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AN INTRODUCTION TO THE STUDY OF NAVAL TACTICS.

By Capitaine de Vaisseau RENÉ de CARFORT.

Translated from the *Revue Maritime* by Fleet-Engineer T. J. HADDY, R.N.

NAVAL tactics may be defined as the art of disposing fleets for combat, but it is essential to give to all the terms of this definition the most extended meaning they will bear. The art of disposing fleets for battle is not limited to the formations and evolutions which precede or accompany the different phases of a naval action; it comprises also the whole series of studies and measures, having for object the disposition of the fighting elements in each of the units of which these are composed. These previous arrangements will enable us to obtain at the decisive moment the best possible utilisation of all the arms which contribute to final success, quite as much, and perhaps more, than any of the tactical combinations proper of the last moment. The rôle of the tactician commences, therefore, long before the struggle. It is exercised really during times of peace, during the preparation of the plans of war-ships, their armaments, and their union into squadrons. To him it belongs in the first place to welcome or to reject the *perfectionnements* of every kind which modern science may be pleased to offer daily in relation to engines of warfare for naval service. However perfect a new arm may be, or however ingenious its mechanism, its employment ought to be governed by its value under the special conditions of its utility for service on board ship, that is to say, in a heavy sea and under the fire of the enemy. He should also endeavour to assemble judiciously the instruments of battle at his disposal, create types of ships appropriate to the end at which he aims, and form them into harmonious groups of which all the elements are completed one by the other, and lend each other mutual support. This important task, the true preparation for all tactics, is not the work only of supreme authority; each commanding officer must contribute to the same, not only when called upon to supervise the work of completing a new ship, but also when in a commissioned ship he has to co-ordinate and utilise arrangements already existing, to bring out their best qualities, to discover and correct, as far as possible, their defects. During the first part of his career the officer must study the theory and practice of all the branches of which nautical science is composed, branches so diverse and complete in themselves, that to render real service he must become

a specialist in one of them. But the moment he commands even the most feeble unit, he ceases to be either gunner, torpedoist, or rifleman, in order that he may be a specialist only of this complete arm, the ship of war. Leaving henceforward to others the duty of ensuring the due preparation of the different machines, he gives himself to the study of their simultaneous and judicious employment in the hour of battle, that is to say, their tactical employment. Each of the arrangements which he may make to this end, especially in the time of first commissioning, will exercise its influence on the future result in action, when the collective power of the ship has to be manifested. To be at his best in this rôle of preparation, the commander must not rest satisfied with the experience he has gained while serving in the junior grades; most frequently the ship which he has now to make fit for battle, has a very distant resemblance to those in which he has already served. It is not one of those latter that he can usefully take as a comparative term. The ideal type which to his mind responds to the actual necessities of maritime war, alone should inspire the resolution he takes and the opinions which guide him. It is necessary for him then to have this formation of ideas, a theory, or, if the word is preferred, a doctrine, from which is evolved for him a clear conception of what squadrons and war-ships ought to be. It is this doctrine which we purpose to study in the following pages, without seeking to place it above the inestimable teachings of experience, and with the single ambition to formulate some of the general principles on which rest, by reason of the rapid and radical changes in *matériel*, the constitution and construction of ships and fleets.

FIRST PART.

Maritime War: General Notes on War.—The logical basis of all conceptions of military order rests for the officer in a wholesome appreciation of the true character and importance of the mission with which he is entrusted. War is not only an unfortunate necessity of our times, a remains of ancient barbarism from which we suffer, waiting for the time when the wisdom of our race will agree to avoid it. Such a view is incomplete, and does not suffice to give to him who commands that serene and inflexible sense of the duty he has to fulfil. The officer must be convinced that war is quite otherwise than an unfortunate and accidental necessity; that it is in reality one of the laws, and perhaps the highest of those, which dominate the development of societies. It is the decisive and indispensable phase of this vital competition which is in exercise to-day, and legitimately, amongst the nations, after having been exercised between individuals, families, clans, and provinces. In this incessant and also profitable conflict of ideas and interests, recourse to force as the last and supreme argument can never be abolished whilst distinct nationalities exist, for none of them has the right to abandon the patrimony of its intellectual traditions and acquired wealth, or to renounce without constraint its own individual existence. The last unification of races and classes to which the unconscious effort of humanity tends is only compatible with a superior degree of civilisation and morals, from which, as

yet, we are very far distant. Universal peace will be established one day, but only by the final victory and exclusive predominance of the most noble, the most intelligent, and the strongest race. The end of war is to insure and affirm, in view of this far-off selection, the development of the national life, and its resistance to, or the assimilation of, rival nationalities.

The Peculiar Characteristics of Modern Warfare.—Although war has been the fruitful means of drawing together the march of the ages and uniting one by one all the elements of which the fatherland is made up, its true rôle has often been overlooked. This is particularly noticeable at the present time, because the progress of the human mind, while making war less frequent, has at the same time made it more deadly. The prolonged hostilities of former days have given place to short and decisive encounters, which diplomacy, while knowing them to be inevitable, endeavours to stop, and in which clearly personal ambition and spite no longer play a part, but the public interests and often the very existence of the nation.

Everyone naturally realises that these exceptional circumstances call for the arousing of all their energies, the ordinary course of life is stopped, business ceases, and agriculture itself deserted, the whole nation armed makes for the frontier, calling in and swallowing up for its purpose all the resources of the country; such are the peculiar and striking features of the warfare of to-day. Preparation for war consists, generally speaking, in training the greatest possible number of able-bodied men and of collecting the vast quantity of stores which will be necessary for their action, and of studying the methods of attack and defence.

There is, however, another point of view which we must not pass over in silence. It is not enough for a nation, in order to predominate, to be the most intelligent or the strongest; she must above all be the noblest, that is to say, the most moral and the most imbued with the sense of her duties. The most deadly engines of war are powerless in the hands of men bereft of this spirit, and against which nothing can prevail. The first and most efficacious preparation for war is to raise the moral level of the population. War ought not only to be a great evidence of intelligence and strength, but above all should testify to the moral superiority of the people.

Concerning the Rôle and Importance of Maritime Frontiers.—Frontiers which are the natural or conventional boundaries of countries may be regarded in some respects as the organs of life outside the country and of its relations with other peoples. They serve in time of peace to regulate the exchange of the various products of the soil and of industry, and in time of war as the impenetrable ramparts of the country.

The part played by sea frontiers is, from these two points of view, very different from that played by frontiers on land. By means of the latter, the country is in fact in immediate contact with its neighbours on the continent. It is to a certain extent tributary to them, from a commercial point of view, since its trade can only be established with them, or by their intervention. It endeavours to export to them the overflow of its

productions of all kinds and must in return submit to the importation of the goods, ideas, and even the language of its rival neighbours. This continuous work of assimilation tends to increase the development of the means of communication, and in consequence to lead rapidly to an acute stage in the vital competition, which exists between two countries separated by a common frontier.

If war breaks out, the attack or defence of the frontier is the initial and dominant factor of the hostilities which must of necessity have for the scene of action the territory of one or the other of the adjacent nations. The struggle thus entered upon may finally result in a modification of the frontier by the annexation of neighbouring provinces to the victor, or even at the crushing and complete assimilation of the vanquished : war between two nations whose territories limit each other is therefore of the most menacing and terrible nature and should be prepared for with the most careful deliberation.

Quite another affair is the problem imposed on the defenders of maritime frontier, by which force intercourse is maintained with all nations. The sea is the common route open to all, which leads to all ports, and from this it follows that maritime commerce necessarily has a much greater importance than that of overland trade, and is the source of all power and wealth to the nation having the advantage which the sea frontier gives. From a military point of view, the violation of maritime frontiers is really an operation of the secondary order, as it presupposes the destruction of the sea-going squadron of the country, its first line of defence, or that they have been reduced to impotence. It is, besides, an operation exclusively maritime, confined to the coast, but it may well be followed by an invasion of the country by the landing of an armed force. War between two countries which have not a common frontier will naturally commence at sea, and be followed by an attack on the frontier. It may also have this character when two bordering nations have a sea outlet which is common to both. Such is the case with France and Italy. Both of them are backed by the massive heights of the Alps on the land side, and have their neighbouring coasts reciprocally prolonged to form the western basin of the Mediterranean. Their commercial relations are carried on more easily by sea than by the mountain defiles, and from this results a conflict of interests which should logically lead them to dispute the supremacy on this common sea. On the contrary, war between two countries having a common land frontier and coasts washed by the waters of different seas, such as are France and Germany, must be before all a continental war. It would be an error all the same in this case to minimise the importance of the maritime frontier. Each of the two countries engaged will employ, as we have seen, the whole of the resources at its command. Now these resources are limited, and it is permitted to suppose that neither of the armed Powers in presence of each other, supported by a series of fortifications and entrenchments, will be able to succeed at once in finishing the war by obtaining a decisive victory. It will be, then, of the greatest importance to each of the two Powers to be able to appeal to neutral States and to obtain supplies of

whatever it may need, by means of its sea frontier. The sea will have, in consequence, the double mission of guaranteeing, by an effective blockade of the coasts by the strongest sea Power, free access to all its own ports, whilst it has all access to those of its adversary and all communication by sea with neutral Powers. It will be well to notice here the particularly favourable position of France from a geographical point of view. By the Mediterranean and Algeria she commands Africa, and by the Suez Canal, which is her work, she extends her influence to the Far East. By these ocean coasts she has a view of the new world, and her fleets radiating from these two maritime frontiers may be compared to two arms stretching towards the universal commercial riches of the globe. By her land frontier, extending from the north to the south of Europe, she can and should exercise a legitimate influence on the Continent; but she must not forget that maritime commerce alone can furnish her with the means of exercising that influence. It is an energetic and wisely exercised colonial policy that will procure the resources of which she has need in order to sustain the inevitable claims of her Continental policy.

