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Modern Naval Tactics

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MODERN NAVAL TACTICS.

By Commander P. H. COLOMB, R.N.

THE steady advance and final adoption of steam as a necessary appliance of naval warfare has brought in its train a vast variety of changes, whose approach had been unforeseen, and for whose reception, even when recognized, the preparations have not been altogether adequate. Recognition of a change has been more or less tardy in proportion as the necessity for it made itself less or more strongly felt. But, although in civil affairs, the pressure enforcing a change is usually in equal ratio to its importance, and therefore, if the premonitory symptoms produce their natural effect the change is made before the evil consequences of delay have had time to act; in the affairs of war it sometimes happens that the importance of an object is not generally admitted, and in rare cases not even suspected, until either some terrible calamity to a nation's arms through the want of sufficient capacity to appreciate facts, or some splendid success, rifled from the hand of fortune by a master mind, show that the failure or the success were equally the result of a neglect of, or an intelligent use of facts, which were at the outset common property.

Thirty-three years had steam itself been toiling upwards in our fleet in times of peace; almost belying the few who steadily predicted its triumph, until the outbreak of the Russian War, with a suddenness never equalled, swept away for ever the notion of a sailing fleet, and set the workshops of England going, to turn out with all speed those hundreds of marine engines which the years 1854-5-6 saw created.

A lost Austrian war, and an easily overrun Danish territory, are historically connected with lack of rifled and heavy ordnance. Nor will the annihilation of the "Cumberland," in the waters of the Chesapeake, or that more recent and more sudden destruction of a Confederate ship, the "Albemarle" by a torpedo, be considered by our countrymen as disconnected from any failure of our arms in future cases of the like nature.

A great service like our navy can by no means afford to lag behind in a full appreciation of the facts which surround its position, and which will inevitably govern its proceedings in any future naval war; for though no sensible man can see the seeds of decadence in our maritime prowess, or can anticipate aught but ultimate success to our arms, we are proverbially liable to early reverses or indecisive successes at the commencement of hostilities; and we really cannot foresee the consequences of an ill-commenced naval campaign with the costly and elaborate appliances of modern warfare.

It is therefore important that we should, from time to time, study and endeavour to master, the probable effects in future wars of those changes in the material or moral condition of the navy, which are either finally established, or whose establishment seems certain within a reasonable time. More distinctly should attention be directed to the solution of those questions whose importance is very great, but whose pressure for solution in the quiet times of peace is either slight or altogether absent. Of such a nature is the subject with which I have this evening undertaken to deal.

I envy no naval officer who thinks the science of tactics is rightly placed in the shade to which our navy has tacitly condemned it; nor can I avoid fearing that, unless some English labour, commensurate with that of foreign growth, is bestowed upon it, we may one day have cause for repentance.

Like all cases in which scientific truth finds the path barred by the inertia of settled ideas, there have not been wanting, from the earliest days of steam, a succession of advocates calling for the necessary dispositions to meet the changes it was working in our fleet manœuvres. Whatever the results of this advocacy may have been in foreign navies, our own, it cannot be denied, has taken very little notice of the subject; and, if our only official treatise, the General Signal Book, represents the embodied wisdom of the navy in this behalf, it may be well should we discover that the wisdom of foreign navies goes no further.

In 1846 Admiral Bowles, in a forcible pamphlet, showed the necessity of modifying the old systems of tactics, and carefully studying those probable in future. The late Captain Moorsom followed in 1854 with a small work; and in France Count Boüet Willaumez wrote his *Essai de Tactique à Vapeur*. This was soon followed by the French official *Tactique Navale*, translated into English in 1859; and it is worthy of note here that the French Evolutionary Signal Book, founded on this manual, is corrected, year by year, as the experience of the squadron of evolution appears to direct; a course which, if honestly carried out, can hardly fail of satisfactory results.

In 1858 the late Sir Howard Douglas gave us his *Naval Warfare with Steam*; and Sir William Martin printed for private circulation some remarks on steam evolutions, which later were made the basis of a complete system.

One result of these contributions to the science was a slight modification of our General Signal Book in the new issue of 1859. A few purely steam evolutions were added, and an endeavour was made to arrange the wording of the old sailing instructions and orders, so as to embrace the new circumstances. Sir William Martin, with the Mediterranean fleet, now carried out a series of very important experiments, and drew up a complete scheme—which I think it is a subject of regret has not been more generally circulated in the profession.

Whilst England and France were thus contributing to an elucidation of the questions involved in the matter, Russia was, under the auspices of a renowned and gallant officer, carrying out experiments which extended over four years, and which resulted in the publication of Admiral Boutakov's "*New Basis for Naval Tactics*"—a work of which the recent translation into French, has rendered it available for our purpose. Every one who has read this work must agree in thinking it a very remarkable addition to our knowledge. Opinion may be divided in the English navy as to the practicability of the views advocated, but I think it can be shown that the writer has raised questions, a right understanding of which, will for the future form the foundation of our fleet movements.

It will be readily premised that in a short paper like the present, it is not possible to deal with such varied and complex questions as the subject brings before us, except in the most cursory and general way. I propose, therefore, to treat only of the leading principles which appear to govern the theory and practice of the science.

I am not one of those who think that a system of tactics can be produced off hand, nor do I wish to give the product of the study a weight greater than its due. Experiment, and experiment only, can solve most of the questions propounded to us, but we can undoubtedly, by careful study and discussion smooth their course, and assign the limits beyond which they need not pass.

I believe, however, that it is only those who have given much attention to the matter who are fully alive to its intricacies and its generally unsatisfactory character; that consideration should, however, stimulate our efforts, as the importance of a solution is at the least commensurate with its difficulty.

The subject naturally divides itself into two great branches, which for the purposes of this paper may be separately headed: with the proviso, however, that their connexion being really most intimate, this separation is only excusable on the ground of clearness. The two branches may be termed the *mobilization of fleets* and *naval strategy*.

Most modern writers on the science have confined themselves to the consideration of the former part, naturally avoiding the vagueness and uncertainty which clings to the latter. Were it possible to ascertain with precision the forms in which fleets will in future

prepare for attack and defence, *naval strategy* would properly form the basis of the whole subject, just as in old times the *line of battle* being established as the universal fighting order, all others were valued on their capacity for speedy conversion into that normal attitude. As it has never been possible since the introduction of steam to assert positively what the normal position of a fleet will be, and as it now seems more than ever uncertain, most authorities have been content with the very wide basis of all possible forms of attack and defence for their systems; and their only endeavour has been to show how from any given formation in any given direction, a fleet may, by the use of many diverse movements, pass to every variety of position or direction which is possible. This proceeding has, I think, somewhat embarrassed students, for it is difficult when a great variety of considerations are placed before us on the same level, to attach to them their relative values, or to ascertain their bearings upon each other.

Under these circumstances, I propose to examine first the movements of bodies of ships acting in concert; then the modes by which this concert may be best secured, and lastly, I shall devote a short space to the consideration of future naval strategy.

With one exception, all modern tacticians have drawn a complete line of demarcation between steam and sailing tactics; but this seems hardly a judicious mode of treatment; for as stated by a distinguished tactician, "there is such an analogy between the power of changing positions in a squadron sailing free, and in another propelled by steam, that the principles which regulate the evolutions of the one, will govern those of the other." The value of this observation lies in a deduction from it that this similarity of movement may be made the medium of conveying instructions to officers which might otherwise be unattainable. The value of the most carefully devised rules in tactics, is materially diminished by the absence of practice in their application, and it is therefore no unimportant part of a tactician's duty to provide, in the every day movements of a fleet in peace, that practice which will stand us in such good stead in the enemy's presence. Evolutionary drill of a large steam fleet is so expensive* a matter that no nation can practice it to any great extent in time of peace; whilst in war time the efficiency of a fleet will depend so completely on its supply of fuel, that our admirals will be very chary of its expenditure for drill purposes.

These considerations seem to point out that one of the very first objects to be striven for in the arrangement of a system of tactics, should be the incorporation of sailing into steam tactics. Not to graft, as has already been ineffectually attempted, the new system upon the old, but to frame an entirely new system of steam tactics, and to take in so much of the sailing systems as may be possible without confusion. Masts and sails have now assumed the position of a true auxiliary power, which twenty years ago was thought the

* "Edgar," at 8 knots, burns $2\frac{1}{2}$ tons per hour, say 48 tons per day, at 15s. per ton. With 12 ships, equal £432 per day.—P. H. O.

final position of steam, so that tactical arrangements should be based upon those inverted values.

