THE BATTLE OF NANCY

A Double Envelopment

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COMBAT situations confronting corps commanders of World War II presented few opportunities for employing the double envelopment as the scheme of maneuver. The situation facing XII Corps at Nancy, France, early in September of 1944, however, did offer such an opportunity. The XII Corps Commander, quickly discerning that the conditions favored a pincer movement, executed a double envelopment and achieved decisive results.

General Situation

The occasion for the employment of the double envelopment by XII Corps resulted from a series of incidents which occurred during the pursuit of the German forces eastward across France. The breakthrough at St. Lô by the First Army, and the eruption of the Third Army from Avranches, set the stage for the German withdrawal to the east. Early in August, the Third Army, attacking in conjunction with the First Army on its left (north) flank, began a sweep which ended late in September.

XII Corps, as part of the Third Army, began its part in the liberation of France after its concentration southeast of Le Mans, during the period 12-15 August. Within 16 days, the Corps advanced some 250 miles, crossing five major rivers. These rivers were successfully crossed by the use of tactics which utilized speed and surprise. By 31 August, the Corps had seized and secured a bridgehead east of the Marne River extending from Chalons-Sur-Marne to Vitry Le Francois (Map 1).

The next 2 days saw XII Corps across the Meuse River and established in force at Commercy. At this time, the Corps was disposed as shown in Maps 2 and 3. Note that the attacking elements of the Corps were one infantry division (80th Infantry Division) and elements of the 4th Armored Division. The 35th Infantry Division was employed to protect the Army's south flank. The Corps at this time was operating on a front of some 30 miles (Map 2).

The Commercy bridgehead was the springboard for the capture of Nancy.

Before going into the battle of Nancy, it is well to relate a few facts which had an important bearing thereon. The advance of XII Corps, following its concentration at Le Mans, entailed only light casualties and was extremely rapid. By the end of August, however, the Corps was forced to slow down. Gasoline and artillery ammunition were in short supply and replenishment was far below the requirements of the Corps. Consequently, the armored units and most of the infantry units were partially immobilized. The advent of inclement weather early in September was also a deterrent to rapid advance. Finally, the speed of the XII Corps sweep militated against the collection of adequate and accurate information of the enemy.

The Terrain and the Enemy

The terrain between the Meuse River and the Moselle River consists of a series of wooded ridges and open valleys cut by numerous streams south of Toul and by lakes north of the town. The valleys are

controlled by the high ground at Toul and Pont-St-Vincent. The Moselle River valley is dominated by the high ground east of the River. The Foret de Haye, the natural approach to Nancy, is a heavily wooded plateau protected by the loop of the Moselle River and the old forts strategically situated to guard this approach. East of Nancy, the country is generally flat and poorly drained. Several dams and catchment basins in this area form ponds and lakes. Large sections of this area can be flooded by breaching the dams.

The German forces opposing XII Corps were disposed generally as shown in Map 3. It was estimated that the Corps was opposed by 24,000 men actually engaged, and 12,000 men in reserve, but these figures proved to be highly conservative. The enforced slow-down of XII Corps in late August permitted the disorganized and fleeing enemy to halt and entrench behind the barrier of the Moselle River. It also permitted reinforcements from Italy and Germany to occupy positions along the Moselle River from Pont-A-Mousson in the north to Epinal (Map 2) in the south. Strongpoints were established west of Pont-A-Mousson, Toul, and Epinal.

There were few opportunities in World War II for a corps to execute a double envelopment, but the attack toward Nancy was one instance where such a maneuver was feasible, and the results were decisive

The Operation

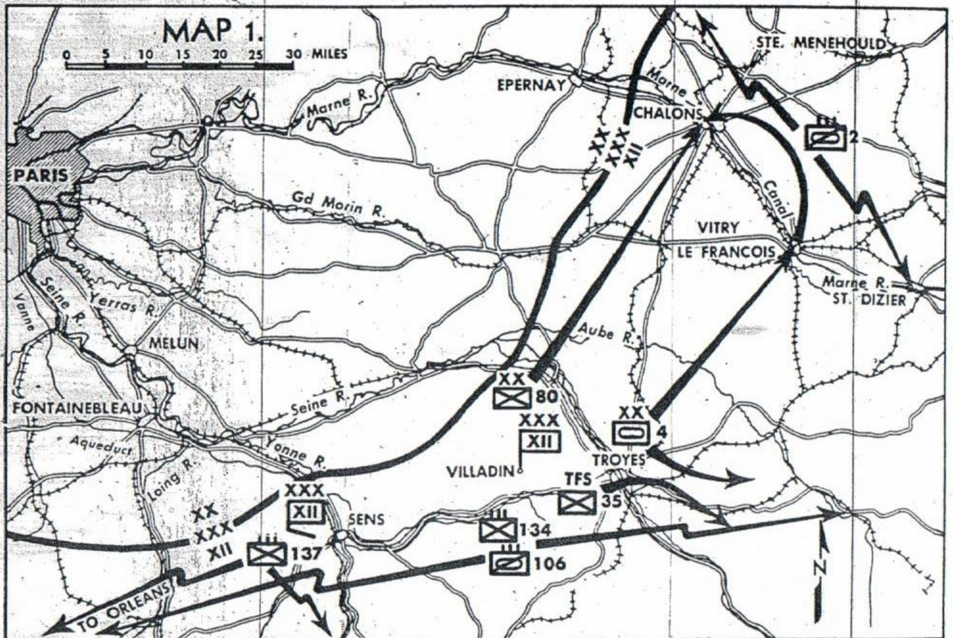
By 4 September, XII Corps was able to obtain sufficient gasoline to resume the advance. The Corps Commander, therefore, directed the 80th Infantry Division to conduct a "reconnaissance in force" east of the Moselle River. The attack, if successful, would be exploited and would precede a general advance to seize a crossing over the Rhine River at Mannheim. The plan provided for a thrust by elements of the 80th Infantry Division to establish a crossing point at Pont-A-Mousson (historically a crossing site since the days of the Romans). The crossing was to be exploited by Combat Command A of the 4th Armored Division, which would attack southward and envelop Nancy from the north. A second task force from the 80th Infantry Division, supported by Combat Command B of the 4th Armored Division, was to establish a bridgehead at Toul and attack through the Foret de Haye in order to seize Nancy from the west.

