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AIRPLANE AND BATTLESHIP

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"THE AIRPLANE AND THE BATTLESHIP"

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AND

"DANGERS IN CONTROVERSY OVER BATTLESHIP CONSTRUCTION"

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THE AIRPLANE AND THE BATTLESHIP

(By Rear Admiral G. J. Rowcliff, member of the General Board, United States Navy)

(For the first time since war began, the naval problems of modern warfare, emphasizing the relationship of all weapons to one another, are outlined by a member of the General Board of the United States Navy. We believe this is the first impartial and thorough presentation of the subject laid before the public.—*The Editors.*)

There has been considerable discussion, some controversy, attended by the resurrection of ancient and contentious ghosts, concerning the relative merits of airplanes and battleships, or perhaps more broadly, aircraft and surface ships. The controversy has centered more importantly around the sea-going implements of traditional power, for not so much has been said as yet concerning the relative merits of airplanes, tanks, artillery, and fortifications or other military weapons employed ashore.

The trend of the discussion, for ostensible progress, seems to indicate that those who are advanced thinkers or who fancy themselves as advanced thinkers, and certainly the dreamers, as has always been the case, tend to foster or to demonstrate verbally the obsolescence of the older weapons of which the battleship is the symbol, in favor of the newer weapons of which the airplane is the symbol. Generally speaking, the responsible military authorities have not expressed themselves, partly because, perhaps, they are too busy, and partly because they too well realize the painful realities which in practice often vitiate theoretical positions and discussions. The argument in general has been carried on by those who hope to make war cheap or simple, by those who hope to make their dreams come true, by those who for various reasons are propagandists for one side or the other, well mixed with a considerable amount of wishful thinking and limited understanding.

It is the purpose of the present article to promote common understanding, to present a picture by outlining the general truths as simply as may be, by no means as simply nor as completely as might be desired.

It is not the purpose of this article to make a case for any single weapon of war; nor yet to slow the wheels of progress; but rather, now that we have a mean war on our hands, to promote straight thinking among intelligent people who sometimes are susceptible to propaganda and their own enthusiasms. Each of the following

paragraphs has a purpose, and it is recommended that such consideration be given to each that its significance may be appreciated. The comments herein are personal in origin and general in application.

ON THE NATURE OF WAR

History appears to record somewhere between seven and eight thousand wars of one sort or another. The same sort of flesh and blood has taken part in all these; but in the early wars men with limited resources made personal and bloody contact with other men of similar resources so that in the end human strength or human numbers would prevail and have it over with in a conclusive manner. As time has gone on war has become increasingly a matter of total resources and of mechanized apparatus, much to the advantage of those nations which possess natural resources and the skill to make use of them through cleverness or industry. Indeed, the natural resources themselves are most potent underlying causes of controversy and belligerency.

As always, the nature of the opposing belligerent, his resources and his location, determine the nature of the weapons best suited to overcome him. With this in mind, leading powers have tried to prepare themselves against their most probable enemies in case they should become involved in controversies. The effect of this, in anticipation of the modern war, is to produce preparation of material, mechanized apparatus and trained personnel in accordance with the resources of the individual nation and its position with relation to possible enemies. A further result is more or less to standardize the forms of apparatus as influenced by domestic skill.

The nature of the preparation is powerfully influenced by consideration as to whether one's country intends to remain on the defensive within its own reasonable and restricted zone of influence or whether it is to take the offensive against a distant enemy, or even to engage in aggression abroad. These are primary considerations which must and do influence the nature of preparation.

It is as well to note at this point that in the last 20 years there have been no two pieces of national belief so well implanted (for various reasons) in the minds of American people as the two concepts that "our boys shall not be sent abroad to fight again," and inasmuch as we are a democracy which does not seek empire, "we shall build a Navy for defense only." Such ideals may be sound enough when national behavior is consistent therewith, but from the military point of view they are unsound tenets because, if a distant enemy is to be defeated, it undoubtedly will be necessary to go where he is to defeat him. So, distance, transportation, communications, existing resources become important.

ON POLITICAL OBJECTIVES

Granting that the statements made above are correct, it follows that political objectives, including moral crusading and self-preservation, should be consonant with preparation if disaster or expensive conflict is to be avoided. If the ways and means of enforcing national objectives are lacking, either the objectives must be modified or suitable preparations must be made in due time. Similarly, if there is a tendency to bestow distasteful advice and regulation, however meritorious, upon another autonomous nation, suitable consid-

eration should be given to the relative forces available and to the logical conclusions resulting from manifestations of displeasure thereat. Where the prospective enemy may be is no less important than what forces he may have available.

ON MECHANIZATION AND NATURE

As men have tended to avoid physical combat by substituting preliminary work in a factory and by extending distances between combatants in the field, some simple truths of natural philosophy have exerted their influences more and more powerfully, inasmuch as all mechanized apparatus requires material, weight, space, fabrication, and highly trained operating personnel.

Mechanized apparatus embodies three elementary military characteristics which are functional, whether active or passive.

Of these, the most important is the armament which visits destruction on the enemy as exemplified by the tank gun, the airplane bomb, the submarine torpedo, the battleship gun, or the howitzer of the artillery.

Second, there is the protective element which may be passive, as exemplified by the plating of tanks, the pilot's armor in planes, the heavy armor and compartmentation of battleships and the shields of artillery when used. There are also active elements of defense such as speed, maneuverability, gun fire, and so forth.

Third, if the weapon is mobile, there must be provided a power plant for propulsion, and this mobility is divided into the two important elements of speed, which requires a certain design of machinery, and radius of action which requires capacity for a certain fuel; while the nature of this fuel largely controls all the other military characteristics. Thus a coal-burning battleship could have no such capabilities as our newer ones, and the thought of a coal-burning plane or a coal-burning tank just makes us smile.

All of these elements necessitate previous preparation in detail. After they are assembled they have a composite military value. However, in the nature of mechanical apparatus they must be combined by design in proper proportions which must be predetermined, as based on the desired operational characteristics, on the availability of material, on the skill of the manufacturer, and on the medium which is to support the apparatus in action. It is a simple manifestation of natural philosophy that when a mechanized creature can rest on the earth where it has a solid foundation, provided enough suitable terrain can be found, the three elements cited above can be combined to a superlative degree not possible when the creature has to be floated in the water or borne in the air. Thus, we should be able to construct a mobile fortress moving across the country which would demonstrate military power and stamina superior to anything which can be floated in the water or carried in the air. Practical considerations, like terrain and roads limit the application of this natural truth.

When we go to sea we find that on a given tonnage only two of the major characteristics cited above can be combined in a ship in considerable degree, and even so that great compromises and sacrifices must be accepted if the ship is to float and to be of reasonable size. In building this ship all three characteristics must be limited; one or two of the characteristics may be enhanced at the expense of the

remainder. Thus a battleship normally carries a heavy armament, heavy protection, and quite moderate speed; while in a destroyer—of small tonnage—protection and, to some extent, armament are sacrificed for speed. In the nature of things the larger the ship is built the higher the degree of all three elements which can be embodied in her, and of course this accounts for the increase in the size of ships (and planes) developed over a period of years.

When the mechanized creature must be borne in the air it is found that more drastic limitations must be accepted and more extensive compromises made, for in general only one of the three important elements can be developed to a high degree, which accounts for the high speed of planes, the limited weight-carrying capacity and the relatively weak armor for protection of pilot, motor, or gasoline. The plane, however, due to its nature, possesses two characteristics, one favorable and one unfavorable, which are not shared by other mechanized units at sea or on land. The plane, by climbing, stores within itself a potential energy due to its position, which later can be used to good advantage either in the dive or in dropping a bomb. However, the advantage of position entails the danger that damage, or casualty to machinery or pilot, may bring the plane down, whether on land or sea, with varying complications and implications. A plane cannot stop in the air and consequently can neither hold ground in a military sense nor can it hold an advantageous position for longer than an instant; and thus some other creature must be used to consolidate the gains, if any.

The laws of nature absolutely exact that every piece of mechanized equipment be a compromise in design based on judgment as to what it is to accomplish during its lifetime. It is to be remembered that the same materials are available for all equipment and that the same skill of fabrication is available for all equipment, and thus the same laws tend to require that all weapons, no matter of what sort, arrive at some balance of potentiality when combined in due proportion and properly used. The problem, therefore, reduces itself to arranging so that there are present at the conflict those weapons most suitable for the particular occasion, and that those which happen to be present are used with the utmost skill. Let it be noted that the weapon must be present and in effective use; it is not enough that it be a happy dream in the mind of an inventor or a designer, or that it be a dormant mass in the hands of the tactician.

