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MEMORANDUM FOR: The Director of Central Intelligence

FROM : John H. Stein
Acting Deputy Director for Operations

SUBJECT : MILITARY THOUGHT (USSR): The Use of Electronic Computers in Military Science Research

1. The enclosed Intelligence Information Special Report is part of a series now in preparation based on the SECRET USSR Ministry of Defense publication Collection of Articles of the Journal "Military Thought". This article points out the necessity and advantages of developing computer descriptions of operational problems so that they can be researched more scientifically. It refers to Soviet and US experience in this field and makes some suggestions on the composition and organization of the proposed research groups. This article appeared in Issue No. 1 (80) for 1967.

2. Because the source of this report is extremely sensitive, this document should be handled on a strict need-to-know basis within recipient agencies. For ease of reference, reports from this publication have been assigned

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MILITARY THOUGHT (USSR): The Use of Electronic Computers in Military Science Research

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Summary:

The following report is a translation from Russian of an article which appeared in Issue No. 1 (80) for 1967 of the SECRET USSR Ministry of Defense publication Collection of Articles of the Journal "Military Thought". This article, written by Colonel A. Laptev, points out the necessity and advantages of developing computer descriptions of operational problems so that they can be researched more scientifically. It refers to Soviet and US experience in this field and makes some suggestions on the composition and organization of the proposed research groups.

End of Summary

[redacted] Comment:

Colonel Laptev also wrote "Introduction of Electronic Computers into Staff Work" in Issue No. 2 (72) for 1964

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The Use of Electronic Computers in Military Science Research

by

Colonel A. LAPTEV

Mathematical methods and electronic computers are already being quite widely used in various scientific research organizations to develop weapons systems and combat equipment. They are gradually beginning to be used also for research on the combat capabilities of troops in operations. Computers are being employed for this purpose in some research exercises in military districts and in war games conducted by academies.

The purpose of such exercises and war games is to investigate the combat capabilities of front and army troops, the employment of missile/nuclear weapons, and the conduct of an operation under conditions of strong radioactive contamination of the terrain, and to estimate the capabilities of the forces and means of the air defense and the air army of the front in an operation. Thus, in war games conducted by the Military Academy of the General Staff, computers have been used to determine the number of nuclear warheads required for an operation (for an initial nuclear strike and for carrying out the immediate and subsequent tasks of the front), to accomplish the allocation of nuclear warheads among rocket troops and aviation, to establish possible losses on both sides from nuclear and chemical weapons, and to do research on the capabilities of forces and means when conducting an offensive immediately following nuclear strikes and on methods of choosing the optimal nuclear warhead yields for destroying troop groupings in different situations.

As can be seen, the study of new questions of military art with the use of computer technology is already going on. But it must nevertheless be said that in staffs and military educational institutions there is still not enough work being done with the use of computers, and it is directed mainly towards refining certain individual aspects of military affairs, while the conduct of integrated scientific research on questions of strategy and operational art is not yet being widely done.

The reason there has been only slight application of mathematical methods is first and foremost that most staffs and some military educational institutions do not have computers. Another factor is that there has been inadequate development of methods of conducting military science research with the use of computers, and existing mathematical methods do not provide for studying many complex questions of military affairs.

Meanwhile, the time has already come for us to turn decisively to the use of mathematical methods in all the most complex theoretical research.

A considerable number of methods for performing operational-tactical calculations in support of the combat employment of troops in operations have been worked out in scientific research organizations and military academies. It has been established through analysis that it is already possible at the present time to perform up to 20 percent of the complex calculations in staffs by computer. However, as the number of problems developed for computer solution increases and the machines improve, i.e., in the next two to three years, this number may grow as high as 50 to 70 percent.

In our view, there are two expedient methods of using computers for military science research:

-- performance of complex scientific research projects in order to work out the theoretical bases and concepts of operational art and determine the prospects for development of new types of weapons and equipment,

-- conduct of special scientific research exercises and war games to work out new questions of the use of troops in an operation.

Let us attempt to examine these methods in greater detail and to present our ideas on ways to implement them.