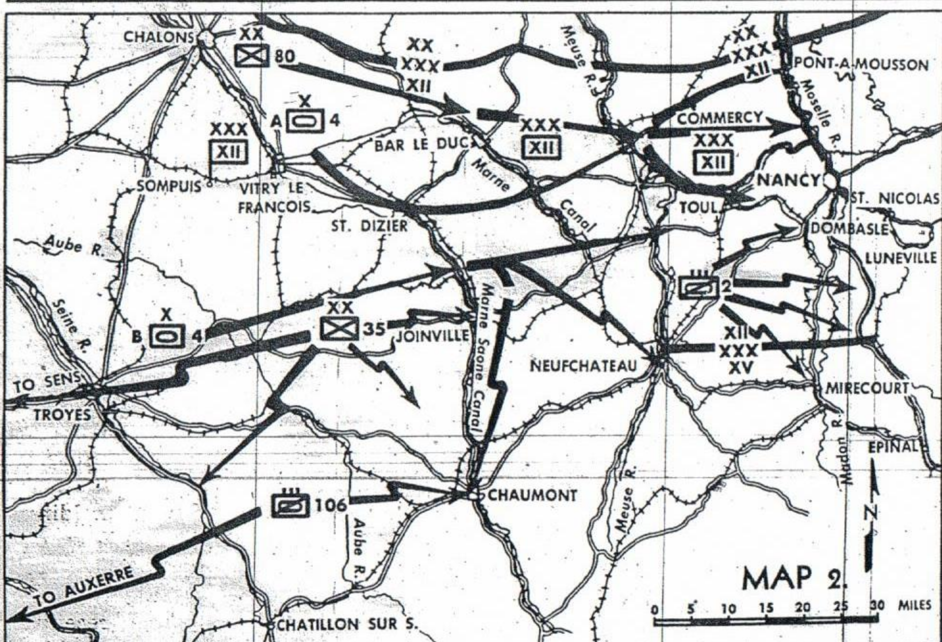
The 35th Division, which had been protecting the Army's south flank since the capture of Orleans (15-16 August), was to continue its mission. At this time, the 35th Division was protecting more than 100 miles of vulnerable flank (see Maps 2 and 3).

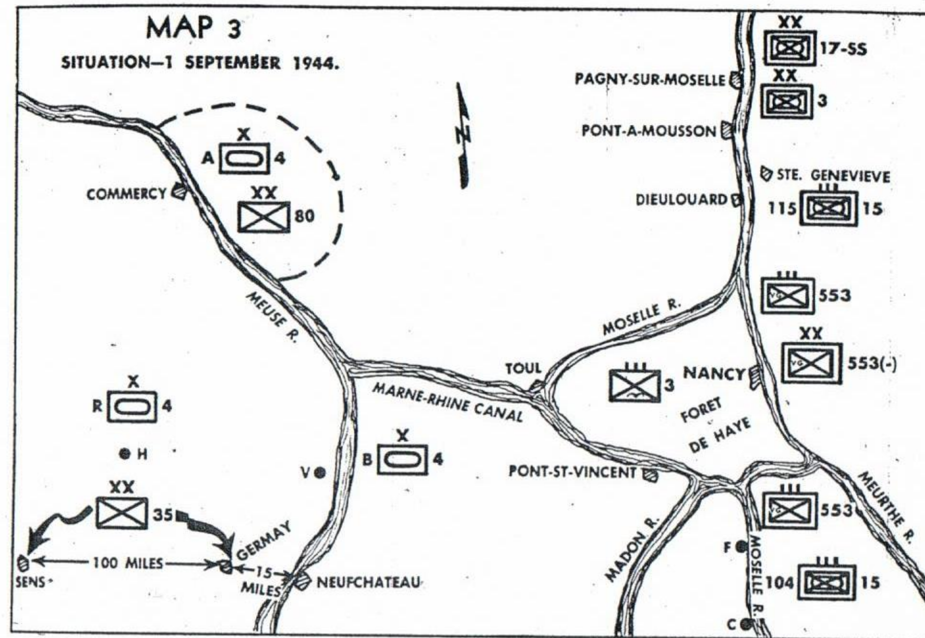
The attack of the 80th Infantry Division at Pont-A-Mousson was launched early on the morning of 5 September. The attack was necessarily made without benefit of thorough reconnaissance and with minimum artillery support. Throughout the day, the division attempted, without success, to establish a bridgehead. Small groups which succeeded in crossing the river were repulsed by strong enemy counterattacks. That night, the 80th Division regrouped and again attacked. A small force succeeded in crossing the River but was driven back the next morning.