Aim of Maritime War.—The preceding considerations are sufficient to bring into relief the important part the Navy has to play in time of war and to determine the object which, under all circumstances, it should endeavour to realise. Whether its power is exercised against a neighbouring nation or a people separated by sea, whether its object be the defence of its own ports and dependencies, or to safeguard foreign interests, the naval power of a great country will always propose as its goal the control of the sea in the region determined—that is to say, to maintain in this region the liberty of its communications and to interrupt those of the enemy. It is with a view to satisfying this double objective that fleets and ships of war should be constructed and disposed.

Restricted Field of Action of Modern Fleets.—Let us maintain, in the first place, that modern fleets are impotent to realise this objective everywhere, and to take indifferently as their theatre of operations the vicinity of the coasts, the seas of Europe, or those more distant, as was done by the sailing fleets of the last century. These found wind everywhere, which was their motive power, could obtain victuals and necessities for their crews in all countries, and possessed the incontestable tactical advantage of a range of action almost unlimited. The characteristic of modern fleets is, on the contrary, to unite with great military power a very limited range of action. On the one hand, the propelling machinery, powerful engines, and capacious boilers occupy the largest part of their hulls; on the other hand, the weight of artillery, armour, and various kinds of mechanism constitute the most important part in the factor of expense. The capacity of the coal bunkers, that is to say, the radius of action, cannot be augmented without detriment to the speed of the ship or her military strength. Moreover, combustibles justly considered as contraband of war, cannot be supplied by neutrals. The tactician can only exact for modern fleets that their range of action shall be that which is strictly indispensable for the mission devolving upon them, and is forced to design in practice fleets of different natures and compositions, according to the special rôle assigned

to them. This obligation leads us to pass rapidly in review the different operations of maritime war, from the defence of the coasts, the minimum of naval action to which a nation having a frontier can be restricted; to the action of squadrons on the open sea, which is the highest manifestation of her power.

Coast Defence.—The organisation of coast defence is not of capital importance for a nation whose fleets possess an incontestable superiority over those of her rivals. England, for example, can with reason consider the bulwarks of her ships the real ramparts of her sea frontier. On the contrary, when a part of the littoral is situated in the immediate neighbourhood and under the constant menace of a superior maritime Power, preparation of her defences of every nature becomes a necessity of the first order. Such is the case with our littoral in the Channel. The principal object of the defence of the coast is to oppose the landing of an enemy's forces, and the sea squadron should in these circumstances support this object with all its strength. The secondary object is to resist all attempts of the enemy's fleet to effect a temporary occupation of any point on the coast, destruction of semaphore stations, guard houses, and the bombardment and imposition of ransom payments on her ports. In any case the defence has opposed to it a floating enemy; and this, as we have already remarked, makes it exclusively a maritime question. The troops which accompany the assailing fleet or convoy are inactive: they take the offensive only after they are landed, that is, after the final check to the coast defence. The work of the coast defence is then at an end, and it becomes a question of territorial defence with which the land forces have the charge and responsibility. The work of the Navy is confined in reality to the defence of the littoral, or coast line. This defence is principally assured by batteries and forts constructed in the neighbourhood of the most accessible points of the coast. These works having to deal with ships, ought in principle to be provided with artillery similar to theirs, and with sufficient power to pierce their armour protection. The methods of firing even should in a certain sense resemble that employed on board ship against a movable target. The coast forts are then veritable ships on land, and their sea front may be very well compared to the battery of the ship. This comparison is rigorously true when speaking of batteries which are often furnished with armoured turrets similar to those of ships afloat. High batteries and mortar batteries might also be provided with naval guns without any inconvenience. When we consider theoretically a duel between a battleship and a coast battery, we are led to conclude that the advantage will always remain with the latter. The battery, can, in fact indefinitely increase the thickness of its parapets and of its steel defences. By the employment of disappearing gun mountings and smokeless powder it can be rendered invisible from the sea, and it can also maintain a very considerable reserve of ammunition. The ship, on the contrary, is always visible; it has only a limited protection, and the number of shots it can fire is restricted. From this condition of affairs it would appear that the defence of the coast might be assured by the forts only, if in addition to the

above they are completed by an efficient obstruction for the entrances of the harbour by means of lines of torpedoes or boom defences. As it is practically impossible, however, to construct defensive works at all vulnerable points, it becomes necessary to extend and complete the fortress defences by means of a defensive fleet, the units of which are in their turn veritable forts on the sea, having the quality which is wanting in land defences—that of mobility. This defensive fleet, which will always operate near the coast and can be constantly revictualled, need only have a very limited range of action. It may be composed of ships of different types, monitors, rams, gun-vessels, all fitted to carry a powerful armament and to fight, if need be, by impact. It would combine its action with that of the torpedo-boats, the latter by preference acting by night, and by surprise attacks, and taking refuge by day under the protection of the forts or defence ships. Finally, these mobile columns could be employed in preventing access to the shore for landing parties by boats, or by the lighter ships of the enemy. The dissimilar elements of this organisation must have a continued action under the direction of a single authority, which can only be that of the Navy. It would be useless to consider at greater length the action of the defence, our object only being to point out the place in it which the ships of the coast-defence fleet should occupy.

Squadrons in Action.—The organisation of the maritime frontier defences can only be the prologue to the naval action of a great Power, of which the territories, countries, and the flag itself are scattered and engaged at all points of the globe. To abandon these interests; to refuse to protect and maintain those commercial routes, which are the exterior radii of the national life, would be equivalent even in the case of a purely Continental war to an immediate and irremediable defeat. It is vain to object that in this case the fate of the country would be decided on the land frontier, and any naval action, however brilliant it may be, would have no effect on the final issue of the war. We believe this opinion to be quite untenable. We have already shown the necessity imposed on each of the belligerents to maintain not only the security, but free access to its coasts. The possibility of being able to replenish at sea, and to prevent your adversary from doing so, may greatly contribute to final success. France in particular has the greatest interest in obtaining as soon as possible the supremacy in the seas adjoining her territory. As regards Germany, she ought to be able to close to this power the passages to the Channel and the North Sea. On the other side she occupies the two shores of the western basin of the Mediterranean, and could never consent to see the communications between Algiers and Marseilles interrupted, and allow the enemy to separate one of her provinces from the remainder of her territory. Beyond doubt the first object to pursue, is to prevent the invasion of the country by the enemy's troops; but nothing can prove that invasion could not be effected by way of the sea. In the case where the land frontier is formed by a natural barrier, such as the chain of the Alps, an enemy which is master of the sea would in preference seek an easy and open passage for its forces. It is of the highest importance therefore to prevent the aggressor obtaining access to the waters in

the vicinity of the coasts. This result can only be obtained by a suitable extension of the coast defence. The torpedo-boats, as we shall see further on, are powerless to realise the object we have in view, and it will be the same in the case of all ships of extreme speed, but inferior in military strength to those of the enemy. If we demand of coast-guard ships the task of opposing the passage of the enemy's squadrons, we should then give them the speed and range of action which they are lacking, construct ships of high freeboard, add to them cruisers and swift vedette-ships, indispensable to prepare and complete them for action, form them, in a word, into a sea-going squadron. Also whatever we may do, the necessity appears evident that we should maintain in the North and in the South two fleets, which would be the highest expression of the naval power of the country, and whose mission would be to acquire the supremacy of the sea in the neighbourhood of our territory over the squadrons of our eventual rivals. These squadrons would play in relation to the maritime frontier the same rôle as the Army in the land frontier, with this difference, whereas the latter at the commencement of hostilities would be massed behind the frontier, the former would be in front and beyond it in face of the enemy. We have not to examine here how the battle between the squadrons would be carried out. The two adversaries, both convinced of the necessity of obtaining command of the sea, might seek to meet each other at the outbreak of hostilities; one might perhaps, on the contrary, force the enemy to accept battle by engaging in one of these secondary operations which logically ought not to be undertaken till after the squadrons have been engaged.

We will limit ourselves to the simple statement of the fact that this encounter is inevitable, and that even in a Continental war it will exercise a considerable influence, and may be decisive. It is hardly necessary to say that in case of war against a maritime Power the fleet would always play a preponderant rôle. It would be an error to believe, for example, that a naval Power such as England could be seriously shaken by a so-called commercial war, directed solely against her commerce. The English squadrons, left incontestably masters of our territorial waters, would blockade our ports and prevent our cruisers from putting to sea. If some of them should succeed in getting out it would soon happen, after a more or less extended career, that they would be captured for want of coals by the cruisers of the enemy. The squadron or fleet action, in view of maintaining free access to our ports, would be therefore in this case the necessary prologue to the commercial war. We would remark here that up to the present we have reserved the name of "squadron" to define powerful fleets designed to meet in our own waters their European rivals. The maritime war in distant seas would necessitate the employment of ships which, in order to have a large range of action, must necessarily possess somewhat less military strength.

The Attack on the Enemy's Coasts.—This attack can only be an episode of the battle of the fleets; but in principle it ought to succeed it, and only become possible after victory. If in particular we consider the principal end which we can have in view on the enemy's littoral—the landing of an

army corps—we may affirm that this operation cannot be carried out except under the protection of a fleet having control of the sea. The necessity of having to protect a convoy of transports with troops and material puts this fleet at a great disadvantage if it has to contend at the same time against a force intact, and nearly equal to it in power. It will have also the important mission of keeping off the enemy's isolated cruisers, to engage the coast-defence ships and other mobile defences of the littoral, and if need be to destroy the defensive works on the coast at the point chosen for the disembarkment. All these operations are, as for the defence of the coast, as a whole exclusively maritime, since the transported troops cannot enter into line till they have been landed. The blockade of naval and commercial ports too cannot be undertaken except by a squadron which has previously reduced the rival fleet to inaction. The restricted field of action of modern fleets, in fact, requires that a secondary base be established near the point blockaded where the blockading squadrons can replenish in detail, and which can be connected with the principal base by transports passing to and fro on a secured route. The forcing of passages is an operation which a fleet would sometimes have an interest in undertaking in order to attack the defence works from the rear. In principle it may be stated that the direct attack on a military port by day is not to be recommended. A squadron operating alone could not engage the forts and force the entry to a fortified port of the first rank without exposing itself to great loss, and seeing many of its units either lost or placed out of action, and thus compromise the supremacy which it has with so much difficulty gained over the enemy. It is only in a case where the forts may be invested on the land side by an army of occupation that it could with advantage make a favourable attack from the sea. It could then combine its movements with those of the army, of which it would form, so to speak, one of the wings, and lend the aid of its powerful artillery. The bombardment of undefended towns is not to be included amongst the operations directed against the enemy's littoral. A squadron could without doubt exact from a commercial port, giving a sufficient time for the purpose, the money, combustibles, and victuals of which it may be in want. But to wantonly burn and destroy an undefended town would be an act without influence on the issue of the struggle, and be contrary to those higher principles which we have assumed throughout this study. We should not fire on disarmed troops, we should cease fire when the enemy has struck his flag, *à fortiori* should we respect the persons and property of non-combatants except when in overwhelming force; resistance alone calls for and justifies the use of arms.