The unalterable laws of time, distance, velocity, gravity, specific gravity, expansion of gases, hydraulics, aerodynamics, thermodynamics, and so forth, absolutely control us, and complicate our problems in all weapons and apparatus. They are our masters, but, because these laws behave consistently, we can and must learn how to use them in the design of weapons. Let it be noted that many features of design are interlocking and interdependent so that long prearrangement is necessary; and that fabricated articles once critically designed and built are not, as a usual thing, profitably alterable—they can be just inefficient or obsolete.

Thus nature, in a roundabout way, brings us back to the essential wisdom of human beings in preparation for war in the design and fabrication of weapons, and in the use of mechanized weapons.

ON TYPES OF APPARATUS

Each of the types of ships (planes) of the Navy is built to accomplish the purpose of destruction, using one or more of its outstanding characteristics which are deliberately built into the ship so as to give that particular type an advantage in specific particulars. By way of illustration some of these will be mentioned briefly, for it is impossible to discuss them all exhaustively in a readable article.

The ability of a submarine to submerge is its outstanding quality. Silence, reduced visibility, and stealth are valuable assets. On the other hand a submarine when submerged too far is essentially impotent and is a helpless prey to the proper sort of counterweapons. Physical facts make the submarine somewhat of a lone wolf in operations. The design of a submarine depends on considerations of positive and negative buoyancy, and on the limitations of power plants when under water, which are so critical as to make design a matter of extreme compromise. It is physically impossible to build a submarine which will stand the pressure at great depths, or to provide a submarine with any appreciable degree of protective armor or any great speed; and every torpedo, every round of ammunition and every ton of fuel put into it are matters of detailed consideration. Nevertheless, a submarine has a usefulness in modern warfare which is its own and which is not shared to any considerable degree by any other type on account of its peculiar properties.

Similarly the outstanding characteristics of the destroyer are its speed, its relatively small size tending to handiness in maneuvers and to invisibility, the silence of its torpedoes and its ability to carry depth charges quickly over submarines.

Increasing the tonnage, and therefore the possibility of enhanced qualities, we have the cruiser with still greater power than the destroyer, greater destructive gunfire, greater stamina due to compartmentation and thickness of plating, considerably increased radius of operation, and greater seaworthiness; but still with no great amount of armor for the protection of sides and decks.

Increasing the size still further brings us to the battleship, of which the outstanding characteristics are crushing gunfire against all types of surface craft, considerably increased protection against damage by any naval weapon, as permitted by increased tonnage, and relatively lower speeds than those built into cruisers or destroyers. While the outstanding characteristic of a battleship is gunpower, she is expected to demonstrate the maximum power of survival against all naval weapons and ability to keep the sea. Under the laws of natural philosophy, power of survival may be enhanced by increase in size which permits interior subdivision and extensive armor both on sides and on decks. Quite naturally with the advent of air menace the tendency has been to add some deck protection to all types of ships, and to improve anti-aircraft batteries both for high level and close-in air defense. Such changes, and others, are evolutionary, but inevitable. Battleships take a long time to design and to build. Consequently great foresight should be used in providing new construction, in providing replacements for losses and in design work to meet the military needs during the life of the ship. Other types of ships and planes share these

evolutionary exigencies in less degree. Both the sizes and expenses of units increase correspondingly. Of all naval craft the battleship still can and should embody the maximum power of survival when well designed and properly used.

ON NEWER TYPES

The newest type of combatant ship is the carrier which is designed specifically to carry planes of such types as may be determined upon. Carriers must have speed to make them of the maximum usefulness to their planes; they must have capacity both on decks and in hangars for the accommodation of planes; they must have size to provide a large landing deck and a stable platform at sea for plane landing and take-off, under permissible weather conditions. It is a physical fact that no carrier can have complete armor to protect its planes, ammunition, and gasoline, nor can it have a very heavy flight deck, which is high up in the ship, to resist gunfire or bombs to the degree which might be desirable or to the degree which it is possible to build into the battleship. It is also true that every gun, every knot of speed, and every ton of fuel oil or gasoline that is put in the carrier reduces the number of planes and their equipment which can be carried. Compromise again.

Continuing into the air with our naval weapons, we find several types of planes each, like the several types of ships, useful to each other in cooperation and to the ships beneath them for certain purposes. All military planes are alike in one particular, they must have speed and great engine power and limited weight, to enable them to take the air and to climb into advantageous positions rapidly, with practical limitations to enable them to land on ships or at landing fields. The high power and high speed thus required are inherently uneconomical. Every gallon of gasoline which is carried to extend the radius of action reduces the maneuverability, the guns, or ammunition or bombs or personnel which can be carried. If the radius of action is pushed to the maximum all other characteristics must be limited accordingly; and if in addition a military load is to be carried the actual protection for plane and pilot must be very scant indeed. The design of a plane is a critical matter; and increase of any characteristic is paid for dearly in some other quality. Planes require a suitable place to land and frequent servicing; they require much maneuvering space, because collision is fatal; they cannot stop in the air; they cannot hold any position for more than an instant; it is necessary that they reach quite exact positions in the air in order to create effective offensive damage with the limited load which it is possible for them to carry. Fundamentals demand considerable numbers of planes for effectiveness; but vital needs, especially for fuel, and maneuvering space are opposed to numbers; and it is an important fact that while on occasion they may accomplish significant damage or destruction, they cannot remain to conquer. There is no weapon so nearly useless or so vulnerable as a plane when it is not in the air.

There was a time when the plane was believed to be a cheap military weapon. Such is not the case; not only are large numbers required, but any light mechanism which operates at such speed and power is not cheap. By the time there are provided in addition to constantly changing designs and frequent replacements, accessories like landing

fields, carriers, hangars, repair shops, barracks, supplies, special fuel, transportation, special personnel and training, and so on, the cost of delivering a given amount of destruction with effectiveness at a specified distant point is found to be comparable whatever the means. Suitability and adequacy of means for the given task are what count in winning a war, not indeterminate differences of cost. "Can it be done, and if so how best?" is the question.

Planes which land on carriers are limited in size and in weight to the strength and capacity of the landing spot. As a consequence carrier planes on the whole should be less capable than land planes, within the full possibilities of design, and sea planes should be still less capable tactically than carrier planes as to feasible physical characteristics. However, as will be seen, there are other considerations which in operation tend to preserve the balance. The most important of these is that carrier planes take their mobile base with them; and this affects radius of action, choice of loads, upkeep, relaxation of personnel and assistance when in trouble.

As in the types of ships, each type of plane—fighter, bomber, torpedo plane, observation plane and flying boat—has its peculiar characteristics possessed to a maximum in each type and not possessed to an equal degree in other types as a matter of design permissible under natural laws. All of the types of ships and planes mentioned above have distinct characteristics which make that particular type superior in some respect to the others on account of the limitation of natural laws and the acceptance by the designer of the limitations in other characteristics which are unavoidable in producing one or more superior characteristics which constitute the reasons for the type itself.

ON STRENGTH AND WEAKNESS

None of the types of ships or planes are indestructible or immune from damage, but there is a vast difference in degrees of stamina and immunity which should be thoroughly considered.

In each and every case the designer and the manufacturer are hopeful that by skill he may be able better to overcome natural laws and limitations in materials and in processes so as to produce at any particular time a weapon which will be superior beyond previous realization. Thus a constant and progressive struggle goes on with infinite complication down to the last detail so that minds and ingenuity are taxed to squeeze the last possibility in military assets out of the materials and processes available.

Similarly, each of the types mentioned above has its weakness which the designer and the manufacturer hope to minimize by their skill, and the tactician hopes to minimize by having supplemental craft present to supply the deficiencies and by the proper tactical handling of a combatant force. Thus it is that in a naval campaign all of the types of ships and planes mentioned above are necessary in due proportion depending upon the problems to be met. Each of them can be dispensed with under some circumstance and each of them is necessary under some circumstance depending upon the sort of operation to be undertaken. Since the discussion is focused on the battleship, the plane carrier, the bomber and the torpedo plane, let it be said that the maximum power of survival of a battleship may be realized by increasing its size with good design; and as a matter of physical fact

this should give it a reasonable degree of immunity from probable mines, bombs, torpedoes and projectiles, provided it is used in conjunction with the suitable supplementary craft and provided it is properly employed tactically. Briefly, size and skill in design should give it relative material stamina.