Were any further argument needed to enforce the propriety of this course, we have it in the fact that modern fleets are constantly under steam and sail both, and that if either the movements themselves for each power, or the orders directing them are not identical, there remains an alarming source of error and confusion. It is more generally admitted now than formerly that the difficulty of preserving order in a fleet has not been reduced by the advent of steam. The increased size of the ships has no doubt contributed to this result, but beyond this, as the speed of each steam ship depends on a force within herself, and only partially under the control of the officer in command, whilst the speed of each ship in a sailing fleet depends upon a force which is common to them all, and whose effect is strictly under the control of those responsible for her station, it is evident that a steam fleet is more liable to disintegration than a sailing one.

The assertion that the maintenance of a uniform speed is the first requisite in a mobile fleet, requires no comment; and if this be difficult of attainment at present, some means should be sought to effect it. Would it not, for instance, be possible to place the control of the throttle-valve in the deck officer's own hand? Something would be gained by the employment of a dial under the eye of the officer of the watch, upon which by means of the pressure corresponding to her passage through the water, the ship's speed at any moment could be ascertained. Might it not even be possible to connect this force directly with the throttle valve, so that any given speed might be accurately maintained, the instrument acting as a governor upon the engines? Such an arrangement would doubtless contribute both to the security of the engines, and the saving of fuel.*

Admiral Boutakov considers that uniformity of speed may be obtained sufficiently close for practical purposes, by causing the fleet to steam in line abreast for a short period, and regulating the speed upon the slowest ships. After the determination of this "*question capitale*," as the Admiral calls it, the next point is to establish uniformity of evolution under the action of the helm.

Until Admiral Boutakov wrote, this most important element was either quite overlooked, or very scantily dwelt upon by tacticians, but that Officer has now pointed out with remarkable clearness and elaboration how completely the celerity and precision of fleet movements depends upon a proper understanding and application of the laws which govern the path of a ship when acted on by her helm. The Admiral states that having at first "resolved the problem in a manner quite as inefficient and arbitrary as those who had entered the lists with him on the subject," he soon "struck upon the very simple idea that every evolution of steam ships was inevitably based upon

* Since writing the foregoing, I have learned that Admiral Bullock has invented a dial log of the kind mentioned, which may be seen at Potter's, in the Poultry, and which it appears very important should be tried in a fleet.—P. H. C.

two geometrical lines, *the circle and the tangent to the circle.*" This idea he terms "the root" of the question, and although many English naval officers will consider he has unnecessarily elaborated the theory, I hardly think any one who reads the work can fail to be very much struck with the arguments put forward. It will not lighten the weight his views may have, to be told by the writer that, in the laws pointed out, we have "an easy means of manœuvring with rapidity, exactitude, and perfect regularity, and that this has been proved by the captains of the squadrons commanded by the gallant officer, *during four years of experiment.*"

It is a well known fact that a ship steaming ahead with her helm over, describes a curve so nearly resembling a circle that for all practical purposes it may be taken as one. The diameter of this circle can be increased to any extent by diminishing the helm, but its decrease is subject to considerable limitation. *The smallest circle in the shortest time*, is described by a screw ship when going full speed with her helm at an angle of 45° . Every diminution of speed increase the time but decreases the diameter of her circle; whilst every diminution of the helm increases both the time and the diameter of the circle described.

Fig. 1, Plate I, gives a comparative view of the circles described by a gunboat going full speed, with the different degrees of helm marked against each. The diagram is prepared from a series of experiments conducted by Captain Key in 1862, who kindly furnished me with the results, and from which I draw most of the conclusions here given. That diagram shows us very distinctly, not only the importance of the enquiry we are now making, but also the beneficial results to be expected from increased power over the helm.

Before we can ascertain the exact bearing of the laws just stated upon the subject before us, it becomes necessary to apply them to the classes of ships which now, and for many years to come must form the main body of our fleets.

Table 1 is an extract from some I have drawn up on the data given by the experiments just quoted, and which furnish the only valuable facts I know of, connected with the matter under discussion. Admiral Boutakov in his table of the calculated circles of ships uses this proportion:—As one hour is to the time occupied in describing the circle, so is the speed per hour to the circumference of the circle. Applying this proportion to the calculation of the circles of a gunboat steaming 7 knots, and whose period of revolution for various degrees of helm is given in the second column of the table, we get the circles whose circumferences are given in the third column: but the actual circles, which were carefully measured, are only of the circumferences given in the fourth column. We see therefore that a certain retardation takes place, due to the resistance of the rudder, and that a considerable reduction must be made from the calculated circles, in order to obtain the real ones. This correction in the form of a multiplier is given in the last column. The experiments were tried with several areas of rudder, and though their object was different from that for which I am now using them, enough data are given to

show that the corrections apply approximately, whatever the area of the rudder may be, which leads me to suppose there is a fixed law governing the motion of all classes of ships under helm action, which law when discovered, may be usefully applied.

Even the small portion of the experimental results I have placed before you, point out the possibility of expressing the variations in time of evolution, and diameter of the circle in terms of the rudder angle. Investigation, so far, has satisfied me that this law is contained in the following statement. *The diameter of the circle varies inversely as the sine of the helm angle, and the period of revolution, directly as the cosine of the angle.*

In table 2 are a few of the times and diameters calculated on this theory compared with those observed, which seem to bear out the truth of the idea.

Whatever corrections larger and more accurate experiments might bring to the data given in the tables before you, I think I am fully justified in assuming their truth for the present, and in using them as I have done in preparing the diagram (fig. 2, Plate II).

We have here represented the inversion of a column of six ships of the modern class, just as it might be expected to take place under present circumstances; and I do not think any comments of mine could increase the force with which that diagram appeals to us. To my own mind it brings conviction of the importance of the prints first publicly put forward by Admiral Boutakov. The absolute confusion into which a column is thrown during the process of inversion is well shown by the shaded vessels, each of which is in the given position at the moment when the "Royal Oak" has completed her half circle.

We have thus reached the second stage of our inquiry. Not only must a uniformity of speed be secured, but a uniform radius of evolution must be sought for. Movements must be regulated by the slowest ship in the one instance, and by that describing the largest circle in the second.

Admiral Boutakov states that this uniform radius is obtained sufficiently near for practical purposes by inverting the line "together" several times till the ships fall into their proper places, and then each ship marking the position of her helm, and in all future movements using that angle.

I have thought, however, that if some circle of evolution were permanently fixed for two or three classes of our ships likely to be acting in concert, the proper helm-angle for each individual could be calculated and marked upon the tell-tale; then all confusion would be avoided on any number of one class coming together.

Throughout the rest of this paper I consider that uniformity of speed and radius of evolution have been attained; and for convenience I assume this radius to be 200 fathoms, the established distance apart for ships in column. Whatever the radius be however, the relative bearing of the facts to be adverted to, remains the same.

It should be here stated also, that in all the diagrams given, the unshaded ships represent the position of the fleet before manœuvring; the shaded ships, any intermediate stages it may be necessary to

mark; and the black ships the final position of the fleet on completion of the manoeuvre. In this arrangement I follow Admiral Boutakov, and should express my obligations to him, not only for this, but for the very large draft I have made from his *Nouvelles Bases* for the purposes of this paper.

The change of position of a column of ships proceeding in any direction is effected either by the helm, by a variation of speed, or, finally, by both continued. Variation of the helm is not only capable of being determined with greater accuracy than variation of speed, but its effects are made more quickly as well as more distinctly visible by reference to the fixed line supplied by the compass. Again, as every ship in a fleet must continue in motion in order to preserve its relative position, the process of taking up a station with reference to any particular ship must always be a matter of some complication so long as the moving object is to be the guide. When, however, the courses of the ships are parallel, there is not such difficulty, as a reduction or increase of speed will effect the object. If I rightly apprehend Admiral Boutakov, he would draw the closest attention to these points. He would have all evolutions commenced by a movement of the helm only, until the ships were in such a position that, by assuming parallel courses and varying their speed, they may either complete the manoeuvre, or place themselves in such an order as may require the helm only to do so.

The methods of changing position by means of either helm or speed alone, may be termed *simple movements*, whilst those requiring the employment of both powers may be termed *compound movements*; and it is obvious that, generally speaking, if a change of position can be effected by a simple movement it should be used in preference to a compound one, even at a sacrifice of some delay; for increased celerity of movement is dearly purchased at increased risk of confusion.

Examples of simple movements by variations of helm are given in the changes from K L to A B, to M N; or to O P; and by variation of speed in the change from M N to R N, and from O P to O Q (fig. 3, Plate III), whilst examples of compound movements are given in the changes from K L to R N or I J, or to any of the positions south of the original one except O P and S T.