War against Commerce.—The reflections above apply in part to the enterprises undertaken against the maritime commerce of the enemy, and which are assuredly amongst the means best calculated to injure her naval power. These attacks complete the action of the fleets by realising one of the two objects in all naval war—that of interrupting the communications of the adversary. In violating this national interdiction, in putting to sea under the cover and protection of their national flag, the trading

ships participate to a certain extent in the action of the belligerents. They would not, therefore, be respected in the same way as the private property of non-combatants. It must be always understood that the object of war against the trade routes is the capture, and not the destruction, of the prize. It is only when, by force of circumstances, the ship captured will be an embarrassment or danger to the captor that it should be sunk, after having, of course, placed the crew in safety. This obligation leads us to the conclusion that light and small ships, particularly torpedo-boats, are unsuitable for action against trade routes, as they have not sufficient men to man the prizes, nor sufficient accommodation for their crews if obliged to destroy them. The trade route ships should have great displacement, large range of action, and very high speed. Their rôle is, before everything else, to interrupt the enemy's communication by sea.

Conclusion.—This brief consideration of the different necessities for maritime war which we have here presented will show the immense importance of the battle squadron properly so called. It is the fleet, which in enabling us to obtain the command of the sea, will assure the defences of the coast and the metropolis, and render it possible for us to attack the enemy's coasts and trade routes. To-day, as in the past, actions between the line of battle-ships will alone decide the maritime destiny of the nation. This truth has not been shaken by the radical changes which have taken place in the qualities of ships of war, and which have succeeded in making them to a great extent independent of the caprice of the elements, bearing in themselves the principle of their movements and all the elements of their power.

SECOND PART.

The Battle-ship: Definition.—A war-ship, the instrument of maritime war, should be, let us repeat, constructed and fitted with a view to realising the double object which is proposed: to maintain the liberty of communication by sea, and to interrupt those of the enemy. Her rôle is to act in the open sea and to be before all capable of remaining there and moving with safety. We, therefore, refuse to give the name of battle-ship to any vessel, whatever her size and armament, which bad weather will oblige to put into port, or to reduce speed, sooner than mercantile-ships of the same tonnage. This quality of keeping the sea, that we may call navigability, is the first and essential quality that we must demand of the constructor before any military installation. We have seen besides that naval action has for its aim the command of the sea, and in destroying the ships of war or capturing the merchantmen of the adversary. It is only exceptionally directed against the defences of the coast. If the artillery of the ships may be sometimes used against the latter, the military arrangements as a whole should be conceived with a view to engaging battle-ships. The ship of war can, it appears, then be defined in a general way as a sea-going ship fitted for combat against the enemy's fleet.

Naval and Military Powers.—This definition comprises two parts, which correspond to the two terms constituting the battle-ship, the ship proper and the armament, the floating platform and the fortress. The first is endowed with nautical qualities which permit her to reach any given point, and the second possesses the necessary military qualities for battle. The nautical qualities—navigability, range of action, speed, handiness—not only affect navigation, they have besides considerable importance from a tactical point of view. They contribute in a large measure to the military efficiency of the ship, and for this reason we think it advisable to designate them by the general expression of “nautical power” in opposition to the “military power,” which comprises the whole offensive and defensive arrangements of the ship. It is essential never to confound these two terms of the power of the battle-ship. We can now indicate plainly the difference which distinguishes them in the tactical point of view by the following rules, the evidence for which requires no demonstration:—1. The nautical power of a squadron is exactly equal to the nautical power of those of its units which possess the least; on the contrary, its military power is the sum of the military powers of all the ships of which it is composed. It is clear that a collection of ships possessing, for example, different speeds can only move simultaneously at the speed of the slowest one, whilst every ship provided with an armament and protection adds to the offensive and defensive power of the whole. 2. The nautical power of a ship of given tonnage can only be augmented to the detriment of her military power and *vice versa*, each of them, in fact, corresponds to her displacement, which is the whole fraction disposable at the price. Before drawing any conclusion from these axioms, it will be well to examine briefly in the logical order of their importance each of the elements which constitute the opposing qualifications of the battle-ship.

Navigability.—The first of these, navigability, comprises many factors, of which without contradiction, the most important is stability. We must demand that the battle-ship shall be *uncapsizable*, not only by wind or sea, but also when through injury any one of her water-tight compartments has been flooded. If this essential condition is not fulfilled, divisions into compartments instead of being a safeguard will become a danger to the ship. Stability of form, that which we have in view, may be somewhat restricted by the necessity of obtaining stability of platform for precision of fire for the guns. It is to the constructor we must look to establish under his own responsibility the due relation between these two terms of stability, and to fix the metacentric height which in conjunction with special form of hull will under all conditions give the complete security required. We would renounce for our part an armament, or any military installation whatever, which would compromise itself by undue increase in the weight of the upper works, and consequent lessening of the metacentric height. It is not sufficient only to secure the stability of the ship, it is just as necessary that she should be seaworthy in a heavy sea. It is an error to think that the whole of the upper works of the ship can be used for military purposes apart from the general

theory of flotation. The ship should, in the first place, be able to sustain her fighting speed in all ordinary weather against a moderately heavy sea, not without experiencing of course a certain falling off in her speed, but without suffering from it any serious injury, and that she should still be able to use her guns with effect. This essential quality of the ship not only demands solidity, but also suitable form in the forepart exposed to the shock of the waves. It ought never to be sacrificed, for example, by reducing the freeboard forward in the desire to obtain a right-ahead fire for the bow guns. On the broadside the height of the waves and the inclination produced by rolling reduce the area which is available for the artillery. The line which, taking account of these two factors, is always out of the water is the true limit of the hull; the part of the hull above the water-line cannot be considered as completely above water. All installations comprised between these two limits, that defined as the true limit of the hull and the water-line, which project beyond the ship's side, such as sponsons, shoots, etc., often exposed to the blows of the sea, produce shocks and spray which injuriously effect the aim of the guns. This effect would be still more accentuated if the side of the ship were of tumble-home form. We require from the constructor before all else that the hull of a battle-ship should be clear and straight to the gunwale. Lastly, that the ship be habitable and that the crew can find sufficient breathing space in all parts where they are obliged to live. The ventilation of the compartments, principally those where the temperature is high, should be assured, not only under ordinary conditions, but also during action; it is not admissible to close ports and scuttles and expose the crew to the danger of suffocation. We may add that the ventilation of the compartments must be obtained not only by supply of fresh air, but it is very important to provide in each of them for the exhaustion of the foul air. We also consider that habitability is not complete without an upper deck where the men can at least take a few steps in the open air.

Range of Action.—We have designedly placed range of action immediately after navigability. If the first is the essential quality for all sea-going ships, range of action is the first determining factor in the ship of war. It is by this that she is classed, on principle, in one of the fleets that we consider necessary for the national defence—the home squadron coast defence, or the divisions for distant seas. Range of action is generally defined as the greatest distance that a ship can cover with her own resources at an economical speed, but from a military point of view it is preferable to compare them by the distances covered at high speed. We shall then define the tactical range of action as the distance which can be covered at the “fighting speed,” and we shall see later in what sense this is understood. We have already had occasion to show, and the course of this study will still emphasise the fact, that the range of action can only be augmented to the detriment of the other qualities of the ship. It is, then, essential to fix at once the minimum range of action that the ship should possess in order to fulfil the object for which she is designed. It is to the tactician that belongs the task of fixing this first quality, which the constructor must not reduce in any case,

nor under any pretext. The range of action depends on the quantity of coals which can be carried in the bunkers; it is important not to include in this quantity the coals used for auxiliary purposes on board; this latter, which we may call coals for consumption, should rather be assimilated to victuals and stores. The supplies for the above, including fresh water, should be, like the range of action, fixed for the constructor according to the different types enumerated above. The necessity for replenishing and revictualling should, at least, extend for as long a time as the range of action, but should never be confounded with coals for propulsion, which principally affect the displacement of the ship. It is not without interest to remark with regard to this, in time of war unsuitable displacements in battle-ships will cause them to lose part of their tactical value by reducing the range of action immediately obtainable. We shall have something to say later on about the artillery and ammunition supply, which only affect the military power of the ship.

Speed.—Of all the elements of nautical power, speed is, without contradiction, that which contributes most directly to the military effect of the ship. We must guard ourselves against including it amongst the factors of military power of which it is only a useful auxiliary. The ship which possesses superiority in speed can attack or avoid her adversary at will; she can maintain the distance most favourable to her, and thus choose the nature of action she wishes. She is in a situation similar to that of the ship which, in old times, succeeded in taking advantage of the wind. But, as formerly, this advantage only becomes efficient if the ship possess at the same time an armament superior, or, at least, equal to that of her rival. If she is manifestly inferior in strength she can use her superior speed to escape action, and fly from her foe. The speed which can thus usefully contribute to the military action of the ship of war has nothing in common with that which is obtained by means of forced draught and special conditions at the full-power trial of the engines. The ship would never try again to reach this speed, for she could not do it without exposing herself to injuries which she has the greatest interest in avoiding. Tactical speed, or, in other words, “fighting speed,” is that which can be sustained indefinitely under natural draught without fatiguing either the *personnel* or the engines, the crew being at their stations for action. This last condition implies the possibility of supplying the coals from the bunkers to the stokeholds without interfering with the working of the guns or the ammunition; this “speed for action” corresponds with a determinate power of the engines and revolutions of the screw; it is that which would be adopted in general under all circumstances of war, having in reserve the power to increase her speed in case of need. Away from districts frequented by the enemy, it will often be to the advantage of the ship to proceed at economical speed, thus permitting her to obtain the most extended range of action. There exists, of course, a fixed relation between range of action and speed. These two elements together give to the ship all her nautical power.

