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Lieut. W. M. F. Castle R.N.

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Evening Meeting.

Monday, June 30th, 1873.

VICE-ADMIRAL SIR FREDERICK W. E. NICOLSON, Bart., C.B.,
Vice-President, in the Chair.

ON THE GAME OF NAVAL TACTICS.

By Lieut. W. M. F. CASTLE, R.N.

ON my arrival in England, a short time ago, I was much surprised to find that my name was connected with a "Naval War Game." I did not realise the great responsibility that my friends had incurred for me, and the great difficulties to be overcome, until I obtained the "Rules of the Conduct of the War Game," published by Captain Baring, R.A. I can hardly express my feeling after the perusal of these rules, for I saw at once that this "Land War Game" was the result of many years deep thought and hard work, and that my attempt at a "Game of Naval Tactics" can only bring us to the outline of a subject, so deep in its development, so complicated in its details.

However, having received an invitation from the Council of this Institution to read a paper on the progress that I had made in my game, I am here this evening, feeling how unworthy any effort of mine must be to add anything to the development of a science still in its infancy; but I hope that my endeavours to work out many of the details, will meet with the careful and lenient consideration of those who are interested in the movements of fleets, whether for the defence of our country, or the keeping up of that unparalleled historic name, which has been gained in a great measure through the vigilance, self-denial, intelligence, and hardihood of our seamen.

In explaining this game, I must ask you to place yourselves this evening in the position of a Commander intrusted with the command of a fleet during war. Your first study would then be to ascertain the steaming, the turning, and the fighting power of your ships, the object to be accomplished, the number and general character of your enemy; these are facts required in playing this game. Each player having digested them, he then forms a general idea of the power, &c., of the respective fleets, and in his dispositions will proceed as his

judgment directs. Any knowledge as to the ability of the opponent would also be useful, as it would enable him to use discretion in the performance of a hazardous strategic movement.

Should we be embroiled with a Foreign Power, not only would it be necessary to defend our own coast line, but it would be also necessary to afford protection to our colonies; under such circumstances the necessity of a thorough knowledge of the winds, prevailing currents of the ocean, coast line, accessible ports, facilities for coaling, and of numerous other facts indispensable to complete efficiency in a Commander-in-Chief and his staff, must be patent to any person who has given a thought in that direction.

We all know what weight a few well directed blows, aimed surely and scientifically, have in the result of mortal combat. So, in order that the leaders of our future fleets may strike boldly and surely, knowledge of the various powers and resources of the enemy must form an important element in the character of the attack. The Admiral must have the clearest possible conception of the power of each individual ship, and unbounded confidence in the ability of his captains, who in their turn should be animated by an *esprit de corps*, and a spirit of chivalrous respect for their Commander.

To be an active and efficient tactician would be of little worth, if the quality of a strategist be wanting, as I imagine the former would have only a small field, if any, to display his powers, if deficient in the latter quality. Therefore, I think I am right in saying, that to be a successful tactician, one ought to be a good strategist. The power of finding your opponent, meeting him at the greatest advantage to yourself and at the greatest disadvantage to him, involves weighty considerations, arrangements, and forethought. Such considerations, too, as in the day of battle, ought not to be left to the "chapter of accidents," which I much fear would be increased should any Commander be guilty of such indiscretion. For, instead of adding fresh laurels to those already so nobly won, England's naval glory would, I fear, be tarnished, and the historic reputation which at the beginning of this century adorned the annals of our Navy, would be sadly overshadowed. It is for this reason that I hope the consideration of this important subject may be facilitated in some small degree, if only by familiarising those who study their profession with the terminology and method of naval evolutions.

Should England be called upon to withstand invasion, I am of opinion that a numerous fleet of light draught, heavily-armed vessels of moderate speed would be most necessary and useful for the defence of our shores. As we already possess such a fleet, I shall pass them over without further allusion, and proceed to consider what part our ironclad, ocean-cruising fleet might be called upon to play. England's vital point is to be found elsewhere than upon our own coast line. She is dependent on her Colonies and merchant navy for the luxuries, aye, even the necessities, of life. Were we engaged, therefore, with a naval Power of any pretensions whatever, it would not only be necessary to have a large fleet to insure free access to the Channel, and so render safe the arrival and departure of our merchant fleets,

but we should also have to keep a very careful eye in the direction of our great Colonies—Australia and New Zealand; for it is in these directions I think we have most to dread. Our colonists themselves are not altogether blind to this eventuality. Melbourne has set the example of buying heavy ironclad turret ships to protect her coast line. At this present moment Sydney has devised a very fair system of submarine miné defence. A young but intelligent colonial Navy is being trained, not for mere vanity, but looking forward, with that far-sightedness which has so distinguished the plodding, thriving colonies, to the time when England being attacked through them, they must bear their part in defence of fatherland.

Considering these facts, and that in all probability the scene of glory for the Royal Navy will not hereafter be confined more to our own shores than during former wars, I proceed to explain the game, hoping that my humble endeavours to work out the necessary details will meet with your kindest consideration.

I cannot lay sole claim to the idea of this game, for it was proposed to me by an old messmate* several years ago, his idea being to move little blocks, representing ships, over a chart placed on the ward-room table; the idea soon dropped, but the very great success of the German KRIEG-SPIEL, and the invitation to express my ideas before the members of this Institution, led me to attempt the working out of the proposed game during the few unemployed hours at my disposal.

The strategic portion of this game may be carried out on the ordinary chart, such as is supplied to ships, for it is nothing more than a problem. Given certain facts with regard to the single relative and collective power of ships, coal-carrying capabilities, proximity or otherwise of land, season of the year, object to be accomplished, points at which mails are to be intercepted, stations at which colliers are to be met, and a host of various other details, a knowledge of which would add to the confidence of the Commander in the arrangements made at home for the efficiency of his squadron: these are the data. An acquaintance with them is indispensable to prevent embarrassing disappointments, which tend to affect the morale of a squadron longing to render a good account of the expected enemy.