For the carrier the situation is different. If it is to have good speed, and some respectable carrying capacity for planes, then much gunpower and armor protection must be sacrificed. Even extreme size will not save a carrier from being vulnerable, although increased size will add to carrying capacity, possible landing loads, and deck protection. The flight deck of a carrier, on account of its height in a stable ship, continues to be vulnerable in some degree. All types of surface ships can operate with some effectiveness at night and in low visibility, and can survive varying degrees of bad weather, important military considerations. They are much handicapped in defense, and practically useless in offense, when immobile—at anchor, in dock, or even stopped in the open sea.

The bomber enjoys the advantage of position when achieved, but in order to be even a menace the bomber itself must come to that position exactly. The bombload which a bomber can carry is limited and the gasoline supply is limited so that there must be a compromise reached between these and other elements. Although a bomber's inherent range of operation may be considerable, before it starts it is irrevocably committed to a certain kind of load as between gasoline, sizes of bombs, ammunition, etc.; and when that choice has been made it cannot be rectified, possibly until the limited load has been expended, and certainly until the bomber has returned to a base which must be surely available, lest the plane be lost.

Similarly the torpedo plane's principal advantage is its speed; like the bomber it possesses the advantage that it can attack in numbers provided it is not intercepted at a distance. Its weakness is similar to that of the bomber. Like all planes it is nearly useless and very vulnerable when down; it is much hampered by bad weather and low visibility.

Fighters, too, enjoy a place of their own; they are essential both in covering and in defeating bombers and torpedo planes. Great speed and maneuverability are gained at the sacrifice of armament, protection, and fuel; a fighter is fast, handy, and essentially vulnerable, but its help in the tasks it performs is necessary.

There are a number of other important types of ships and aircraft which it is not necessary to mention by way of further illustration.

ON SIGNIFICANT DISSIMILARITY

Each type of ship and each type of plane is carefully built to overcome or to counter the military characteristics of one or more other types under certain circumstances or when used in combination. To illustrate, it is the reasonable expectation in design that a submarine may be able to sneak up and hit a battleship, while the destroyer hopes to bag the submarine, the cruiser hopes to bag the destroyer, the battleship hopes to eliminate the cruiser, the bomber and torpedo plane from the carrier normally hope to bag carriers and battleships while the fighter hopes to ruin the bombers and the torpedo planes, and so forth with infinite variations. The designer

strives within his knowledge and skill to provide a capable type which will create the most damage with the least jeopardy in attacking but will suffer the least significant damage when itself hit.

One further simple illustration in design: The fighter is the natural enemy of the bomber or torpedo plane. If it is known in advance that the fighter need carry gasoline for only a very short time in the air, then a fighter much improved in armament and maneuvering power can be designed and built. Similarly, if it be known in advance that ships of the Navy will never be required to fight more than a few hundred miles from a well-protected home base, weight thus saved in fuel can be built into other valuable characteristics, like guns or armor. National policy therefore affects the fundamental design right from the start.

From the above brief comments it will be seen that the question always is how much can be built into the ship (plane) through care and skill and how effective can this be made by proper use.

ON DAMAGE AND DESTRUCTION

Each of the types of ships and planes mentioned above carries weapons which are more or less peculiar to itself, and which have required great skill and much time in the designer's and the manufacturer's efforts. The object of each, of course, is to create fatal damage and destruction which will produce military defeat for the enemy and in the end result in victory for the owner; or to prevent such destruction, defensively.

It is important to observe that not all damage is useful in producing defeat inasmuch as it is possible to create much damage by picking foolish objectives or by the futile use of force without really producing defeat or bringing victory any nearer.

Any experienced person will admit that a suitable amount of high explosives placed properly will create noise, disturbance, and destruction in appropriate amount, and that any missile properly directed will create damage on impact subject to well-known natural laws. These facts, of course, lead us into infinite ramifications of design and use, but it seems appropriate to indicate some of the prominent characteristics and limitations which have to be dealt with.

The primary naval weapon is the gun which shoots projectiles. It is a physical fact that steel makers cannot produce a satisfactory gun above a certain size any more than they can produce satisfactory armor plate beyond a certain thickness and quality, or a usable Diesel engine beyond a certain moderate power, or a cylinder for a gasoline engine beyond a very narrowly limited size; no one knows how to set aside such limitations in mechanical processes. Similarly the muzzle velocity of projectiles is limited by skill in manufacture. The size and velocity of projectiles is limited, and the resulting energy directly proportional to mass times the square of the velocity is limited. The projectile may carry permanently a large amount of high explosive, in which case it must have thin walls and will break up easily on impact, or it may carry a small amount of explosive in which case its destructive force due to bursting is reduced. If it bursts on impact it loses the disruptive advantage of bursting in a confined space, and consequently choice must be made between impact fuzes and delayed-action fuzes. Only a limited number of projectiles or bullets can be fired

from any one gun within the life of the gun, and only a limited number of bullets or projectiles can be carried in any one ship or plane on account of the weight and space. These considerations and many more must be determined by the designer long in advance.

Similarly the characteristic weapon of a submarine is the torpedo. Only a certain small number of tubes can be built into a submarine and only a limited number of torpedoes can be carried on board. These torpedoes must fit the tubes exactly, and they must be designed long in advance to determine how far they will run and how much explosive charge they will carry, for a torpedo can be built to run a long distance with a light warhead or a very short distance with a very heavy warhead. Similarly a torpedo's speed must be predetermined, for torpedoes at best are of such limited speed that it is usually found unprofitable to fire them at fast, small, quick maneuvering ships like destroyers. The torpedo warhead bursting on the side of a ship possesses a destructive force proportional to the size and character of the explosive charge and also to the head of water above it so that the depth at which it strikes is a matter of great importance. Its destructive effect in ships is usually countered by cellular compartmentation of such design as is found by experience to be the most effective. It is a physical fact that the shell of a torpedo is of limited strength so that the height from which it can be dropped into the water by a torpedo plane is relatively small. Yet the torpedo is an important weapon, hard to design, difficult to build, delicate to maintain.

Likewise the mine when exploded under the bottom of a ship has a destructive effect dependent on the charge and the depth of the water. In some respects the mine is the most destructive weapon, but it has serious limitations, of which the principal one is its immobility and the fact that when once planted the planter has no more, or limited, control in the matter.

The airplane bomb, like the projectile, can be a thin-walled, high-capacity bomb or it can be an armor-piercing bomb with comparatively low capacity for explosives. Generally speaking explosives which burst in the open air on impact have comparatively small disruptive effect on structures as compared with those which penetrate first. In order to make an effective flight a bomb must be released from one point in space exactly or it will miss, and it is a physical fact that the velocity of all bombs is limited under the force of gravity to the maximum terminal velocity, which is considerably less than that which can be achieved by a bullet or a projectile. It is possible to build shore construction or ships, provided the ships are built low enough and big enough, which usually will defeat bombs of the size which can be carried in planes in any significant numbers. The weight which any plane can carry is very limited, so that choice must be made as to whether engine weight, gasoline weight, or bomb weight is the most useful for its prospective work; and on any particular occasion choice must be made as to the size of bombs, for a plane which can carry ten 100 pound bombs can carry only two 500 pound bombs and only one 1,000 pound bomb. No bomber can dive with much of a load. It is the effort of antiaircraft batteries to keep horizontal bombing high so that the percentage of misses will be greater, and so that there will be better possibility of maneuvering the ship below. It is obvious that on any occasion nature has limited

the maximum destructive effect in bombing even if the utmost skill be used.

There are a number of other naval weapons and variations of naval weapons which need not be mentioned because the complications would detract from the illustrations already used. Great ingenuity has been used to design weapons of varying and comprehensive characteristics so that each will have its advantage, but it is no less true that each has its disadvantages and its limitations so that again wisdom in design, wisdom in manufacture, wisdom in supply, and wisdom in use are important, whether on the offensive or defensive.

There is a vast difference between ineffective noise, indiscriminate damage, unproductive activity, stunts, and effective operations. Damage to be effective must be wisely and precisely placed. Let us deliberate on the applications of this point so that we may become discriminating as to what makes progress.