Handiness.—In order to enumerate the different factors of nautical power, it remains to say a few words on the turning qualities of the battle-ship.

At the period when she possessed but one screw the diameter of her turning circle exercised in certain cases a considerable influence on her military action ; it determined, in fact, a circular zone behind her where the enemy found himself in a favourable position for an attack at close quarters by the ram or torpedo. The battle-ship at present has less interest in reducing her turning circle, since she possesses at least two engines which permit her to turn more easily. She can always, however, still gain a marked advantage by the possibility of turning quickly without altering the speed of her engines. The constructor should then endeavour to procure her this advantage, taking care that the inclination produced by this turning movement may not be harmful to the use of her artillery. We must demand besides that the efficiency of all the steering gear mechanism, wheels, tiller, steering engines, etc., should be guaranteed, and assured to the same degree as that which we require on a weapon of war, on which we shall have to speak further on. We may, in fact, say of all motor machines, and generally of all the vital organism of the ship, that it is on the whole in truth a gigantic weapon which the captain manipulates by means of the propellers and the tiller.

Offensive and Defensive Powers.—The military power of the ship is composed of distinct parts, inseparable from one another : offensive power and defensive power. The first comprises all arms designed to act against the adversary ; and the second, all arrangements which permit of their action under the fire of the enemy. The qualities which we demand of a weapon of war are the following : In the first place, the weapon should be able to be handled with safety ; it is indispensable that the crew should know that, unless from gross carelessness, they have nothing to fear from the arms that they use. They should also be simple—that is to say, the mechanism should be put in action in a simple manner. The employment of modern arms no doubt requires special knowledge, principally for mounting and adjusting fittings, but the weapon should not be at the mercy of an indispensable man alone capable of working it and who may be wanting at the moment of action. It is important, in the third place, that this mechanism be strong ; whatever their complication, they should be as far as possible free from risk or damage by negligence or unskilfulness. It is necessary that we should be able to rely absolutely on the good action of a weapon of war at the precise moment when it is required. It should be efficient, that is to say, it should do the greatest possible injury to the enemy ; this last condition is evidently the most important, but it can only be realised after the three others. However terrible may be the effect of an engine of war, we should reject its employment if its management appears dangerous, complicated, or uncertain ; and, in conclusion, we repeat that the arms should be at the same time safe, simple, strong, and efficient. To these, which are general qualities, a fifth condition must be added peculiar to arms destined to be employed on board ship : the working and efficiency of these latter should be as little as possible influenced by the movements of the ship. The offensive weapons of the battle-ship are three in number—the gun, the ram, and the torpedo ; we leave on one side portable arms, the rifle, the cutlass, and the revolver—which, although very

useful in special cases, cannot be considered as the arms of the ship. These latter, designed to fight a floating enemy, have to fulfil two objects : either to sink the adversary by acting against her under water, or to put her out of action by acting against her essential organs and her *personnel*, by the destruction of her upper works. Inversely, the defensive has to assure on the one hand, the flotability of the ship, and, on the other hand, the protection of her different mechanism and of her *personnel*. Both these terms of military power of the ship are completed the one by the other.

It is not possible to rely for defence on a courageous and vigorous attack; in the sea where these exist in natural obstacle or shelter, we must affirm in presence of the progress made in modern artillery that the best guarantee for the offensive lies in an efficient protection.

Artillery.—The gun is the weapon *par excellence* of the ship of war. Naval battles have always been, and still are, artillery duels. The ram and the torpedo only play an occasional part, for the fleet which possesses the advantage in speed can easily avoid attack by these weapons. The artillery, on the contrary, is the arm for all distances, and is sufficient to produce the two effects which we require of offensive arms—*i.e.*, to sink the adversary, or put her out of action. Its rôle is to penetrate and to destroy, and to those two ends two kinds of projectiles are employed—armour-piercing and explosive shells. Both act by percussion, for the incessant variations of distance between the opponents only permit of the use of time fuses under special circumstances, such as shrapnel and bursting shell against light ships at a limited range. We may remark here that we endeavour to give to armour-piercing shells a certain destructive effect after perforation by means of a small explosive charge. In the same way we seek to obtain the explosion of the other shells only after the penetration of the unarmoured sides of the ship. We approach, then, in these two cases to the type of projectile which can produce both effects successively and completely. The obstacles against which naval artillery has to act in the case of her floating target are three in number. The first consists of the ports of the ship, turrets, and water-line, which have received the maximum of protection, and are covered with the thickest armour. We must employ against these obstacles the heaviest guns, that is, those with the greatest ballistic power. This ballistic power, which is more a result of velocity than of weight of projectile, is not necessarily proportional to the calibre or weight of the gun. We should endeavour to realise this result by the employment of lighter metal with more resisting power. It is none the less true that in the actual state of metallurgical progress the most powerful artillery has necessarily considerable weight, and, in consequence, the number of heavy guns which can be carried is limited. Their employment necessitates hydraulic and electrical complications, and the manœuvring of them is slow. Besides this, the supply of ammunition must be considerable; the shots from the heavy guns are then of necessity fewer, and should be carefully aimed during the action. It would be bad tactics to direct them against obstacles of the second category, comprising the parts of the ship of least resistance, or provided with very

thin armour. These parts would be more efficiently attacked by guns of less calibre, the quick fire of which would permit a larger weight of projectiles being directed against it than from the heavy guns in the same time. The parts of the ship devoid of all protection, the thin plates of the superstructure, and the hulls of light ships, would be pierced or destroyed by the projectiles of light Q.F. guns, and which would act also against the *personnel* not under protection.

The division of the artillery on board into three groups—heavy, medium, and light—is, as we see, required by the nature of the obstacles to which they are opposed, but it must be noted that the *rôle* of the heavy gun is always predominant. Its fire may be decisive if the ship is struck at the water-line, and is almost always effective whatever be the part of the ship struck. One might even employ sometimes against the upper works explosive shells of large calibre, the ranges of which would be considerable; the arrangements concerning the number and position of the heavy guns constitute, therefore, the most important factor of offensive power. The number being limited by the necessity of developing the other elements of power should force us to obtain the maximum efficiency of these guns, by giving the most extended field of fire possible. Theoretically, the battle-ships should only carry a single gun of large calibre; the military power of a squadron could be increased in this case to the necessary strength by increasing the number of its units, but this arrangement would constitute, on the one hand, wasteful expenditure of the country's resources, and, on the other hand, it would not be possible to place this single piece at a point on the ship commanding an all-round fire. We are, then, led to give a battle-ship at least two heavy guns, placed in the middle line, one forward and the other aft, and having on each side of this line the most extended field of fire possible. These two positions are in truth the only ones suitable for the heavy artillery, and if it is considered necessary to increase the number of heavy guns to four for ships of large displacement, it would be advantageous to place at each of these points two guns contained in the same turrets. This arrangement always possesses two defects: the first is, that a single lucky shot might disable both guns at once; but the saving of weight realised allows of the maximum protection being given to the guns thus coupled, and reduces as much as possible this defect. In the second place, the bow and stern guns by their cross fire on each broadside leave a triangular zone which most of their projectiles can cover. The arrangement of the four guns lozenge fashion, that is to say, one forward, one aft, and one on each broadside, does not, it is true, possess these defects, and theoretically permits of the fire of three guns in each of the four principal directions; but this advantage is purely imaginary, for the fire of the guns situated at the centre and on the broadside cannot be obtained except by a re-entering and defective form of upper work, which exposes the forward and after parts of the ship to serious injury from the flare of the guns. We reject also on principle the use of flare plates of thin steel, which can easily be destroyed by the Q.F. guns, and dangerously increases the dimensions

of the target offered to the enemy. In reality and in practice, the lozenge arrangement only permits us to use one gun right ahead or right astern, two on the bow or the quarter, and three on the broadside : one of the four pieces is always idle, in the case of a single target. The arrangement in couples forward and aft, on the contrary, permits us to use two guns right ahead and right astern, and four on the broadside. It thus gives superior offensive power with considerably less weight, since only two turrets are required instead of four, and to this arrangement we must logically give the preference.

We have obtained for the heavy artillery the maximum of ballistic power by reducing to a minimum the number of its units. We should demand, on the contrary, that the guns of medium calibre should be as numerous and handy as possible, preserving the ballistic power necessary to act efficiently against the obstacles which they have to destroy. We may place these guns in any part of the ship where their action is not interfered with by the fire of the heavy artillery. In the twin system, which we have already advocated, the medium guns can be placed with advantage in the central part of the ship, those guns nearest the extremities could fire right ahead and right astern on each side of the turrets for the heavy guns. We believe this arrangement preferable to placing these guns of medium calibre on a higher platform. The difficulties that we find in the latter case in giving complete protection to their mountings, and the necessity of reducing the height of the battle-ship above water as much as possible, demand in our opinion, that all the heavy and medium artillery could be placed at the same level. The forward guns should be placed considerably higher above water than the after ones, so as to be always workable in a heavy sea. We thus preserve the whole of the highest parts of the superstructure for the light guns, of which the predominant quality is rapidity of fire. It is not necessary to place this artillery very high, as its principal object is to act against torpedo-boats, and in this case the fire should be made as *raking* as possible. The aim of the guns placed in the tops is necessarily very uncertain, not only by reason of the movements of the ship, but also on account of their height above water entailing a considerable angle of depression. These guns can only act usefully against the *personnel* on board ships not protected by the flying decks and bridges. It is doubtful if this object is sufficient to justify the employment of military masts, which serve as their supports, and which are liable to be carried away and destroyed during the action by explosive shells, and so become a serious danger to the ship. The masts of battle-ships should be fitted for signal purposes with the least possible surface as a target for projectiles. The efficiency of fire, apart from calibre, depends on the two factors correctness of aim and rapidity. Theoretically, rapidity of fire should only take the second place, but in practice the chances of hitting the enemy increase with the number of projectiles that it is possible to send against her during the time, generally very short, that she is in a favourable position for attack. There is, then, always the advisability to perfect the mechanism of the artillery so as to obtain the greatest possible