"The Game of Naval Tactics" is not a study of fancy moves, and imaginary formations, for I have devised it for use in connection with the General Signal Book; and, to be played to any real purpose, the game requires great patience and attention, strict adherence to the rules laid down, and also great accuracy on the part of the players. Thus each move and consequent change of position is studied with as much care as if real squadrons were being manœuvred. In fact, we must try to assure ourselves of the practical character of the circumstances as laid down in the problem to be worked out.

I have chosen for convenience, as I shall show presently, a square space enclosed by lines representing 16 nautical miles in length. This space is of convenient size, as it is capable of representing an area enclosed by 16, 8, or 4 nautical miles. This change of scale can be

* The Rev. Fred. Davies, M.A.

made at pleasure, and will be found convenient at certain stages of the game. Thus when a series of movements have been made by both squadrons, but, owing to the smallness of the scale and the proximity of the ships, the space is found to be insufficient, both parties may agree in suggesting to the umpire that the whole area be taken as representing a space enclosed by lines 8 or 4 instead of 16 miles in length, and the position of the ships can then be relaid and the game continued. This change of scale will be convenient, as it will make the effect of the different movements more perceptible. The advantage of the larger scale will be seen should two ships be so placed with regard to each other that ramming is imminent.

Again, a chart representing the small scale area will also represent the distance at sea, at which vessels would be out of sight of each other. I have experienced much difficulty in arranging a scale large enough to represent the track of a ship, or leading ship of a squadron or division, when altering course any number of points to starboard or port; but I have adopted the scale shown as the nearest and most sufficiently exact measurement for that purpose. Many experiments have been tried at various times during evolutionary cruises to measure the diameters of the circles made by ships when turning completely round at various speeds, and I think it has been generally accepted that the modern type of ironclad makes a complete circle, the diameter of which is about three and a half times their length. The circle is not, however, quite complete, as the ship generally finishes slightly inside the original starting point.

Another difficulty presented itself,—the very great difference in length between ships of the various classes which would probably form the line of battle. During the autumn of 1869, the combined fleets, consisting of the Channel and Mediterranean Squadrons, with the Admiralty Flag flying at the "Agincourt's" main, were cruising off the mouth of the River Tagus; each class of ironclad ship was represented in this squadron, and each varied considerably in length. I have, therefore, for the present, struck a convenient average—300 feet.

Another difficulty arises from the difference of the diameters of the circles made by the various ships when turning. Some have balanced rudders, others ordinary ones, and some, perhaps, rudders moved by Rear-Admiral Inglefield's hydraulic steering gear.

Owing to the complications that would have arisen in making many different scales to represent the turning arc of each class of ships, under various speeds, I have taken 8 knots as the average speed at which a ship moves through the water when turning. Although I have named this speed, the player is at liberty to suppose any other he may consider most consistent with the data previously laid down.

It may appear to many that I have spoken rather indefinitely on the before-mentioned points. I have not, however, had access to any official records of turning circles, except those of the Channel Squadron during the autumn of 1867, but I have obtained much trustworthy information from Captain Colomb's papers published in the journals of this Institution, more particularly from his paper on "Modern Naval Tactics." For reduction of speed during turning, I have taken the "Bellerophon,"

a ship of 300 feet, as an average example, and I find that her speed, when steaming 12 knots, was reduced when actually turning, to nearly 8 knots an hour. This and a similar experiment made by the "Lord Warden" at 10 knots, I think justify me in considering 8 knots as about the average speed a ship makes when turning a circle. I have not thought it necessary to trouble the meeting with any speeds under 10 knots.

The object of the game is to facilitate the study of the evolutions, laid down in our present Evolutionary Signal-Book; and to familiarise Officers with the mode of performing them; with the time and space that a few combinations must occupy; and with the points to be attended to or to be avoided in actual practice.

It may be thought that a method of showing by scale the various movements of a squadron of ships is unnecessary, prior to contact with the enemy, since, with steam, so long as we can hold our fleet in hand, and have it ready, a host of preliminary evolutions may be superfluous. Some Officers of known experience are of opinion that on sighting an enemy, it is only necessary to form groups, that is, pelotons of three or four ships, and attack the wings, avoiding the main body, and when a suitable distance to their rear, to retrace one's steps and prepare to repeat the same tactics; others prefer the old line of battle. But a Commander-in-Chief may have other objects in view,—he may be weak, he may expect assistance and support from a friendly force, perhaps dispersed for the purpose of gaining information of the enemy, and it may be necessary to postpone a general and bold advance. His objects in delaying the fight may be many, but still these are not the points I wish to bring before you this evening, for I take it for granted that the various evolutions, illustrated in the Signal-Book, have each their special intention.*

In the preliminary arrangements of the game, it is open to the students or players to decide at what speed the circles should be described by the whole squadron, but I have taken 8 knots, as I said before, as the average speed in turning. It is, however, always possible to arrange the scale for any speed that circumstances may require and the position will admit. It rests with the students to select from an imaginary fleet the description of ships they prefer to form their squadrons, say, so many "Devastations," "Cyclops," "Sultans," "Vanguards," "Monarchs," or "Glasgows."

I do not intend this evening to bring the squadron into actual contact, but explain the principles on which the game is founded, hoping that, should a discussion follow this paper, I may learn something practical, which will prove of assistance in the further development of this game. I will now proceed to read the rules, and explanations of the various tables, scales, &c.

The Playing Board (Plate I).

The board on which this game is played is 64 inches by 64 inches. Lines are drawn 4 inches apart across the board from side to side, and

* Since this was written, I have learnt that a great change is about to take place in the "Evolutionary Signal Book."

Side Scale when five divisions represent one Nautical Mile.

SCALE I.

To be used when each Division on the Board represent One Nautical Mile.

Speed 14 knots or 28000 Yds. per hour.

Speed 12 knots or 24000 Yds. per hour.