From the laws governing the turning powers of ships it is evident that variations of speed can only be used when proceeding on a straight course; if the speed be increased or reduced during the process of turning, the ship will find herself out of position on completion of the manoeuvre.

Compound movements may therefore usually be divided into two or more simple ones, and the conclusion of each of these may be made use of to rectify inaccuracies, and to restore order before passing to the next. The position M N for instance is one of these "points of rectification" as we might call them for lack of a shorter term. The line K L having its course and direction west, proceeds by a simultaneous movement to change the course to N.N.E., retaining its direction at west as before. On the accuracy with which this formation is taken up, depends the correctness of the remainder of the evolution.

The line should therefore be "dressed" in that position before any further change is undertaken. In the lines R N, O P, O Q, and S T, we have other instances of the same thing, where the ships may continue as long as necessary to preserve the same course and direction without interfering with the ultimate success of the manœuvre.

There are some compound movements which have found advocates on account of their supposed celerity in which these points of rectification do not exist; so that in the performance, each ship makes an entirely independent series of movements, and cannot perceive any errors with reference to the other ships, until the movement is complete. The opportunity for disorder is therefore, so much the greater, unless some special means be supplied whereby each ship's course is distinctly traced out and marked in terms of the only fixed points or lines available, namely, the spaces travelled over in the passage of the ship's head from point to point of the compass.

Examples of this kind are given in the change from K L to C D (fig. 3) and in figures 4 and 5 (Plate II), all of which are quoted from different authorities. Now Admiral Boutakov has shown very clearly that the course to be pursued by every ship in a case of this nature can be strictly ruled in the terms just mentioned, by what he calls his system of "co-ordinates." The first ship in figure 5 for instance, will describe the starboard co-ordinate of 73° , that is, she will port her helm till her head comes N. 73° E., she will then shift it till she regains her former course and steer due north to her proper bearing from the centre ship. The second ship will describe the starboard co-ordinate of 50° , and the fourth and fifth ships will perform the same evolutions to port. But although these rules are capable of strict application, it is sufficiently obvious that there must be great special advantages to justify the use of an evolution so completely disintegrating a column during its performance.

In the diagram (fig. 3) I have endeavoured to give at one view the most important elementary movements of which a column is capable. And for the purpose of comparison, I select a single change of course and direction from W. to N.W., which clearly embraces the principles of all other movements. By the term "direction" I mean the bearing of the leader of the column from the other ships, and in the diagram this *direction* is placed above, while the *course* is placed under the line at the van or rear of each position.

In discriminating between the relative values of any movements, our attention should be first directed to the position held by the new formation with reference to the old. In the cases before us, the change from K L to A B is evidently the simplest; nor when tested as to speed does it contrast badly with others. At a speed of 8 knots, the change will be completed in 7 minutes, whilst there is no other movement, except that from K L to C D, which is complete in less time. This is the simple alteration of course "in succession" the most familiar of all tactical movements.

The next method to be considered is the change of course and direction on the rear to starboard, or on the van to port (fig. 3, Plate III, and fig. 6, Plate IV), for the movements are precisely the same as to

simplicity and duration. In these cases, we have, first a simple movement by the use of the helm only, then a simple movement by variation of speed, and lastly a simple movement by the helm. When the movement is on the rear the ships turn together 8 points plus half the number of points between the old and new direction, as at M N. They then proceed on that course until a new line is formed on the new direction, but with their heads as before, which is shown at R N, this last line being correctly formed, they turn together 8 points minus half the number of points between the old and new course, and the evolution is complete as at I J. If this movement takes place on the van, as represented in fig. 6, the only difference is that the shorter arc comes first and the longer last in the simultaneous movements, and the new line is formed nearly in the position G II.

The next change is from K L to E F, fig 3. The ships all turn to a course perpendicular to the new direction, proceed on that course until they arrive in line abreast, and then turn together to the new course. The evil of this proceeding is shown in the decrease of distance between the ships in the new line, and this decrease becomes more serious, the greater the change of direction. The last method to be considered is the change from K L to G II, and which I have added merely as a suggestion derived from the theory for calculating the circles of ships. I have, with Admiral Boutakov, supposed it possible to mark the helm angle of each ship so as to give them a uniform radius of evolution. I now suppose it possible to mark the tell-tale so as to give the power of turning on any radius measured by cables' lengths. A ship, for instance, which turned on a 2-cable radius at 20° , would turn on a 4-cable radius at 9° , and on a 6-cable radius at 6° , and so on. A line composed of ships so arranged would for any change of direction on the van or rear, turn together 8 points so as to form line abreast. The pivot ship then puts her helm to the proper angle for a 2-cable radius, the next to the 4-cable, the next to the 6-cable mark, and so on. They would then steam on till they came into line abreast on the new direction, and turn together to the new course. It should be stated that this method seems to be proposed in the authorized Signal Book, but the only directions given are for the ships "to get into their stations as fast as they can." If the means I propose are practical, to which I hardly pledge myself, the nature of the movement would be simplified. For as the times of turning have been shown to vary as the *cosines* of the helm angles, there would not be a great deal of difference in the time of arriving in line abreast, and the ships' courses would never near each other as they do in other methods.

Now, in all the methods which are given in the diagram, there are, as we see, great differences in the position of the new lines, and there are also great differences in the times of performance, owing to the different spaces over which any one ship has to pass. The relative values of these quantities all vary according to the angle included between the old and the new direction. Those who desire to inquire fully into these differences—and no efficient system can be formed without a full inquiry—will find them clearly set out in Admiral

Boutakov's book. Here, time will only allow me to point out that as regards *position*, the place of the new line cannot vary in a direction perpendicular to its own, more than twice its length, whilst in a direction parallel to its own, its possible variation is only the length of the line, no matter which of these means is used to effect the change.

As regards time, the duration of the change "in succession" is always equal to the time required to pass through the length of the line and the arc between the old and new directions. Whilst in the movement on the van or rear it is equal to the time required to pass over an arc of 16 points plus twice the sine of half the angle between the old and new direction, when the radius is equal to the length of the line. The time occupied in this method, therefore, increases much more rapidly in proportion to the greatness of the change of direction than in that of the simple alteration of course in succession; so that, when time is an object, and the change of direction is small, the simple method is preferable on all grounds except position. Respecting this point, we must suppose that the line G II, formed by a movement on the van, can only take up such a position with the view of passing ahead on a line parallel to A B. This position, however, would be equally gained, were the line K L to proceed on its course until the leading ship is ahead of the position G II, and then alter course in succession to N.W. thus performing the evolution in a simple manner, and in a shorter time. Whether the movement be one of advance, the cause of it being to the westward of the original line, or of retreat, the cause of it being to the eastward, it seems probable the change of course and direction on the van has not counterbalancing advantages to make up for its want of simplicity.

In the case of the change of direction on the rear, the matter is different. The position to be occupied by the line I J in its onward course can be attained by two other means. Either by a successive inversion of the line to an East course and afterwards to a N.W. course, or—which is really the same evolution—by every ship following in the wake of M throughout its movements. The change of position is essentially one of retreat; but in the movement on the rear as given, every ship commences the retreat immediately, whilst in the last two cases the rear ship does not make any retiring movement until she has advanced as far as the head of the original line. Besides this the shortest time in which the line can be changed from K L to I J, or any position ahead of it, is by the movement on the rear.

These are important considerations; for if the tactician's business is to produce necessary results by the speediest and simplest means, every evolution he can put aside as valueless, is so much clearing of the ground before him. Means have been proposed for a change of course and direction on the centre as shown in figure 4 (Plate II). This has received condemnation at the hands of Sir Howard Douglas, and I own that the complication of the manœuvre appears to far outweigh its supposed merits.

If the change required be one of direction only, the course remaining as it was originally, it may either be produced by changing the course

and direction both, and then returning to the old course by a simultaneous movement, which is the preferable method; or else it may be managed by the method of co-ordinates, as in fig. 5, but upon the van instead of the centre.

Before leaving the consideration of the movements of a single column, I should point out that if the line be inverted *together* before the change of direction takes place, and a movement be made upon the then van, the line will be nearly in the position of that now formed upon the rear. If the change be made by an alteration of course in succession, the position will be the same, but the reverse leader will become the leader, and so on. It is also to be observed that the movement on the rear can be equally well made under sail as under steam, when the wind is anywhere between S.S.W. and E. The others can be made with the wind between N.N.E. and E.S.E.

