detection of the enemy and determination of his course, positioning of the CAP, and the attack—there were noted the following difficulties that were being encountered:

"(a) *Limitations in coverage*—Range in the order of magnitude of 100 miles, no protection against low-flying aircraft beyond the horizon, inability to detect high-flying aircraft, serious nulls in the area normally covered.

"(b) *Limitations in altitude determination*—Inability to determine altitudes accurately or consistently at low position angles.

"(c) *Concealment of aircraft*—Inability to detect aircraft in the vicinity of land masses, heavy clouds or when protected by 'window.'

"(d) *Limitations in display*—The display of information was slow, complicated and incomplete, rendering it difficult for the human mind to grasp the entire situation either rapidly or correctly and resulting in the inability to handle more than a few raids simultaneously. Weak communications prevented information from being properly collected or disseminated either internally aboard ships or externally between ships of a force.

"(e) *Limitations of interception equipment*—Insufficient range and accuracy of airborne interception radar and the unsuitability of visual sighting due to normal atmospheric conditions.

"(f) *Confusion of Identity*—The inability not only positively to tell friend from foe, but also the inability to determine personal identity of friends."

"At this time," the report continued, "it appears unreasonable to demand extremely long ranges, precise altitude, or solid coverage from a single radar, and therefore, it appears probable that the principle of advanced pickets, both surface and airborne, will continue as an essential supplement to the radars aboard carriers and capital ships." But for the long-range problem, CNO called for:

1. Shipboard radars that would detect aircraft and guided missiles up to 300 miles away at altitudes up to 50 miles;

2. Airborne radars that would pick up other aircraft and missiles at 100 miles; others adequate to guide a fighter to an interception on a target twenty miles away;

3. Altitude determination up to 150 miles away with a margin of error not more than forty to sixty minutes of arc;

4. Detection of aircraft "irrespective of the proximity of land masses, atmospheric disturbances or 'window' type of concealment";

5. A method of presenting radar information "automatically, instantaneously, continuously and in such a manner that the human mind . . . may receive and act upon the information in the most convenient form"; instantaneous dissemination of information within the ship and force;

6. Positive discrimination between friend and foe and, if possible, personal identity.

A presage of things to come, the airborne CIC was already in operation in restricted form and was planned as a supplement for the destroyer picket. The British had equipped a Wellington bomber with a new type radar, VHF radio and a radio altimeter and had from it vectored a Mosquito against German Heinkels bearing flying bombs. They foresaw the use of this kind of patrol bomber to direct escorting fighters in defense of an attacking air group. CNO referred to it as an aerial picket, apparently envisaging its use in the interception of enemy raids. We were equipping special TBM planes with airborne early warning radar, and it was planned that four CV's would receive the corresponding shipboard gear to operate with these planes. Also the Navy was experimenting with special B-17's containing an airborne CIC and equipped with similar radar.

APPENDIX—FIGHTER DIRECTION TRAINING

In the early days of radar most of our information was gained from the British. Various observers were sent to England and the British fleet, and their reports formed the basis of our early experiments with radar and fighter direction. The observers, on their return, passed on the information to others in what might be termed apprenticeship teaching.

One that got through. SANGAMON *has her whiskers singed by a hairbreadth near-miss. Shortly after, another Kamikaze crashed full into the flight deck.*

After fighter direction was accepted as a necessity for the United States Fleet, a training program was instituted to produce eighty fighter director officers and 275 radar plotting officers or junior FDO's by July, 1943. In August, 1941 some personnel were sent to a five-week radar course at the RCAF Radio School in Ontario. On 22 September the Fighter Director School, NAS Norfolk, convened its first class in radar plotting and fighter direction. It was to train reserve aviation specialists for the Atlantic Fleet. On 1 October the first class convened at the Fighter Director School, NAS San Diego, destined for the Pacific Fleet.

With the outbreak of war it was realized that a much larger program would be needed. The problem of choosing the best personnel for this duty caused some concern. A series of tests used by the British in selecting fighter direction personnel was analyzed by the Bureau of Medicine and Surgery; it was not recommended. As late as June, 1943 the Commander in Chief, Atlantic Fleet, recommended that only officers with actual experience as pilots are suitable as Fighter Director Officers, but for the most part those trained in the new program were V-5 candidates who had failed in flight training and aviation specialists recruited from civilian life wha had had some occupation requiring them to meet people frequently and make themselves understood easily: newspapermen, lawyers, teachers, salesmen, and insurance personnel. These were usually graduated as assistant or junior FDO's or as CIC watch officers, but many of them eventually became Fighter Director Officers in charge.