Speed 10 knots or 20000 Yds. per hour.

Speed 8 knots or 16000 Yds. per hour.

also others at right angles to these lines. The distance between each pair of lines represents 2,000 yards, or a nautical mile. In order to facilitate the counting of the several divisions, every alternate line is drawn in red ink. The board therefore represents a space enclosed by lines 16 nautical miles in length; or it may represent a space enclosed by lines 8 nautical miles in length. Again, it may represent a space bounded by lines representing 4 nautical miles; in this case *four* divisions represent one nautical mile.

The scale on the left side of the board represents the nautical mile 4 inches in length; it is divided into divisions of 500, 100, and 50 yards. On the right side of the board is a scale representing the nautical mile 8 inches in length; the scale is divided as the other.

The board, for convenience of packing and general use, is made up of 16 blocks of paper, each block being 16 inches square and 12 sheets of paper thick, on the same principle as a drawing block, so that when one surface of paper has been used, it can be removed and the board be ready for a new game.

The markers for noting the position of the ship upon the playing board are made of thin flat lead; the distinguishing colour and fleet number of the ship they are intended to represent, is fastened to them,—a pin secured to the body of the marker, facilitates its manipulation. The markers are made a convenient size, but should it be necessary on the playing board to represent the exact dimensions of a ship, an outline may be drawn to the scale of the unit that the board represents, viz., on the full sized board $\cdot 19$ of an inch, when two divisions represent 1 nautical mile $\cdot 38$ of an inch, when four divisions represent 1 nautical mile $\cdot 76$ of an inch in length.

The leaders of each squadron bears a flag, either RED or BLUE, fastened to the head of the pin.

Scales 1, 2 and 3 (Plates I and II).

Scale 1, Plate I, represents four different speeds, viz., 14, 12, 10 and 8 knots, and is used on the full-sized board for measuring the distances corresponding to certain times. The lower edge is marked in yards, the upper edge in minutes and seconds; so that, when a certain distance has been run, the time occupied is easily found, or, if a ship has moved at a known speed for a certain number of minutes, the corresponding distance can be found.

Scale 2, Plate II, is on the same principle as Scale 1, and is to be used when two divisions on the board represent ONE nautical mile.

Scale 3, if constructed, would be on the same principle as Scales 1 and 2, and would be used when FOUR divisions on the board represent one nautical mile.

Altering Course Scales (Plate III).

SCALE A to be used in combination with SCALE 1, *i.e.*, when each division on the board represent one nautical mile. The scale is constructed on the following principle: suppose the average length of the

representative class of ironclad to be 300 feet, and that her speed when turning a circle is reduced to 8 knots. The average diameter of this circle being $3\frac{1}{2}$ times her length. The number of yards described in the circumference of the circle may be easily calculated—

$$\text{thus } 3.5 \times 100 \times 3.1416 = 1099 \text{ yards (about).}$$

Dividing this circumference by 32, the number of yards contained in each compass point is found. Table B, has been constructed on this data.

SCALES B and C are constructed on the same principle as SCALE A just explained, and would be used when *two* or *four* divisions on the board represent respectively one nautical mile.

When altering course ONE or ANY number of points to starboard, select either of the scales, A, B or C, according to the unit of measurement in use; place the left hand corner A so that the horizontal line AB touches the stern of the ship; the line AD in the same line as her course; count off the required number of points to the right (for instance, 5 points), follow the line radiating from this point of compass to the board, there make another pencil mark, then remove the scale, and join these two points. The line joining these two points will represent the new course of the ship.

Horizontal Scale (Plate II).

A most useful scale for all rectangular formations.

A separate scale of this description is required for each unit of measurement. They are divided into three parts, viz., horizontal bar, slides, and perpendicular scales. The horizontal bar is about 12 inches long; the upper edge is divided from the centre at each 50 yards; the lower scale is divided from the centre at each 400 yards; the divisions on the latter scale are called CORRECTION MARKS. The right or centre slide is adjusted to either of these correction marks; according to the distance the columns are to be apart when moving from SINGLE COLUMN in line ahead to COLUMNS OF DIVISIONS in line ahead. An example of its use will be given later in this paper.

The indentations on the perpendicular scale represent ships; they are each 400 yards apart. A few other ordinary scales are required, such as a long straight edge, parallel rulers, and a box of mathematical instruments.

TABLE A.

Table A. This table shows the NUMBER of yards a vessel will pass over the water in calm weather during a known time at a known speed. Its use requires little explanation; it would be principally used when measuring long distances. Knowing the time a ship proceeds in a direct course, and the speed, the DISTANCE is easily found. For instance, moving at 10 knots per hour for ten minutes, the distance by Table A = 3,333 yards. To measure this distance on the Playing Board (Plate I) refer to the *side scales*.

TABLE A.—Distance in Yards that a Ship moves at a given speed during a given time.