rapidity of fire; not forgetting that the ammunition passages and fittings must have the same qualities of simplicity, safety, and endurance as we require for the gun itself, and permit of as rapid a supply of ammunition as is its fire. We believe it to be a mistake to endeavour to solve the latter problem by the rapidity of movement of the ammunition carriage, which can be obtained only to the detriment of safety. The necessity of quick fire is rarely unforeseen, and can be provided for in this case by taking care to commence in good time, if the method of supply by our endless system of ammunition pockets be employed; the movement of the ammunition from the magazines to the guns is then slow and continuous. We can then very easily provide in the magazines a supply of ammunition equal to the demands of the gun. The rapid fire of medium calibre guns must be carried out with judgment. The tactical principle of firing on the enemy with the greatest possible activity directly he is within range cannot be applied in actions at sea. The adjustment of aim for very long ranges cannot be effected with any degree of certainty, and the limited supply of ammunition available would be exhausted in two or three hours under these conditions. Rapid fire, then, for medium guns should not be used until the range has been obtained with certainty, and at distances where the flatness of the trajectory would render a misjudgment of distance unimportant. In principle the heavy artillery should not come into action except at such a range as would ensure the penetration of the enemy's armour. This distance, which is calculated in advance, in the majority of cases, would also be favourable for the employment of the Q.F. guns of medium calibre, and may be considered the fighting range. The ship superior in speed and armament could impose this distance on her adversary by a circular duel, keeping out of the range of her torpedoes. It would, however, on the other hand, be generally better to present the bow to the enemy, and, if she accepts the challenge, to reserve the fire of the heavy guns and the quick-fire artillery for the moment of her passing the broadside, the most suitable nature of projectile to be employed having been determined beforehand. It may not be without interest to observe that with an arrangement of the artillery of all calibres in groups of two, armour-piercing projectiles and explosive shells could both be employed at the decisive moment. Without enlarging further on these considerations, we may state, in conclusion, that the principal qualities we require of artillery are rapidity of fire and flatness of trajectory. It follows that the artillery will not include mortars, a weapon with slow fire and curved trajectory, the employment of which demands a complete stability of platform, and an exact knowledge of the distances. They can be used with advantage for attacks on the coast defences and the bombardment of forts, but we may remark that the artillery on board can also be used for these special circumstances. We must treat briefly of the supply of ammunition, which represents to some extent the capacity of the military power of which the ship is capable. These supplies should be fixed by the highest authority, as the range of action for the military rôle for which the ship is designed. In no case should it be modified by the constructor, on whom it should be imposed

as an absolute condition. The magazines must be situated below the water-line and in the vicinity of the guns; and lastly, to simplify as far as possible, the ammunition service on board, it should be composed of three calibres only: one for the heavy guns, one for the medium, and one for the light guns.

The Ram and the Torpedo.—The object of the heavy artillery to penetrate and sink the ship by piercing the water-line, is continued below this by the ram and the torpedo, designed to act against the unprotected portions of the hull. The damage produced by the shock of these weapons is often sufficient to cause the loss of the adversary, but this efficiency is considerably lessened by the difficulties connected with their employment. It is, in general, only after a clever manœuvre, profiting by unforeseen circumstances in the fight, that a ship will find itself in a position to use the ram or to launch a torpedo. The ram, it is true, possesses those qualities of simplicity and energy which are the essentials of weapons of war. Action by shock practised from the highest antiquity, is made again possible in these days, in virtue of weight and speed of modern battle-ships, and will still remain for a long time one of the eventual factors of military power. It would be however a mistake to suppose that the ram, which is the weapon under the direct control of the captain of the ship, will be the object of exclusive attention during the action, and that the guns and torpedoes may be fired and controlled without him. Under all circumstances the manœuvring of the ship is governed by the necessity of obtaining the best possible utilisation of all her armament. It is the captain alone who is responsible for their combined action, and for deciding on the precise moment and the conditions for their employment. In the majority of cases it is a question solely of the artillery, and if the ram is sought to be employed its action can be prepared for and reinforced by means of the heavy guns and the torpedoes. The captain who proposes as his only object the use of the ram, runs the risk of having to report only the futility of his efforts. The facility of evolution with which the modern battle-ship is gifted, thanks to her twin screws, permits of her easily avoiding the direct attacks of her foe, unless she is disabled. Besides, the shock of ramming may prove to be as disastrous for the rammer as the rammed. We may question if the ram is not condemned to act only against a disabled and immovable enemy, or one obliged to hold on a straight course. Even in this case it must not be forgotten that any ship which so threatens another exposes herself to being stopped by a torpedo before attaining her object. Torpedo-tubes, suitably disposed forward and aft and on the broadside, play in this way a truly defensive rôle, by creating around the ship a zone which it would be dangerous to approach. The automobile torpedo may be compared to a ram which can act at a distance in all directions. This manner of looking at it better defines the tactical employment of the torpedo; it may be considered as a sort of submarine projectile. Although it holds the medium place between the ram and the heavy artillery, the slowness of its movement under water compared with the flight of the projectile in air, makes it difficult to regulate its aim. The two invariable factors principally to

be taken into account are the course and speed of the enemy. If possible, the torpedo should only be used at short distances, where it would have the greatest chances of success. The launching of the torpedo by means of submerged tubes makes the aim still more uncertain. We consider that it would often be advisable to have the tubes fixed, and to manœuvre the ship for their employment. It would, however, be of the greatest advantage, when the ship is no longer manageable through injury to her machinery, to have submerged tubes which could be trained on their object.

Flotability.—We pass now to the study of the defensive arrangements, which we define as those having for their main object the insuring the flotability of the ship which is attacked at the same time by heavy guns, the ram, and the torpedo. Against the first, up to now no better protection has been found than that given by a complete belt of armour at the water-line, extending from bow to stern. The minimum height of this belt is determined by the limits between which the line of flotation varies by rolling at sea, and by changes in draught, due to consumption of coals and stores. To the penetrating power of the projectiles this armour must offer a resistance which is not necessarily proportional to its weight and thickness. Progress in the manufacture of armour, as in guns, leads to the production of a metal more and more resistant in proportion to weight. It would be always advisable to extend the belt up to the level of the designed freeboard by diminishing thickness. When a belt does not exist, it is rather illusory to reckon on the protection afforded by an armoured deck to ensure the flotability of the ship. Useless, from this point of view, if placed above the water-line, it is dangerous if placed below it, for it fetters the action of the different means at our disposal for keeping the water out of the ship. The armour deck must, then, be arranged in turtle-back form, of which the central part is above the water-line, and the sides extend considerably below it. It must be observed that the inclined surfaces presented to the broadside in this case make them very vulnerable to the fire of shells charged with mélinite, of which the explosion produces its maximum effect in a direction perpendicular to the trajectory. Even so fitted, it should not be employed alone, from the risk of its becoming more dangerous to the stability of the ship than a deck fitted entirely above the water-line, as a single rent in the plating may be sufficient to cause the whole of one side of its surface to be immersed. It becomes a necessity to complete it by a line of cofferdams rising just above the level of the water-line, and by division into small compartments of all the parts of the ship above it. As no substance sufficiently light, incombustible, and effective has been discovered with which to fill the cofferdams, the system can only lessen the effect of projectiles to a certain extent by limiting the invasion of water to a few of the compartments on board, and the heel which this would cause might prove dangerous to the ship if no means were at hand to immediately avert it, and, above all, to pump out the compartments filled. The protection of the hull

below water from the attacks of the ram and the torpedo has to be altogether given up, and efforts are limited to reducing as much as possible their destructive effects. This is arrived at by the introduction of the double bottom and by multiplying the pumping arrangements. The subject, the study of which appears to be the exclusive domain of the engineer, should, from a military point of view, present those features of simplicity and safety in the fittings which we require of all mechanism which has to be manipulated in action. It is to this condition alone that they could efficiently contribute to the defensive power of the ship.

Protection.—Theoretically we might conceive it to be possible to secure completely the flotability of the battle-ship, but in making her insubmergeable we should only have solved one part of the problem of defence. The powerful artillery and modern explosives would not be long in paralysing her movements and reducing her to impotence, and it is therefore of the most evident necessity that, on the one hand, the organs of propulsion and manœuvring should be protected; and, on the other, the offensive power placed in the upper parts of the ship, that is, the artillery of all calibres.