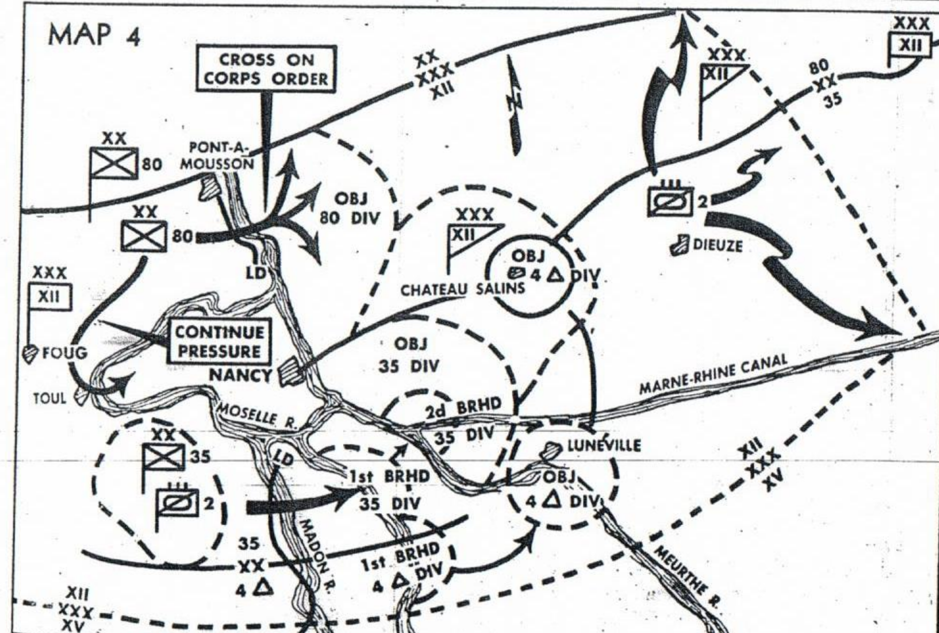
The attack of the Task Force at Toul succeeded in establishing and holding a bridgehead east of the Moselle River. All attempts to advance through the Foret de Haye, however, were unsuccessful.

On 5 September, XII Corps received a directive from Third Army to seize Nancy


MAP 1.
0 5 10 15 20 25 30 MILES
STE. MENEHOULD
EPERNAY
Marne R.
CHALONS
PARIS
Gd Morin R.
Canal
VITRY LE FRANCOIS
Marne R.
ST. DIZIER
Yerras R.
Seine R.
Vanne
MELUN
Aube R.
FONTAINEBLEAU
Seine R.
Aqueduct
Loing R.
Yonne R.
XX 80
XXX XII
XX 4
VILLADIN
TROYES
TFS 35
XX XXX XII
XXX XII
SENS
137
134
106
2
TO ORLEANS
N


CHALONS
XX 80
XX XXX XII
Meuse R.
PONT-A-MOUSSON
X A 4
XXX XII
BAR LE DUC
XXX XII
COMMERCY
XXX XII
Moselle R.
SOMPUIS
VITRY LE FRANCOIS
Marne
Canal
NANCY
TOUL
ST. NICOLAS
ST. DIZIER
DOMBASLE
Aube R.
LUNEVILLE
Seine R.
X B 4
XX 35
JOINVILLE
Marne Saone Canal
2
XII XXX XV
TO SENS
NEUFCHATEAU
MIRECOURT
TROYES
Madon R.
EPINAL
106
CHAUMONT
Meuse R.
Aube R.
N
TO AUXERRE
MAP 2.
CHATILLON SUR S.
0 5 10 15 20 25 30 MILES


MAP 3
SITUATION—1 SEPTEMBER 1944.
XX 17-SS
PAGNY-SUR-MOSELLE
XX 3
PONT-A-MOUSSON
X A 4
STE. GENEVIEVE
COMMERCY
XX 80
DIEULOUARD
115 15
MEUSE R.
553
MOSELLE R.
XX 553(-)
TOUL
NANCY
X R 4
MARNE-RHINE CANAL
3
FORET DE HAYE
H
V
X B 4
PONT-ST-VINCENT
XX 35
MEURTHE R.
553
GERMAY
MADON R.
F
MOSELLE R.
SENS
100 MILES
15 MILES
NEUFCHATEAU
104 15
C


MAP 4
XXX XII
CROSS ON CORPS ORDER
XX XXX XII
XXX XII
80 XX 35
XX 80
PONT-A-MOUSSON
OBJ 80 DIV
XX 80
XXX XII
2
DIEUZE
LD
OBJ 4 DIV
XXX XII
CHATEAU SALINS
FOUG
CONTINUE PRESSURE
OBJ 35 DIV
NANCY
MARNE-RHINE CANAL
TOUL
MOSELLE R.
2d BRHD 35 DIV
XX 35
LD
LUNEVILLE
1st BRHD 35 DIV
OBJ 4 DIV
XII XXX XV
2
35 XX 4
MADON R.
1st BRHD 4 DIV
MEURTHE R.
XII XXX XV

and establish a bridgehead east of the Moselle River. This directive, and the inability of the 80th Division to advance on 5-6 September, caused the Corps Commander to make new plans for accomplishing his mission. Two important developments occurred at this time which permitted the Corps to employ the 35th Infantry Division in an assault role. First, the Seventh Army, attacking north from southern France, had advanced sufficiently to make a juncture of the Third and Seventh Armies imminent. Second, XV Corps was assigned to the Third Army and given the mission of protecting the Army's south flank, thus relieving XII Corps of this responsibility.

In view of the changed situation, XII Corps devised a plan which was to result in a double envelopment of Nancy and the establishment of a secure bridgehead east of the Moselle River. The plan envisaged an attack by the 35th Division south of Nancy, a holding force at Toul, and an attack by the 80th Division north of Nancy (see Map 4).