Knots.	m. 60	m. 50	m. 40	m. 30	m. 20	m. 10	m. 9	m. 8	m. 7	m. 6	m. 5	m. 4	m. 3	m. 2	m. 1	sec. 45	sec. 30	sec. 15	sec. 10	sec. 5
14.....	28,000	23,330	18,664	14,000	9,332	4,666	4,200	3,932	3,282	2,800	2,333	1,866	1,400	933	466	358	233	116	76	38
13.....	26,000	21,667	17,335	13,000	8,666	4,333	3,900	3,467	3,033	2,600	2,166	1,733	1,300	866	433	324	216	108	72	36
12.....	24,000	20,000	16,000	12,000	8,000	4,000	3,600	3,200	2,800	2,400	2,000	1,600	1,200	800	400	300	200	100	66	33
11.....	22,000	18,330	14,666	11,000	7,333	3,666	3,333	2,933	2,582	2,222	1,833	1,466	1,111	733	366	273	183	91	61	30
10.....	20,000	16,667	13,332	10,000	6,666	3,333	3,000	2,666	2,331	2,000	1,666	1,333	1,000	666	333	249	166	83	54	27
9.....	18,000	15,000	12,000	9,000	6,000	3,000	2,700	2,400	2,100	1,800	1,500	1,200	900	600	300	225	150	75	50	25
8.....	16,000	13,330	10,666	8,000	5,333	2,666	2,400	2,133	1,892	1,600	1,333	1,066	800	533	266	198	133	66	44	22
7.....	14,000	11,665	9,332	7,000	4,666	2,333	2,100	1,966	1,641	1,400	1,166	933	700	466	233	179	116	58	38	19
6.....	12,000	10,000	8,000	6,000	4,000	2,000	1,800	1,600	1,400	1,200	1,000	800	600	400	200	150	100	50	33	16
5.....	10,000	8,333	6,666	5,000	3,333	1,666	1,500	1,333	1,165	1,000	833	666	500	333	166	124	83	41	27	13
4.....	8,000	6,665	5,333	4,000	2,666	1,333	1,200	1,066	941	800	666	533	400	266	133	96	66	33	22	11
3.....	6,000	5,000	4,000	3,000	2,000	1,000	900	800	700	600	500	400	300	200	100	75	50	25	16	8
2.....	4,000	3,332	2,666	2,000	1,333	666	600	533	470	400	333	266	200	133	66	48	33	16	11	5
1.....	2,000	1,666	1,333	1,000	666	333	300	266	233	200	166	133	100	66	33	24	16	8	5	2

TABLE B.

Table B gives the *time* and *distance* in which a ship will describe a *whole circle* or *any portion of it* when the helm is put to starboard or port, and is based on the experiments carried out by the Channel Squadron off the coast of Portugal, 6th and 7th November, 1867. This table will be always used when changing course; for instance, alter course 5 points to starboard, time occupied by Table B = 38 seconds.

Portion of circle.	Distance.	Time.	
		min.	sec.
32 points.....	1,090 yards.	4	7
16 "	545 "	2	3·5
8 "	272 "	1	1·7
7 "	238 "	0	53
6 "	204 "	0	46
5 "	170 "	0	38
4 "	136 "	0	30
3 "	102 "	0	23
2 "	68 "	0	15
1 "	34 "	0	7·7

TABLE C.

Table C shows the *time* which a column of ships will take to form *columns of threes* from LINE AHEAD at different speeds.

Knots.	6.	7.	8.	9.	10.	11.	12.
	min.	min.	min.	min.	min.	min.	
12.....	2·83	3·23	3·86	5·24	7·82	15·47	
11.....	3·25	3·91	5·28	7·84	15·49		
10.....	4·03	5·30	7·86	15·52			
9.....	5·32	7·88	15·54				
8.....	7·93	15·56					
7.....	15·60						
6.....							

The tables are all constructed on the same principle.

In Table C, the upper line of figures in each table represents the speed of the leading ship; the figures in the side column, the speed of the vessel which has to move over the longest distance. To use this table, suppose the speed of the leading ship or column to be 6 knots, the speed of the ship which has to steam over the longest distance to be 9 knots; by entering Table C along the top column, with the speed of the leader, and the side column with the speed of the last ship, the time required, viz., 5·32 minutes, is found.

Or again, for example, suppose the Fleet to have been steaming in ONE OR MORE columns in line ahead at 10 knots, and the signal is made for columns of THREES, the leader reduces his speed from 10 knots to 6; the rear ship has a small reserve speed, and consequently steams 11 knots, then by Table C the time is found to be 3.25 minutes.

TABLE D.

Table D shows the time which a column of three ships will take to form *groups* from LINE AHEAD at different speeds.

Knots.	6.	7.	8.	9.	10.	11.	12.
	min.	min.	min.	min.	min.	min.	
12.....	1.08	1.22	1.42	1.73	2.38	3.94	
11.....	1.26	1.45	1.79	2.42	4.02		
10.....	1.5	1.82	2.45	4.29			
9.....	1.89	2.52	4.36				
8.....	2.6	4.45					
7.....	4.6						
6.....							

TABLE E.

Table E shows the time that six ships may form the *indented line*, from COLUMNS OF DIVISIONS IN LINE AHEAD, at various speeds; ships in close order.

Knots.	6.	7.	8.	9.	10.	11.	12.
	min.	min.	min.	min.	min.	min.	
12.....	2.31	2.36	2.45	2.57	2.78	3.14	
11.....	2.55	2.65	2.76	2.98	3.38		
10.....	2.85	2.93	3.22	3.66			
9.....	3.26	3.54	4.00				
8.....	3.86	4.39					
7.....	4.91						
6.....							

TABLE F.

Table F shows the time that six ships may form the *indented line* from COLUMNS OF DIVISIONS IN LINE ABREAST at various speeds; ships in close order.

Knots.	6.	7.	8.	9.	10.	11.	12.
	min.	min.	min.	min.	min.	min.	
12.....	4·62	5·5	6·89	9·15	13·69	26·9	
11.....	5·53	6·9	9·16	13·7	27·0		
10.....	6·91	9·17	13·71	27·1			
9.....	9·19	13·73	27·2				
8.....	13·74	27·3					
7.....	27·4						
6.....							

General Rule for use.—Enter the upper column of knots with the speed of the leader of division, the side column of knots with the speed of the ship which has to pass over the longest distance, and the corresponding time is found.

Appended to this paper are the equations by which these tables have been formed.

Should this "Game of Naval Tactics" find few friends, yet I hope that these little tables may prove useful, for if embodied in the Evolutionary Signal-Book, they might be used as a guide, when performing evolutions in actual practice.

TABLE G.

Table G shows the DISTANCE in yards that the last ship of a fleet, when steaming in SINGLE COLUMN IN LINE ahead, will have to steam over, to take her new station *in line abreast*. To use this table, enter the *side* column with the fleet number of the last ship, the top column with the order (close or open), then refer to Table A with the known speed and known distance, and *the time* for the evolution is found.