In April, 1942 the school at San Diego was ordered to Maui in the Hawaiian Islands; it actually relocated in the Navy Yard, Pearl Harbor. As late as April, 1943 the schools at Pearl and Norfolk were the only ones giving basic training in fighter direction. They prepared officers for shipboard and land-based operation, and their courses, almost identical, covered the three closely related

Declass, Declass in Full, March 1998, Per OPNAVIST 5513 16-02

Declass, Declass in Full, March 1998, Per OPNAVIST 5513 16-02

subjects of fighter direction, radar theory and operation, and the techniques and functions of CIC (plotting, maneuvering board problems, telephone talking, and voice radio procedure).

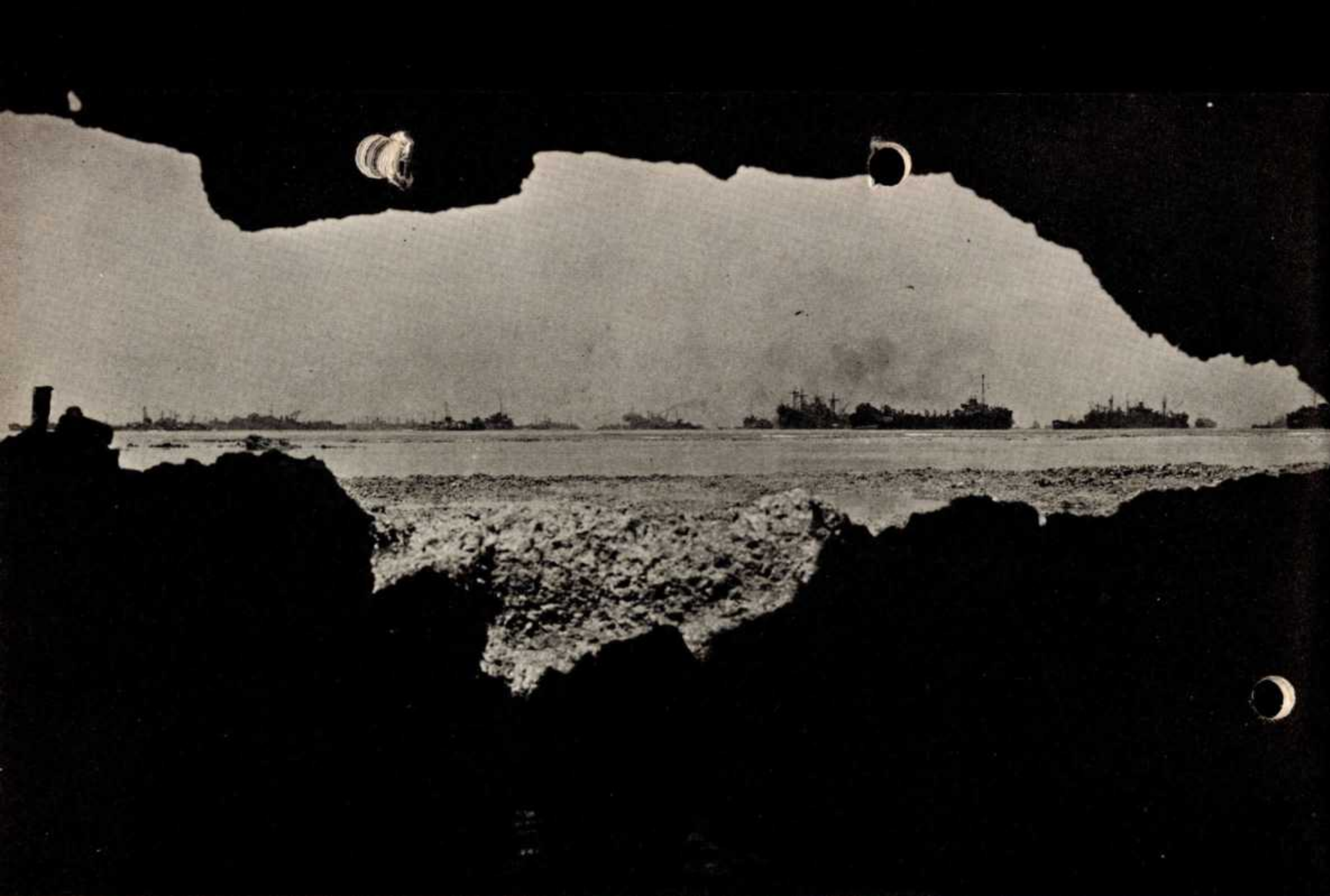
Those officers who were destined for duty in Argus units originally received additional training at the Army school at Orlando, Florida. In January, 1943 officers assigned to Argus units began going to the Advanced Base Depot, Port Hueneme, California, where their units were formed and they received additional lectures and group practice.