ON TACTICAL EMPLOYMENT

The end and object of the offensive employment of military apparatus is to create such significant destruction as to bring about defeat, but the ways of doing so are infinite in their variety for the purpose and are extremely complicated in their application. It is desired, however, to mention a few points which have specific application and which are popularly not often thought of.

Certain types of craft are suitable for one kind of campaign, or even for different phases in the same campaign, depending on the forces to be met and where they are to be found. It is the care of the high command to combine the various types available in such a way that they will supplement each other adequately for the best results on any particular occasion.

Thus, in general, at sea light forces—planes, submarines, destroyers, cruisers, and carriers—are used for raiding, for reconnaissance, for striking, for enemy attrition or softening, and for screening own movements. As between more or less equal opposing forces, such light forces tend to eliminate or greatly reduce each other as a campaign progresses, thus requiring more and more support from heavier forces, and also necessitating considerable replacements. On any occasion they may or may not be supported in action by heavier forces of cruisers, planes, carriers, and battleships as strength members. They may or may not be followed ultimately by expeditionary forces of infantry, artillery, air forces, and collateral services to hold territory; but it is certain that if the sea is to be used freely and denied to the enemy it must be held by such naval force, and continuously, as to accomplish the result; and it is equally certain that if sea or territory is to be held it must be occupied in sufficient force to control it. It is manifest that the farther such area of control or occupation is from the original source of friendly supply the more difficult and expensive becomes the problem for the belligerent on the offensive. Evidently an overseas enterprise involves control of the air, the sea, and finally the land; but control does not mean necessarily that all enemies and all jeopardy have been eliminated, but rather only sufficiently reduced for the purpose, the feasible use.

The process of war is to control the means of existence or destroy the lives of an opposing nation composed of people. This is no less

true now than it was a million years ago; but it has become the fashion to hope, and to try to believe, that such ends may be accomplished at a distance without too much physical jeopardy by hit-and-run methods, rather than by a crushing force, and without the heavy jeopardy unavoidably entailed by its use. It is a fact that human beings, although having a taste for criticism and quarrels, do not like some of the horrors of war in large quantities, and one way or another hope these can be avoided. Hence they by one means or another try to avoid the most unpleasant features, particularly for themselves and for large masses of their friends and countrymen. Thus they, through wishful thinking, tend to beguile themselves concerning the stuff which is necessary to win an overseas war. This is not a question of individual bravery, but it is a matter of habits, sound thinking, and mass hardness.

Personal courage does have a great effect upon the employment of ships and planes in the field. The collective performance of a small light force which knows that it is adequately supported by a heavy force or strength member is superior to that of a light force which has no such hope. The collective performance of the crew of a ship, which must begin to fight instantaneously with effect or sink, is on the whole superior to performance dependent on individual effort. Thus the captain of the submarine who alone is looking through his periscope must determine without any check upon him whether he will make an attack, and when and how; or whether he will abandon it. At this point judgment and training determine the difference between maximum effectiveness and foolhardiness, for the torpedoes may be hastily fired without effect, or by bad judgment the submarine may expose herself and be destroyed without effect, or she may run away without adequate effort.

Similarly in a plane, an attack, by bombers and torpedo planes adequately met by fighters or even by adequate gunfire, may turn away or be broken up so as to be without any effectiveness whatever. Thus planes have been known to drop their loads in open fields or on unprofitable objectives, and go home, without accomplishing anything, when difficulties are met or opposition encountered.

ON APPROPRIATE USE

Not only may naval weapons be handled in action skillfully or unskillfully, as the case may be, but they may be selected properly or improperly for any particular occasion. To some extent their proper selection depends upon an intelligent use of available information, but sometimes it depends somewhat on luck, for a military commander who through chance or intention takes chances and succeeds with inadequate force is a great man, popularly speaking, but if he is caught at it and meets disaster he usually must bear his own shame.

First, it is necessary to select from the units available those which best supplement each other and are of characteristics suitable to compose the force suitable for the purpose. If the proper units are not available this perhaps may be a national calamity through a failure to prepare, but if they are available it becomes the responsibility of the high command to select and to use them properly. As remarked above, all types of ships and planes may be used alone on some occasions and each may be dispensed with on other occasions.

Next in importance to the high command is the selection of suitable objectives in attack.

Generally speaking, no major fleet is complete under existing conditions without all of the types of ships and planes mentioned above, including an expeditionary force and many types of auxiliary ships for fleet maintenance and fleet supply especially if an overseas campaign is to be prosecuted.

Let it be said, however, in ordinary common sense, that, unless there are compelling reasons therefor and benefits to be gained proportionate to the risks run, there is no more good judgment in sending capital ships into a hot submarine menace without destroyers or other antisubmarine vessels than there is in sending valuable ships into a respectable air menace without adequate air protection by fighters or otherwise, or than there is in sending any vulnerable military force into an uncertain and critical situation without reconnaissance or some information on which to base an estimate of the forces which may be met. Thus it is possible that a force be in an appropriate area, and no less possible that it be in an entirely inappropriate place under the circumstances.

It is a simple and elemental consideration that ships and planes are mobile; maneuverability is a primary characteristic, and lacking special circumstances it is no more appropriate that ships be caught unprepared, stopped at sea, or anchored in harbors, than it is that planes be caught on the ground. Both ships and planes must be serviced at their bases and their personnel must have opportunity to rest, but on such occasions they must be screened and protected by other means than their own or accept the chances correspondingly.

Let it be well remembered that after the raids and operations of attrition a substantial force must control the wide sea and its uses. Someone must remain to hold and to dominate.

ON WEATHER AND VISIBILITY

The effectiveness of all weapons, because they are controlled by human beings, is powerfully influenced by weather. Weather puts much uncertainty into the tactical use of weapons. Weather may be either a friend or an enemy. It may be skillfully used or it may be an unfortunate encounter. It is not too much to say that bad weather disturbs the normal functions of all military weapons to a greater or less extent. Generally speaking, it tends to increase the effect of their weaknesses from the battleship right down to the fighting plane. It is easily perceived that some of the types of weapons mentioned above can be used in some kinds of weather, and not at all in other kinds. Disturbances of the air, disturbances of sea, heat, cold, fog, rain, wind, snow, ice, and icebergs, all have tremendous effect. Performances which can be expected under the best weather conditions are sadly reduced or completely eliminated in adverse weather, and those who go to sea or go into the air are seriously limited thereby.

Similarly daylight and dark, clouds, sunlight, twilight, moonlight, and black nights have enormous influence, but they are nonetheless unavoidable physical facts which impose limitations, and sometimes offer opportunities. The range of visibility is short under the best conditions, compared to the size of the ocean; it has a profound effect on, and lends much uncertainty to, operations at sea, and still more

so in the air. For example, poor visibility under water causes submarines to operate alone to such a great extent; fog at sea in general puts a stop to the military operation and effectiveness of planes.

It will be sufficient to indicate, concerning a composite force of battleships, cruisers, carriers, destroyers, submarines, bombers, torpedo planes, and fighters, that under certain conditions such a force must operate under reduced efficiency because some of the types mentioned can operate only with reduced efficiency or not at all. For instance, when the sea becomes rough the smaller ships must slow down first, on account of their light construction, and consequently so must the larger ships or else the destroyers which are needed will be left behind. Similarly, in foul weather planes cannot fly, they must be taken aboard or grounded; but they are necessary for use in negotiable weather. Just the force and direction of the wind is a primary consideration in all plane operations, while plane navigation over comparatively short distances adds much uncertainty to plane operations.

Old Man Weather always has to be considered, and it is because of his uncertain behavior that many dreams of performances are seriously limited in practice, for it is no less certain that bad weather will be met some time than it is that dreamers will continue to premise performance on the continuation of good weather, which also happens sometimes in the experience of the naval tactician, after the bad weather is over.

Similarly it has been found that seasons and latitude have a considerable effect on war and campaigns, and the conduct thereof.

It is a debatable question whether a frosted foot, or a frozen carburetor, or an overheated engine, or a bullet toward the heart is the most to be feared, but such considerations do affect the operation of ships and planes, and at least the psychological and physical advantage, at any particular time and over a time during a campaign, is on the side of the ship or plane having the greatest size, the most stability and the most creature comforts. Human beings are like that; the softer they are and the better their habits of living the more they are just like that; and mental and physical conditions have great effect in the cooperative effort of preparation and conduct of war.