No. of Ships.	Close order.	Open order.	Remarks.
	Yards.	Yards.	
2.....	565	1,130	
3.....	1,130	2,260	
4.....	1,697	3,390	
5.....	2,260	4,520	
6.....	2,828	5,650	
7.....	3,493	6,780	

Rules for the Students or Players.

The students to consist of five persons, viz., one umpire, two principal players and two assistants,—the principal players are to name all moves. Each move to count for two minutes of time. The principal players will be furnished with several slips of papers (Form I), on which they will communicate their intentions in writing to the umpire. Each player writing in a different coloured ink.

FORM 1.

Colour of player.	Number of moves demanded.	Evolution.	Speed.	Remarks.	Times, &c.
					<div style="text-align: right;">h. m.</div> Players' entry.. Umpire's „ .. Termination of evolu- tions }

A player may claim five moves at one time. He may claim a new move before the move that he is making is finished; but this move cannot be commenced until the time for the last movement has expired. Should a player, in writing his intention, fail to use the terminology of the Signal-Book, the mistake should at once be called attention to by the umpire, who will delay the execution of the movement half a move (*i.e.*, one minute); this is most important, as in practice any mistake in signals delays the evolution and causes endless confusion. During delays the ships will continue to move on in their original formation.

Should a player wish to increase or decrease the speed of his ships, he may do so two knots, by telling the umpire and the assistant player of his own side his intention; but should he wish to proceed at such an increase of speed as would in actual practice entail more boiler power, he must claim ten moves, communicating his intention to the umpire in the usual manner.

The umpire's decision under all circumstances is to be final. He should furnish the leading players with a special idea, written distinctly on paper, naming the object to be accomplished, the time allowed for the execution of this duty, the place at which coals may be procured, mails met, reinforcements found, ports that have to be closed; those that have to be defended, extent of cruising ground, proximity of land or shoal water, strength of the opposing force, their position on a certain date; in fact he must supply each player with as much intelligence as would probably be communicated to the commander of a squadron ordered away to form a portion of a combination. He will keep an account of the moves made by each player on Form 2.

After having registered the move demanded, as will presently be explained, the umpire will give the player's assistant the slip of paper (Form 1), in order that the movement on the board may be marked off. No move is to be made until one move (two minutes) has elapsed since the receipt of the notice. The umpire must check any undue haste on the part of the players, and prevent either making too many moves in advance. He must prevent talking or observations by either side which will hint to either party any information; he may stop

the game whenever he may think it necessary in order that the assistant players may mark up the relative position of each squadron. After stopping the game, the umpire may limit the number of moves; this will be found necessary when the opposing ships are in close proximity. On the receipt of the slip of paper (Form 1) from the principal player, the umpire should note the interval of one move upon it, and then pass the paper to the assistant player. For instance, Red at 10h. 14m. demands three moves; under the time entered by the player, the umpire notes the interval of one move, also the time for completing the evolution, in the following manner:—Form 1, players' entry 10h. 14m., umpire's 10h. 16m., evolution finished (three moves for evolution) 10h. 22m.

FORM 2.—REGISTER OF MOVES.

Form 2 illustrates the table in which the Umpire keeps the record of the moves.

RED.				BLUE.			
Move column.	Hour.	Evolution.	Remarks.	Move column.	Hour.	Evolution.	Remarks.
1	1	A.M.		1	1	A.M.	
2	2			2	2		
3	3			3	3		
4	4			4	4		
5	5			5	5		
6	6			6	6		
7	7			7	7		
8	8			8	8		
9	9			9	9		
10	10			10	10		
11	11			11	11		
12	12			12	12		
13	1	P.M.		13	1	P.M.	
14	2			14	2		
15	3			15	3		
16	4			16	4		
17	5			17	5		
18	6			18	6		
19	7			19	7		
20	8			20	8		
21	9			21	9		
22	10			22	10		
23	11			23	11		
24	12			24	12		
25				25			
26				26			
27				27			
28				28			
29				29			
30				30			

RED's moves are registered in the left columns.

BLUE's moves in the right columns.

The column numbered from 1 to 30, is arranged for recording moves, two minutes to each move; the column numbered from 1 to 12 a.m., and 1 to 12 p.m., for recording the hour; the "evolution" column for recording the evolutions; "remark" column for remarks.

Suppose we wish to register a move, commencing at 10h. 14m. a.m., place a pin bearing the colour of the player in square 10 of hour column, this registers 10 hours; place another pin in 7 square (move column), this registers the minutes, viz., 14m. Supposing the player to claim 3 moves, the umpire places another pin in square 11, thus registering the one move imposed by the umpire (as was before explained) and the number of moves demanded, viz., 3. By this means we have registered 10h. 14m.; also 10h. 22m., the former being the time at which the evolution was commenced, the latter the time when the evolution is finished; any remarks that the umpire may think necessary should also be entered.

Should the umpire impose the fine of half a move (that is 1 minute), the minutes in the move column, if previously even, will become odd; when marking odd minutes, place the pin on the line between the squares in "move" column.

Since the registering of seconds would involve some complication, the nearest minute must be taken, or dice may decide whether it shall be the minute just elapsed, or the next in advance.

By these means the umpire regulates the moves, and checks a player making too many moves in advance, or getting too many moves in arrear of his antagonist.

The record of blue is kept precisely in the same manner.

RELATIVE SPEED TABLE FOR SAILING SHIPS.

Since ships, whether ironclad or otherwise, may cruise under sail, it is necessary that the umpire should have some rules furnished him for treating such cases.

Ships under sail, with the wind free, may be supposed to move with greater speed than those close hauled.

Description of Vessel.	Force of wind.	On a wind.	Free.	Remarks.
		Knots.	Knots.	
Frigates (wood cased or otherwise)	4 to 6	5	7	This table represents the speed of ships under ordinary conditions. The umpire must state all circumstances of the weather, if ships are under sail, when he names the time of sighting one another.
Ironclads.....	„	4	6	

Under ordinary circumstances, the umpire may allow 16 minutes for a fleet to prepare for action, and to have steam ready for 8 knots.

