“THE REMOTENESS of UNCONVENTIONAL EQUIPMENT”

by

JOHN K. NORTHROP

President, Northrop Aircraft, Inc., Hawthorne, California

** Mr. Northrop entered aviation prior to World War I, working for the Lougheed Brothers, then building twin-engine flying boats. Served in Army Signal Corps* ***in*** *World War I and returned to the Lougheeds, whose name is widely known today* in *the phonetic spelling of Lockheed. In 1923, he joined Douglas Aircraft as a designer and project engineer on many early Douglas planes. In 1927 was one of the organizers of present Lockheed Company. His first flying wing design was built and flown in late '20's but had to be abandoned until the early '40's because of finances. The Northrop Corporation was organized in 1931 for design of numerous aircraft under Northrop's direction. Present Northrop Aircraft was formed in 1939 with Northrop as President.*

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SUMMARY

Three major classifications of guided missiles suitable for intercontinental warfare are briefly described and their relative characteristics discussed.

Qualified estimates of time and cost required for the production of various quantities of missiles in the different classifications are presented, and the importance of evaluating time and cost requirements in addition to technical possibilities is stressed.

Dangers of over-optimism concerning rapid development of push-button warfare are pointed out, and some advantages of guided missiles, once they are available, are outlined.

AVAILABILITY VS. TIME

Analysis of the remoteness, or the availability vs. time, of unconventional equipment, and an estimate of the years required to translate push-button warfare theories into practice, involves a high degree of guesswork because of the fact that little or no actual experience in such fields of endeavor is available at this time.

For this reason the time and cost estimates submitted herein must be viewed as qualitative rather than quantitative data. They have been obtained from personnel who are as well qualified as possible under present conditions of limited experience in the field, but they may be largely in error even if the premises on which they are based remain unchanged by new discoveries or developments. If new discoveries should be made affecting the fields of endeavor concerned, the figures given might vary several hundred percent.

ONLY LONG-RANGE MISSILES CONSIDERED

At the risk of over-simplification it is assumed that unconventional equipment means guided missiles and that the only guided missiles that would justify a general translation of push-button warfare theories into practice are those able to carry at least a 5,000-pound warhead for a range of at least 4,000 miles.

The first of these assumptions is based on the fact that the general category of guided missiles is the only major development that could warrant a revolutionary change in our military planning. The second assumption is made because any missile capable of less than intercontinental range must be used as an auxiliary to manned aircraft, ships and armies rather than as a substitute for them.

THREE MAJOR CLASSIFICATIONS

Sufficient engineering analysis of the problems involved in the design, development and production of long-range guided missiles has been completed in the past two years to warrant dividing such weapons into three major classifications. These are, the subsonic pilotless aircraft, the supersonic pilotless aircraft, and the supersonic rocket.

SUBSONIC PILOTLESS AIRCRAFT

The first of these weapons is analogous to the German V-l buzz bomb which was used in large quantities against London and other Allied cities in World War II. The V-l had a range of about 150 miles, a high speed of 300 to 400 miles per hour, and a type of guidance which was only suitable for use against widespread target areas, even at the short distances over which it was employed.

Based on fairly complete design studies it is reasonable to expect that almost any competent aircraft manufacturer could, in a modern design, extend the speed of such missiles to 600 miles per hour and the range to 4,000 miles. The methods and equipment necessary to accomplish these improvements are already well known in this country. Important elements such as power plants suitable to the project are now in existence and the aerodynamic problems involved have been solved, both here and abroad, in the design and construction of numerous piloted aircraft.

The most serious problem remaining unsolved is that of accurate guidance over the greatly increased ranges required. Considerable progress in overcoming even this obstacle has been made in the past year and a half, and there is reasonable assurance at this time that guidance mechanisms could be perfected almost as rapidly as the missile itself.

SUPERSONIC PILOTLESS AIRCRAFT

The second classification of guided missiles requires increase in the missile's speed to supersonic velocities—perhaps 1,200 to 1,400 miles per hour—through the development of airframes suitable for such speeds and the solution of the aerodynamic problems encountered. Although some progress has been made in the basic research necessary for the design and construction of such a vehicle, actual development along such lines is negligible and there is nothing on which to base hope for the early or rapid successful development of such equipment other than a very limited series of model tests. A typical idea of the problems involved may be obtained from the fact that in order to produce such a missile, it will be necessary to perfect power plants having five to ten times the thrust, and more than double the thrust per unit of frontal area, of any now running. The design and construction of such power plants, even under high priority, must of necessity

involve several years of intensive work.
Supersonic wind tunnels and allied equipment necessary even for model testing in the supersonic field are extremely expensive. Because of greatly increased drag and resulting poor over-all efficiencies at supersonic speeds, much larger and more complex aircraft will be required to accomplish a given objective, than though a subsonic vehicle were used. For these reasons the supersonic pilotless aircraft will take considerably longer to develop and will be much more expensive than the subsonic type. The problems of guidance of the supersonic pilotless aircraft are in large measure similar to those of the subsonic vehicle, although appreciably more difficult of solution. Nevertheless, the same general type of guidance equipment, with some additional development and complication, is conceivably suitable for either subsonic or supersonic aircraft.