The protection of the engines and the boilers is secured by the armoured belt and the protective deck. The last of debatable utility from the point of view of flotability, very efficiently protects all the interior organs of the hull from the direct shock of the projectiles; we are even being led to increase the protective effect of the armoured deck, by adding a débris deck, and a second horizontal steel deck, situated above the water-line; the space comprised between the two armoured decks can be filled by a system of cellular construction, and thus to almost completely isolate the hull from upper works; this isolation should never be so complete as to interfere with communication between the two parts of the ship, or with the ventilation of the lower compartments. As regards the protection of the artillery, the first condition in any system is that it be complete, that is to say, protects all the apparatus necessary for working the gun. It is vain to place one part behind armour and to leave another essential part exposed; if, for example, one of the pressure pipes of the hydraulic system is exposed directly to the fire of the enemy, the armour, however thick it may be, which protects the main body of the carriage is only cumbersome and useless. For the heavy guns situated necessarily, as we have seen, ahead and astern, the system of closed and movable turrets furnished with an armoured tube protecting the ammunition hoist is that which best realises complete protection. This system has, however some defects—it is difficult to control exactly enough the movement of the turrets and to perfectly secure the aim in direction. The shock of the projectiles also may damage the rotation-engines and so make the turret immovable; for these reasons we give the preference to barbette turrets, completed by strong movable cupolas; with the carriage in both cases it is necessary to carefully protect the central tube and the lower part of the turret when it does not rest directly on the protective deck. The thickness of the plates to be employed depends on the angle

at which they can be struck by the projectiles; the sloping and rounded form of the cupolas and shields allows of giving them a less thickness than that of the sides. The whole should be capable for the heavy guns of resisting armour-piercing projectiles of the largest calibre, for we must not forget that this heavy artillery is the principal if not the only *raison d'être* of the ship of the line, of which the offensive power rests entirely, or nearly so, in keeping this artillery intact. It is only when they are arranged for firing right ahead or right astern, as on board cruisers, that the guns of medium calibre can be advantageously placed in turrets or semi-turrets. In principle we should not seek to obtain right-ahead and right-astern fire for the broadside guns, nor even to give, them by means of sponsons projecting much from the ship's side, a very extensive field of fire. In the larger number of cases of chasing at sea, the ship chased has for her object to make for the naval force to which it belongs or a port of refuge. Her route must make of necessity an angle, with the ship chasing, which permits of the latter using her broadside guns. In the very rare case where the ship is isolated and having a free field finds herself in a situation to give chase directly in the wake of her adversary, it is an advantage for her, without doubt, to be able to use as large a number of guns as possible. This advantage should always be considered the secondary one, and disappears before the necessity of preserving her course and speed in all weathers which is not possible with forms of forebody affording any hold for a shock of a heavy sea. We consider that all the broadside guns should be arranged in the battery behind armour capable of keeping out explosive projectiles, the protection of these guns should also be completed by a system of shields, domes, and bulkheads forming casemates, and designed to limit as much as possible the effects of explosive shells which may have penetrated to the interior of the ship. The light artillery may be advantageously arranged in groups on the upper deck protected by movable cupolas having a sufficient thickness to resist the projectiles of similar artillery. Finally, the definite adoption of Q.F. artillery of medium calibre makes it necessary to protect in a complete manner all the military organs of power in the ship. This obligation is imposed principally for the Whitehead torpedo, the delicate mechanism of which could not resist the shock of the lightest projectiles; these torpedoes with compressed air could not be left exposed to the fire of the enemy without risking the explosion of the air reservoir. These weapons cannot be used except in the protected parts of the ship or below the water-line. Tillers, steering gear, etc., must be rigorously placed out of the reach of the enemy's projectiles; it is not sufficient, however, to protect all the mechanism; the protection of the *personnel*, which is the soul of the whole, and cannot be replaced during the fight, must be considered with the greatest possible care. The captain must not leave the armoured conning-tower in which he directs the movement and the action of the ship; the second and other officers must not either, without necessity, quit the protected posts which have been assigned to them. All movements of the *personnel* under the fire of the enemy should be rigorously proscribed or only effected under

the protection of the side armour. From these results the necessity of establishing a complete system for transmission of orders from the conning-tower to all parts of the ship, which will complete in a manner that system of protection for the ship which gives her all her value. To make evident the vital importance of protection during a modern action, it is sufficient, in our opinion, to imagine a duel between two ships: one furnished with a powerful and numerous artillery not protected; the other with a single gun of medium calibre with complete and absolute protection of all her organs. The advantage at the end of a longer or shorter time would evidently rest with the latter; the military power of a ship then cannot be measured only by that of her offensive weapons. In the same way, nautical power cannot be defined only by extreme speed. We should, leaving out secondary arms, consider the protected artillery and all its parts, including its floating support, that it is the sole element characteristic of military power.

The Actual Antagonism between Nautical and Military Power.—We will now rapidly enumerate the arrangements which constitute nautical power and the military power of the ships of war in endeavouring to formulate for each of them the tactical conditions which it ought to satisfy. It is clear that the typical battle-ship should unite the maximum of nautical power and the maximum of military power which science is able to give it. Before enquiring whether the construction of such a ship is possible, it would be instructive to throw our eye backwards on a sailing-ship, which constituted the tactical units of the fleets of war at the commencement of the century. Nothing would be more inexact than to consider the modern ship of war a simple perfecting of the old vessel. Without doubt no comparison can be made between the old smooth-bore guns and the present rifle artillery; on the other hand, it is superfluous to emphasise the superiority of the powerful motive machinery of our ships over the masts and sails of the old ones; we can only say, as we have already, that by reason of the motive power the sailing-ship had a range of action almost unlimited.

Her speed, depending only on perfection of form and sail area, surpassed that of some of the finest sailers of the mercantile marine. Her nautical power could thus be developed to the maximum extent without injury to her military power. Her displacement being superior to any weight of military which could be possibly worked on her batteries, the number of guns by multiplying the gun ports could be brought to a maximum compatible with the size of the ship. This conception was completely realised only in the frigate; in the two- and three-deckers the number of guns and gear introduced for the purpose of augmenting their military efficiency caused a reduction of their sailing efficiency. But although even at this epoch antagonism between nautical and military efficiency was not altogether absent, we may assert that the old sailing-ship attained the highest degree of perfection by almost complete harmony in their various factors of power. The appearance of the first steam engine in our ships marked the commencement of a new era; of a series of ideas and arrangements destined in reality not to perfect the old ships, but to

cause them to disappear by substituting little by little for wood the iron and steel and all the other materials employed in modern vessels of war. Only at the present do we see the complete abolition of masts and sails and the definite adoption of the ship of metallic construction throughout. The different elements of her power taken separately are incomparably superior to those of the ancient ship; but as everything depends on the progress in metallurgical science, the progress of the modern ship is limited. Even at the commencement of her career she meets with a difficulty at present insurmountable, the conflict necessarily established between nautical and military power. Supposing, for example, that we decide to give to a ship of certain form and tonnage the greatest possible speed and range of action. It is clear that, not having to take account of the interior energy she has to carry, the whole of the displacement would be utilised to give her the most powerful machinery and greatest weight of coals that she could carry. All weights consecrated to offensive and defensive power would entail a diminution of her range of action. If, on the contrary, we wished to give her the greatest possible military power, the weight of the guns, turrets, ammunition, and armour would in turn take up the whole available displacement. In the first case, we have created a vessel of extreme speed, but inoffensive; in the second, a strong fort but immovable.

Ships of the Line and Cruisers.—How then shall we solve the difficult problem which we have proposed? Shall we by a compromise between the two terms of power produce a cruiser battle-ship, having in consequence an inferior nautical and reduced military power? We do not think so. The tactician proposes, as we have already said, to obtain the supremacy of the sea in a certain region, that is, to maintain freedom of communication for himself and to interrupt those of the enemy. For the first purpose he must have the most powerful ships, from a military point of view; and, for the latter, faster ships than those of the enemy. Now we cannot require of the naval architect that he should construct vessels which are at the same time the fastest and most powerful. It is in vain to endeavour to obtain the result by a considerable increase in tonnage and consequent cost, for the necessary protection for the organs of defensive power increases rapidly with the dimensions of the hull. The solution which consists, as is done by a neighbouring nation, of constructing ships of great displacement, incompletely protected, but fast and furnished with a powerful artillery, is bad and should be rejected. However rapid and strongly armed these ships may be, they will be powerless to dispute the supremacy of the sea with vessels slower, it may be, but with artillery equally powerful, completely protected by thick armour. We are then forced to admit that the modern ship of war must be double, that the tactical units of our fleets should be, in fact, composed of two factors: the powerful ship of the line charged with maintaining freedom of communication, and the cruiser possessing the nautical power for interrupting those of the enemy. This point gained, it is necessary still to affirm that this separation of the two powers need not be absolute nor lead to a singular assemblage

of vessels powerfully armed but without speed, or of swift cruisers entirely denuded of all serious equipment: In reality, we have not to exact for our battle-ships the greatest quality, but the greatest intensity, of military power, if we may use the expression; for example, if we admit the three-hundred-and-five-millimetre gun is actually the most powerful piece of all our artillery, the ship of the line should carry at least one of these guns, of which all the organs, including the platforms, that is to say, the hull which supports it, is completely protected. The quantity of power can then be obtained by multiplying the number of ships. We have seen elsewhere that it is advantageous to carry four heavy guns (two forward and two aft) of which it is possible to absolutely protect all the organs. This first and necessary condition of the battle-ship being realised, we demand of the naval architect to give her the minimum range of action strictly indispensable for the mission she has to fulfil, and that we shall fix in advance in a definite and final manner the greatest speed of which she is capable with her tonnage. On the other hand, if a speed of twenty-three knots, for example, is that which the best cruisers or mail boats of the adversary can attain, the cruisers of our squadron should unite a speed of at least twenty-three knots to a range of action fixed beforehand, which agrees with their special mission; and we demand of the engineer at the same time the maximum of protected artillery possible. We see then in what a logical fashion the terms of the problem present themselves. In neither case can we dream of imposing on the constructor all the elements of his task; we must leave to him for the battle-ships speed, and the cruisers for artillery; we shall simply consider as most perfect battle-ships those which, without sacrificing their military power realise their greatest speed; and cruisers which, without losing their speed, carry the heaviest armament, in both the utilisation of the financial resources from which results the highest proportion of total power to tonnage. We may add that the tactical unit battle-ship-cruiser is only transitory, these two terms are destined to approach each other to the day, still far off, when by the employment of a metal light enough and resistant enough it will be possible to unite their elements in a single type.