Experiments and training in night fighter work under Project Afirm were authorized in the spring of 1942 at NAS Quonset Point, Rhode Island, and the first completely equipped Navy night fighter squadron, VF (N)-75, was commissioned on 1 April 1943. Intended mainly to furnish night fighter squadrons, the school was also called upon to supply night fighter directors, and in consequence the establishment of a regular course of instruction in this subject was recommended to BuAer in February, 1943. Officers were sent to this school after completing the basic course in fighter direction. A second night fighter school began operating at NAS, Barber's Point, Oahu, in May, 1944; it trained squadrons, and a few controllers.

In March, 1943 the "urgent and ever increasing demand for officers with fighter director training" caused the Vice Chief of Naval Operations to recommend that a new and more adequate school be established. The Chief of the Bureau of Aeronautics recommended that "one large school be established of sufficient size to meet the total needs of the Navy and Marine Corps," estimated as 100 Naval officers and 25 Marine officers monthly. In May Cominch ordered the school at Norfolk moved to the Naval Air Station, St. Simons Island, Georgia, and directed that facilities be provided there for a Naval Radar Training School to instruct officers in fighter direction and CIC. The school at Pearl Harbor was to be used for "refresher training and emergency replacement training." The same directive also tentatively recommended establishment of training facilities at Beavertail Point, NAS Quonset Point, Rhode Island, the night fighter school. The move to St. Simons was made in June.

The BuAer letter recommending establishment of the new school had also called for a school in the forward area at Noumea, New Caledonia, and this school was established in June, 1943. It gave refresher and advanced training to Argus units, CIC teams, and radar-equipped air squadrons. Personnel of destroyers and other ships which had no fighter directors or CIC officers aboard were

Special fighter director teams served aboard destroyers, in carrier and amphibious task forces. They did much to remove menace of air attack from main fleet units.



Part of invasion fleet off Okinawa. CIC on AGC's in anchorages like this coordinated air defense both afloat and ashore in critical early days of an assault.

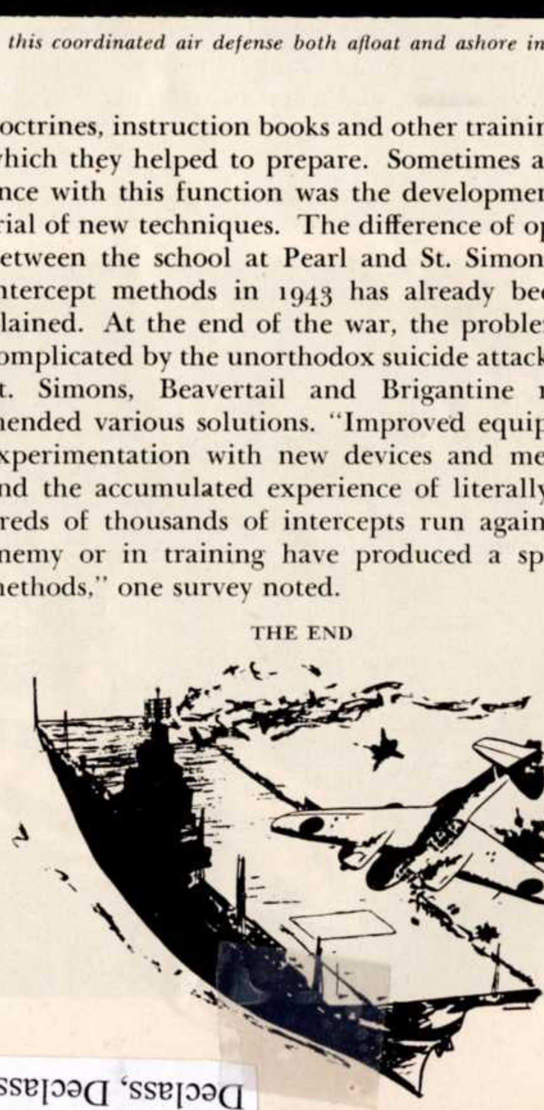
given basic training in this work. Training in night fighter direction, the development of operational techniques and procedures, and the collection of information of fighter direction and radar, based on experience in the forward area, were other functions of the school. It filled a great need during its comparatively brief career, for it was not practicable, in view of the time and distance involved, to send officers to Hawaii or the mainland for instruction in new methods or in the use of equipment installed in the forward area. The school was discontinued after the battlefront moved out of the South Pacific.