The carrying out of integrated scientific research projects and special scientific research exercises and war games using mathematical methods signifies a new and higher stage in military science research. This assertion is justified by the fact that such research makes it possible to reveal more fully the nature of missile/nuclear warfare and, perhaps, to reinterpret certain

concepts of military art. Whereas until recently research had to rely primarily upon the experience of past wars and training exercises and on operational-tactical calculations, it is now possible through computers to perform a more thorough qualitative and quantitative analysis of the capabilities of new means of armed combat and to obtain well-grounded recommendations on the preparation and conduct of an operation and on the creation of prospective types of weapons and equipment.

Therefore, we believe that in carrying out integrated scientific research projects and conducting research exercises it is necessary to provide for working out questions of planning and organizing an initial nuclear strike, of employing nuclear and chemical weapons in an operation, of front troops going over to the offensive immediately following nuclear strikes, with enemy counteraction taken into account, and of planning the regrouping of forces over large distances using basic forms of transport under conditions of enemy nuclear and chemical action.

It is time to work out methods for evaluating the combat capabilities of large units and formations, for substantiating the balance of forces and means required to successfully conduct an operation, for determining the rate of advance possible under different situational conditions, etc.

In order to carry out these tasks it is necessary to work out and validate in good time the criteria for evaluating the effectiveness with which they are carried out and the combat effectiveness of units and large units sustaining losses from nuclear and chemical weapons, and also to formalize the basic processes associated with research into problems of military art.

An even more important aspect of research using mathematical methods is to provide a scientific-theoretical foundation for the basic trends in the development of the armed forces, to evaluate existing and to determine prospective systems of weapons and equipment, and to examine the most expedient organizational structure of the troops and staffs.

Research into all of these problems of military affairs is conducted on the basis of extensive use of various mathematical methods, especially optimization methods, probability theory, linear and dynamic programming, game theory, queueing theory, and

particularly methods of mathematical modeling. There still remains much for scientific research organizations and military educational institutions to do in order to perfect these methods.

It is obvious to everyone that the performance of integrated research in an area of military art is a difficult matter. It can only be done by a group of writers made up of representatives from scientific research organizations and military educational institutions, since the task consists first and foremost in uniting the efforts of outstanding specialists on operational matters with those of well-trained mathematicians and engineers.

In order to raise the quality of scientific research and comprehensively take account of both military and economic factors, the appropriate highly qualified specialists must be assigned to work out certain questions. The responsibility for carrying out major integrated scientific research projects must obviously be assigned to military educational institutions, with other leading scientific research organizations also being involved in them. Such a distribution of responsibilities is necessary because integrated research deals basically with operational questions, and, as is well known, there are no scientific research institutes capable of directing such work. The principal role in carrying out such scientific research projects must unquestionably go to the Military Academy of the General Staff, the Main Staffs of the branches of the armed forces, and other directorates of the Ministry of Defense, and the projects must be directed by the General Staff.

The entire process of integrated research can be broken down into five stages, which are closely interconnected (see chart on page 8).

MODEL CHART OF THE ORGANIZATION AND CONDUCT OF RESEARCH ON AN INTEGRATED SUBJECT MATTER

Average percent of work in stage	20% mathematicians 80% specialists on operational matters	50% mathematicians 50% specialists on operational matters	75% mathematicians 25% specialists on operational matters	50% mathematicians 50% specialists on operational matters	20% mathematicians 80% specialists on operational matters
Name of stage	Development of operational-strategic concept or background of research. Analysis and selection of mathematical research methods.	Formalization of process to be researched.	Development of new mathematical methods and methodologies for conducting research.	Conduct of research on topic.	Analysis of results obtained and collation of materials.
Stage number	I	II	III	IV	V
Content of work in stage	1. Definition of research objectives and problems. 2. Definition of work stages. 3. Development of operational-strategic concept or background of research. 4. Analysis of available mathematical methods and ready methodologies. 5. Selection and development of new mathematical methods for research.	1. Development of operational-strategic formulations and descriptions of the solution of new problems. 2. Definition of basic criteria for computer solution of these problems and for the output results required. 3. Definition and validation of basic assumptions in the solution of problems. 4. Selection or determination of necessary refinement of methodologies.	1. Development of new mathematical methods or improvement of existing methodologies. 2. Testing of the readiness of methodologies on control variants of problems. 3. Development of control variants of the solution of problems. 4. Conduct of research according to available methodologies.	1. Performance of calculations on partial problems and analysis of results obtained. 2. Performance of calculations on integrated problems and models and analysis of results obtained. 3. Performance of calculations integrally for entire topic as a whole.	1. Analysis and sorting of results. 2. Comparison of different materials obtained as the result of calculations. 3. Collation of research materials. 4. Discussion of results achieved. 5. Conclusions and recommendations.
Average time to complete stage	3 to 4 months	5 to 6 months	1.5 to 2 years	5 to 6 months	3 to 4 months