ON TIME AND DISTANCE

It is a well understood military principle that adequate force must arrive in time if it is to be of the maximum effectiveness. Accepting the correct choice of the hour of arrival, this then depends upon speed, endurance, and distance, which to some extent are matters of a designer's choice. The sea is very large; but the air is vastly larger and has also a vertical component to be negotiated by planes, with difficulties of its own and expenditure of fuel.

To the high command it makes an infinite amount of difference whether the designer long before was properly informed as to how fast and how far the ships and planes would be required to move under their own power, otherwise they may have to be refueled en route or frequently supplied with all manner of needed articles, all bothersome operations.

Distance has great effect upon the auxiliary types for maintenance and supply because it is one thing to rest on home bases with their hinterland full of resources, and quite another thing to rest upon deserts

abroad to which everything must be transported. A tanker, for instance, big-bellied, slow, and unprotected as it is, may use much of its fuel just going and coming, without delivering any appreciable amount of fuel; the finer it is as to shape and the faster, the less it delivers. Thus, too, the cargo submarine, and the cargo plane, although appropriate on some occasions, are very uneconomical and of doubtful adequacy for large projects.

Long distance whether horizontal or vertical is a fact of nature which, without any effort of the enemy whatever, greatly increases the war effort and correspondingly reduces effectiveness, ultimately down to the vanishing point, thus entailing great waste and dissipation of resources and energy.

Old Man Distance is an ally of Old Man Weather. Together these two have ended the rosy dreams of many a military commander and of many a theoretical designer or inventor; and they have brought grief to many a skipper and many a pilot. Propagandists normally are independent of time, distance, and weather. Not so seamen and airmen in war.

ON PERSONNEL

It has been pointed out above that all of the military weapons are built to produce damage, somehow, somewhere. Scientific progress has made them complicated. Therefore, in spite of the fact that a balance is necessarily established to some extent between the types of weapons based on designer's intelligence and manufacturer's skill, they still depend for effectiveness very largely on the training and the ability of personnel who man the weapons. On any particular occasion it may happen that a weaker unit prevails over a stronger unit through bad luck (such as unfortunate initial damage), adverse circumstances, lack of training, or through faulty tactical employment. Granting that all designers and manufacturers are of equal skill, the superior training of the operating personnel would cause it to prevail in the long run. Let it be said that the more complicated and the faster moving the piece of apparatus in use the greater must be the human skill, alertness, and tension in operating it; and that the more susceptible the operation is to error the greater becomes the difficulty in training the personnel to perform the operation under stress of action. As a corollary the less secure the personnel is in action and the more exacting its natural problems apart from the enemy's effort, the greater the difficulty in finding and training the personnel to achieve results and the more meager are the total results with imperfectly trained personnel. Involved in this are practical questions of leadership, human behavior, and mutual support which in a military organization operate in favor of the larger units in achieving results with similar weapons, although the smaller units may behave more spectacularly and may individually be highly effective on a particular occasion.

There is no substitute for an adequate number of trained personnel, especially in operations involving the activities of several units or several types of units. There is no training which wholly supplants experience and practice.

There are innumerable large and small operations in ships and planes which must be skillfully handled by some individual, to whom they are as important as the hitting of a target beyond the horizon by

16-inch projectiles; or handling a submarine to avoid anticipated patterns of depth charges; or saving a squadron of planes caught in fog or storm.

On any occasion one part of a composite force, through circumstances, may perform with maximum effectiveness or brilliancy but its effectiveness nonetheless is due to a degree to the accompanying or supporting forces which enable the operation to be performed and without which the operation as a whole would be impossible. All of the personnel in such an operation contribute to the result, good or bad; not only must they know their own duties thoroughly, but they must have extensive experience and training at sea in order to cooperate with the other types, so that all air, surface, and subsurface units may operate together after indoctrination with complete understanding and confidence in each other. However, there is not much use in building apparatus which wartime personnel, in number and quantity, cannot handle. The finest laboratory apparatus which a scientist can devise, the most complicated electrical apparatus of a ship, and the most delicate controls of a plane become useless when personnel is too few, too unskilled or too inexperienced in cooperation to make up an effective force. Neither seamen nor airmen can be created overnight; nor individually interchanged instantaneously without reduction in efficiency, for they form an inseparable team where life and death are at stake. Team work in military organizations is hard to achieve. Not only are fundamental training and experience difficult to attain, but the effects of large numbers of changes in personnel, and casualties, must be surmounted.

Personnel too is sometimes weary, sick, injured, deafened or punch drunk, causing loss of efficiency or absence. A mild epidemic or unsanitary conditions may put a ship out of action, easily.

Trained and experienced personnel has an influence on design as well as on operation, because unnecessary suicide is no more popular with military men than with other healthy and hopeful adults. Trained personnel in the end, if it has opportunity, will effect up-to-date changes in design. Contrariwise, it will abandon or condemn any inadequate weapon which has too little merit, including any type of ship or plane which on the whole has neither a good chance of effectiveness nor a good fighting prospect of survival. Therefore, it is well to seek advice from and listen to broadly trained personnel as distinguished from laymen, propagandists, or specialists.

ON BASES AND SUPPLIES

All ships and planes require the establishment of protected bases for maintenance work, repairs, spare parts, fuel and other expensive supplies, and all personnel requires rest and recreation. No mechanical apparatus and no crew can operate continuously, but duration of operations is in favor of the large unit and the personnel attached thereto since the large units carry with them more of the necessities for a military campaign and for daily living than the small units. Thus large ships can go for long periods of time without reservicing, while small planes require attention every few hours for material and for personnel; nevertheless arrangements must be made so that all of the types can operate together when necessary. Unreadiness to operate merely weakens the force by that much, and even under

best conditions there are always some units which are unready, to a greater or less extent, so that never is the total force present and available.

When a fleet rests on its own main bases, protected when it rests in security by the Army, the situation is quite different from what it is in a distant area lacking in harbors, landing fields, fuel, fuel storage, spare parts, shops, drydocks for damaged ships, hospitals, recreation facilities, and so on, ad infinitum. The ship that is so strong and dependable today becomes a tactical liability when she has a hole in her bottom and there is no drydock to go into. The plane which performs so brilliantly today is completely eliminated without gasoline, spare parts and shop service for the plane after a few hours, and without rest for the worn-out crew.

A submarine may operate at sea for as much as 2 months, but at the end of that time the ship requires maintenance work and the crew requires rest; and there is no alternative. Similarly planes not only require suitable places to land but, when in even moderate numbers, require great parking places, large shops for frequent overhaul, enormous supplies of highly inflammable gasoline, numerous replacements for planes, and extensive barracks for the ground and operating personnel, with all of the miscellaneous trimmings. All sorts of mechanical apparatus and personnel are like that, even in time of peace; in time of war, when there is wear and tear and damage to material, and stress and strain on personnel, the situation is much worse.

All of the types have their peculiarities and their limitations which must be cared for.

Everything required to go overseas is limited in quantity, size, weight, and general character by the protective handling, storage, and shipping facilities available.

Thus an overseas expedition against a puny enemy might be successful with any one type of ship or plane; but if the enemy is strong, well equipped and well established a much larger and more complete force and a much greater effort is required because time and distance are his allies in addition to whatever preparation he may have made himself. The belligerent going far overseas must have, and answer, everything the enemy has—only more, and better. More than enough or unsuitable weapons not only increase the expense to no purpose but hamper the campaign by absorbing personnel, facilities, and transportation. Unsound advocates and unwise choices can do harm to a campaign in this respect.

ON TRANSPORTATION

Brief mention of the types required for transportation of personnel, planes, artillery, shops, materials, food, inflammable fuel, hospital facilities, and explosive ammunition is unavoidable. These types are highly specialized, and distinct from combatant types, but are quite as necessary for overseas work—the greater the distance and the poorer the facilities at the other end, the greater the need of enormous total capacity; and carrying capacity is severely limited by any additions of speed, guns, protection, fuel consumption and such elements. The economical cargo ship has a big belly and slow speed in order to accomplish quantity delivery. On the other extreme of the transportation facilities are the cargo submarine and the air

transport, both very uneconomical for what they deliver. Intermediate types with characteristics in between are numerous. All of these require escort in hostile areas.

Let us not forget that distant operations of mobile mechanized units are dependent on supplies, particularly a sure current supply and an ample reserve of food, of ammunition, and of fuel, the source of energy, which high-speed operations and the high-powered units devour. Without sufficient supplies of such commodities as fuel oil and gasoline, ships, planes, and shops may be hampered in operations, may become relatively ineffiective or even dead. The greater the area of operations, and the more distant, the greater the need.