Time for the attack of the 35th Division was set at 110500 September, with the Madon River as the line of departure. The 80th Division was to be prepared to cross the Moselle on Corps order. The 4th Armored Division was ordered to attack with Combat Command B on the right of the 35th Division, Combat Command A being prepared to cross north of the 80th Division or to exploit any success obtained by the 80th Division. The Corps artillery provided a northern and a southern support group by employing two fire direction centers.

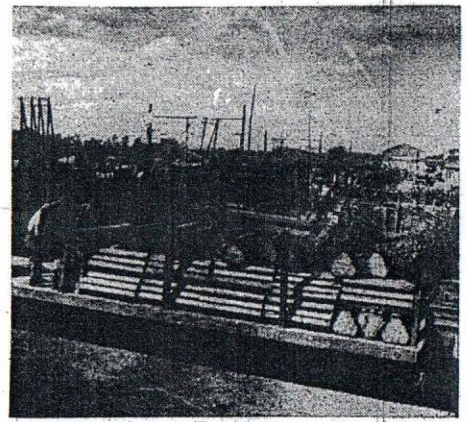
The attack by the 35th Infantry Division and Combat Command B, 4th Armored Division, on 11 September was successful. By noon of the next day, both units were firmly established on the east bank of the Moselle. Strong German counterattacks were repulsed and heavy losses inflicted upon the enemy. Late afternoon of the 12th found the Germans retreating to the northeast, closely pursued by the attacking forces who were assisted by combat planes of the XIX Tactical Air Force. Three days later (15 September), all elements of XII Corps south of Nancy had either crossed the Marne-Rhine Canal or had closed to the near bank, Map 4). This action succeeded in cutting the Nancy-Lunéville Road, thereby denying this route of retreat to the German forces in the vicinity of Nancy.

The success of the 35th Division and Combat Command B on 11-12 September dictated a prompt effort to cross the Moselle River north of Nancy. Consequently, the Corps Commander directed the 80th Division to attack early on the morning of 12 September in the vicinity of Dieulouard. The Division advanced against surprisingly light resistance and by 0800 had seized the heights in the vicinity of Ste. Genevieve. A heavy ponton bridge was constructed by nightfall, and the remainder of the Division began moving into the bridgehead. The next morning, the enemy made a determined effort to destroy the 80th Division bridgehead and succeeded in advancing within 100 yards of the bridge site before being repulsed. Not until late afternoon was the original perimeter of the bridgehead restored.

Armored Action

The 4th Armored Division played an important role in the encirclement of Nancy. As stated above, Combat Command B crossed the Moselle River south of Nancy and severed the Nancy-Lunéville Road.

On 11 September, Combat Command A attempted to cross the Moselle River in the vicinity of Pagny-Sur-Moselle. This attempt failed due to a lack of adequate bridging and equipment. The success of the 80th Division on the morning of the 12th, and the early construction of a heavy bridge across the Moselle at Dieulouard,



Above, men of the 317th Regiment, 80th Infantry Division, reach the bank of the Moselle River on 5 September 1944, under German fire from the far heights. Right, ammunition being unloaded at Le Mans, France, in August 1944; XII Corps concentrated southeast of Le Mans a few days before this picture was taken. Below, the mayor of Nancy, France, thanks personnel of the 35th Infantry Division for their part in the liberation of the city on 15 September 1944; the city fell as a result of a double envelopment executed by XII Corps, composed of the 35th and 80th Infantry Divisions and the 4th Armored Division.—US Army photos.

provided a means for Combat Command A to cross the River.

When the leading elements of Combat Command A arrived at the 80th Division bridge site on the morning of the 13th, the German counterattack was threatening the 80th Division bridgehead. The Corps Commander, who was present at the bridge site, had to make a quick decision. If he permitted Combat Command A to cross, the bridgehead might be saved and success exploited; however, he ran the risk of losing part of his armor, for there was no guarantee that the bridgehead would hold. A failure to commit the armor could well result in the loss of the bridgehead. After a conference with his subordinate commanders at the bridge site, he ordered Combat Command A to cross the bridge.

Thus began one of the finest armored actions of the war. Combat Command A crossed the river, crashed through the German counterattacking forces, drove the Germans from the high ground at Ste. Genevieve, and advanced rapidly to the east. That night Combat Command A "coiled up" 3 miles west of its original objective of Chateau Salins. On 14 September, Combat Command A drove south and by nightfall contacted Combat Command B on the Marne-Rhine Canal. The juncture of the two armored columns closed the pincer on Nancy.

The Capture of Nancy

While the two divisions were crossing the Moselle River on 11-12 September, the Corps Commander organized Task Force *Sebree*. This force, composed of elements of the 35th and 80th Infantry Divisions, plus supporting tanks and artillery, was ordered to advance through the Foret de Haye and to attack Nancy from the west.

On 14 September, patrols from Task Force *Sebree* entered the Foret de Haye, which a few days before had been heavily defended, and advanced over a mile without resistance. On the morning of the 15th, the Task Force advanced through the forest and by 1100 was in the city of Nancy. No resistance was encountered. Nancy was captured. The double envelopment had "paid off."

Conclusion

The battle of Nancy demonstrates the effectiveness of using the double envelopment as a means for destroying the enemy or forcing him to withdraw to avoid destruction. An attack through the Foret de Haye in the early stages of the operations would have been costly to XII Corps, for later information proved that this area had been strongly held and was indeed a formidable obstacle. The threat of envelopment from the north and south forced the defenders of this bastion to withdraw. The unopposed advance and occupation of Nancy by Task Force *Sebree* was undoubtedly made possible by the double envelopment.