Example of the Use of the Horizontal Scale. (Plate II).

Suppose fleet in single column in line ahead.

The player of the red squadron intends FORMING COLUMNS OF DIVISIONS IN LINE AHEAD, ships turning to starboard (Plate IV).

The player hands the slip of paper (Form 1) to the umpire, correctly written up (as previously explained); this represents the signal being hoisted. The umpire detains the paper and adds to it, the interval of one move, then passes it on to the assistant player. (This represents the signal being hauled down.)

The assistant player first selects the horizontal scales for the unit of measurement, and places the centre slide immediately over the position of the leading ship; the horizontal scale being at right angles to her course. He then moves the right slide to the third correction mark, and transfers the position of the right division to the playing-board. The position of the left division may be marked off by measurement, each ship abreast of her opposite neighbour. In order to find the time that this evolution will take to perform, the assistant-player refers to Table B for the time of two changes of course at right angles, viz., 2 m. 1 sec.; he next counts the number of hundred yards between the inner edge of the centre and right slide, viz., 850 yards. Then suppose speed of ship to be 8 knots, 850 yards at 8 knots = 3 m. 12 sec.; whole time occupied in performing evolution = 5 m. 13 sec.

Example of the Use of Tables C and D.

I have classified Columns of Threes and Groups under the same head.

Tables C and D give the least time that these evolutions can be performed under the most favourable circumstances, at various speeds; in actual steam evolutions these tables would be of little use, except as a reference and a guide. But in playing this game, since the umpire may decide the practicability of any evolution, it necessitates some exact data to start upon.

Fleet in COLUMNS OF DIVISIONS IN LINE AHEAD, Diagram 1; Plate V, to form columns of THREES.—The player of the red writes on paper (Form 1), in red ink, the number of moves he demands, the movement he intends making, viz., form columns of threes. Leader reduces speed to 6 knots, wing ships increase speed to 9 knots, three moves. The umpire then records, in Form 2, red's time and moves demanded, and hands the signal to the assistant, who carries it into execution. The assistant-player, on reference to Table C according to rule, finds that the time this evolution will occupy is 5 m. 51 sec.; he then refers to Table A, 5 m. 51 sec. at 9 knots = 1,750 yards.

To lay off this distance on the Playing-Board (Plate I), draw a line 1,750 yards in length from the position of the rear ship in the column, 282·8 yards to the right of her original course as in the Diagram

From Line Ahead to Columns of Divisions in Line Ahead.

PLATE 4.

From Line Ahead to Line Abreast.

PLATE 7.

Columns of Three's from Line Ahead.

Groups from Line Ahead.

PLATE 5.

DIAGRAM 1.

DIAGRAM 2.

From Columns in Line Ahead
to Indented Line.

From Columns in Line Abreast
to Indented Line.

PLATE 6.

DIAGRAM 1.

DIAGRAM 2.

1, Plate V. (A) is the position of the leader, (B) the left wing ship, (C) the right wing ship. With a very little practice the assistant-player would learn to make these movements very quickly.

A few seconds will elapse after the completion of this movement before the time (three moves) claimed for it, has expired. If no move has been previously demanded, the columns of three will continue to move on in the original direction.

The same rules are applicable for group formation (Diagram 2, Plate V), and therefore will not require any explanation.

The next formation provided for is FORMING THE INDENTED LINE, from DIVISIONS IN LINE AHEAD (Plate VI, diag. 1). Table E is constructed to facilitate this movement. Supposing the fleet to be moving at the speed of 6 knots, and either player wishes to form the indented line, the player gives the umpire the slip of paper (Form 1), stating his intention; this slip of paper is handed to the assistant player in the usual manner. Supposing the left division to have an excess of speed of 2 knots. Then on reference to Table E, it will be found that the least time in which this evolution can be performed, is 3.86 minutes; now lay off the new position of the leader of the right division, at 6 knots per hour during 3.86 minutes, and place the leader of the left division 400 yards distant and 4 points on the right leader's quarter; the remaining ships will be placed in their respective positions.

When reforming column in line ahead from this formation, Table E may again be used.

If, again, the fleet be in TWO COLUMNS IN LINE ABREAST (Plate VI, diag. 2), and it is wished to FORM THE INDENTED LINE, the number of ships in each division being three, the player acts as before, the assistant player refers to Table F, and ascertains the time; for instance, leading division steaming 6 knots, the rear division has an excess of speed of 3 knots, their time by Table F = 9.19 minutes; lay off on the Board (Plate II) the distance at 6 knots during 9.19 minutes, and protract the positions of the remaining ships.

Again, suppose the fleet to be moving in SINGLE COLUMN in LINE AHEAD, and a broader front is required, for instance, to form SINGLE COLUMN in line ABREAST (Plate VII). This evolution will be expedited by the leading ship reducing her speed to steerage way, the remaining ships moving by the shortest road to their new front, when there take up the speed of the wing ship; when all are in line abreast they increase speed together. To ascertain the time and distance, refer to Table G for distance; enter Table A with the distance found and speed of the last ship, and you find the required time.

Having spoken of the evolutions which treat exclusively of changing formations, we next come to a series of evolutions such as changing directions of columns; columns of bow and quarter lines, &c. These evolutions I propose to treat much in the same manner as the before-mentioned ones; for this purpose, tables must be computed on the same principle as Tables C and D, and with a little ingenuity on the part of the assistant players, any of these movements may be plotted down on the playing-board.

Altering the course of columns, preserving the formation of the fleet;

either when in columns, in line ahead, or in line abreast, and preserving bearing and distance, present difficulties, which at present I have not endeavoured to overcome, but I imagine that should opportunity occur, the time for these evolutions at different speeds and with various numbers of ships, might be noted. These times would be generally useful in supplying data for this game.