SUPERSONIC ROCKETS

The third type of guided missile that must be considered is the supersonic rocket. This vehicle is exemplified by the V-2 developed by the Germans during the war for the attack on London. The V-2 effort was one of the outstanding technical accomplishments of World War II, requiring approximately six years to complete, and an estimated outlay of the equivalent of $250,000,000. When it is considered that the maximum range of the V-2 was about 200 miles and the accuracy attained permitted only general bombing of large areas at short range, it may be realized that a tremendous amount of research and development is necessary before a suitable long-range rocket with proper guidance can possibly be obtained.
Qualified experts, starting with information on the V-2, and expanding the field of knowledge in the past two years, have determined that the range of supersonic rockets can be increased to something more than the 4,000 miles assumed essential for intercontinental warfare. However, the size, weight and complications of the missile are all greatly increased and the whole project is so dependent on the development and availability of superior fuels that the time and cost estimates made for such an endeavor are the least reliable of all those submitted.
It is in the field of guidance that the most significant difference between pilot-less aircraft and rockets occurs. The reasonable assurance of suitable guidance which we believe exists for pilotless aircraft cannot be claimed for the rocket at this time, and projects now well under way for the development of guidance systems for pilotless aircraft are largely inapplicable to the problems of rocket guidance.

RELATIVE VALUE OF VARIOUS TYPES

In determining and comparing the values of the three types of guided missiles briefly described above, it is necessary to consider many characteristics of each which cannot even be outlined in a paper of this scope, let alone properly evaluated. Space permits the mention of only a few of the most important, namely, time of development and production, cost of development and production, degree of accuracy to be expected, and relative ease of interception by an enemy.
Subsonic pilotless aircraft are definitely superior to other types in respect to the first three items and inferior in the last. The supersonic rocket is inferior in the first three and definitely superior in the last. The supersonic pilotless aircraft falls between the two in respect to each of the four items.

TIME AND COST CONSIDERATIONS

Many articles and discussions of the relative merits of aircraft and guided missiles, as well as the various types of guided missiles, concern themselves solely with the technical possibilities and completely neglect two essential considerations. The first of these is the time required for the perfection of such a potentially valuable new weapon. The second is the relative cost thereof.
The ability of the nation to protect itself, either through defensive or counter-offensive operation, is definitely limited by the economic willingness and ability of the nation to produce, both in times of peace and under the stimulus of war. This ability may be measured in terms of dollars appropriated by Congress, or man hours, or pounds of strategic materials available to the production effort. These economic limitations may very readily determine the final selection of new weapons, regardless of the technical possibilities.
It is apparent, in comparing the economic value of a 600-mile per hour subsonic pilotless aircraft with a 3,500-mile per hour supersonic rocket, that if the rocket cost ten times as much as the aircraft, only one out of ten aircraft need reach its objective to equal the offensive power of a 100% effective rocket, and that if cost is taken into consideration, the pilotless aircraft may be more attractive than the rocket, even if the rocket were equally available. On the other hand, the subsonic aircraft would be useless if the enemy were known to have defenses that would detect and stop a very large proportion of those launched. If the warhead of a guided missile represented a very great expenditure, as is the case with atomic bombs, it would be necessary to use the most positive method of delivery, almost regardless of the cost of the vehicle itself.

QUALIFICATION OF ESTIMATES

Based on limited information available at this time, and subject to the many qualifications outlined above, we have endeavored to summarize time and cost estimates for the development of the three categories of guided missiles described. The estimates cover three necessary steps in the quantity procurement for wartime use of such weapons. The

first step is the research and development required for the production and test of five experimental missiles. The second step includes the first, plus the manufacture and launching of a service test and preliminary training quantity totaling 200 missiles, which number might be inadequate in the case of rockets. The final step is the production of 5,000 missiles.

Time and cost estimates are submitted for the first two phases of the program but for the third, cost estimates only are furnished, as the time involved would depend entirely on the number of organizations used and the priorities granted to such production. The time estimates assume a definite decision as to the extent of the program to be undertaken, at the time the program is started. In other words, it would be impossible to complete and test 200 subsonic pilotless aircraft missiles in a four-year period and at a cost of $25,000,000 unless the decision were reached at the inception of the program that it was to include a total of 200 missiles. The time and cost would both be greater if the first phase experimental program were completed prior to a decision to proceed with the service test and training quantity program. They would be much greater unless the selected program were pursued vigorously and with adequate priorities.