The battle of Nancy further illustrates the soundness of the combat principles taught in our field manuals. A few of the principles applied in this operation are as follows:

Principle.—During the decisive phase of combat, the place of the commander is near the critical point of action.

Example.—The presence of the Corps Commander at the 80th Division bridge site enabled him to make an important and quick decision.

Principle.—The command seeking to attack by double envelopment must be deployed, or be capable of deploying, on a broad front against an enemy on a much narrower front or with little capacity for maneuver. The maneuver is executed by making a secondary effort in the center while striking with enveloping forces on both hostile flanks. When mobile reserves are available in reserve, they may complete the envelopment by an attack from the rear.

Example.—The principle is well illustrated by the battle of Nancy (see Map 4).

Principle.—The objective should have the following characteristics:

a. Its capture must be possible within the time and space limits imposed by the assigned mission.

b. The threat of its capture should compel the enemy to evacuate his position or risk destruction therein.

c. Its capture should facilitate contemplated future operations.

d. It should produce a convergence of effort.

e. It must be easily identified.

Example.—The operation plan of XII Corps applied this principle well (see Map 4).

Principle.—The armored division should be employed as a unit. The detachment of any element should be made with the knowledge that the ensuing effort of the division will be impaired.

Example.—The principle above is excellent. There are times, however, when the employment of armor will be dictated by the existing situation. XII Corps, operating on a wide front with a vulnerable flank and an obscure picture of the enemy, chose to employ the combat commands of the 4th Armored Division on separate missions.

Principle.—The infantry will normally provide a gap through fortified areas or bridge rivers for the passage of armored units.

Example.—Bridge constructed by 80th Division.

Principle.—Armored units are normally assigned deep objectives in order to exploit the gains of the infantry, to destroy enemy lines of communications, and to prevent withdrawal of the enemy.

Example.—The objectives assigned to elements of the 4th Armored Division were 20 miles behind the Moselle River line.

Continued study of the ground and practice in its adaptation to one's purpose is the key to tactical efficiency.

Major General C. H. Boucher, Great Britain

Success in almost every human endeavor depends upon the production of the preponderating force at the right place at the right time.

Rear Admiral T. H. Troubridge, Great Britain

North to Everywhere

Lieutenant Colonel William R. Prince, *Cavalry*
Instructor, Command and General Staff College

FORTY years have elapsed since the Wright brothers made their historic flight at Kittyhawk. In those days, distances were great and the world was 25,000 miles around. To a farmer in Kansas, China was on the other side of the world and therefore must be 12,000 miles away.

Since that historic moment when the simple flying machine of the Wright brothers barely lifted itself above the sand dunes of the North Carolina coastline, developments have been such as to necessitate a complete re-orientation in our concept of world geography. We have been thinking so long in terms of east and west crossings of oceans and continents by ships, road, and rail that it would take some time to accept what we have learned in the past few years—that the world is round in all directions.

Before long-range, pressurized, stratoliners made their appearance, our idea of travel was as though the world were flat. The distance from Washington, D. C., to Moscow was 6,000 miles, from New York City to Tokyo 7,500 miles. Roads, railroads, and sea routes encircling the globe followed generally along parallels of latitude, or around its fat girth. They could not penetrate and cross over the formidable, frozen, top and bottom sides of the world. The poles of the earth were the preserves of a handful of intrepid adventurers.

Mercator Projection

The world was treated as a cylinder, the ends of which represented the north and south poles. We split this cylinder up one side, opened it out, and laid it flat. For millions of persons, this type of projection onto a flat surface is probably the most common geographic representation of the world. It is the projection shown in Figure 1. A traditional Mercator projection, it has led to at least three widespread misconceptions.

One of these misconceptions pertains to distances. The distance between Washington and Tokyo laid off on a Mercator chart is about 7,500 miles, but if a string is stretched between these two points on a globe the distance is considerably reduced. A second misconception pertains to directions. On a Mercator projection, it would seem that one should travel almost due west to go from New York City to Tokyo, since both are at about the same north latitude, but the shortest route is in a northerly direction and cuts across the northern tip of Alaska. The third and probably greatest misconception pertains to distortion in size which occurs when we make a cylindrical projection of a sphere. On the Mercator projection, Greenland appears to be three times the size of Australia. Actually, it is but a third as large. A Mercator projection neglects the poles of the earth because the latitude of each pole, on such a projection, would equal infinity. An example of the extent of distortion which occurs from this type of projection is shown in Figure 2.

Air Age Changes

With the advent of the Air Age, the already recognized principle that a great circle is the shortest path between two points on the globe came into the realm of wide practical application. Air routes between two such points in opposite hemispheres, while seldom passing over the North Pole, nevertheless cut great circles that fall well within the Arctic regions.

Why is the Antarctic excluded? Why should the same condition not hold for the south polar regions as well? An inspection of a world globe will help supply the answer.

Approximately 70 percent of all the land area of the world lies north of the equator. Of the 30 percent in the southern hemisphere, a third is the vast, isolated, largely unexplored and uninhabited Antarctic Continent, and therefore only 20 percent of the inhabited land area of the world is south of the equator. Those land masses within the northern hemisphere include all of North America, Europe, Asia, two-thirds of Africa, and one-sixth of South America. Sixty percent of all the water area of the world is south of the equator. Figuratively speaking, then, the north half of the world is land and the south half is water.

The population distribution is even more radical and further accentuates this half land, half water, concept. Ninety percent of the world's peoples are gathered within the northern hemisphere. Of the cities in which they live, 90 percent of all those having a population of 100,000 or over are north of the equator. By air, the capitals of all the great powers are closer to the Arctic Circle than they are to the equator. Mexico City and Chungking are both well within the northern hemisphere.