We must now pass on to a rapid application of the foregoing considerations, to those forms and orders of sailing in which it has been proposed to manœuvre a modern fleet. These orders are seven in number, namely, one, two, three, or six columns in line ahead, as in figs. 3 and 6, &c. One, or more divisions in angular formation (figs. 8, 9, and 11, Plate V); one division in indented order (figs. 10 and 12), and an order in groups or knots.

The mobility of a single column we have already treated; that of three and six columns clearly involves only a repetition of the principles exercised in the movements of two columns; whilst the order in "pelotons" or knots—of French invention—does not appear worthy of occupying our time. There remain therefore the orders in two columns, in angular formation, and in "indented order," to be disposed of. "Except while evolutions are in progress or pending," says a great authority, "columns should be in lines ahead. Of all formations, the one most easy for ships in a scattered state to assume is the line or lines ahead; when assumed, it is more easily maintained than any other, especially at night or in thick weather." The change of course and direction is therefore with two columns, as with one, the primary evolution. Fig. 6, Plate IV, points out how, by one small preliminary movement, this change is made as easily by any of the methods given in fig. 3, Plate III, as with one column; that is, when the change of direction is less than a right angle. The two columns being in the first instance a regulated distance apart, with their heads upon a line perpendicular to the *direction*, which in this case is *west*, are required to change that course and direction to N.W., preserving the relations of the columns to each other. The pivot column should reduce its speed, until the head of the wheeling column has drawn ahead *half the number of points* in the change of direction. Both columns may then perform the selected evolutions simultaneously; at the conclusion of which, the wheeling column will be at the proper distance from the pivot column, but astern. It will only be necessary for the pivot column again to reduce speed, to allow the other to arrive abreast of it. It seems here the proper place to point out that a decrease of speed is always at command, whilst an increase is not so;

to ensure accuracy of movement therefore, a certain maximum speed should be established, and varied only in reduction.

If the change of direction in two columns is greater than 8 points, it is evident the wheeling column, if not very close to the pivot, must pass over a very great space to preserve its position on the original side of the pivot column. In such a case it seems decidedly preferable to wheel the formation by columns. The movement is precisely the same, except that the port column now becomes the pivot, and reduces speed, so as to allow the starboard column to draw ahead half the number of points before commencing the evolution. When reformed on the new direction, it is found the columns have changed sides, and what was the port column has now become the starboard. Here we must advert to a most important consideration, namely, whether it is necessary for the mobility of a modern fleet in columns to prescribe the sides *permanently* on which divisions shall lie. If, for instance, a fleet is in two divisions, numbered first and second, does any necessity exist that the second division should be *always* on the port side of the first? Whether, in short, in Sir Howard Douglas words, there is an objection to "clubbing a fleet?" When ships fought under sail, the weather position was the all-important one. The Admiral almost invariably held it, heading the weather division, and thus ready for any emergency. Fleets cruising, obviously spent most of their time on a wind, and this weather position once taken up was by the simplest of all possible movements perpetually retained. How is it now? Can any one declare that the starboard side is intrinsically more important than the port? more commanding, or more open to attack? Can the starboard position be maintained in a steam fleet by the simplest movements? If not, what remains as the only reason for maintaining that which is the foundation of our present evolutionary code? It is that "fogs, gales, detached duties, and leaving harbour, frequently cause fleets to be dispersed. When 'rejoining' or 'closing' ships have ascertained the position and course of the flag ship, they should as a consequence, know where to form with relation to her. . . . Even in daylight, signalling is often inconvenient; but at night it is only in fine weather that signals can be distinguished, and they should not be required to indicate a ship's established station." This was written before the flashing system of night signals had taken the important position it has now attained. Those who have seen it in use in fleets, know as a certainty, that no argument can now be founded upon the difficulty of signalling at night, as it no longer exists. With regard to the remainder of the statement, I would say, are we justified in retaining an element of confusion permanently, for the sake of avoiding it in special cases? Our authorized system of tactics is based entirely upon the presumed necessity for thus prescribing permanently the position of divisions of a fleet. Sir Howard Douglas, reasoning from the analogy of military movements, does not believe in this necessity, and I very humbly following him, cannot but perceive that a great deal of complication is avoided, if the Admiral is left perfectly free to place the divisions of the fleet where most convenient for the time being. Nevertheless,

great and experienced tacticians are on the other side, and we must not forget that. (I have dwelt upon this because it is quite a fundamental principle in modern naval tactics).

The distance apart of columns should clearly be regulated by their length, and not arbitrarily fixed as at present. Probably if it were *equal* to their length it would be found convenient.

We now come to the angular formation of Sir Howard Douglas, given in figs. 8, 9 and 11, and which has found a place in all systems of tactics. With this formation, unless the course corresponds with the direction of one wing, as at B, fig. 11, we have a double line-of-bearing to preserve, respecting which lines, an authority I have often quoted says, "they require two adjustments, one of distance and another of direction, independent of the course; and close as adjacent ships should be to each other, it is obvious that a large deviation from a bearing will speedily be produced by a difference between their rates. Such a disturbance in a few instances would obliterate any trace of a formation. . . ." At the very outset, therefore, we get a strong objection to the formation, which, if valid, would prevent its being used in the everyday movement of a fleet, which again is absolutely fatal to its use against an enemy. For what Admiral will be rash enough to attempt to maintain an order in the face of an enemy which he finds too complicated to form his fleet on under ordinary circumstances? Of course Cornwallis' retreat will occur to my naval hearers as a direct contradiction to this view. But I am afraid we have decided too superficially, in admitting the belief that Cornwallis placed his five ships in any particular form. Ekins, for instance, in his first edition, gives two totally different forms—one of them certainly an angular formation, but with the point turned *from*, instead of towards the enemy. He confesses this is incorrect, and gives another totally different plate, which James asserts is equally incorrect. Brenton assumes the wedge form, but I believe does not make out his case by any special reasoning.

Besides the difficulties alleged to exist against the maintenance of such a formation, the gravest defects are discovered when we apply the test of changing course and direction while preserving the form. Figures 8 and 9 are attempts to show how this may be most speedily managed. In fig. 8, the movement is pivoted on the starboard wing, and in fig. 9 on the angular point, and it will be immediately seen that both of them involve such variety of movement, that nothing short of constant practice could prevent confusion.

In neither method is that form of compound movement without points of rectification—to which I previously objected—avoided. The change, in fact, can only be effected by the use of Admiral Boutakov's co-ordinates, and if English naval officers object to their use, they must, in consistency, object to formations whose mobilization can only be attained by employing them.

The last formation to which we may apply the test of mobility, is the French "indented order." This, as may be seen from the diagram fig. 10, is simply the order in two columns with their distance apart decreased, and with the ships of one column abreast of the intervals in

the other. The mobility of such a formation is precisely that of two columns, but with the times and spaces required for any evolution considerably reduced. This is at once perceived from the diagram figure 10.

Now the order in two columns, is that which has been found since ever we have had a navy, the one most suited to a cruising fleet, and in our greatest naval victory it was that selected for attack with no less than 27 sail. Is it likely that with the evident tendency towards reduction of numbers, and increase of individual efficiency in our fleet, we shall ever see a larger fleet acting in concert than Nelson had at Trafalgar? Would not a larger fleet be practically out of control? If this be so, as far as mobility is concerned, we might well content ourselves with the order of sailing in two columns; and the simple approach of these columns to each other under steam, would without altering the every day process of manœuvring, give us the "order indented," recommended by the French as an efficient fighting order.

After we have selected the form or forms in which we propose to place our fleets, the changes of form or position necessary, and the manner in which these changes are to be made, we have still a most important element of mobility to arrange, namely, the mode in which simultaneous action is to be secured: the process of transmitting the orders of the commander of the fleet, and the nature of those orders.

If a General on land were restricted as an Admiral is at sea—to the use of signals for the conveyance of his orders—what position would he assume in manœuvring his troops? He would place himself where he could best see and be seen. We in the Navy say practically that these are secondary matters. The Admiral's main duty is to set an example of personal bravery and lead in—or at any rate place himself in the "fore-front of the battle"—the centre of his line.

Why was it that in olden times, with sailing fleets, the Admiral invariably took part, and usually a foremost part in the combat, acting so differently from his brother-in-arms on shore? Simply this, that if he did not do so, there was no other occupation left him. Movement, or at any rate, combined movement was not possible very soon after the fleets joined battle. The firing brought the wind down, their masts were shot away, and the ships lay deprived of any power to obey orders, had such reached them. But we in modern times have forgotten these things, and we have spoken as if the presence of their Admiral under a hot fire were necessary as an animating spectacle to stir up the courage of his followers!