PHASES AND COSTS IN DEVELOPMENT OF GUIDED MISSILES

Item	Subsonic (600 mph) Pilotless Aircraft		Supersonic (1,400-mph) Pilotless Aircraft		Supersonic (3,500-mph) Rocket	
	Time	Cost	Time	Cost	Time	Cost
Research, Development, Experimental Engineering and 5 Experimental Missiles	3 years	$ 6,000,000	6 years	$ 30,000,000	10 years	$ 150,000,000 to $ 250,000,000
Research, Development, Production Engineering and 200 Service Test and Training Missiles	4½ years	$ 25,000,000	10 years	$ 100,000,000	15 years	$ 250,000,000 to $ 375,000,000
Production Quantity of 5,000 Missiles		$375,000,000		$1,500,000,000		$2,500,000,000 to $3,500,000,000

The chart is submitted with the reiterated caution that it must be used as a comparative rather than an absolute estimate of time and costs involved.

PUBLIC DANGEROUSLY OVERSOLD

From the information now available we are forced to conclude that the general public has been greatly oversold on the possible imminence of push-button warfare, and that even if we select the simplest and cheapest program of development, about five years would elapse under peacetime conditions before it would be possible to make available sufficient guided missiles to be used as effective weapons in intercontinental war. Under the stimulus of wartime conditions it is possible that the time required could be reduced somewhat below the estimates given, but in any program of production of a new type weapon the days at the start of the program are just as important as those at the end. Therefore it is vital that a decision be reached promptly and pursued vigorously if we are to achieve even the estimated timing. The idea that push-button warfare of any type could be used for any purpose within months, or even two to five years, is a dangerous fallacy that must not be allowed to interfere with the availability of existing and improved military equipment of conventional types.

GUIDED MISSILES A SUPPLEMENT

When guided missiles come into use as effective intercontinental weapons it can only be expected that they will supplement more thoroughly proved types of equipment. An extensive period of active use after the time of their introduction in any conflict must be planned before they could be expected to form the major backbone of our offensive equipment. We must recognize that there is as much opportunity for improvident in guided missiles as there is in aircraft, and at all cost avoid a "Maginot Line" philosophy which would permit complacent reliance on the earlier types that may be built. It is essential that research and development continue on high priority in this largely unexplored field if any semblance of security is to be maintained.

It must not be assumed from the above that shorter-range missiles of various types may not be developed and perfected as auxiliaries to more conventional military equipment in less time than above mentioned. During the period of World War II very rapid improvement in fire power and destructive force of aircraft occurred through the perfection of more powerful short-range rockets, heavier bombs and more powerful guns. The backbone of the striking force, however, remained the aircraft which transported the actual weapons of destruction over the distances involved.

It is of vital importance, therefore, that all those concerned with the defense of the United States lend their efforts to the debunking of the public insofar as the imminence of push-button warfare is concerned, so that we may maintain an adequate air force of constantly improved types over a period of at least the next ten to fifteen years. On the other hand, the basic advantages inherent in the use of guided missiles warrant the continuation of research directed toward their ultimate perfection on a high priority schedule.

ADVANTAGES OF GUIDED MISSILES

A few of the important advantages inherent in their use are as follows:

First, the knowledge of the existence of such weapons may prove a powerful psychological deterrent against aggression on the part of any enemy. Very few wars are started without the reasonable assurance on the part of the aggressor that he can overpower the enemy promptly and with comparatively little damage to his own economy and existence. The sure knowledge of powerful and instantaneous reprisal in spite of anything that could be done should serve to give pause to those contemplating aggressive maneuvers.

Second, the guided missile produced in years of peace and under comparatively leisurely conditions could be maintained in a condition suitable for virtually instant mobilization, far more easily than would be possible with a manned air force of conventional aircraft. Once produced, the missiles could be stored in widely scattered and well camouflaged outposts, either above or under ground. The maintenance expense and the man power required would comprise a very small fraction of. that needed to maintain a conventional air force of equal striking power in like readiness. Problems of personnel procurement, personnel training and personnel risk would all be greatly minimized if missiles were used.

Third, the know-how is presently available for the design of a 600-mile per hour missile with a range of 4,000 miles or better, which can be built at a reasonable price, and which is suitable for mass production in shadow factory organizations. Quantity production of long-range bombers to accomplish the same type of mission is a comparatively difficult, costly and complex project.

Entirely neglecting the humanitarian aspects of the case, it will always be easier to secure man power for the factory than for the field of battle. The United States has always been pre-eminent in the field of mechanized quantity production—the use of guided missiles takes full advantage of this supremacy.

QUALIFICATIONS OF GUIDED MISSILES

At least in the early stages of their use, guided missiles having the necessary range for intercontinental warfare cannot be expected to achieve usefulness against pin-point targets such as bridges, individual factories, etc. They can be extremely useful for attack on industrial areas, however, with explosive, incendiary, biological or atomic warheads. There is no particular reason why they cannot be developed in sizes to carry warheads two or three times the weights assumed earlier in this paper.