A climatological factor also favors the Arctic over the Antarctic. In general, the weather and climatic conditions over the Arctic are much less severe than those experienced on the Antarctic Continent.

These are reasons why the aerial highways between the new and the old world will cut across the Arctic. Greeley's famous advice may well be revised to a modern phrase: "Go north young man, go north!"

Polar Projection

Considering the world from an infinite distance directly above the geographic North Pole, we see that the pole is approximately at the center of the land masses of the world. A projection of the world, centered on the geographic North Pole, will supplant, in time, the more common Mercator chart as the familiar geographic face of the earth (see Figure 3). The full implication of a polar-centered world is not yet wholly appreciated. It will not be until commercial air transportation is fully developed.

The first thing that strikes one as he looks at a polar-centered map is that he is looking down into the center of an elongated body of water almost completely surrounded by land. It has much the same general aspect as the Mediterranean Sea. Could this be the Arctic Ocean? It does look like an ocean on a Mercator map. Viewed in true proportion, as on a globe, it has more the appearance of a sea—the

Between the major land masses of the northern hemisphere, the shortest airline and water distances are across the Arctic regions, which are destined to grow in importance in world strategy, travel, and trade

Mediterranean of the north, in the middle of all the land masses of the world and separating Eurasia from North America.

Little known yesterday, this sea is becoming a most important body of water. It is the only natural body of water which physically separates the two great land masses, Eurasia-Africa, and North America-South America—this by only the 50-mile width of Bering Strait. How many people realize that one may travel from the southern tip of South America to the southern tip of Africa, pass through five continents, and hardly see water?

The Arctic Ocean

Since the Arctic Ocean is destined to grow in importance in world strategy, travel, and trade, it would be of interest to explore it briefly.

The surface covers an area of about 5,500,000 square miles. This is five times the area of the Mediterranean Sea and one-twelfth the area of the Pacific Ocean. Its expanse is entirely contained within the Arctic Circle and its perimeter is 80 percent bordered by land. If the Arctic Ocean is considered to include all of the waters within the Arctic Circle, its length is close to 3,000 miles and its narrowest width is 1,200 miles.

The Arctic Ocean is neither an area of extremely low temperatures (minimum of —55 F) nor of violent storms (55 miles an hour winds are rare). This degree of mildness, compared with the severity of the weather in the sub-Arctic, the Antarctic, and even in the North Temperate Zone, is due to the great body of water whose surface temperature is never lower than about 28 F, since salt water will freeze below that temperature. The pack ice on top of this great mass of heated liquid acts as a great stove lid through which the heat underneath must come through. As a consequence, the Polar Basin is much warmer than the surrounding sub-Arctic regions.

The main basin of the Arctic Ocean is quite deep. A sounding of 9,000 feet without bottom was taken by Robert E. Peary at the North Pole in 1909. The deepest soundings were recorded by George H. Wilkins in 1927, over 17,000 feet, 550 miles northwest of Point Barrow, Alaska.

Pack Ice

The principal characteristic of the Arctic Ocean is the pack ice which, even towards the end of summer, covers two-thirds of the surface. It has been variously described or imagined as a solid, homogeneous mass or cap, firmly and squarely implanted on the northern "top" of the earth. There is no vast expanse of solid ice or an ice cap as such, even at the North Pole. Admiral Richard E. Byrd gives the following description of the ice at the North Pole as he saw it during his historic flight on 9 May 1926.

"It did not look different from other miles of ice over which we had just passed. There was the same stretch of brilliant white marked by ridges, hummocks, and a few leads (open channels in the ice) recently frozen, showing green against white. From pressure ridges, I knew that the ice there was in constant motion. The ice was composed of large cakes, of fields whose edges, except at the leads, jammed up against each other and were pressed so tightly by wind and ocean currents that ice and snow was forced up to varying heights, depending upon the pressure exerted. Cakes were glistening white with hummocks. Here and there on most of them, and on some drifts caused by strong winds, I knew the surface was more uneven than it looked from the plane. Floes were of many shapes and sizes, and pressure ridges ran willy-nilly, apparently without rhyme or reason."

When the large floes break up during the summer, they remain separate until autumn. As winter approaches, low temperatures begin to cement the floes together. Then, under the stress of wind,

currents, collision with adjacent floes, and differential stress, leads form, exposing open water. In the winter, the open water in the leads freezes rapidly, cementing separate floes together and forming smooth, even surfaces. This process, together with the sluggish motion of the floes, makes it possible to travel over the ice with comparative safety during the winter, afoot or by sled. It was across such ice that Peary made his trip to the North Pole in 1909 from the north end of Ellesmere Island, a distance of 450 miles.

There has been much speculation as to the thickness of the pack ice, estimations anywhere from 20 to 200 feet may be gained from reading some literature. The 20-foot ice is an exception, and 200-foot ice is never there except where ice is piled up against beaches and is jumbled up in great masses. The latter, however, is not to be pictured as characteristic of the entire sea. There is more substantial evidence of the average thickness of the pack ice from two famous drifts by ships which have taken place in the Arctic Ocean: the Norwegian ship *Fram* (1893-1896), captained by Dr. Fridtjof Nansen; and a Soviet ice-breaker *Sedov* (1937-1940). Data compiled by the personnel of these two ships during the drifts indicates that in the 40-year period intervening between the two drifts the thickness of the pack ice had decreased by about 3 feet. The *Fram* recorded the normal ice depth as 10 feet, whereas the *Sedov* recorded a depth of 7 feet.