Thus, then, the Admiral's functions as a commander of a fleet in old times, ceased with the commencement of the action. The fleet became disintegrated, and fought out its victory in a succession of single combats. Have we reason to believe that what has been, will be, in this case? or are we not rather to adopt the view of our gallant late opponent in command of the "Vladimir," and say that steam will "effect in naval tactics a revolution analagous to that which took place in military tactics at the end of last century." That "*we should and we can demand from steam ships, formations and evolutions as sudden as they are unexpected?*"

If we look at the only decisive naval combat ever fought in the open sea under steam—that between the “Alabama” and the “Kearsage,” the one great element which was present here, but absent in all former actions, was rapid motion. Will not this element extend to fleets? It is from these facts I take the view that in future actions the Commander-in-Chief will not take a position in the line. He will place himself in some swift, quick-turning vessel, not unarmed nor unplated, but still a light ship—the flag ship of the future—where he can best view the movements of his own and the enemy’s fleet, and where his signals can be at once perceived from all quarters. Such, as I look upon it, is the first requisite for giving prompt effect to the combinations formed in the Admiral’s mind.

The next point to be studied is the language in which the orders directing movements should be conveyed. These orders should be terse, short, unambiguous, and should not require reflection on the part of the recipients before carrying them out; they require a basis, therefore, of the clearest definitions, and their number must be very considerable to include the various attitudes in which a fleet may be found.

Our Evolutionary Code, the General Signal Book, is the growth of centuries; by little and little have alterations been made in it as the wants of a fleet became more and more understood. After the long naval wars, this book remained to us as the combined wisdom of our warrior forefathers. How could their successors presume to alter arrangements so sacred? But, on the other hand, steam pressed more and more into the van of determined facts. How to leave all the work of the founders of our great name untouched, and still make provision for the new and increasing wants? Such was the problem set before those at whose hands the book was to obtain remodelling; and who, therefore, hesitatingly endeavoured to avoid destroying the old formulæ, whilst adding those required in the new circumstances of the navy. The result of this is but the natural one. Our Evolutionary Code is on all hands allowed to be unfinished, defective, and ambiguous. I propose now to give two instances of the action of these ambiguities, which recently occurred under my own observation, as they point out not only the sources of error but their remedy.

A squadron of eight ships (fig. 13, Plate I) was lying at anchor, with their heads south, in two columns north and south. The exit from the roadstead was to the southward, and the wind was abeam. The columns were in inverted order; that is, the headmost ships in order of sailing were now the sternmost, by reason of the direction of the tide.

The officer in command, wishing to weigh under steam, and intending that the real leaders of the columns (Nos. 1 and 5) should weigh first, and the others in succession (2 and 6, 3 and 7, &c.) made a signal to the following effect:—“The headmost ships in each column to weigh first, the rest in succession;” this being the only general signal possible under the circumstances. The result was that Nos. 4 and 8 ships at once prepared to weigh, and No. 8 actually did so, thus leading both to confusion and delay in the departure of the squadron. The error arose simply from the fact of the term “headmost ship of a

column" being altogether undefined in the Signal Book. Officers are left in doubt as to whether the term is to be permanently applied to the regulated leaders of divisions when in sailing order, or to those ships which happen to be ahead at the time the signal is made.

The second case I have to adduce involves an ambiguity common to a great number of our evolutionary signals, and as serious as it is common.

The situation is given in fig. 14. The ships, still eight in number, were in line of battle under steam and sail on the port tack, wind just free, the starboard division leading. It was intended to form the order of sailing in two columns, the port column forming on the starboard side of the starboard or leading column, in the position at A.

There was in this case a choice of three signals to express the Admiral's wishes. The first said, "form the second order of sailing under steam," with a note of reference to a plate which is reproduced in fig. 15. The second was, "form the prescribed order of sailing in two columns," with a note of reference to the same plate. If the first of these signals had been made, the port column must immediately have taken its port position with reference to the other column, *not* what the Admiral wanted. If the second signal had been used, Captains must have debated, first, whether the ships were considered under steam or sail. If they decided under steam, and had acted on it, they would have gone wrong, as we have seen. If they decided under sail, they had then to consider whether they were supposed on a wind or "large." If they had decided for "on a wind," they would have gone to leeward, and right, if otherwise, to windward and wrong. The third and last signal at the Admiral's disposal, which was the one used, gives the order, "form the order of sailing in two columns," with a note stating that "when divisional flags accompany this signal, the upper flag will point out the weather column, if sailing on a wind; and the starboard column if sailing large or before the wind, or under steam." Here we had precisely the same confusion as in the other cases. Who was to decide whether the ships were under steam or sail, when they were under both, or "large" or "on a wind," when it was doubtful? The result of the proceeding was, however, that the port column went the port side of the Admiral, exactly where he did not want it.

We have seen, in these two cases, the gravest mistakes made, from a want of clearness in the expressions intended to produce the simplest combinations. May we not justly suspect that in more complicated as well as more important evolutions, this ambiguity and looseness of wording, if left unimproved, may hereafter lead to very serious consequences.

Besides a want of perspicuity which is very apparent throughout our Evolutionary Code—and which is probably due to the number of hands through which it has passed; it seems apparent that a great deal of the confusion proceeds from the many varieties of movement which most signals are made to include in their signification. Not many orders can be issued which direct one single movement, under all circumstances the same; but we have "*if*" so and so is the case," then

such or such modifications are to be made in the original order. This injudicious compression seems to proceed from a desire to reduce the number of evolutionary signals as much as possible. And it is most singular to observe, that it is only amongst the very important signals that this compression is found. All orders relating to Officers, stores, provisions, &c., in the general Signal Book, are clearly expressed, capable of no double meaning, and requiring no reflection to obey them; but when we come to those referring to fleet movements, the enemy, and other important matters, where vital interests are concerned—then only do we meet with the numerous “ifs” and “ors” to which I take exception.

It is quite an axiom in signalling, that speed cannot be gained at the expense of certainty, so that you cannot convey an order in ambiguous terms without causing delay as well as confusion. To increase the mobility of a fleet, therefore, a very large increase in the number of evolutionary signals is required, each expressing a direct and clear order. A large choice in the Signal Book means a small number of signals to produce any given effect. It is for the Admiral to reflect and choose his distinct orders and for his Captains to act on them with that promptitude and decision which cannot follow a vague command. The first requisite in definite orders are definite terms. As we stand, we have redundancy without definitiveness. A “line ahead” for instance has four other different names;—a division, a squadron, a column, and a line of battle. Here again there are some terms *expressive of position*, which are retained by portions of the fleet when those positions are not held; there are others which may or may not change—it is not known which. If a fleet is divided into two parts they are called divisions, and have two special flags to distinguish them, if into three parts they are called *squadrons*, and have three other different flags to distinguish them. Many of my hearers will say, “these are mere details, why trouble us with them?” My answer is, that on these very details, hangs the amount of success to be obtained by our fleet in a future naval war. I am in great fear, when I think of the approach of an English fleet towards an enemy, and of the effect upon the Admiral’s mind of the alarming discovery, that his fleet is not in hand—that his orders are misinterpreted, and his fleet in hesitating doubt.

And yet the principles on which the remedy for all these things may be founded, are not difficult of discovery, we only want sufficient boldness to perceive that a great change has come over our Navy, requiring a great reform to meet it. And that could the spirits of our naval heroes animate us, we should quickly shake off the trammels of tradition, the most dangerous shackles in matters of science, as they are the firmest safeguards in matters of politics.

What then are these principles? First a selection of terms inexpressive of position and unchangeable. As for instance, in a fleet divided into two parts they would be termed the *First* and *Second Divisions*, if in three parts, the *First*, *Second*, and *Third Divisions*, so the established headmost ship of a column might be called its “*Leader*,” the established sternmost ship its “*Reverse Leader*.”

Then we want a selection of terms, exclusively referring to position, van, rear, centre, port, and starboard, only applying to the part of the fleet which holds such position at the moment.

Framing all orders on these terms and using no others, and not stinting ourselves as to the number, so that we secure the distinctness of the commands, we may rest assured that so far as the meaning of words goes, we shall have gained our point.

Such simple orders as I have shown to be defective under present arrangements would then stand thus: for fig. 13 (Plate I) the order would be, "Weigh, leaders first, the rest in succession, reverse leaders last." In fig. 14 it would be, "Form the second order, the second division forming to starboard."