With reference to "stationing," I do not think that it is necessary to enter into an explanation as, I take it, that such evolutions would not be attempted in the presence of an enemy.

In conclusion:—I wish to be thoroughly understood, that this game can never take the place of experience. I do not pretend that it will be useful, to those who are already experts in the art of manœuvring ships. I only hope that it may be useful to those, who have not had the great advantage of schooling in evolutionary squadrons, also to those who intend making naval tactics a portion of professional study.

There is one point that I am anxious to dwell upon. I believe that I am right in saying, that at present no facility whatever for the study of tactical formations is given by the authorities to the Officers in command of ships by furnishing them with the turning curves made by steam-ships on their trials. The turning curve of each ship should be tabulated and supplied to each vessel for the use of the Officers. Another point we are deficient in is the absence of an authorised "manual of naval tactics" which could be procured by Officers desirous of studying this important subject. We ought to have a tactical drill book similar to the Army Light Infantry Drill Book—a book procurable at the nearest stationer's shop. If a naval man has a taste for military manœuvres, he can study to his heart's content every branch of the "Land War Game," but there are no helps whatever in the study of Naval Tactics.

Perhaps I have laid myself open to censure in that I have not brought before you to-night, the method of performing all the movements given in the Evolutionary Signal-Book. Time has not permitted my entering into them all, but I have endeavoured to treat a portion of them thoroughly, in order that it may be seen that the remaining evolutions are susceptible of similar treatment.

In making these explanations, I am to a certain extent restricted from quoting the Evolutionary Signal-Book, but I sincerely hope that I have not trespassed on its "confidential" character.

I have only spoken of the elementary, but, I am inclined to think, most useful evolutions, avoiding questions of rams, guns, or towing torpedoes; for until this game is accepted in its simpler form, I think it would be unwise to introduce the consideration of various offensive arms, which would in their varied uses add fresh complications.

I feel sure that all present this evening, recognise the necessity of some such assistance in exact tactical studies as, under the name of a game, I have endeavoured to explain. Should the game only be studied occasionally by a few Officers, it will bring imaginary opposing squadrons into tactical contact with each other. This must raise discussion which will assist to fix the limits of practicable plans and

ideas in the heads of those who interest themselves in the science of naval evolutions and tactics.

General Formulae by which the Results shown in the foregoing Tables C, D, E, and F, may be found.

In each case let a yds. = distance passed over by fastest ship in 1 min.
 b = " " " slowest " "
 and n = Nos. of minutes.

TO CONSTRUCT TABLE C.

$$\begin{aligned} a^2 n^2 &= 400^2 + (800 + nb)^2 - 2(800 + nb)400 \times \cos. 45^\circ \\ &= 16000 + 640000 + n^2 b^2 - 452480 + 565.6 bn \\ a^2 n^2 &= 347520 - 1034 bn + n^2 b^2 \\ n^2 + \frac{b \times 1034}{a^2 - b^2} n &= \frac{347520}{a^2 - b^2} \end{aligned}$$

$$n^2 + \frac{b \times 1034}{(a-b)(a+b)} n = \frac{347520}{(a+b)(a-b)}$$

EQUATION FOR TABLE D.

$$n^2 - \frac{b \times 234.4}{(a+b)(a-b)} n = \frac{93760}{(a+b)(a-b)}$$

TABLE E.

$$n^2 + \frac{b \times 566}{(a+b)(a-b)} n = \frac{920978}{(a+b)(a-b)}$$

TABLE F.

$$n^2 - \frac{b \times 1834.4}{(a+b)(a-b)} n = \frac{921280}{(a+b)(a-b)}$$

Lieutenant BROWN, R.N. : I should like to ask the lecturer, as no arms are used by the ships, what is the ultimate issue of the game as played between the two players according to the present rules, I mean, what influences the decision of the umpire with respect to the various ships and the ultimate issue of the game?

Lieutenant CASTLE : I am rather afraid that Lieutenant Brown has mistaken what I wished to convey to the meeting. What I have been working at for some time, is to show what I have shown you this evening. I have not attempted—nor do I intend to attempt, until I have worked through the whole of the Evolutionary Signal-Book and really fought this battle,—to enter into the subject of the power of one ship against the other when fighting. There is one point that, before I come to actual contact, I should be glad to mention. I have taken average diameters, and average circles, average lengths of vessels, and average speeds. That is all very well indeed on the playing-board; but when we come to the disposition of the fleets with regard to each other, and there is no time to make signals, then, I think, the curves that I spoke of just now (the curves that I thought were so necessary to be supplied to each ship, of the turning powers of various vessels) may be used with very great advantage. It appears to me that the climax of what is to be done at present, is to bring the squadrons into contact with one another. We ought to have some pre-arranged plan, so that, if we attack in a formation, on

arriving within a certain distance, we should have some definite idea of the individual work of each ship. That will be the conclusion which, ultimately, we shall arrive at. Of course, there are several courses open. We may have several separate flags for separate movements. One flag would be the signal to engage, or to alter the course four points to starboard, or to port, or to pass through line, or on the right of the line, or on the left of the line. Whenever I have played this game, these are the points that we have always argued about. I have not the power at present of deciding which ship will have the advantage when in actual contact. One man would say, "My guns will penetrate your armour." Another will say, "My armour will resist your guns;" and all this provokes discussion. I do not think, at the present moment, that I am prepared to discuss with anybody that portion of the game. At the same time, I think, it is very easy indeed for the umpire to decide which, in his opinion, has the best position at the commencement of the attack. You might leave it to him, at any rate, to say who is in the most favourable position.

Lieutenant BROWN: I meant it is the business of the umpire at the conclusion of the game to decide, when the two fleets are brought within a distance when no more signals can be made, which fleet is in the best position for attack. (Lieutenant CASTLE: That is my object.) The curves in Plate 3 have been calculated for an average length of 300 feet for each ship? (Lieutenant CASTLE: Yes.) Have the two extremes of the longest and shortest ships been tried to see what difference the length would make according to the scale on the chart on which you propose to work out the plan; have you always assumed that same average during the game?