ON TREATIES, BUDGETS, AND SUCH STARK BUT PRACTICAL ABNORMALITIES

In practice, preparation for war costs a great deal of money, requires much training, takes much time. Wise preparation for war depends upon the definiteness and the consistency of national policy.

Under a party system of government there is not apt to be consistency of national policy, either foreign or domestic; the party system is like that.

Waves of more or less violent economy and liberality succeed each other with irregularity but certainty. Waves of imperialism, isolationism, nationalism, internationalism, belligerency, and pacifism take charge from time to time and have their effect over a period of years. In time of peace and economy, war is in disgrace; but in time of national crusading and exaltation, war becomes noble again; and both of these states of mind have an effect on the annual budget, and so upon military planners and on naval designers.

Thus, for example, after the last war several shipbuilding plants went into bankruptcy or went out of business for lack of work. The designers either died or went into other lines of business so that the highly technical matters involved in building ships and planes and the facilities for quantity and quality production suffered accordingly. Not only that, but during the same period of time the American Merchant Marine became pitifully decadent for reasons unnecessary to discuss here.

The efforts of the Conference for the Limitation of Naval Armaments which met in Washington in 1922 with the succeeding meetings abroad are noteworthy as to abortive efforts, principally because the resulting restrictions concerned themselves so considerably with limitations on the powerful battleship and the cruiser, and efforts in negotiation gradually petered out so that they failed to carry through to the smaller and supposedly less expensive and less important weapons, which flourished and developed accordingly.

Thus for a longish period of years, nearly 20 in fact, design and production of the most powerful naval weapons lagged while the designers and fabricators became much reduced in numbers and inexperienced, even if they did not quite disappear altogether.

A single illustration will suffice to make a point. The U. S. S. *Oregon*, which carried 13-inch guns and 8-inch guns and was well armored for her day, was a heroic figure in the Spanish War, and justly so. She was a battleship of her period of about 10,000 tons and did noble service. Such has been the progress in naval design

since that time that the cruiser *Houston*, recently lost, could steam further and faster, and shoot so much farther and so much faster and straighter, that, had they ever met, the *Houston* could have stood off and hammered the *Oregon* to pieces without having a single projectile come anywhere near her. The *Houston* was only a 10,000-ton treaty cruiser, although limited in size artifically. So much for progress in design and apparatus, and just so much for obsolescence in times of great industrial and mechanical progress.

Since mechanical skill in design and manufacture can be turned into any one of several channels, the conclusion is rather obvious that obsolete or badly designed apparatus of any kind cannot compete fully with up-to-date apparatus. Stagnation in mental effort, whether in business or in national defense, brings its own inevitable consequences; no designer or builder can work miracles.

The point is that if there is to be progress in design and construction, all governed by natural laws within the ingenuity of human beings, effort and production must be continuous and progressive in all lines if the relations of natural forces are not be to upset by artificial and obsolescent arrangements. The alternation of feast and famine, whether due to political or budgetary considerations, produces the abnormalities of alternating starvation and indigestion in the national defense no less than in any other activity. Considering progress in the development and use of materials, it is unreasonable to expect yesterday's apparatus of any kind to equal or compete with what could and should be possible today. As between the various types of engines of war, the practical question of quantity, quality, suitability, and degree of obsolescence enter into the picture. Look at the history and the date on the underlying design before drawing any conclusions about mechanical apparatus, ships, and planes.

The general effect on the availability of trained personnel is parallel.

ON SOUND AND UNSOUND DEDUCTIONS

For purposes of study and for the information of those who design ship structures (as well as for those who train personnel) a considerable number of experiments have been conducted over a period of years to demonstrate the effect of high explosives of several sorts and various quantities on structures of various forms and shapes imitating structures of ships or possible ships. Of course, such experiements are not entirely satisfactory nor entirely conclusive because they do not cover the infinite variety of circumstances which may accompany the use of high explosives against ships. It may be accepted that such experiments have been too few in number, but this applies to all sorts of expensive experiments which may be of use to designers engaged in research.

To supplement such experiments and to further improvement in construction there have been made from time to time planned experiments on actual ships of a kind intended to establish facts as to damage.

In regard to the experiments mentioned above it may be said that, because they are too few and to some extent inconclusive, the test comes in battle, but unfortunately that is too late to accomplish the purpose of preparation, and in the end furnishes few data to substantiate facts or comparisons between materials and their assemblies.

There have also been a few other artificial experiments, in the nature of Roman holidays, primarily for the stimulation of psychology and the fortification of propaganda such, for example, as those that were conducted some years ago using the U. S. S. *New Jersey* and the U. S. S. *Virginia*.

The mere fact that the *New Jersey* and the *Virginia* were sunk by bombs from planes does not mean that the plane and its bomb are superior to the battleship because the circumstances did not promise any other result. The ships had been built under an out-of-date philosophy; they had been out of commission without upkeep for a considerable time; their plating, seams, watertight doors and hatches were in poor condition; there was no defense by guns or otherwise; their pumps were dead; they were quietly anchored in a smooth sea, with excellent weather conditions, within easy range of the air base, and finally the planes were guarded by destroyers to keep them safe. The destroyers in fact could have sunk these battleships with torpedoes while they were waiting for the planes to take off the first time. There was no reason to suppose that these two battleships could survive an unlimited amount of high explosive deliberately dropped on or around them over a period of several hours, provided only that the planes were able to pick it up and drop it. If on the other hand the planes had never been able to sink those two old battleships, at anchor and defenseless, that would have been significant indeed. These comments are not intended to belittle the performance of the planes on that or any other occasion but merely to recognize physical facts. The plane operators were doing a new stunt for a purpose and they made the most of the opportunity.

ON CURRENT EXPERIENCE

Actual experience of planes and battleships in single combat against each other is comparatively scant, and in the nature of things should be so, because this is not the way forces should be employed. The attack on the battleship by planes is normal enough as an offensive operation, in which the planes enjoy the highly valuable initiative; but on the part of the battleship it is strictly defensive because no battleship can take off to pursue a plane and so must await the attack and operate defensively with maneuvers and antiaircraft fire. However, it should not be expected that a battleship in these days will meet a heavy air menace unopposed, for the primary defense against bombers and torpedo planes is to destroy them at their source or to counter them on the way to their attack by other suitable planes—fighters. Antiaircraft guns add great jeopardy to the attacking planes but they are not the primary defense. However, they may bring down some planes before bombs and torpedoes have been released and in some cases may insure that the planes do not return to a second attack. Battleships are not expected to withstand an unrestricted menace by planes any more than they are expected to withstand an unrestricted menace by submarines, destroyers, cruisers, mine layers, or any other single type without either due care or counter operations; but even so up-to-date construction, equipment, and training are essential—energized by proper use.

Engagements between mixed types of ships and planes are extremely complicated when it comes to drawing conclusions from the results.

As a usual thing a great deal of the data which would be useful in the evaluation of the results is missing, perhaps because some of the units and some of the personnel have been destroyed, and in many cases the significant history does not readily appear to the eye. Thus it is that the analyst has a very difficult task in drawing sound conclusions.

The instances that happen are so small in number that usually they furnish no criterion from a statistical point of view. Isolated incidents of all sorts happen, and while certain facts result it is unwise to conclude that similar results will happen so, normally.

It may be confidently stated that naval and military staffs do everything in their power to collect data and to analyze results to the end that they may be able in the future to damage the enemy with greater facility. Often much of the necessary data is missing and sound conclusions are arrived at with considerable uncertainty. Even so, the staffs have much more information at their command than the public at large, for whom it is highly inadvisable to jump at conclusions or to accept appearances as to underlying causes without sufficient information, experience, and breadth of view.

In the present war there have been several occasions on which battleships have been disabled or sunk by aircraft and these occasions cover a considerable variation of circumstances; and there have been other occasions on which planes have been shot down by gunfire from battleships; but in no instance is it wise to draw conclusions unless all of the background and the existing circumstances are taken into consideration. In some cases essential facts are missing from the information available and in some cases, even if the information were available, its significance might not be appreciated.

For example, not long ago a British battleship was lost close to the east coast of Indo-China, sunk by Japanese planes, during a rapid operation of meager forces without air screening to counter a Japanese landing operation in force. Some of the facts are known, but the analyst would have to consider among other things the following:

Whether the ship's operation was meritorious in that the result could compensate for the jeopardy.