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As is evident from the chart, a very large role in research goes to specialists on operational matters: they initiate and complete a project and also carry out its most important part in the fourth stage.

The number of personnel assigned to an integrated scientific research project will depend on the complexity of the topic and the qualifications of the workers. There is still insufficient experience in carrying out such scientific research projects, and it is thus difficult to make substantiated estimates regarding the number of researchers and their distribution by specialty.

As a point of departure, we may take as our base the experience of carrying out a scientific research project on operational-tactical questions. In this case, for working out problems with regard to planning a front initial nuclear strike and to employing nuclear and chemical weapons during an operation, a group of 20 persons was set up: six operations officers, seven mathematicians, and seven programmers.

The time required to perform the research is determined by the complexity and difficulty of the work and by existing mathematical methods. If any sustantial development of new mathematical methods, particularly of extensive models, is required during the execution of a scientific research project, the time may be fairly prolonged, up to two and three years or longer.

While the carrying out of integrated scientific research projects to examine problems of military art by computer is something new and still insufficiently developed, there is already a certain amount of experience in the organization and conduct of special research exercises and war games. In our view, the research war games conducted at the Academy of the General Staff are the most successful form for conducting such measures.

We shall dwell for the most part on the question of employing computers in the preparation and conduct of such research war games and exercises.

In developing the concept and plan of a game or exercise, a great many calculations of all kinds are performed by computer in

order to set up the most realistic grouping of forces and means on both sides and to work out a theoretically validated course of action for the exercise. Finding extensive application here are problems connected with estimating the effectiveness of the employment of means of mass destruction, the combat capabilities of troops, the qualitative balance of forces and means, and the efficiency of air defense troops, and with planning the regrouping of troops, etc.

In order to more fully reflect the entire process of conducting an operation, all hypothetical situations for the exercise are worked out beforehand on computers. In the interests of greater objectivity, certain of these materials are processed only on computers, for example reconnaissance data concerning the enemy grouping and targets, especially of missile/nuclear and chemical means, and concerning losses on both sides.

Computers are employed particularly extensively to investigate particular questions during the course of a game or exercise. For example, when the decision is being made and the operation planned, front combat capabilities under various situations are estimated by computer. During combat actions, through performance of all types of calculations, the necessary balance of forces and means for successful conduct of the operation is determined and the possible rates of advance and other questions are studied.

Within the staff of the directing body, mathematical models are used to enact the main episodes of the operation and to estimate the results of combat actions on both sides, particularly of the employment of nuclear and chemical weapons, which makes possible greater objectivity in judging the possible outcomes of the operation and the quality of decisions made.

Research into the main questions of conducting an operation may take roughly the following sequence in an exercise: First, a decision is made in general outline for the operation or the performance of some particular task, and the general research problems are defined. Then the staffs and directorates taking part in the game, through the use of computer calculations, refine these decisions and do the research of the questions posed. Then the results are analyzed, collated, and submitted to

the participants for discussion. In some cases involving particular important problems it is advisable to hold a scientific conference on the result of the exercise.

The duration of a research exercise depends on the volume of problems posed and the thoroughness with which they are worked out, but it will always take more time than an ordinary exercise. This is caused by the need to conduct supplementary scientific research both by ordinary methods and by computer. For this purpose it becomes necessary to have long pauses in the operations.

A more complex form of research exercise using computers must come into use in the future: the enactment of all basic questions through two-sided mathematical models or specially developed major research problems of an operational-tactical nature.