One additional school should be mentioned. It was established at Brigantine, New Jersey, under NAS Atlantic City. It did not primarily train fighter directors but trained fighter squadrons in the procedures they would be expected to follow when on combat air patrol.

Some graduates of the schools were retained as instructors for following classes, but the majority of instructors were officers with a background of experience in combat zones, who were in touch with the latest developments in Japanese tactics and the most practical methods of defeating them.

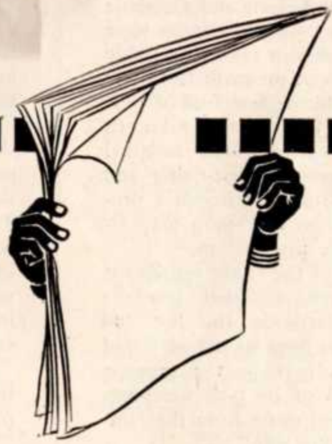
The schools in addition to training personnel served to standardize procedures based on the doctrines, instruction books and other training aids which they helped to prepare. Sometimes at variance with this function was the development and trial of new techniques. The difference of opinion between the school at Pearl and St. Simons over intercept methods in 1943 has already been explained. At the end of the war, the problem was complicated by the unorthodox suicide attacks, and St. Simons, Beavertail and Brigantine recommended various solutions. "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," one survey noted.

THE END



Declass, Declass in Full, March 1998, Per OPNAVIST 5513 16-02

Declass, Declass in Full, March 1998, Per OPNAVIST 5513 16-02



in the NEWS

Almost daily, the newspapers publish stories on scientific and other developments affecting naval, land, and air warfare. A periodical selection of the most interesting and important news-stories should enable many Navy officers and men to read informative articles which otherwise they might miss, and to frame a useful picture of scientific progress in its major military applications.

NOTHING IN THE PRESS MUST BE INTERPRETED AS RELAXING THE INDIVIDUAL RESPONSIBILITY OF ALL MILITARY PERSONNEL WITH REGARD TO SECURITY.

NAVY EXPANDING AIR TEST CENTER

Base at Patuxent River, Md., Will Be Able to Evaluate Any Developments

By John Stuart (New York Times)

Patuxent River, Md., May 18: The Navy is expanding its center here to make it suitable for testing of any possible developments of naval air warfare. On 6000 acres along the southern bank of the Patuxent's mouth there are huge runways capable of accommodating huge planes. And in the equipment of the center are devices to test the tiniest radio tube which makes a part of a communications set or the seeking nose of a guided missile. * * *

The role of Patuxent is to test finished products and new materials under the conditions in which they are designed to serve the Navy.

Perhaps the most spectacular device here has earthbound replicas of the catapults and arresting gear which in the last phases of the recent war enabled our carriers to shoot off and recover planes. The catapults are fixed in direction, but the arresting gear is mounted on a huge turntable which can be swung with the wind.

"We've learned to catapult any plane across the wind," Captain Barner said. "They still have to land into the wind and catch their hooks in the cables of the arresting gear."

Improvements, however, are constantly being worked out here. It is no secret that the Navy foresees a carrier which may be wholly submersible to avoid atomic attack. Catapults faster in action and more powerful than those of the present may be needed to launch planes or guided missiles in the few moments of its surfacing for an attack.

Planes powered with jet engines and gas turbines are being flown here and the problems of their service and maintenance under shipboard conditions are being worked out. Not only are Army types of interest to the Navy, but the hangar holds some yet undisclosed secrets in planes and power plants of the Navy's design.

8000-HORSEPOWER ROCKET ENGINE FOR AIRCRAFT REVEALED BY NAVY

By Frederick Graham (New York Times)

Pompton Plains, N. J., April 26: An aircraft rocket engine that weighs considerably less than the average automobile engine but generates about 8000 horsepower was demonstrated publicly for the first time here today by the United States Navy.

Cooperatively designed, built and tested by the Reaction Motors, Inc., and the Propulsive Devices branch of the Navy's Bureau of Aeronautics, the new power plant presumably is destined for service in fast fighter planes. Naval officers at the demonstration were close-mouthed about this aspect of the engine, but as one of them observed, "It's hardly the kind of power plant you'd put in a kiddie car."

The new power plant, which weighs only 210 pounds, appears to be as simple in design and operation as it is slight in bulk. It consists of four cylinders of high-quality alloy steel, two of them placed side by side and one on top and another on the bottom.