Whether the ship should have been there at all, in a strategical sense.

Whether air support was available and used.

Whether the underlying information was adequate or deceptive.

Whether the ship was handled skillfully in accord with the best practice.

Whether the design and construction of the ship was in accord with the best and latest practice.

Whether the internal security measures were adequate for the prevention and control of damage.

Whether the armament and fire-control gear were adequate.

Whether the ammunition was of proper design and functioning.

Whether the personnel was well trained.

Whether there was an element of distinct surprise.

Whether there was an essentially overwhelming force.

Whether there was an element of luck present.

The answers to these questions cannot be taken for granted. We may think we know them but unless we actually do know the answers to these and others we cannot evaluate the causes of loss.

Again, there was recently sunk in the Atlantic a German battleship operating without any air support after being attacked by planes and

ships using several sorts of weapons. Before sinking she did great damage to her enemy; she was slowed down by a torpedo from a plane to a speed equal to what was a few years ago maximum battleship speed; she was literally shot to pieces by an overwhelming gunfire of concentrating forces; she was finally sunk by a torpedo from a ship; apparently she gave and took everything that might be expected of a ship; and yet in her loss the same questions would have to be answered, conclusively; but much valuable information went down with the sunken ships.

Exact evaluation and correct deduction are sufficiently difficult for the expert. It is desirable to seek the best advice available in case it should be necessary to draw conclusions. Most people are not called upon to draw conclusions in this matter and should keep an open mind in consequence. Military experts have always been active searchers for progress; many a commercial device of today was a military demand of yesterday before it was a fact.

It is particularly desirable to avoid discarding the facts of yesterday and today for the possibilities of tomorrow or for the dreams of the day after tomorrow until the improved possibilities are actually within grasp. Things have a habit of being as they are for good and sufficient reasons, provided we can just find out what the reasons are. Evolution takes place in military affairs as in other affairs with some deliberation because the errors of revolution are apt to be too expensive in an effort to substitute even the most clairvoyant dreams for the existing substance established by historical development.

ON BATTLESHIPS AND AIRPLANES

The collateral background has been briefly covered in the preceding paragraphs. It is believed that enough has been said to indicate that sweeping and didactic statements on the part of one sort of enthusiast or another should not be accepted without breadth of view and without full knowledge and appreciation of the facts. Even in the Military Establishment there are waves of enthusiasm for some particular weapon which on some occasion has appeared effective, and there are also waves of fear of a military weapon which has just accomplished execution under special circumstances. Invariably these waves are succeeded by a condition of equilibrium tending toward general progress when opportunities for progress are offered.

In the past there have been various sorts of men-of-war; they started tiny and simple. The battleship of today with its great size and complication is the outgrowth of the battleship of yesterday through force of circumstance and necessity; and yet it can be obsolete. It has been pointed out that most of the battleships in existence today are of old design and were subject to artificial limitations so that there are in existence few, if any, fully representing the possibilities of free design premised on up-to-date philosophy and the latest scientific achievements; but this can be merely temporary. The battleship of tomorrow will be no different as to naval philosophy, but rather different as to details of construction, equipment, and use. We may expect confidently that as long as the surface of the sea is used for the transportation of persons and goods, so long will some type of ship be needed to represent the maximum force and maximum power of survival among ships—and this ship can be called a battleship.

The case of the airplane is not on a whole so very different, except that the airplane as a physical fact has been in existence only a few years. Its progress has been rapid because attended by a certain glamour, by a commercial urge and by concentrated scientific developments, although as pointed out above its limitations are quite different from those of the battleship. Most airplanes in existence today are already superseded in the minds of the inventors by the dream of tomorrow, and planes are being turned out today which will be obsolete tomorrow, indeed are already obsolete today. As in the case of the battleship, however, the advantages, the disadvantages, the expense, the difficulties, and the complications of today must be accepted.

ON THE PRESENT AND FUTURE

The plain fact is that the airplane has added to the complication of war, enhancing the position of the rich and mechanical-minded defender and fortifying him to some extent in his zone of influence. Yet there are practical reasons outlined above why planes of late design cannot be present, in unlimited numbers, efficiently manned, at the scene of action at any one time; "the sky black with planes" does not happen. Neither infantry, nor artillery, nor tanks, nor fortifications, nor submarines, destroyers, cruisers, battleships, can neglect consideration of this weapon; undoubtedly they cannot operate with the same impunity as formerly but they will operate extensively and effectively when well designed and well handled; they are progressing in design, equipment, and in use to counter both the new and the old jeopardies which they have to meet. None of the types of ships has been eliminated, nor is there prospect that they will be. New ways and means are being found, all subject to the same natural laws. Operations of planes will be conducted in the presence of ships; and operations of ships will be conducted in spite of planes. There will be found no new substitute for human ingenuity, skill, courage, and training in fabrication, and in use, with competent leadership.

Since the primary purposes and uses of battleships and planes are not by any means identical and since their characteristics are so entirely different that each possesses few of the outstanding characteristics of the other, it happens that neither can be evaluated in terms of the other by any means whatever. Both are necessary military weapons in due proportion, depending on the object to be achieved.

Both will, and should, continue to exist as engines of war so long as there is war, so long as they are useful against the enemy, so long as there can be found considerable numbers of human beings to take them into action, and so long as there are people who believe sufficiently in military preparedness to provide them; nothing to the contrary is in sight.

IN CONCLUSION

It is to be confidently expected that the maritime wars of the future will begin in the air, and under the surface, but that they will progress to a finish on the surface. Against any significant enemy the control of the sea will be gained by the push of crushing force, accepting its jeopardy and losses, and thrusting its way resolutely into the critical area in support of lighter units, perhaps after these have been largely expended, and finally staying there to use the area by means of the

occupation of such stable force as may be necessary to overcome, and to keep overpowered, the enemy at his source, wherever that may be.

At such a time the mobility of planes, in such numbers as remain, will be necessary and very acceptable to the battleships; while the power and toughness of the battleships, and the other types in proportion, will be necessary and very acceptable to the planes.

At that time stamina and power of survival will loom large in the military picture as a concomitant of offensive power.

(The opinions and assertions contained in this article are the private ones of the writer and are not to be construed as official or reflecting the views of the Navy Department or the naval service at large.)

REAR ADMIRAL G. J. ROWCLIFF, UNITED STATES NAVY

Rear Admiral G. J. Rowcliff, United States Navy, graduated from the United States Naval Academy at Annapolis in 1902. He is also a graduate of the United States Naval War College at Newport; has served ashore as a member of the War Plans Division of the Office of Naval Operations; as assistant budget officer for the Navy Department; as head of the Department of Engineering and Aeronautics at the United States Naval Academy; as commanding officer, United States Naval Training Station at Newport, R. I.; and as director of naval communications under the Chief of Naval Operations, Navy Department.

At the outbreak of the first World War, Rear Admiral Rowcliff was gunnery officer on the staff of Vice Admiral D. W. Coffman, United States Navy, commanding the Battleship Force of the United States Atlantic Fleet.

During the war, he served as gunnery officer on the staff on Rear Admiral Hugh Rodman, United States Navy, commanding the Sixth Battle Squadron of the British Grand Fleet, and also as executive officer of the U. S. S. *New York*, the flagship of the Sixth Battle Squadron. He was present at the surrender of the German High Seas Fleet to the Grand Fleet off the Firth of Forth.

Since then he has commanded the Forty-first and Forty-second Destroyer Divisions of the Scouting Fleet; served as fleet material officer and as fleet tactical officer on the staff of Admiral R. E. Coontz, United States Navy, commander in chief, United States Fleet; commanded the U. S. S. *Cincinnati;* commanded Destroyer Squadron 4, Battle Force.

He holds service medals for the Spanish Campaign, Mexican Campaign, and the World War; and was awarded the Navy Cross after the World War.

His commission as rear admiral dates from January 1, 1936.

On June 1, 1936, he was appointed Judge Advocate General of the Navy by President Roosevelt and was relieved from this duty to go to sea on June 20, 1938.

On July 13, 1938, he took command of the Cruisers, Scouting Force, United States Fleet, consisting of four divisions of 10,000-ton cruisers, with additional duty as commander, Cruiser Division 5. His flagships were U. S. S. *Chicago, Tuscaloosa, Houston.*

On October 1, 1940, he assumed additional command of Cruiser Division 4, vice Cruiser Division 5, retaining command of Cruisers, Scouting Force, then operating as a part of the United States Fleet in the Hawaiian area.