But few other points require notice ere we conclude the whole question of the mobilization of fleets. In the arrangement of the symbols conveying orders, it should be remembered that evolutionary signals are the most urgent of all, requiring the promptest attention. It is a well understood principle that the most urgent signals should be composed of the smallest number of symbols; and, therefore, the practice which now exists of using additional flags to modify the meaning of evolutionary signals, should, if possible, be abolished.

The free use of diagrams in the Signal Book is of the greatest value, and their number might be advantageously increased. They should, however, not be of the arbitrary and unsystematic character which they now are, but should be drawn to scale, with the approximate courses and positions of the ships marked on them.

Such then appears to me a faint outline of the various principles and requirements called forth by the necessity of securing the mobilization of a modern fleet.

Some of our most distinguished Admirals have pointed out the advantages of increased communication by signal between ships in a manœuvring fleet; and it is undoubtedly the case, that in time of action some additional mode of communicating intelligence or orders, besides the flags, would be an advantage. I hope that so soon as our improved night signals are completely established, we shall find their principles fully applicable to the supply of this want by day.

We have now, before concluding, to give one rapid glance at the future of "*naval strategy*."

If we take a general survey of the nature and progress of naval weapons, we observe that on all sides we are increasing the defensive, or resisting powers of ships, whilst we are at the same time bringing up the powers of our artillery to something like a level with them. We: ay, or may not, therefore, be decreasing the effective range of naval guns—we do not know this yet. We do know, however, that we can only keep up or extend this effective range at the expense of a great reduction in the number of the guns used. What does this reduction in the number of guns mean? It means less smoke and therefore less confusion in future naval actions. It means also fewer shots at an enemy in any given time. It means that an antagonist cares less about raking fire, and may come to close quarters comparatively unharmed. If, having arrived at these conclusions, we

take another survey, we see a new weapon, or rather the revival of an old one, steadily advocated for years by Sir G. Sartorius, springing into favour in all directions. Nearly all war ships are being fitted for the destruction of opponents by means of a beak, or armed stem. At the very time, therefore, that this new weapon is becoming recognized as efficient, we are actually driven by the force of circumstances to prepare the way for its use by the reduction in the number of our guns! What effect the universal adoption of this weapon will have upon future naval duels in the open sea, it may be difficult to say, but its effect on the battle formations of a fleet is perhaps easier to surmise.

Let me, however, exclude the idea of the ram for a few moments, while considering the relative strength of a few formations, under artillery fire only.

Not to confuse ourselves with new forms, let us take those orders of battle already proposed, which are but three in number, namely, the simple single column, the angular formation, and the French indented line.

Sir Howard Douglas, perceiving the inherent weakness of the extended line of battle, made apparent in numberless actions, but nowhere so strongly as at the Battle of the Nile, and understanding that though no other formation was possible with fleets whose only motive power was the wind, many other more desirable formations might be maintained under steam, proposed to apply the well-known principles of fortification to ascertain the formation most proper to be employed for the mutual support of the ships composing a fleet. He argued, that if ships were placed so that the broadside fire of one might be crossed by the bow or stern fire of another, the strength of the formation would be proportionately increased. Sir Howard wrote when the line-of-battle ship was in favour, and calculated on a bow and stern fire of from 7 to 9 guns, and though at present the proportionate power of the bow and stern, as compared with the broadside, appears less than it was, it may probably recover itself in the reduction of the number of guns with which we are threatened.

The scope of the General's views may be understood from fig. 16 (Plate VI) which represents a portion of the line of battle, and fig. 17, which is a portion of Sir Howard's proposed order. If we suppose the ships in fig. 16 to be attacked by two others steering the same course, they may clearly place themselves at A and B abeam of the rearmost ship without receiving a greater fire than a half broadside from their immediate antagonist, and half the stern fire of her next ahead. The attacking ships must forge ahead considerably to experience the broadside fire of the headmost ship, and when they do so, they at once begin to feel less of the broadside fire of the rear ship. If, however, the same attack be made upon the rear ship in fig. 17, as at C and D, the ship D will experience not only the half broadside of her antagonist, but the whole of the stern fire of the next ahead, while the ship C will certainly receive a portion, and, if she forges ahead a little, the whole of the leading ship's broadside, in addition to the half broadside of the rear ship. It seems to be in these points that

the weakness of one formation and the strength of the other consists, and such strength or weakness evidently remains to them in advance, retreat, or in simple resistance. Of course, I am called upon, not to omit the probability of the presence of turret ships in fleets from my surmises; their presence would doubtless have an important effect on formation, supposing a whole fleet composed of them, but we need not imagine they would *reverse* the elements of strength in comparing any two formations, although they might, from the larger are covered by their broadside fire, bring up the strength of all formations to a closer level.

Before proceeding I might remark that, if I gather Sir Howard Douglas' views correctly, he does not put forward the angular formation, or double echelon, so much as an order of battle, as an order of sailing, one of great strength, in which fleets should permanently sail, ready to repel or advance to an attack as they stand, and as a convenient position preparatory to forming a *single line of bearing*, which seems his ideal of an actual battle order. I cannot shake off the conviction that the great artillery General was not, in his proposals, fully alive to the fact that a formation, to be preserved, *must* progress. A single line of bearing must therefore be perpetually either nearing or separating from the enemy, and could not be maintained as a formation of simple resistance; in which point it therefore is objectionable.

Reverting, now, to the diagram. If we take three ships into consideration, and place them as at E. (fig. 18), we have the line of battle, if, as at F, we have the angular formation continued. In this diagram, the ships are 300 feet long, 250 yards apart from centre to centre, and engaging at a distance between the centre ships of 200 yards; to allow for possibilities, I suppose that the broadside fire covers an arc of 6 points of the compass from each ship. Considering the two formations separately, we observe that whilst three ships may so place themselves upon the rear or headmost ship of the line of battle, and receive no heavier fire than when the third ship was absent, in the angular formation it is not possible to maintain the fire of three broadsides upon any one of the ships, without receiving generally part of another ship's broadside, and certainly the bow or stern fire of two ships, besides the fire of the ship they are attacking.

Considering now the two formations as opposed to one another, we see first that the base of the angular formation is less than the length of the line of battle, therefore its fire is more concentrated. The broadside fire of the base ships is in fact available upon the centre ship of the line of battle, whilst none of the broadside fire of the van and rear ships of the line can be directed upon the centre ship of the angular formation. But this superior concentration is gained in a much looser order; for though the angular ship is distant from the wings but 250 yards, the same as the interval in the line of battle, these wing ships are distant 350 yards from one another. We may suppose, therefore, that order can be more easily maintained amongst three ships so placed, than when placed in the corresponding line of battle.

But this formation, besides representing the three angular ships given at A, fig. 11, Plate V, also represents the three ships of the French indented order, given at D, fig. 12.

If now we add two more ships to these three, we may use them to extend the complicated lines of bearing, where we obtain Sir Howard Douglas' formation, A, or to extend the simple lines ahead, when we obtain the French indented order, D, fig. 12. In both these orders, the principles of mutual support are rigidly carried out, and carried out in a manner which leaves small choice between them. The *length* of the formation is the same in both cases, and though in the angular figure, concentration of the whole broadside fire takes place at 400 yards due north of the angular ship, whilst in the indented line it does not take place within 600 yards, yet on coming within these distances, the wing ships in the angular formation cease to act at all, whilst the extreme ships in the indented line still exercise their bow and stern fire. In such brief examination as we are here able to give, there does not appear to be much difference in strength, as to broadside attack by artillery, between the indented and the angular formations, so long as the angular point is directed towards the enemy. If, however, this is not the case, the formation becomes weaker and weaker, until, should the attack be parallel to one wing—as, for instance, from the north upon B, fig. 11, nearly half the power of the fleet is lost, and the formation becomes in that respect worse than the line of battle.

In advancing to attack, the angular formation will be in the positions given in figs. 8 and 9, and the indented form, as at C, fig. 12. And in this form also, the advantages of bow fire appear pretty equally balanced. It seems, on the whole, that the question between the angular and indented orders becomes entirely one of mobility. So far as I can see these advantages lie on the side of the latter; but as I have, since my views were formed, been kindly shown by Admiral Boutakov some simpler methods of moving the angular formation, I should state my want of perfect conviction upon the matter.

It is right also to state, that Sir. H. Douglas distinctly condemns the “indented order,” apparently for the reasons which to my mind constitute its merits—the looseness of its order relative to the concentration of its fire.

But in order to set aside any lingering affection we may retain for the old *line-of-Battle* as a fighting order; let us just recall the fact, that the serious part of a future naval attack does not appear to be the guns—but the rams. How will they affect the question?