Specialisation of War-ships.—The ship of war, whether of the line or cruiser, fulfils then the factors of military and nautical power, but certain of these factors, protected artillery, or high speed, alone reach their maximum intensity so as to constitute the dominant quality of the ship and to class her in one or the other of the two great divisions that we have established. It has often been sought to push this division of work further in specialising the war-ship, in preserving, for example, a single element of her power and reducing to the minimum or even annihilating all the others. We can thus obtain the ship of extremely reduced tonnage, and yet very efficient from the special point of view we seek to realise. Amongst the different attempts of this nature, attempts which, let us remark, have all been condemned more or less completely by experience, we may cite in the first place the torpedo-boat, of which the military power is constituted by a single offensive arm, and of which the nautical power resides only in high speed. The absence of all protection, on the one hand, and the reduction of

the range of action to the minimum on the other, cause the antagonism of the two powers to disappear, and constitute, during a very short time, it is true, but with small and economical dimensions, an elegant solution of the naval problem. It should be remarked that the torpedo possesses actually only one of the qualities of a weapon of war efficiency; it cannot remain without danger exposed to the fire of the enemy, and requires minute and frequent adjustment. It is subject to various injuries which hamper its action, it is in reality neither safe, nor simple, nor robust, and may be defective at the precise moment when it is required to be used; besides, and in spite of all sighting apparatus, the fire of the torpedo is uncertain, and should not be carried out except at short distances. Now the torpedo-boat denuded of all protection, cannot, however small target it presents, approach the battle-ship which it attacks except at great risk. These risks are such since the adoption of quick-firing artillery with a flat trajectory, that it ought not in the majority of cases to attack by day but should be content to act at night and by surprise; we may add that she is sensibly defective in navigability, an essential quality for all ships of war, a heavy sea causes a loss of speed and considerably interferes with the action of her mechanism. The torpedo-boat is then far from being for battle-ships and cruisers the redoubtable adversary that has been supposed, if we reflect that her tactical speed is not very superior to that of battle-ships and cruisers, and that, by presenting their sterns to her, they can keep her a long time under a destructive fire; and that, besides, theoretically a surprise can always be avoided; we are led to conclude that if she is not soon to disappear like the ancient fire-ship has disappeared, the modern torpedo-boat must be transformed. The weapon which she carries must be perfected and given the protection which it requires in becoming submerged, or, at least, be rendered practically submergeable at the moment of attack. It would be premature to consider the consequences which this solution would entail, but such a problem is already foreseen. The idea of the ram-ship is otherwise, the only arm of which, the ram, possesses, as we have already said, the sum of the qualities which we can expect of a weapon of war—simplicity, safety, strength, and efficiency, and for which can be realised the absolute protection of the motive organs. We have already spoken of the difficulties which combat by shock represents. The ram-ship, altogether impotent against a faster foe, cannot acquire the speed which she wants without losing something of the complete protection, which is her *raison d'être*, only by possessing dimensions comparable to those of the ships which she attacks. Up to now, we have been of necessity led to utilise her in a surer manner by giving her torpedo-tubes and heavy artillery. The ram-ship thus transformed by force of circumstances has become, with a high speed, the armoured battle-ship of our squadrons, and with less speed and dimensions the armoured defence ship of which the principle rôle is to serve as an auxiliary to the coast batteries and form the tactical unit of the defence fleets. As we see, the attempts at specialisation of the battle-ships to the end of attaining restricted dimensions are fatally destined to failure, it is impossible to obtain a mean between the two extremes—the submarine

and the battle-ship. We shall only speak then in passing of two other specialised ships of war, the gun-boat and the mortar-boat, the conception of which has recently none the less made some noise in naval circles. The nautical power of these ships lies, as in torpedo-boats, in a momentarily high speed, and their military power is an offensive weapon destitute of all protection. The gun-boat carries simply a gun of medium calibre—an arm useless against armoured battle-ships or even protected cruisers. It has all the defects of a torpedo-boat, without the advantage of efficient weapons, and without the power of submergeability. We may say as much for the mortar-boat, we can certainly conceive the light-ship furnished with a shell-gun of large calibre launching a projectile charged with a powerful explosive, a sort of projectile torpedo, the shock of which would produce on the upper works of a battle-ship a considerable destructive effect; such a ship is a veritable torpedo-boat, condemned as she is to act at night by surprise, and at short distances, for the aim of a bomb with curved trajectory requiring absolute stability of platform is impracticable on a small ship. As to the bombardment of fortified positions it seems that the ships of the fleet, thanks to their endurance, their protection, and their range of action, are incomparably better qualified to execute this operation than the light ships of which we treat, incapable as they are moreover, however numerous they may be, to maintain a blockade in heavy weather. Let us then leave on one side the dream of the naval nobody, and affirm with a large majority of officers the necessity for large ships, at the same time sea-going and powerful, which alone can make them efficient masters of the sea. It remains to say a few words in conclusion on a class of ships which cannot properly be called ships of war, but which, nevertheless, are called on to render most important services. To this class belong those ships in which military power is suppressed in order to obtain the maximum of speed, united with a certain range of action, and amongst these we place despatch-vessels in the first line, which serve as a connection between the two elements of which our fleets are composed—*i.e.*, battle-ships and cruisers. Such a ship, to which we give sufficient tonnage to enable her to keep the sea in all reasonable weather and maintain her speed, has not to fight even her equals; her only object is to bring to their destination orders and information which she carries from one group of ships to the other which she would accompany. If it is possible to do so without detriment to her nautical qualities, we might give her a light quick-firing armament, suited to act against torpedo-boats. The despatch-boat, cruiser, or squadron-scout is in some sort the connecting link with the tactical unit, the battle-ship-cruiser, which she permits to develop all her power without the disunion of the elements. Finally, we ought not to forget that the commercial route war, in spite of the secondary rôle which we assign to it, completes the programme which we have traced for the swift cruisers of our fleet, their mission being to interrupt the communications of the enemy. It will thus be advantageous to have amongst these latter, ships capable of acting effectively against merchant-ships, that is to say, endowed with high speed, great nautical and a cer-

tain amount of military power. Subsidised mail boats, furnished with medium calibre guns, usefully fulfil this object. It is important to remark that we should never give up the maintenance of our commercial routes except in the presence of an enemy incontestably master of the sea. Although supplies by the maritime frontiers may be carried out under a neutral flag, we could and might be obliged to utilise the national mercantile fleet for this object in the majority of cases. It is then theoretically not a wise policy to withdraw, at great cost, the mail boats of our great national companies from their exclusively commercial mission. It would be preferable to provide special ships of large displacement, extended range of action, and great speed, constructed for this particular work. A few of these cruiser-privateers, stationed at the commencement of hostilities at suitable points, would render great service in paralysing, or at least doing great injury to, the commercial trade of the enemy.

THIRD PART.

Modern Fleets.—Squadrons are collections of war-ships designed to act simultaneously—that is, capable under all circumstances of concerting their movements and their action. The tactical unit being necessarily composed, as we have seen, of two terms, the battle-ship and the cruiser, combining their powers to obtain complete control of the sea, the squadrons should be composed of equal numbers of battle-ships and cruisers. Squadrons of the first line, which are the highest manifestation of the naval power of the country, and which must bear the first brunt of the battle, must be composed of vessels which possess the greatest intensity of military power, united to the highest possible speed, and of cruisers which possess a nautical power superior, or at least equal, to that of the enemy's cruisers, and at the same time provided with armament and protection as complete as possible. Fast battle-ships and armoured cruisers, united by scouts, above all seaworthy and of great speed, thus constitute the only theoretical elements of such a fleet. By reason of the incessant and parallel progress in all branches of nautical science, the most recent ship of each type, speaking generally, will alone possess the whole power which the latest results of metallurgical science can give her; and this cannot be avoided. To lay down simultaneously a number of ships of the same model, followed by an unavoidable delay in construction, would result in the formation of a squadron which, after a few years' service, would only be able to oppose inferior types to the most recent units of the enemy. The constructor, in fact, has not the power to modify his work. Retouches practised with discernment, changes of artillery and boilers, may without doubt, considerably ameliorate the conditions of the ship from a military point of view; they can but rarely increase her nautical power. The tactician finds himself practically face to face with units of war of different types and qualifications, amongst which he must choose with care the units forming the squadron of the first line, capable of always combining their movements to a common end.

Homogeneity. — In order to ensure concerted action under all conditions, it is necessary that the ships of a squadron should be homogeneous; and it is important to define what is meant by this homogeneity which we require as a necessary condition for squadrons of the first rank. We cannot demand that all these ships should be alike. Remembering the axiom formulated at the commencement of this study, that the military power of the fleet is equal to the sum of the military power of its units, we may say that, from a strictly military point of view, it would be best to unite the greatest possible number of ships, whatever may be their strength. It is nothing of the sort. We know that the nautical power of the whole is exactly equal to that unit of it which possesses the least. The addition of a single battle-ship of feeble nautical power reduces the nautical value of the whole squadron, and the tactical inferiority which thus results may counter-balance to a large extent the advantage gained from the military qualifications of this single ship. We see that it is as necessary to choose battle-ships for the first line only amongst those which possess the wished-for homogeneity of nautical power. From the point of view of navigability, for example, it is clear that all the ships of the squadron should be capable of withstanding the same degree of heavy weather at sea. If one of them is forced to slacken speed, the whole squadron must do the same, if they are to act in concert. A conclusion of the same kind is imposed on us in the matter of range of action, which is, as we have seen, a determinant factor in the ship of war, and, consequently, of the fleet. The work expected of a naval force in time of war is that it shall be able to cover at fighting speed, or at economical speed, a given distance; battle-ships following the most direct route, cruisers having to open out to form divisions of contact, for chasing and scouting, and consequently having to cover a greater distance than the battle-ships, but equally determined beforehand. The despatch-vessels and scouts proper, having to serve as the connecting links between the different fractions of the naval force, have need of a still more extended range of action, and proportional to the two first. We have not to consider here what should be the relation and absolute value of this range of action, the whole of which constitutes the range of action of the first squadron of the line, as it must be determined by the authorities after experiments in time of peace, according to the object which it is proposed to pursue in time of war. This determination should logically precede, let us repeat, the conception and construction of the ships destined to form part of the squadron, and it is evident that we can only add to their number later ships possessing a range of action at least equal to theirs. We should carefully exclude those ships which may be forced to remain behind precisely at the moment when the execution of the principal strategic movement for which the fleet is organised is being carried out, and cruisers and scouts which would not be able to fulfil their mission just at the last moment of the projected operation.