The ice of the Arctic Ocean is of two kinds: that type already described, which is constantly moving and has a natural drift in a clockwise direction toward an outflow between Greenland and Spitsbergen; and fast ice which is immobile and solidly anchored to the coasts. In the summer, the pack ice averages from 5 to 15 miles off shore and much of the fast ice disappears. Thus a relatively open water passage (shore lead) is provided for ships. However, due to the vagaries of the drifting ice floes, it is seldom that such passages can be navigated without the assistance of aerial ice reconnaissance and ice-breakers.

During the winter, the pack ice and the fast ice generally come together. Where the motion of the pack ice is rapid, as after a heavy gale when its speed may be 2 or more miles an hour, there is severe grinding of the pack along the edge of the land ice. The rending and crashing of the floes at such times is deafening.

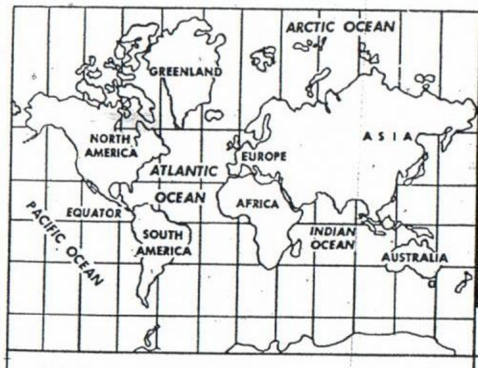


FIGURE 1. MERCATOR PROJECTION OF THE WORLD, CENTERED ON EURÓPE.

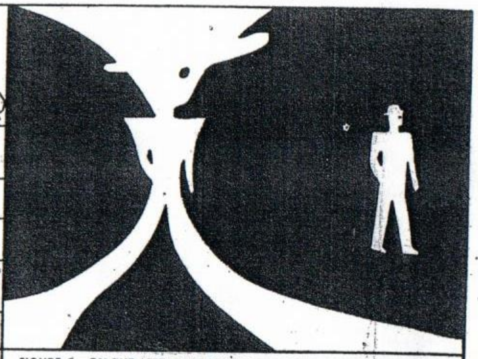


FIGURE 2. ON THE LEFT, THE FIGURE OF A MAN APPEARS ACCORDING TO THE MERCATOR PROJECTION. (FROM EVELYN STEFFANSSON'S "WITHIN THE CIRCLE," REPRODUCED BY PERMISSION OF CHARLES SCRIBNER'S SONS.)

Arctic History

Although man has probably lived in the Arctic for as long as 500,000 years, our recorded knowledge of life there dates from relatively recent times. Pytheas, a Greek astronomer and philosopher, made the initial contribution in the fourth century, B.C., when after sailing 6 days north from Scotland he found an island called Thule (Iceland). Proceeding north an additional day, he encountered much ice "through which the ship could not sail and which would not support man." Pytheas' brother philosophers gave him scant satisfaction in his contentions. They held to the then current belief that the frigid zone where Pytheas had claimed to have been would not support life. After Pytheas, there is little information on the Arctic until the colonization of Iceland by the Norsemen in the ninth century, A.D. In 983, using Iceland as a base, Eric the Red colonized Greenland, and 17 years later, during a voyage from Norway to Greenland, he apparently missed sighting the island and is presumed to have made a landing on the coast of Labrador.

Following this discovery of America, there is another gap of several hundred years in the history of further Arctic exploration. It was not until 1576, with the first of three expeditions conducted by Sir Martin Frobisher, that Europeans again took an interest in the Arctic. Gradually, the value of the fur trade in the north and the desire to navigate a northwest passage to the Orient increased the number of expeditions and added to the knowledge of the arctic. The great goal of being the first to reach the geographic North Pole resulted in a keen international competition and placed much emphasis on arctic travel and exploration. The whaling industry brought many people to the Arctic, where numbers of them settled permanently after the industry declined. With the advent of the airplane, exploration and colonization of the arctic lands received further impetus. A Russian, Lieutenant Nagurski, first successfully flew an airplane within the Arctic regions in 1916. Admiral Byrd made his famous flight over the North Pole 10 years later. Since that time, the USSR, Canada, and the United States have been in the forefront in carrying out many experimental and enterprising flights in, around, and across the Arctic. With the development of multi-engined, high-speed aircraft, Arctic flight is becoming commonplace.

Flying Conditions

It is a mistaken idea that flying conditions grow progressively worse the farther north one moves from the equator. Conditions do increase in severity from the equator until latitudes where annual mean temperatures around the freezing point are reached. In such localities are found dense fog, heavy, sticky snow, and freezing rain, all of which interfere with visibility and the aerodynamics of a plane. This area occurs within the North Temperate Zone and the conditions result from constant variations in temperature from warm to cold and reverse. North of this zone and within the Arctic, however, flying conditions through the whole year are less difficult.

The northern half of the bad weather zone in the United States is in Ohio; in Europe it begins south of Milan. Yet it cannot be denied that there has been a great deal of severe weather north of both these localities, particularly in the sub-Arctic. This brings us to the question of stratospheric flight.

The stratosphere is above all weather, and therefore stratospheric flight over the arctic will be similar to that over the equator, with one exception. The floor of the stratosphere decreases in altitude as one progresses north or south from the equator and continues to decrease until over the poles. Thus, while the stratosphere in northern North America may be entered at 20,000 feet, over the geographic North Pole it may be gained at 15,000 feet.

Besides our growing awareness of the short cuts offered by air travel across the Arctic, we are learning that the high-altitude flying weather in this region is equal to or better than that at any other locality in the world. Before full use can be made of these dual advantages of distance and weather, advance operation bases, strings of radar and loran stations across the Arctic, and weather stations are needed for flight control and for safety.