Each cylinder is about two feet long and contains an igniter combustion chamber and an expansion nozzle where the alcohol and liquid oxygen that are used as fuel are fired by an electric arc. The four cylinders produce about 6000 pounds thrust, which, engineers said, is about 8000 horsepower at a speed of 400 miles an hour.

A few fuel lines and electric wires lead into the cylinders, but there appears to be little more to the engine. It has no moving parts and measures, over-all, only about four feet in length by two feet in height. * * *

Parallels German Model

Lovell Lawrence, Jr., president of Reaction Motors, Inc., said his company had been working with rockets for the Navy since 1941. Some rocket engines, but not of this type, have been delivered to the Navy, it was learned. They were used in guided missiles, but none, it is believed, ever was tested in actual combat.

The new rocket engine, known as 1500N4C, closely parallels the development of the rocket engine the Germans used in the Messerschmitt-163, but is more powerful than the German model. The German model drove the Me-163 at a speed of 623 miles an hour, the highest speed ever reached by a combat plane.

Navy men said that the model shown was sufficiently powerful to tear the frame of the Me-163 to pieces should it be mounted in it. The 1500N4C is not, however, as powerful as the rocket engine employed by the Germans in the V-2 rocket. That model, according to Comdr. Dayton Seiler of the Propulsive Devices Branch, Bureau of Aeronautics, produced 55,000 pounds of thrust.

"MAGIC" RADAR WILL REMAP EARTH; ARMY IS STARTING "SHORAN" NETWORK

By T. R. Kennedy, Jr.,
(New York Times)

April 28, 1946: A recently disclosed precision radar, capable of measuring great distances around the globe by shooting out electronic "bullets" from airplanes in the substratosphere, will be employed soon to remap the earth completely, it became known here yesterday. The system is called "shoran," a bit of wartime magic of the short waves held secret until now.

Engineers of the Coast and Geodetic Survey and Army specialists who have seen and tested shoran say it is capable of locating any spot on earth from any other spot "within a few feet of perfect accuracy." It has become known that the Army already has assigned some of its largest, highest-flying and longest-range planes and begun a program of operations that soon may assume world-wide proportions.

Declared one of the "most significant departures" from accepted geodetic surveying standards in the last 100 years, those who have seen and tested shoran call it "perhaps the greatest single invention of its type for long-range mapping to come from the family of radar in the war."

At the present stage of shoran development, which is said to be far from the ultimate, it is possible to measure a line more than 300 miles long "within ten feet of accuracy."

Geodetic experts have revealed that shoran already has been an indispensable factor in making new surveys of the ocean bottom off Alaska. This summer the shoran activities are to center in the Caribbean to relocate island groups; later the Maine coast will be surveyed and then the Pacific, including the Japanese islands, it was said. * * *

The word shoran is a contraction of the words "short" and "range," compared with the system known as "loran," or "long-range" navigation.

"C. I. C." INDEX

Cross indexed below are subjects which appeared in "C.I.C." from January 1946 through June 1946. See back cover for previous indexes.

Declass, Declass in Full, March 1998, Per OPNAVIST 5513 16-02

Declass, Declass in Full, March 1998, Per OPNAVIST 5513 16-02

of war. "C.I.C."—Vol. III, No. 2, February 1946, p. 26.

Keeping A CIC in Fighting Trim

USS MIDWAY evolves a training program to build and maintain a smooth working CIC team. "C.I.C."—Vol. III, No. 3, March 1946, p. 20.

Bergy Bits and Growlers, or MIDWAY in the Arctic

Usefulness of CIC in locating trouble as indicated by results of MIDWAY's arctic cruise. "C.I.C."—Vol. III, No. 5, May 1946, p. 10.

8th Fleet Briefs CIC Officers

8th Fleet CIC Officers memorandum stating CIC problems to be solved in peace-time and standards to be maintained. "C.I.C."—Vol. III, No. 5, May 1946, p. 34.

Eye in the Sky—Testing Cadillac 2

[illegible]VPB-101 tests and evaluates "Flying [illegible]" at Floyd Bennett Field. "C.I.C."—Vol. III, No. 5, May 1946, p. 28.

CIC's Role in the Atomic Experiment

In this greatest of all bombing experiments—largely an air operation—CIC has a problem as complex as any it met in wartime. "C.I.C."—Vol. III, No. 6, June 1946, p. 14.

COMMUNICATIONS

Yap and Yawp—the Not so Alike Twins of S/P and R/T

A comparative study of R/T and S/P procedures and vocabularies. "C.I.C."—Vol. III, No. 3, March 1946, p. 30.