If we look into the history of all our naval actions, the decisive victories were gained, only when we succeeded in breaking through the enemy's line. The closest possible line of battle was the safest possible position, and an opening therein was hailed with joy by the attacking party as an earnest of success. If there were no opening, it was all but hopeless trying to make one:—as to a ship making sail, and running straight at any ship in the line it would have damaged both combatants equally—and was not put in force, the most that was done was to try and squeeze through an interval.

But suppose an Admiral in command of a steam fleet, some ships of

which are rams, can we not well imagine his exulting in the certainty of victory the moment he saw a close line of battle neatly drawn up in the most convenient position possible for the action of the new and terrible weapon? The enemy could never be so foolhardy as to attempt such a proceeding; the approach of the rams would surely break up the line, for no Captain would allow himself to be fairly run into when he could avoid it, and thus the great aim and end of all our great naval leaders would be obtained before even the action commenced. I cannot believe we shall ever see the line of battle again for these reasons; but instead, we want some form sufficiently loose to allow individual ships, by reducing or increasing speed, to avoid the blow of a ram, without disturbing the general order. Such a formation we appear to possess in the indented order. In the closest order, such as we have been considering, every ship has 350 yards, astern and ahead of her in which she can move, without disturbing the other ships, and this, judiciously used, should be sufficient to avoid the stroke of the ram; suppose one of these approaches from the north the centre ship in D fig. 12, with the intention of striking her, *she* may pass either ahead or astern to let the ram go through, but it will be the business of the ship on her quarter to reduce speed for a moment, and as the ram passes through, supposed to have missed her object, to charge at her full speed, when she can hardly fail to inflict at least some damage in return for the permission to pass. Where a formation is so loose as that of the indented line, it *must* be difficult to break it, and we may expect that many rams might pass ere the gap was wide enough to admit an enemy's fleet between.

As a defence against rams, would not the knowledge that every ship in an indented line had a torpedo extended from her bows, which required only a gentle *rub* to call it into action, be a wholesome disturber of the nerves of any adventurous ram-captain who might be disposed to try the new weapon?

Such, then, is my very rude and faltering attempt to evolve some order out of the chaos in which the science of Naval Tactics, by the tremendous material changes in all Navies, has been left. I have doubtless put forward many faulty views—naturally such are to be expected from comparatively inexperienced men like myself. I have spoken, however, with a freedom which some will condemn as the natural concomitant of such inexperience; but I shall find fault with no one who in thus condemning me, will at the same time add to the weight of his experience, the labour I have given to arrive at definite views.

I have spoken of the existing tactical arrangements in our own Navy in strong terms, because I have for many years *felt* strongly. But it is a very different thing to find fault with the deficiencies of a system, and to say that the system is blameably deficient. It is hardly ten years since the main body of our fleet were sailing ships, and so long as there were any sailing ships in the line of battle, the time for a great change had not arrived. Our Evolutionary Code is yet in its transition state, and I remark upon it, that the fact may be

appreciated, and that if the time has come now for a decided change, we may set about it with some idea of the work before us.

I must, before closing, express publicly my sense of the kindness of Vice-Admiral Sir Wm. Martin in placing his most valuable labours at my disposal, to Admiral Boutakov, and to those other professional friends who kindly supplied me with the hints and the data forming the groundwork of my paper.

I have only to say, finally, that no one can be more conscious of the weakness of my attempt than I am myself. I can but hope, for their own sakes, that my indulgent audience have not shared in my dissatisfaction with my work.

THE CHAIRMAN: As Admiral Boutakov, to whom we are so much indebted, has kindly honoured us with his presence, I am sure we shall all be glad to hear some remarks from that distinguished officer.

ADMIRAL BOUTAKOV: It would be very difficult for me, knowing very little of the English language, to make any remarks. I can only say that it is a great pleasure to me to have my name mentioned in such a distinguished Society.

THE CHAIRMAN: I hope some Officers present will make remarks. The subject is very important, and it has been very distinctly and clearly set before us. Perhaps Captain Selwyn will offer some observations.

Captain SELWYN, R.N.: I do not know why the Chairman calls upon me, unless it be that I made a promise last year that in case no one else would favour us with a better *résumé* of Naval Tactics as they exist, before the time arrived at which I should be able to do it, I should be happy to try my hand at it. But I consider myself quite absolved from the promise, inasmuch as Captain Colomb has so very well fulfilled the task. We owe to him every obligation for having brought under our notice the whole subject, which, I may say, has been almost avoided by naval men, from their feeling the uncertain state in which the question remains, pending the knowledge which we hope to obtain of the powers which we have at our disposal. I confess I listened with some anxiety to hear mention made of the very perfection of that power of which I speak—the application of twin screws. I have only to say that by means of it, a power is given us quite equal, if it is not superior to, that possessed by the infantry soldier. We can “right about face,” or perform any other possible evolution required, with the utmost possible certainty and security. I speak strongly on the subject, for I have myself been witness to its effects. Not only can we train guns more quickly than with handspikes or tackles, but we can go straight astern on any point that may be chosen, of the compass. We can turn on our own centre with the most perfect certainty, and in the shortest time; and we can obtain with small vessels a speed which it is fruitless to expect with the same power applied to the single screw. Therefore, I did listen with some hope that Captain Colomb would have adverted to that, which would have been an important part of the question, as it at once sweeps away the whole of the necessity for curves in very many of the evolutions. We can reverse our order; we can perform evolutions which we could not perform with any possibility before; and for avoiding the blow of the ram, or for any other of those sudden evolutions which he has ably pointed out, may be required, it is very evident that the power of turning on the centre is most important. If only for the sake of simplifying the manœuvres which fleets may be expected by some to perform in the future, the twin screw would be a thing into which we ought to look closely, it has also other advantages. But I confess myself to be one of those who doubt very much whether, in the future, there can be any such evolutions of fleets as we have formerly seen. We now have guns to which it would be perfectly fruitless to oppose the best armour-plate we possess at the distance of yard-arm to yard-arm, which was formerly sought by an English Captain. The certain result of a single discharge of a 600-pounder into a vessel’s side, pointed downwards, would be to send her to the bottom; she could not avoid it. Nor do I think any vessel can be armoured that will effectually resist such a shot

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from a smooth bore, a spherical shot made of hardened steel, at short ranges. We have, partly by the labours of the Officers of the Navy in this Institution, arrived at a definite conclusion in exact accordance with the practice of the Americans in their guns, that there is no rifled gun, no form of rifled gun, which can possibly give the same velocity, and, therefore, can possibly give the same useful result as the smooth-bore, with hardened spherical shot, with a given charge of powder and a given strain on the gun. This being the case, it becomes almost impossible to contemplate with any degree of favour any such arrangements as those which were contemplated of reducing the speed of the "Warrior" of 15 knots down to the speed, say, of the "Enterprise," of 7 knots, in order to preserve an order of battle which would only have the result at last of bringing the ships into a danger which they ought not to seek, and which would ensure the destruction of one, if not of both ships. Now, it is not to be desired that half a million of money should be risked in that way. If you will have ships costing half a million of money—Mr. Scott Russell's fleet of the future—then it is evident we Naval Officers shall have to take the greatest care of them. We shall not be able to feel satisfied if the whole result of a naval action is, that on both sides an equal number of vessels have gone to the bottom. Nor do I think any nation will long entertain the question of naval warfare at all, if such is to be the only result. Sailing in fleets and manœuvring in fleets must lead to such a result. I do believe the experience we have had of the fights between the "Alabama" and "Kearsage," and of other American fights, all point to the question of trial of speed first, and trial of guns second—the speed depending, of course, upon the character of the fuel, to which Captain Colomb adverted—and then on the precision of the gunnery and the particular address of the officers in command. But that we should ever have to depend upon an Admiral's view of the question, when one shot may upset his whole calculations, I do not think is possible. I think when a hostile fleet is seen, it will be chased, and that we cannot afford to wait till the slowest ship comes up, and that they will be caught in the order of their sailing, and that they will then form a series of single combats not under any possible formation. I do not see any possibility of recurring to the old system. I say it would be wise to study all these conditions, and to be even more bold than Captain Colomb, and to throw aside the old formations and the old arrangements of manœuvring under sail. Speaking to that point of being under sail, and the difficulty of knowing whether a vessel is under sail or under steam, I say the Admiral will little understand his business who takes his fleet into action under sail at all. Steam must be the moving power. It gives a certainty which you cannot get under sail; you do away with the great proportion of the embarrassments consequent on the use of sails; and you have to attend only to your engines and not to your yards. Therefore, I do not think, valuable as Captain Colomb's labours have been in bringing the subject before us, that we shall go forward in the direction which he has here indicated in the tactics of the future. Those tactics it is perfectly evident will never be decided until the first battle is fought. I think each individual Captain ought to be enabled to study, much more than he is allowed to do at present, the powers of his ship under steam. The difficulty now is that the economy of the country requires the Captain to be ignorant of his ship's powers. He is not allowed to use steam; he is told to abstain carefully from its use. How, under those circumstances, is he to be satisfied as to the capacity of the ship for what she may be called upon to perform in case of necessity? More latitude must be given, and that that may be done we must have, if possible, a cheaper fuel. To that point I am now turning my attention, as my brother Naval Officers are aware, and I hope shortly to lay before them more important information than I have yet been able to obtain upon the subject.