The comparative safety of air travel over the Arctic Ocean, in contrast to other great bodies of water, is high-lighted by Vilhjalmur Stefansson in his discussion of the fate of an attempted transpolar flight by the Russian aviator Levanevsky in 1937. Stefansson wrote:

"Levanevsky was assumed to have made

FIGURE 3.—A POLAR CENTERED AZIMUTHAL EQUIDISTANT CHART.

a forced landing on the polar sea. Therefore, we consider the various oceans, how they compare for the safety of forced landings.

"Most flyers who have come down on liquid seas far from land and beyond sight of a vessel have been lost. All have been lost who made forced descents beyond the sight of rescuers in a gale.

"Before the Levanevsky flight, there had been perhaps a dozen forced landings on the frozen sea. Some were in good weather, some in falling snow, some in blizzards, and one in a combination of a gale and the darkness of night. All these had been safe descents—no lives had been lost and there had been only minor injuries to planes. The flyers were always saved in one of three ways; they made repairs and flew again; they were rescued, by plane or ship; or they abandoned their plane and walked ashore.

"Take specifically for the North Atlantic the entire period from its first crossing by the United States Navy airplanes in 1919 to the beginning of survey flights by Pan American Airways and Imperial Airways in 1937. During this period, at least 19 ocean descents were made in all weather from calm to gale. Nine planes were lost. The people saved were mostly those who had specially good luck, as coming down in fairly good weather either within sight of a ship or after being able to communicate to a nearby ship through radio an approximate position of their descent.

"During the same period, more than 90,000 miles were flown over the polar sea. There were at least 56 voluntary and forced descents in all weathers from calm to gale (not all Soviet figures are available). No lives were lost from any of these descents."

The importance of the Arctic to air travel is obvious. Less obvious is the importance of the Polar Sea as a navigable body of water.

Submarines

The problems involved in traversing the Arctic Ocean beneath the polar ice pack with a submarine are serious but not insurmountable. The first experiment of this type, made in 1931 by George H. (Sir Hubert) Wilkins in an attempt to reach the North Pole, ended in failure. The submarine *Nautilus*, formerly the USS *O-12*, was obsolete; despite extensive alterations and modifications designed to cope with expected conditions, she was no match for the ice. *Time*, 14 September 1931, describes the plight of the *Nautilus* at the conclusion of her venture in these words:

"They rammed their ice-borer, which was to give them escape if they were gripped under the ice, against an ice chunk and smashed it. Ice crushed the runners atop the *Nautilus*, which were to enable her to slide against the underside of ice fields. She sprang two leaks, became miserably dank within. The propeller edges became saw-toothed and bent, grinding against small ice."

The position of the *Nautilus* at the conclusion of this experiment was north of Spitsbergen and about 400 miles from the North Pole. Despite her severe mauling, she had submerged and navigated beneath the Arctic ice pack.

The modern submarine, with high submerged speed and capabilities of long submersion and great diving depth (nearly 1,000 feet in the experimental dive made by the French with one of the type XXI German submarines) could cross the Arctic Ocean at its narrowest width in less than 48 hours.

A new and more sensitive sonar gear would keep such a submarine constantly aware of its position in relation to the ice ceiling and ice tongues extending down into its path. Such gear would also locate areas of open water in the ice pack, into which a submarine could surface. Submarines in the Arctic in peacetime would be useful as weather stations, radar picket vessels, and loran and aircraft beacon stations. Their strategic importance in war is obvious.

The fact that the shortest airline and water distances between the major land masses of the northern hemisphere are across the Arctic is alone sufficient to give strategic importance to the area in future global war. Strategically, Alaska, Greenland, and the islands of the Canadian Archipelago are the first line of North American continental defense. Development of these areas in peacetime will enhance their value in war.

Development

Great changes are taking place in the general methods of Arctic exploration and development. Side by side with private enterprise, governments have already begun to open up and exploit the northern lands which belong to them. The search for uranium, oil, and iron ore, as well as for natural waterways along the northern shores of North America and Asia, are speeding this work. These vast areas, woefully lacking in overland travel facilities, have been knitted more closely together by air services which connect their remote communities. The Arctic is destined to play a leading role in the coming age of long-range aviation. Most of the great commercial air routes of the world will have to cross the Arctic at one place or another. Air travel will lead to modern airports with all facilities for the comfort and convenience of the traveller. Eventually, the heretofore forbidding polar ice will serve the needs of civilization, by providing emergency landing fields and by supporting portable directional finding stations and light beacons which will chart unerring courses over the Arctic Ocean.

The ultimate passage to the Orient is aerial. The short cut from New York to Tokyo is via Hudson Bay, the Barren Lands of the Northwest Territories, and Alaska. The shortest distance from Chicago to Calcutta is straight north. In short, travel tomorrow will be North to Everywhere!

There are eight great industrial areas in the world today of sufficient productivity to be significant factors in a full-scale war. These eight areas center upon Japan, central Siberia, the Ural Mountains, Moscow, the Don Basin, western Europe, the British Isles, and northeastern United States. All of these key areas lie above 30° north latitude, and the two great land masses on which they are located—the Eurasian and North American continents—have one region of common tangency: the Arctic Ocean with its impassable ice cap. Although the polar ice cap is impassable to ships or surface forces, it offers no barrier to aircraft flying above it. The shortest air route between the central United States and the Urals, between Alaska and Germany, or between Greenland and Japan lies directly over the polar region. Clearly the whole cap of the world, from the thirtieth parallel to the North Pole, is the world of air power.

General Carl Spaatz

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