The Enemy Listened

Startling instances of insecurity in our wartime use of radio are presented in this summation of intelligence re-[illegible]ts and other data. "C.I.C."—Vol. [illegible] No. 4, April 1946, p. 1.

Recorder Eliminates Radio Repeats

Description of Radio Repeat Unit and how it will help eliminate overtaxing radio circuits with repeats. "C.I.C."—Vol. III, No. 1, January 1946, p. 10.

COUNTERMEASURES

Blimp for RADCM

A new wrinkle in electronic's training as NRTS St. Simons utilizes a Blimp as floating classroom for radar countermeasures training. "C.I.C."—Vol. III, No. 3, March 1946, p. 41.

RADCM Interception—Yesterday and Tomorrow

First of a series on Countermeasures. Describing defensive and offensive part RADCM played in winning the war. "C.I.C."—Vol. III, No. 6, June 1946, p. 5.

ELECTRONIC INSTALLATIONS

Electronic Installations on Carrier Types

Silhouettes of carrier types showing location of various radars and electronic accessories with accompanying notes describing the equipment. "C.I.C."—Vol. III, No. 4, April 1946, p. 5.

Electronic Installations on AGC and DD

Silhouettes of AGC and DD showing location of various radars and electronic accessories with accompanying notes describing the equipment. "C.I.C."—Vol. III, No. 6, June 1946, p. 18.

ELECTRONIC SERVICE

EFSG—Electronic Field Service Still Available

EFSG was more than worth its salt. The fleet will welcome continuation of their expert service. "C.I.C."—Vol. III, No. 3, March 1946, p. 33.

FIGHTER DIRECTION

History of Naval Fighter Direction (in three parts)

Part I—covering the beginnings of fighter direction and early development of fighter direction from aircraft carriers. "C.I.C."—Vol. III, No. 4, April 1946, p. 12.

Part II—covering fighter direction in the Solomons campaign and Argus Unit fighter direction. "C.I.C."—Vol. III, No. 5, May 1946, p. 19.

Part III—covers the final phases including the fast carrier task force, amphibious command ship, visual fighter direction and night fighter direction at sea. "C.I.C."—Vol. III (No. 6, June 1946, p. 28.

GERMAN FIGHTER DIRECTION

German Fighter Direction

Describing German "Night Fairy" system of fighter direction which was dependent completely on Radar for transmitting commands. "C.I.C."—Vol. III, No. 3, March 1946, p. 18.

GERMAN RADAR

German Radar—An Interrogation Aboard the Prinz Eugen

A picture of the Nazi radar setup aboard the German heavy cruiser Prinz Eugen. "C.I.C."—Vol. III, No. 3, March 1946, p. 12.

GERMAN ROCKET

Genesis of the German Rocket

British Intelligence and Royal Air Force investigation traces the development of the long-range German V-2 rocket. "C.I.C."—Vol. III, No. 6, June 1946, p. 22.

GUNNERY

Target Information Skull Practice

Graphic illustrations emphasizing results of time motion study of methods of disseminating target information from CIC to Gunnery. "C.I.C."—Vol. III, No. 1, January 1946, p. 30.

Splash!—Next Target!

Report on controlled time study of target indication using SC5, SP, VF, and VC. "C.I.C."—Vol. III, No. 2, February 1946, p. 28.

Target Indication, Target Designation, Target Acquisition

These important terms are defined by the Chief of Naval Operations. "C.I.C."—Vol. III, No. 5, May 1946, p. 27.

Quicker Target Data—The New PD Systems

Delay in indicating and designating radar targets cut by development of a new PD panel. "C.I.C."—Vol. III, No. 5, May 1946, p. 16.

IDEAS OF THE MONTH

Suggestions for solving particular problems by fleet personnel. These ideas have been tried and found to work.

Cursor Scales for the VG

Accurate reading of ranges and bearings directly from the VG facilitated by scales designed by CIC personnel of the USS DULUTH. "C.I.C."—Vol. III, No. 1, January 1946, p. 34.

A Centralized Radio Transmitter-Receiver Panel in CIC.

To overcome complications the SITKOH BAY ship's force designed and built a control panel for multi-channeled radio transmitters and receivers. "C.I.C."—Vol. III, No. 1, January 1946, p. 35.

IN THE NEWS

A periodical selection of the most interesting and important news stories frames a picture of scientific progress in its major military applications. Appears in each issue beginning with Vol. III, No. 3, March 1946.

JAPANESE RADAR

Jap Radar Appraised

A resume of Jap radar equipment, technical training, and the tactical use thereof. "C.I.C."—Vol. III, No. 4, April 1946, p. 29.