Admiral Rowcliff is especially interested in and tends to specialize in fleet tactics, particularly of the light forces, and in gunnery, particularly antiaircraft gunnery; is air-minded; likes to fly; is not a qualified pilot; believes in integrated forces of ships and planes for naval purposes.

On March 9, 1941, he assumed duty as member of the General Board, Navy Department, Washington, D. C.

DANGERS IN CONTROVERSY OVER BATTLESHIP CONSTRUCTION

(Why America needs more, not fewer, dreadnaughts is set forth here by one of the Nation's ablest naval strategists, who served 40 years in the Navy, filling many key posts. In 1940, he warned a Senate committee of Japan's plan of conquest.—*The Editors.*)

(By Rear Admiral Joseph K. Taussig, United States Navy, retired, former Assistant Chief of Naval Operations)

I am one of those contemptuously called "Brass Hats" who still believes that the dreadnaught is one of the most important factors in naval warfare. Its day will never come to an end unless all nations agree by treaty to make it so; and even in that case the most powerful floating craft retained will, of course, take the place and act in the role of the present so-called dreadnaught.

We hear only about the dreadnaught when one of them happens to get sunk or damaged. We hear nothing of the part the dreadnaughts are actually taking in this war because their role is so very important their whereabouts and movements are guarded by all nations with the greatest secrecy.

The fact that most of the active combat operations are being performed by aircraft and submarines and the lighter surface craft has led the public to believe that the battleships and battle cruisers are of no further use. The public are influenced by columnists, radio commentators, and others who feed the people their comments, opinions, and thoughts, most of which are superficial, and are based only on the news which the censors permit to be made public. Accordingly, the great potential value of the battleships isn't generally understood.

It is well known, of course, that some few battleships have been sunk either by bombs or torpedo or gunfire, or a combination of two or all three of these destructive weapons. No consideration is given to the great toll incurred by the enemy through the loss of aircraft, submarines, and surface craft in causing the destruction of or damage to the battleships.

The arguments against the battleship fail to recognize the fact that any object, no matter what the size, can be destroyed, provided sufficient explosives are brought in contact with it—it making no difference whether the explosives are brought by hand or in a truck or carried by aircraft or submarines or destroyer; and accordingly that these few battleships which have been destroyed have, either through ignorance or bravado, not been properly safeguarded in accordance with what should be expected in these days of the torpedo and bomb.

In other words the personnel element, the most important of all, is not considered. Battleships, if properly screened with aircraft and light surface ships, are still able to carry out the objective for which they are built or designed. Most of those now in service were built prior to World War I, and, in consequence, do not possess the defensive qualities in all respects that are needed to meet the great

developments which have recently taken place in aircraft and submarines. This has been recognized in the design of our new battleships. However, in the first of these which are now in service, there was still a lack of appreciation of the great advances made in bombs and torpedoes when vessels of only 35,000 tons displacement were authorized and built.

When it was recognized that the necessary defensive qualities could not be provided in a ship of that size, we went to a displacement of 45,000 tons, and now, in accordance with press reports, ships of 60,000 tons are in contemplation. It is too bad we did not build all of our new ships of this size, as that is the least displacement on which all of the necessary qualifications of armor, armament, speed, and endurance can be obtained.

In the Battle of Midway, which has been proclaimed as a great victory, we were acting on what is known as the offensive-defensive. That is, we were taking offensive action against the enemy for the purpose of defending one of our bases. We did defend the base, but, as the greater part of the Japanese fleet escaped to fight another day, it is surprising that this should be considered a great victory. However, if our battleships had been stationed within striking distance of this battle, I am convinced that, with the initial damage done by aircraft, the entire Japanese force would have been annihilated.

We lightly pass over the great loss in aircraft in attacking surface craft with an equanimity that is entirely unwarranted. The Battle of Midway resulted in a far greater loss in aircraft and aircraft carriers than to the other surface craft. When our gallant Squadron I, composed of 15 torpedo-carrying planes, attacked a well-screened formation of Japanese surface vessels, every plane and all the personnel (with the exception of one officer) were destroyed. Fourteen of these planes never got within striking distance of the main enemy formation. And I am informed on good authority that the same fate met the Japanese torpedo plane squadrons which attacked our well-screened surface formations. They were simply annihilated.

A larger proportion of airplane carriers, cruisers, destroyers, and submarines have been destroyed or severely damaged than of the battleships, yet the propaganda is all aimed against the latter.

After the Battle of Jutland in World War I, little was heard about battleships. However, it was our battleships at Berehaven in southwest Ireland, and the battleships of the Grand Fleet at Scapa Flow and other bases that permitted the destroyers and cruisers of the Allies to escort the convoys which carried millions of troops, together with their huge quantities of stores, fuel, ammunition, and supplies, across the Atlantic. If it were not for those battleships—even though they did not fire a shot—the enemy surface raiders would have annihilated those convoys, our troops and stores would have been destroyed, and we would have lost the war.

We now read of huge convoys reaching ports in Great Britain and Russia and in the Persian Sea. These convoys are escorted by surface vessels and aircraft. Whether or not battleships are performing active escort duty is never divulged. But we may rest assured that the battleships are lurking in the background somewhere within striking distance which is well known to the enemey and prevents the use of their battleships and of other large surface craft in raiding operations

because the risk involved is too great. If we did not have battleships in greater number than the enemy, these convoys would never reach their destinations.

If the Japanese did not recognize the great potential value of the battleships they would not have made the raid on Pearl Harbor. The Japanese knew that the only way we could save the Philippines was for our fleet to arrive there in greater strength than their own before the fall of Manila. They knew that this would be impossible if they could sink or disable a number of our battleships. Accordingly, they undertook the great risk of the raid on Pearl Harbor simply because they knew our battleships were based there. And their objectives were the battleships and not the shore establishments. When the truth finally comes to light, I am confident it will show that it was the damage done our battleships which prevented sending relief to MacArthur and resulted in the loss of the Philippines.

If the battleship has lost its value, why is so much effort made to destroy them? Why do the British keep seeking out the few battleships and battle cruisers the Germans and Italians possess and expend large numbers of aircraft and submarines and other types of vessels in their attempts to destroy them? It is done, of course, because of the great potential value of these ships which requires the British to keep a large part of their Navy watching them so that they cannot get loose among their convoys, the safeguarding of which is essential for the prosecution of the war.

The United Nations have lost to Japan a great part of their colonial possessions in the Far East. I believe the people of this country have no idea of the magnitude of the task required to regain these lost possessions by conquest.

Suppose (and of course this supposition is made only for purposes of illustration) the United States must send 500,000 men to the Far East in order to conduct an offensive campaign. And suppose we omit for the present the immense amount of shipping that is required to get these 500,000 men and their equipment of food, ammunition, stores, mechanized parts, oil, etc., to their destination (and in this original tonnage must be included one transport vehicle for each five men, which means 100,000 automobiles of some nature). In order to keep this expeditionary force operating we must transport across the Pacific 2 tons of stores per man per month. For 500,000 men this means 1,000,000 tons of stores per month. Suppose each vessel used can carry 5,000 tons. This means that every month 200 vessels must leave the United States to support these 500,000 troops. As the turnaround time will be at least 3 months, there will be required for this service alone no less than 600 ships, and probably more.

These ships must be escorted by aircraft and surface vessels. Does one suppose for a moment that these convoys can get through to their destination if exposed to raids by Japanese battleships and cruisers in addition to the attacks by submarines, aircraft, and light surface vessels? If such an expeditionary force is contemplated it can only be successfully supported if our battleships are so disposed and in sufficient strength to make it impracticable for the Japanese to raid these convoys with their battleships, battle cruisers, and other heavy surface craft.

If we and our allies do not get our battleship force to the Far East in greater strength than that of the Japanese, we will never be able to reconquer our lost possessions. This is why I am so perturbed by the ballyhoo concerning the obsolescence of these big ships.

I hope that we will complete all the battleships of the 45,000-ton class now under construction. I regret that decision has been made to discontinue work on the larger ships which have been authorized. And I am convinced that, before this war is over, the people of this country are also going to regret this decision; that is, unless they are willing to let Japan retain possession of the great empires which they have wrested from us. We can never win them back by conquest if the battleships are eliminated.

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