This method will raise the quality of scientific research even more, exclude any subjectivity in evaluating the playing sides, and make it possible to draw more thorough and correct conclusions. This will require the development of complex mathematical models and problems that make it possible to assess the combat capabilities of forces of different types. As a beginning, we might use the method worked out in the Military Academy of Armored Troops for determining the combat capabilities of the troops of a tank army. Such a model makes it possible with the use of computers to obtain calculation data on the combat capabilities of an army taking into account the makeup and quality of troops, the nature of combat actions, the methods and procedure of their employment of the main means of combat, and the optimum exploitation of forces, means, and resources, and also taking enemy counteraction into account.*

Thorough research of the problems of military affairs requires obtaining a number of statistical data and generalized descriptions on the organization and conduct of an operation, the structure of troops and staffs, and the types of weapons to be employed. Despite the repeated raising of this question in our press, it is still being resolved slowly. To date, not one operation of the Great Patriotic War has been analyzed in the detail required for mathematical methods, and few statistically

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* See the article by Colonel I. YEREMIN in this issue of the Collection.

processed materials have been obtained on the utilization of forces and means and the effectiveness of battles and engagements carried out under modern conditions. All of this is one of the reasons for the slow introduction of new methods and high-speed computer equipment into scientific research on questions of military art.

In order to make up this deficiency in scientific work, it is expedient that, in the very near future, personnel from certain military academies and scientific research organizations, under the direction of the General Staff, carry out a series of scientific research projects or special assignments on the statistical processing of the course of the most important operations of the Great Patriotic War and major operational exercises.

It is desirable in the future to carefully evaluate the materials of all of the most important exercises, to study them with the aid of mathematical methods and computers, and to systematically accumulate various numerical coefficients and descriptions. It would clearly be very useful to concentrate all material from training exercises in one place and assign certain specific organizations, using modern methods, to thoroughly analyze the decisions of the two sides, to evaluate the results of employing the principal means of combat, to study the forms and methods of troop control, and then to draw generalized conclusions on all of these questions. All of these systematized descriptions and coefficients can then be utilized in scientific research work and in actual staff activity.

It must be stated in conclusion that, in order to carry out the enumerated projects within the Military Science Directorate of the General Staff, it is necessary to have a corresponding scientific research organization with a good computer base, an organization in which to bring together specialists in different fields of military art, mathematics, and economics. This will help to significantly accelerate the conduct of integrated projects and to carry them out with higher quality. In addition, it will be possible through the operational specialists available in this organization to arrange closer contact with the directorates of the General Staff and to make extensive use in actual practice of the experience gained in exercises and in combat and operational troop training.

This organization will also independently be able to carry out large-scale integrated scientific research projects designed to investigate problems of military affairs, to analyze the substance of materials from operational-strategic exercises, and to collect statistical data on the fundamentals of employing troops and using combat equipment; and it will be able, together with staffs and military academies, to participate in the conduct of scientific research exercises and war games.

Such an establishment, in the form of a tactical-strategic analysis group (STAG), was created as early as 1960 within the US Department of Defense. Its task is to develop models for researching ground forces combat actions and for performing various analyses and tests of operational plans, including plans of the joint staffs.

The tactical-strategic analysis group consists of three sections:

-- the planning section, which studies ground forces problems and determines the expediency of using war games modeling methods in resolving them;
-- the operations research section, which carries out the development of models of the conduct of ground forces combat actions;
-- the computer section, responsible for computer operation.

The group has been assigned the task of working out a complex war game model which makes it possible to repeatedly enact the combat actions of the sides and get statistically reliable results. It is planned during a game to display the game situation on special screens and, by altering the information, to research specific questions about the conduct of combat actions.

The tactical-strategic analysis group does not replace the work of other organizations studying questions of war games, but supplements them. It collects information on all war games conducted in the army and can thus recommend specific variants of combat actions and make proposals during the development of war plans.

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These are some of the considerations for improving research on questions of military art through the use of mathematical methods and electronic computers. There is still much work to be done in this direction, and the sooner it is done the more successful we shall be in working out the most important applied questions of the development of military art, weapons, and equipment.

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