MARINE AIR WARNING

MAWS in Action

The saga of Marine Air Warning Squadrons from Engebi to Okinawa. "C.I.C."—Vol. III, No. 5, May 1946, p. 37.

NAVIGATION

VPR in Navigation

Two new adaptable VPR's make their use in navigation possible in nearly all types of combatant ships. "C.I.C."—Vol. III, No. 2, February 1946, p. 20.

Zig Zag Plan at a Glance

Gizmo developed aboard USS PRINCE WILLIAM to simplify execution of zig zag plans. "C.I.C."—Vol. III, No. 1, January 1946, p. 20.

OFFICER CLASSIFICATION

Your IBM Card in BuPers

New smoothly functioning system supplies qualification information to BuPers. "C.I.C."—Vol. III, No. 4, April 1946, p. 26.

PERSONNEL

Wanted: 15,000 Experts

Statistics showing the need for CIC personnel in the Post War Navy. Compares wartime complements with peacetime needs. "C.I.C."—Vol. III, No. 6, June 1946, p. 1.

PLOTTING

Lookout Plot

Outlining the "Lookout Plan" for plotting close-in raids as adopted by USS FALL RIVER. "C.I.C."—Vol. II, No. 2, February 1946, p. 24.

PUBLICATIONS

CIC Publications

A general classification of Radar Publications with distribution and availability information. "C.I.C."—Vol. III, No. 3, March 1946, p. 38.

New Guide to Airborne Electronics

Aero 55 (B) bows out in favor of a new completely rewritten and amplified Aero 55 (C). "C.I.C."—Vol. III, No. 4, April 1946, p. 40.

RADAR

Origin of Radar

The story of some of the highlights in the origin and development of Radar told by NRL's Chief Coordinator of Electronics. "C.I.C."—Vol. III, No. 1, January 1946, p. 12.

SX Radar Report

First seagoing evaluation of the SX Radar's performance in Fighter Direction and Surface Search set forth in a report by the USS MIDWAY. "C.I.C."—Vol. III, No. 2, February 1946, p. 16.

SG-3, SG-4X Preliminary Report

SG-4X is now being installed as the standard surface search set aboard battle ships and large carrier types, making this report significant. "C.I.C." —Vol. III, No. 2, February 1946, p. 29.

The Weather Forecaster Turns to Radar

Radar offers an actual picture of storms within range of the set and promises to be invaluable in minimizing damage by storms. "C.I.C."—Vol. III, No. 3, March 1946, p. 22.

Moonbeams

Report on preparations for Army radar's trip to the moon and proposed usage of space radar in the future. "C.I.C."—Vol. III, No. 3, March 1946, p. 35.

The Tiger Cat's Eyes are Brighter

SCR-720, S band gear, giving four times the power of the formerly used AN/APS6 installed in F7F Tigercat. "C.I.C."—Vol. III, No. 3, March 1946, p. 29.

Radar Brings Them Aboard Now

Carrier Controlled Approach being developed as solution to hazardous bad weather air operations. "C.I.C."—Vol. III, No. 4, April 1946, p. 33.

RADAR REPEATERS

PPI View of Fujiyama

13,000 foot mass proved to be excellent radar fix during wartime sweeps near Tokyo. "C.I.C."—Vol. III, No. 1, January 1946, p. 19.

Latest on Repeaters VJ and VH

Describing these two tailor-made repeater units and their accessories. "C.I.C."—Vol. III, No. 2, February 1946, p. 11.

RADAR PERFORMANCE

They're Still Using Fade Charts

Consensus of opinion shows fade charts still regarded as reliable altitude determiner. "C.I.C."—Vol. III, No. 1, January 1946, p. 29.

Banana River MEW

Unusual ranges noted in routine operation of Banana River's MEW. "C.I.C."—Vol. III, No. 6, June 1946, p. 25.

RESEARCH

NRL, Backbone of Navy's Scientific Research

For CIC personnel the story of NRL has a special interest—for NRL was one of the birthplaces of radar. "C.I.C." —Vol. III, No. 1, January 1946, p. 22.

Seagoing Combat Laboratory

Task Force 69 is today one of the most valuable Naval Units and promises much for radar and CIC research. "C.I.C."—Vol. III, No. 2, February 1946, p. 1.

Genesis of the German Rocket

British Intelligence and Royal Air Force investigators trace the development of the long-range German V-2 rocket. "C.I.C."—Vol. III, No. 6, June 1946, p. 22.