Captain LEOPOLD HEATH, R.N., C.B.: It is, perhaps, right, when one hears a heresy published in this lecture room, to say one word to refute it. Captain Selwyn compares smooth bores with rifled guns, and says under no circumstances will equal velocity be got out of rifled guns with equal charges of powder. I think I read a letter from our Chairman in "The Times," refuting that, by giving the velocities of some experimental guns, and comparing them with these very smooth bores.

Captain COLOMB: I should say that I specially avoided the subject of twin screws

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as being one upon which it is extremely difficult to get any data; besides, had I entered into that question, it would have opened up so much ground that, instead of occupying your time for an hour and twenty minutes, I should have occupied it for four or five hours, which would not, perhaps, have been satisfactory. But there is another reason why I avoided the question. I do not know, and I have not yet heard, how the *times* of the evolutions of a twin screw ship correspond with her circle. In 1862 some experiments were tried with Ruthven's propeller in a gunboat at Plymouth. That power, when applied in a line with the keel, drove the gunboat five knots and a half, dragging the screw. It was presumed that the power of Ruthven's propeller and the screw—from such experiments as could be made—were equal. When that power was applied at right angles to the ship, it is true she turned round in smaller space, but, instead of taking two minutes and a half to turn, she took three minutes and a quarter. I am not quite sure that in the case of twin screws we should not find something like that to be the result; that the space would be smaller, but that, after all, you would still, by the ordinary use of the rudder, describe a circle in a shorter time, therefore, complete your evolution in a shorter time. I would not for one moment allow it to pass, as Captain Selwyn appears to imagine, that I advocate the idea of using sails in action, or even think of it. My idea of going into action is that I get every single thing down from aloft, and trust entirely to the steam, and if the steam fail, I say that there is an end of it; nothing more is to be done. What I say is this, that the expenditure of coal for drill, is an expense that the country will not bear and cannot be made to bear. Supposing the coals at 15s. per ton, a day's evolutions with twelve ships would cost between five and six hundred pounds. Now, if you have to drill up your ships at that expense, the country cannot stand it. Therefore, my view is that, having your masts and sails,—and you must have them with your screws on account of the expense,—you should make all the use you can out of them, in order to get into the habit of manœuvring your fleet with steam. Whether it be true that we shall never have the fleet formation again, that I cannot say; but I cannot think that any English Admiral will imitate the High Constable of France, and when in the presence of the enemy say, "The Devil take all order, I'll to the throng."

The CHAIRMAN: I am sure you will allow me to thank Captain Colomb for the very useful and well-drawn up paper that he has given us. Whether the future shall be as we anticipate, and we have no more fleet evolutions, it is very important that the subject should be studied, so that, whatever may be the evolutions for the future, the Captains should be prepared for them. With respect to the twin screws, I think it is a mere question of difference of degree. The twin screws, doubtless, have the advantages claimed for them by Captain Selwyn; still I do not think that they nullify the necessity of having steam evolutions. It is a question of degree, of difference of time in which the evolutions may be performed. But evolutions will have to be performed, and if you can effect them in shorter time it will be an advantage. The objection which Captain Selwyn has taken to the difference of speed in ships is a very serious objection. To have a vessel that is equal to fifteen knots tacked on to a vessel of only seven knots would be a defective kind of fleet. It would be better to have all ships of fifteen knots, or all ships of seven knots.

Sir F. NICOLSON: The seven knot vessel is the newest.

The CHAIRMAN: I think it is very objectionable. The study of evolutions would bring out the necessity for having the ships constituting a fleet more equalized in their capabilities. I have much pleasure in returning thanks to Captain Colomb for his clear and instructive lecture.

APPENDIX.

London, 17, King-street, St. James's.
February 25th, 1865.

Sir,—

As Chairman of the Meeting of the Royal United Service Institution on the 20th of February, after Captain Colomb had finished his very remarkable lecture on Modern Naval Tactics, you did me the honour kindly to ask me to make what remarks the lecture might have suggested to me. Your call took me by surprise, since I came only to *listen*, as much as my imperfect organs of hearing and knowledge of English would permit me, and not to *speak*, which is a difficult task for a foreigner. Being, therefore, entirely unprepared, I was constrained to excuse myself for not offering any remarks, and I am afraid I muttered my excuses in a no very intelligible manner. That there might not remain an idea that I had not duly appreciated the kind and gratifying manner in which my work on Tactics and my name as the author of it have been mentioned on that evening, I beg to trouble you with these few lines, in order to say that if I had been at all up to the task of making any remarks on the aforesaid evening I should have answered your summons by expressing my admiration of an Institution so highly useful, and by saying that I would be very sorry if the chance of my presence in it at the time of this lecture should, from motives of delicacy, restrain in the least any one present from making whatever remarks and criticisms he should consider just to make on a subject of such great importance.

As for myself, since Mr. Whitworth, very appropriately, I think, calls a gun a *tool* for accomplishing a certain work, I may call a ship a *tool* in the hands of her Captain, and a Squadron a *tool* in those of the Admiral. The general impression Captain Colomb's lecture produced upon me is, that this new tool, in the present transition times as regards naval matters, requires a new manner of using it.

Since it is impossible to predict what new propellers and modes of propulsion may come in use in the future navies, it appears to me that the present mode of propulsion is the only one requiring for the moment the immediate attention of those concerned. And since the single screw with the single rudder in all movements of ships or congregations of ships produces only circles and tangents to circles (the latter either straight lines or arcs of circles), the circle and tangent seem to me to be the only basis now existing for regularizing those movements and wielding these tools in the most efficient manner.

When driving four-in-hand, what allows the driver to do it effectively? The equal speed, the equal turning powers, and in hand he has his four-horse powers; in fact, he has in them natural uniformity. How much more is not the same required when, instead of four individual forces, you have hundreds and thousands of them to keep *in hand*, whether for simple locomotion or for manœuvring for the best position and the best formation before you come to use your tools? If in the present ships you lack natural uniformity, must not you supply this deficiency by artificially producing uniformity—viz., uniformity of speed and uniformity of circles? If the driver had not bridled and harnessed his four horses to obtain uniformity of speed, they would be only a herd of wild cattle, and the lack of uniformity in turning, would soon remind one of the swan, the pike, and the crab, harnessed to produce the same movement.

If, however, I should allow myself to peep into future possible contingencies; if I were to suppose that instead of using to its full effect the column of water which we now have at our command from the single screw for turning purposes; if, I say, we should use propellers which will allow to turn a ship on her heels, even in that contingency I consider the readiest means of turning and twisting the squadron in any requisite position, to consist in the same laws which the combination of circles and tangents affords us. We shall then only have to turn the ships on their heels to an angular amount corresponding to the *arcs of circles* which now forcibly enter into the laws of evolutions.

As regards what we have heard on the 20th of February about the question of

drilling a squadron, I can only say that in sailing times squadrons were well drilled during their cruises, and if we have now more expensive tools, we must have more expensive drills for attaining the requisite efficiency. The difference, in this respect, of present armaments from the former ones mainly consists in this, that while we went to sea in sailing ships perfectly prepared from boyhood to what we had to do in a squadron, we now come to sea without that preliminary schooling. Let it be provided for, and the difficulty will vanish. Let it be provided, if preferred, by cheap training squadrons of gunboats and dispatch boats, which could easily work out and simplify any code of evolutions and signals; but let us not think that any system is bad because we have not studied it, that it is complicated because it looks so at a first glance, and because we do not know that it may be very simple in application when once understood. There is a saying in Russia that pewter pots are not manufactured by gods, although I, for my part, confess I do not know how to produce them.

Believe me,

Your very obedient humble servant,

GREGORY BOUTAKOV,

Rear Admiral, Russian Navy.

Captain Fishbourne, R.N., Member of the Council of the R.U.S.I., and Chairman of the Lecture of 20th February, 1865.