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### The Analysts' Bookshelf

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## THE ANALYSTS' BOOKSHELF

(From time to time, in these columns, we will review articles published elsewhere which will not ordinarily be available to readers of the *Journal*. Suggestions and contributions will be gratefully accepted.—Ed.)

### EDISON AND OPERATIONS RESEARCH

Although it is widely supposed that operations research in the US Navy began in connection with antisubmarine problems in World War II, the fact is that this problem first came into importance in World War I. The studies in question were undertaken by Thomas A. Edison for the Naval Consulting Board, an organization somewhat similar to the National Defense Research Council. Lloyd N. Scott's *Naval Consulting Board of the United States*, Government Printing Office, Washington, 1920, tells how Edison became involved in antisubmarine warfare and gives many prophetic instances of developments which reached their full usefulness in World War II.

As Chairman of the Consulting Board, Edison reported directly to Secretary of the Navy Josephus Daniels. It was mutually agreed that Edison's inventive ability was desired, rather than his executive talents. Accordingly, he started his work with experiments on listening devices; on reconsideration of the problem, he concluded his objective was to save ships, and that killing submarines was only one means to that end. This choice of the correct measure of effectiveness led him into an operations research activity.

His first step was to go to Washington in the summer of 1917 with three assistants, "intending to make a thorough study of the statistics of submarine activities and their results, and to develop therefrom strategic plans according to some ideas that he had in mind. He expected to find on the Government records understandable and full details, charted, of the sinkings that had already taken place. Not finding this, he and his assistants worked day and night to prepare the charts and data" (Scott, p. 166). Copies of these charts are included in Scott's history.

"From a study of these, it was quite apparent that the steamship companies had been sailing their vessels on the same routes as before the war. From the statistics of the numerous sinkings it appeared that only 6% of the ships had been sunk at nighttime. . . . It was also apparent from the statistics of sinkings that the steamship companies had not learned the lesson of night sailing in the danger zone. From an examination of Lloyd's Register, it appeared that only about 4% of the first-class British merchant ships had modern sounding apparatus aboard, and at that time wireless apparatus was almost unknown on board the British merchant ship.

"With all these facts and this data before him, Mr. Edison commenced to work out his plan, which, broadly stated, was for the ships to sail in and out of the danger zone at night; to forsake as much as possible the old standard lines of travel; to anchor through the day in comparatively shallow waters and harbors where submarines could not approach them, steaming only at night to other ports of anchorage on the way to their ultimate destinations.

"In order to present this plan in concrete form, Mr. Edison made a study of the statistics of shipping passing in and out of British and French ports for a year, and from the information thus obtained he made a graphic chart. He then obtained a full set of Pilot Books covering the British Isles and France, and charted the harbors in which there was safe anchorage for a long distance inshore in comparatively shallow, but safe, waters." (Scott, p. 166)

This work was formally reported in November 1917, followed by a report in December on US coastal shipping. Since no official statistics were available on coastwise shipping, Edison had collected his data with the aid of customs officials, harbor masters, and other groups.

His next step foreshadowed the use of a tactical game board, together with some empirical notions of sweep widths. "Mr. Edison also made a pegged board covering a chart of the channels and coasts of England, Ireland, and Scotland. This chart was laid off in squares of 40 miles each, which is the approximate visibility of smoke from a cargo boat as seen from a submarine in the center of the square. Each square was provided with a peg and a peg hole. One person had the problem of taking into British or French ports, say, 30 vessels. His opponent had a similar pegged board with 13 pegs representing submarines. The first player routed his ships to the various ports at various hours, while his opponent placed his submarines at points where he thought most likely a vessel would come into his visible area, which was then considered sunk. It was found that by following certain methods these 30 vessels could be brought into port with a surprisingly small number having been seen by the submarine." (Scott, p. 167)

At about this time, Edison was consulted on the value of zigzagging. On the basis of his previous analyses, he concluded that the tactic was useless for merchant ships moving less than ten knots "and that the results only led to a loss of our total carrying capacity" (Scott, p. 180)—again employing a cogent measure of effectiveness.