SHORE BASED CIC

Argus Guarded the Pacific Islands

The history of the "shore-based CIC's" which guarded the Pacific Isles until shore-based radar became a Marine activity. "C.I.C."—Vol. III, No. 4, April 1946, p. 46.

SPECIAL DEVICES

Zig Zag Plan at a Glance

Zig zag gizmo developed aboard USS PRINCE WILLIAM to simplify execution of zig zag plans. "C.I.C."—Vol. III, No. 1, January 1946, p. 20.

Radar Camera for Shipboard Use

New 35mm. camera for shipboard use in photographing PPI scopes will soon be available for a limited number of ships. "C.I.C."—Vol. III, No. 1, January 1946, p. 27.

TRAINING

Refresher for Ex-POW Officers

Announcing three refresher courses to bring ex-prisoners-of-war up to date on techniques in CIC, Damage Control and Ordnance. "C.I.C."—Vol. III, No. 2, February 1946, p. 23.

What the Navy Offers in Electr[illegible] Education

Composite picture of Navy Electronic training today with pertinent data on each course. "C.I.C."—Vol. III, No. 3, March 1946, p. 1.

Keeping A CIC in Fighting Trim

USS MIDWAY evolves a training program to build and maintain a smooth working CIC team. "C.I.C."—Vol. III, No. 3, March 1946, p. 20.

NRTS St. Simons Today

The post-war curriculum for consolidated CIC school is already underway at St. Simons—and it's a six months course. "C.I.C."—Vol. III, No. 4, April 1946, p. 9.

All Officers Note

States qualifications for applicant[illegible] MIT's September Electronics cou[illegible]. "C.I.C."—Vol. III, No. 4, April 1946, p. 56.

KETE—Royal Naval Aircraft Direction Centre

The British tactical radar school is compared with its American counterpart, NRTS St. Simons. "C.I.C."— Vol. III, No. 5, May 1946, p. 4.

The War College Looks at New Weapons

War College revises curriculum to include a study of latest weapons and newest strategy. "C.I.C."—Vol. III, No. 6, June 1946, p. 9.

WEATHER

The Weather Forecaster Turns to Radar

Radar offers an actual picture of storms within range of the set and promises to be invaluable in minimizing damage by storms. "C.I.C."—Vol. III, No. 3, March 1946, p. 22.

Declass, Declass in Full, March 1998, Per OPNAVIST 5513 16-02

Declass, Declass in Full, March 1998, Per OPNAVIST 5513 16-02

OPPORTUNITY KNOCKS

The need for CIC personnel—both officers and enlisted—has become critical. The attention of all hands is invited to the excellent prospects for training and advancement of personnel who can qualify for the specialist ratings needed to fill CIC billets as set forth in ALNAVS #293 and #290 and NAVACT #50. These are condensed here for the information of all concerned.

RATED MEN NOW ELIGIBLE FOR OFFICER APPOINTMENTS

Men holding ratings of ETM, AETM, CETM, and ACETM first class—both regular and reserve—are now eligible for temporary appointments to the rank of Ensign USN or USNR. Men recommended must be graduates of Radio Material School or Airborne Electronic Maintenance School, Corpus Christi and their date of graduation must be subsequent to 1 January 1942. Applicants are required to sign an agreement to remain on active duty until 1 July 1947 if appointed. For full particulars see ALNAV #293.

APPLICANTS FOR ST. SIMON'S COURSE DESIRED

Line officers USN and USNR of the rank of Lieutenant Commander and below are still needed for CIC billets. Applications are desired for the six-month course in operational phases of CIC at NRTS, St. Simon's Island, Georgia. The first class convened on 1 July and there will be a new one every two months thereafter. All applications should indicate by date the specific convening class desired. Refer to NAVACT #50 for further details.

USN MEN NEEDED FOR RADIO MATERIAL COURSE

In view of the shortage of Electronic Technicians Mates and Aviation Electronic Technicians Mates BuPers urgently desires requests from regular Navy personnel for the one year course in Radio Material. All candidates must have at least two years obligated service from the date of entry into the school. For complete information see ALNAV #290.

Declass, Declass in Full, March 1998, Per OPNAVIST 5513 16-02

This youngster can teach you a lot!

With this issue "C.I.C." is two years old in its present form. All together, a complete file of the magazine contains a rich and varied mass of material on the concept and operation of CIC and its associated tools that can be matched nowhere. Especially to the younger officers of the fleet, we say, *Don't overlook what you can learn in these pages!*

The fourth semi-annual cumulative index appears in this issue. Previous indexes, which give you a handy guide for study and research, appeared in the issues January 1945, July 1945 and February 1946.