Lieutenant CASTLE: Just so.

Lieutenant BROWN: Have you ever tried the game on the quarter scale?

Lieutenant CASTLE: No, I have not; and I do not put much faith in it. It might be necessary when you are within 200 yards of each other, and when you come to fight with individual ships; but otherwise I do not put much faith in it. It would only be necessary when you come to fighting individual vessels within 200 yards of each other.

Captain WHEATLEY, R.N.: Are the same tactics applied to vessels with end-on fire as for broadside fire?

Lieutenant CASTLE: I have merely taken the Signal Book as my basis to start from, working the fleet evolutions as they are given for our use, taking them for what they are worth. I thought it was the only way of playing my game.

Captain CODRINGTON, R.N.: Do you play the game irrespective of time, like the moves on a chess-board?

Lieutenant CASTLE: Time is the essential point of the game.

Captain CODRINGTON: Then the moves would be behind the signals?

Lieutenant CASTLE: Not exactly.

Captain CODRINGTON: I do not see how, in using these scales and manipulating the models of the ships on the board, you would actually put your fleet in the same position in the same time that a smart hand would hoist a signal?

Lieutenant CASTLE: I do not want to. When I have played my game, I have been two hours in thinking over moves that really occupied 38 minutes. There is no object in moving quickly. When you arrive at some formation, you consider what is to be done next; there is no hurry about it.

Commander ANSON, R.N.: My difficulty was with ships with double screws. Supposing you suddenly stopped or reversed your engines, or one engine or the other engine, it would be important to lay that down on the table.

Lieutenant CASTLE: I do not think double screws would have very much to do with it. You might reasonably, if you are steaming 10 knots, take 3 moves—6 minutes, or 4 moves—8 minutes in a general way. I do not think it would much affect the principle of my game.

Captain COLLOB, R.N.: I am unfortunate in having missed the reading of the paper; but I see at once that there are differences of opinion; and, out of these differences of opinion, we should always get a certain amount of truth. There is no question whatever that the endeavour must be a good one—whether it be well done or ill done—the endeavour is one of those things which is perfectly certain to produce other endeavours. The lecturer having taken it up seriously must have gone a certain length with it. Whether he has begun wrongly or rightly, I cannot say; but

the Officers present who heard the paper, and that very much larger number, including myself, who will hereafter read it carefully, are quite certain to get ideas which will carry them farther; either they will avoid what appear to them to be errors, or they will make advances in the other direction. When I met the lecturer at Portsmouth the other day, he spoke to me about the tables I see. They are quite irrespective of any game of the kind proposed, and the value of such tables is very great in all the movements of our fleets, in those which are proposed to be retained, and in those which are to be condemned; because the great element for their retention or condemnation, is the time occupied in performing them. Now, any single individual asked to pass judgment upon any of these different movements might not always have the means of so doing at his disposal; and the Lecturer having taken the trouble to go through the movements and to calculate, as he has done for different speeds, the amount of time that each movement would take, puts a great deal into the hands of naval Officers that they had not in their hands before—a great deal of excellent stuff that is very useful, and that can be applied at once. As to the general question of the War Game, my difficulty has been, that whereas in the Army what is a disadvantage and what is an advantage, is perfectly understood and known, and has been tried by the experiment of war, as far as the Navy is concerned, we are actually *in nubibus* as to what are advantages and disadvantages. Therefore, if the game is in the nature of the military war game, I cannot quite understand how it is to be decided which has won. In point of fact, whether you may not credit a man with having won—for doing something which further experiment and further consideration would show is just what he ought not to have done. I am bound however, to say, when I mentioned it to, the Lecturer at Portsmouth, he told me that that point hardly entered into his proposal.

Captain BURGESS: I should like to ask Lieutenant Castle how many games he has played, and whether the Officers who played them were generally satisfied?

Lieutenant CASTLE: I have played four games; and the general idea amongst my messmates was that we were a long time making our moves. We took two hours in our final game to get over a time of 38 minutes. Suddenly we brought our squadrons within 800 yards of each other; and then came the knotty point as to who had the advantage. A discussion followed. Instead of the Umpire giving a final decision, every one present argued the point for themselves. The result was, that the next day none of us were satisfied. This game provoked an immense deal of discussion—a thing that had seldom been provoked before. It provoked so much discussion that I think it really led to uncommonly good results, and it was ultimately decided by the Commander of ship, which fleet was in the best position.

The CHAIRMAN: The difficulty which has just been partly answered is the one that I feel. It is this: that after all these manœuvres I cannot see how it can be an easy task for the Umpire to decide who has the advantage. Whether they are 800 or 400 yards apart, the question as to the final decision is then to arise. It is a very different thing in the *Krieg-spiel* as played in the Army, because the whole thing is based upon very different data, and data that are so clear and so easily ascertainable with regard to the movements of troops over roads and over country, and so on. I must say, there seem to me almost insuperable difficulties in carrying this game out to an issue that will really be practically useful; but still, at the same time, it is quite evident that anything that turns the minds of Officers to think about tactics, and the time and the manner in which ships are to be moved, and that, in addition, has the advantage of these tables to which Captain Colomb has alluded, must be useful. I think, therefore, we are very much indebted to Lieutenant Castle for bringing this subject before us—a subject extremely novel to most of us; and I may say I am only expressing the sense of the meeting in returning him our thanks for having brought it forward. I may go further and say we trust that he and others who take an interest in this matter, will work it out, and, at some future time, bring the subject again before us in a more complete state. I cannot help feeling that, at present, we are only on the threshold of a very difficult and complicated question, which may, in the end, be extremely useful to the Naval Service in general. I, therefore, with your permission, will return our thanks to Lieutenant Castle.