It is somewhat astonishing that very little came of all this operational thinking. Edison did forward his conclusions in late 1917 to the British Admiralty, where they are said to be still on file. It is understood that

some of his proposals had already been put into effect; others proved impractical under existing circumstances. The British Admiralty are reported to have previously done some similar analyses in conjunction with the French Admiralty. Nor did Edison's work seem to have had lasting effect on the US Navy, judging by the need to rediscover his statistical procedures at the start of World War II.

A possible cause of this failure to affect naval operations may lie in the position of the Naval Consulting Board as civilian advisors to a civilian, the Secretary of the Navy. In contrast, World War II military operations analysts invariably worked for, and reported to, an operational command, which was in a position to put their recommendations into effect. Although a senior Naval officer was assigned as liaison with the Board, it seems doubtful that Edison had the daily contact with operational personnel which might have obtained immediate action on his conclusions. As a pioneer operations analyst, Edison employed well-chosen measures of effectiveness based on the analysis of operational data, and collected such data himself when necessary. He failed, however, to produce a direct effect on naval operations, and this failure seems to have led ultimately to complete neglect of his work in this field.

WILLIAM F. WHITMORE, *OEG, Navy Department*

(Read before the Society November 18, 1952.)

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#### A TANK BATTLE GAME

In the course of his studies at ORO, George Gamow has developed a game which may have commercial possibilities in the next Christmas gift season. Similar to the well-known Kriegspiel modification of chess, the new game is played with three identical boards, one for each of the two players and one for a referee.

The board, shown in Figure 1, represents a tank battlefield by a lattice of hexagons (selected because they allow a higher degree of isotropy than the square lattice of a standard chessboard), some of which are cross-hatched to represent wooded areas of low visibility. The white hexagons represent open fields, and the size of a hexagon represents the "radius of action" of a tank in battle.

Each player starts with ten markers representing tanks at his back line, and "a move" consists in displacing any number of tanks into any one of the adjacent hexagons. Each player sees his own board only and must infer from the play where his opponent's tanks are located.

If two opposing tanks arrive on adjoining white hexagons, "a battle" is announced by the referee who spins a coin to decide which tank is eliminated. Where a moving tank comes into contact with two enemy tanks simultaneously, it must "shoot it out" first with one of them, and then, if victorious, with the other.

A tank in the woods obtains a clear kill on any tank which moves into an adjacent white hexagon; a coin is flipped to determine the survivor if another tank moves into the same hexagon in the woods. The objective of the game is to kill off all the opposing tanks, retaining the maximum of one's own tanks.

This new game has been played a number of times by ORO staff members—presumably during lunch hour.

T. L. P.

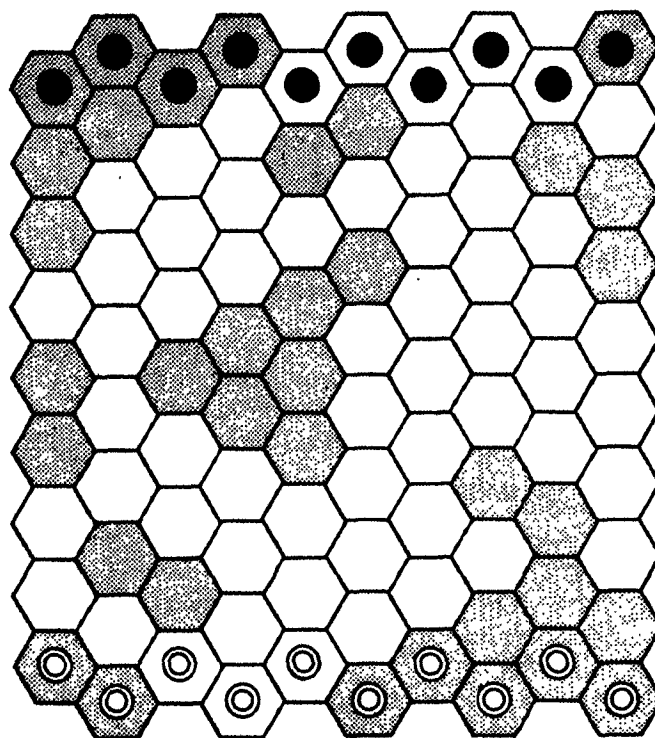


FIG. 1. Tank battle game board, with ten black tanks (top) and ten white tanks (bottom) in starting positions.

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