It is necessary to add that the provision of victuals, fresh water, and coal, etc., should last the same time in all the ships in the squadron; a great excess in some of the ships over the others would only mean a useless load, occupying space and tonnage, to the detriment of the real power of the fleet. We must hold a similar reasoning as applicable to speed. The fighting speed can only be that of the slowest unit, and in a squadron we consider the superior speed of the newest ships will only be able to be utilised under exceptional conditions; but, on the other hand, we should exclude ships whose speed would give to the squadron a manifest tactical inferiority. This last reflection applies with equal or greater force to cruisers and scouts, which would be always able to utilise their high speed when operating alone, but if their speed is inferior they become for the squadron an encumbrance rather than a help. In conclusion, the homogeneity of the nautical power in the units of the squadron, which we argue for, resides in the wisely regulated harmony of these factors, navigability, range of action, and speed, and we may state that such harmony can only be attained by vessels of large displacement. Although the scouting ships can reduce their military power to a minimum, and devote an insignificant portion of their capacity to the power of their armament, the necessity of attaining a high speed, navigability, and a range of action very superior to the battle squadron for which they have to scout, inevitably leads to large displacements, and it appears to us cannot be less than from four thousand to five thousand tons.

Light Divisions.—We are thus led to exclude from the squadrons of the first line the light ships, torpedo-boats, and torpedo-boat destroyers, which in time of war would only serve to embarrass them and prove a danger. There are without doubt conditions in which a squadron might find torpedo-boats of great service, and for these circumstances the commander-in-chief might with advantage form light independent divisions, stationed at suitable points, where they could be allowed to co-operate in the general plan of action. But these combinations which are purely strategic, have nothing to do with the tactical conception of the squadron which we have sought to realise, and which should only comprise, under the name of Light Division, scouts of large displacement such as we indicate above. The torpedo-boat catchers or destroyers should only under exceptional circumstances accompany a squadron as a guard. Their limited range of action makes them unfit for scouting service, and they are more pernicious than useful in an attack by torpedo-boats at night by surprise. We consider then that their sphere is to act always alone on the coasts and against the mobile defences of the enemy.

Reserve Squadrons.—Although the squadrons of the first line can only be composed of ships of recent construction, possessing the wished-for homogeneity of nautical power, it does not follow that the tactician must entirely discard the older units of different types. These ships of the second order constitute with the homogeneity which they possess, the Reserve Squadron destined to play a determined and considerable part in time of war. It is an error to believe that this squadron could be advantageously combined with the active squadron at the moment of

hostilities. They would probably only prove an element of weakness, and it would be preferable to face the enemy with a force less numerous, but homogeneous and of high speed. The formation of strong reserves is as necessary for the fleet as for the army, and the admiral who would consent to do without them would commit an error comparable to that of the general who would engage the whole of his troops in the first action, and thus see himself exposed at the first check to complete and irremediable defeat. It is certain that the meeting of two fleets of the first line in action will leave scarcely one of their units intact. Victory at sea in general will consist in occupying and holding certain positions, and will be to that fleet which has sustained the least damage. The old fleets above were able to continue their cruising and operations after a victory. To-day, as numerous recent examples show, it is probable that victors and vanquished will both have to rejoin their bases of operations as quickly as possible to repair and replenish, and will be for some months unable to put to sea. It is then that the Squadron of Reserve would enter into line. We may affirm that the real victory with all its consequences will belong to the one of the two countries which has a reserve for this instant capable of becoming incontestably masters of the sea after the first shock and temporary disablement of the squadrons of the line.

The Defence Fleet.—Although inferior from a tactical point of view, the Reserve Squadron should possess a homogeneity of its own which permits it to concert the action of its different units at sea. The fleet for the defence of the littoral, on the contrary, can admit and utilise ships of the most dissimilar types. It has only to concert its action with the forts and batteries of the coast, and only requires an insignificant nautical power. Always within call of the dockyards and magazines, it can renew its supplies without interruption. The head of the defence fleet is no other than the head of the Admiralty, who resides on shore, and commands the whole of the defences of the coast and naval ports. His only care is to use to the best possible advantage the qualities of the ships under his orders, and which will easily find their places in the whole organisation, the principal lines of which we have above sketched out. He would thus, for example, dispose of the torpedo-boats for guarding the channels, protecting the coast-line, and following and harassing assailants; but he would not use them for the purposes of scouting, for which the torpedo-boat, which has a restricted view and little endurance, is as little as possible suited. The true scouts of the coasts are the signal-stations, and light ships must be added, which could rapidly scour the neighbourhood and make their reports to these stations. Torpedo-boat destroyers and catchers could usefully protect coastguard ships of slow speed which would have to be stationed on the littoral. The fleets, and, in particular, the mobile defences, could incidentally lend their aid to the sea-going squadrons when the theatre of the naval action was in the neighbourhood of the base of operations.

Foreign Service Divisions.—The squadron of the first line, the reserve squadron, and the defence fleet, constitute the three divisions of the whole fighting fleet properly called, the double mission of which is to maintain

free communications on its own coasts and obtain the command of the seas adjoining its own territories. We know that after having secured this first object, the Navy should be able to defend the interests of the country at all points of the globe at which they may be menaced. Naval actions in distant seas can only be an extension of the hostilities engaged in by the two Powers in the home waters. The opponents have both, in this case, the same reasons for keeping the above three main divisions of the Navy in the neighbourhood of their coasts, and to send abroad only cruisers of great nautical power. These cruisers will be advantageously grouped in time of war to form divisions of homogeneous cruisers, having for their object the protection of the colonies and the national trade, and to attack the colonies and trade of the enemy. Their action will be exercised in fixed districts between limits determined by the position of fortified bases where they would be sure of obtaining supplies of coals and provisions and other necessities. A distant maritime war possesses an entirely different character when it is waged against other than a European nation. Against a native population, deprived of all means of carrying on a naval war, ships of light draught, capable of ascending rivers, will render great service. They should immediately be disarmed in case of a European war, so as not to give the enemy an occasion for an easy victory. If the enemy has a fleet at his disposal, it is evident that the naval force to oppose it must be proportional to the strength of this fleet, and if the fight has to be carried on against regular battle-ships and modern armoured cruisers, similar units will have to be provided for service in foreign waters. Divisions of cruisers in this case become totally insufficient, and must be replaced by squadrons, and this is not possible unless the bases for the fleet beyond the sea are increased in proportion so as to become regular arsenals capable of serving as centres of operations.

Naval Bases for the Fleet.—The transformation of the old fleets has lost them in great part—the independence of their movements. It is not only the capital question of combustibles which prevents them from keeping the sea, and in general constrains them only to move from necessity and as economically as possible from one point to another; the necessity for ammunition compels them to repair to the only points where these stores have been collected in advance. Modern battle-ships cannot repair themselves, nor be careened at any part of the globe. Particular tools and gear are required for the numerous machines and apparatus with which they are fitted, and the slightest damage to the hull necessitates a visit to the dry dock. Repairs by neutrals is rightly considered a violation of the laws of neutrality. Without insisting further on the point, for the above reasons the modern battle-ship cannot do without a base of operations where all her needs can be supplied. We may say that the arsenal or dockyard now forms an integral portion of the fleet; that it is its natural and indispensable complement, and that to fulfil completely the rôle which is assigned to it, it is necessary in the first place that it should be fortified; defended both from the land side and the sea against an attack. Not only the workshops, magazines, and docks should be

beyond the range of the enemy's projectiles; the harbour itself should be strictly closed, so that the vessels which are moored there may be in absolute safety to dismount their engines and overhaul their machinery. With these conditions only is the arsenal a true base of support, and centre of operations for the fleet; where it can be supplied with all the energy it may need for movement and for action.

Convoys.—The close connection which exists between the squadrons and the dockyards gives to the former a tactical inferiority which all possible means should be used to lessen. To this end a large number of coal depôts should be established on the waters where our fleets are likely to be engaged. It must not be forgotten that these depôts, whether fortified or not, are destined to fall an easy prey to the power of the enemy. Besides this the necessity of combining the movements of the fleet, in order to profit by the provision of their supplies, will considerably interfere with the freedom of their operations. We think, therefore, that the problem will be more completely solved by the addition to the squadron of a convoy of supplies, that is, an escort of transport-ships loaded with combustibles, provisions, and ammunition, capable also of receiving the sick and its wounded, and, if necessary, of effecting changes in the *personnel*. So seductive as this idea is, however, we must allow that it will be generally impracticable until the fleet has definitely acquired the control of the sea. In order not to be exposed to destruction or capture at night by the enemy's scouts, the convoy ships could only be placed in the centre of the fighting fleet, and it is evident in case of a surprise such a position would be very embarrassing. In order not to retard the movements of the squadron, the transports must possess at least the same nautical elements as the fleet, and this would mean a considerable reduction in the amount of cargo they could carry. It would therefore always be wise not to undertake an operation necessitating the addition of transports till after the defeat of the enemy, or at least till he has refused an action and has been forced to it by a combined attack in force against his coasts. The initial and dominant fact of the hostilities should be the meeting of the hostile battle-ship fleets; but this meeting will always be followed, if not preceded, by operations of the second order—the blockade or the landing of troops—and which will necessitate transports for supplies or for the troops. The organisation of these transports then must be foreseen and provided for by subsidising mercantile ships, or, better still, by building special ships designed for this duty. Independently of this convoy proper, factory-ships, hospital-ships, and torpedo-boat transports would render great service to the fleet, provided they have a nautical power which would permit them to accompany it, and to get out of the way in time in the event of an action.

Conclusions.—It seems impossible to study these problems of naval tactics without at first tracing the main lines of a general plan, giving an exact notion of what battle fleets ought to be, and what it is possible for them to do. In trying logically to constitute the forces with which we have to act we are forced to bring into relief that which appears to be the essential characteristic of the modern Navy: the actual

antagonism between the nautical and the military power of the ships, and the restricted field of action which results from it. Some day, no doubt, this antagonism will disappear. The battle-ships, without losing anything of their military power, will become more and more rapid, and the cruiser, without abandoning any of her nautical power, will be increasingly better armed and protected. These two tactical factors thus tend towards each other, and will end by producing in the future a single type which will respond to all the necessities of maritime war. Fleets then will be similar amongst themselves; home squadrons and foreign divisions will possess the same homogeneity, and will only form a single fleet, able indifferently to act in distant waters or on the home coasts, like the fleets of the home navies. It would be an error, however, from a tactical point of view, to seek to forestall progress by the premature creation of ships and fleets suited for all services, and which would be inevitably condemned to actual inferiority—in one or other of their powers.