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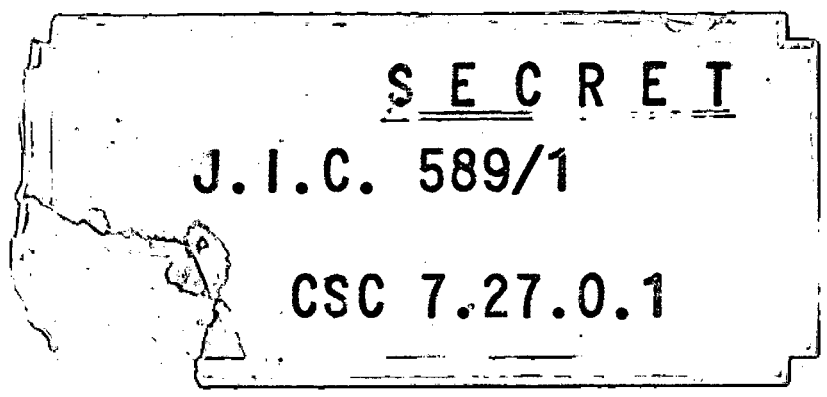

FILE NO. (B 0 0 K) JIC 589/1

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BINDER

CANADA

Department of National Defence

CHIEFS OF STAFF COMMITTEE

JOINT INTELLIGENCE COMMITTEE

IN REPLY PLEASE QUOTE
No. CSC 7-17 (JIC)

SECRET

ADDRESS REPLY TO
SECRETARY
CHIEFS OF STAFF COMMITTEE,
OTTAWA.

23 Jan 52

G. de T. Glazebrook, Esq., #40
Dept. of External Affairs.
DMI #41
DAI #42
DNI #43
DSI #44
RCMP #45
JIB #46
#47 - JIS to be returned
#48 - Binder

US JIC Paper JIC 589/1

1. Enclosed is a copy of JIC 589/1 dated 8 Jan 52, entitled "Estimate of Soviet Capabilities for the Conduct of Military Operations in Arctic and Subarctic Environments", which has been received from the US JIC through CJS, Washington. The paper incorporates the revised pages which are noted in the decision on JIC 589/1 dated 21 Dec 51 (see second page).

2. The recommendations contained in para. 2 of the enclosure to JIC 589/1 were approved by the Joint Chiefs of Staff on 9 Jan 52.

(J.E. Beswick)
Major,
Secretary.

Enc.

JEB/5459/fp

S E C R E T
SECURITY INFORMATION
J.I.C. 589/1
8 January 1952

COPY NO. 48

JOINT INTELLIGENCE COMMITTEE

SUPPLEMENTAL DECISION ON J.I.C. 589/1
(Estimate of Soviet Capabilities for the Conduct of Military Operations in Arctic and Subarctic Environments)

NOTE BY THE SECRETARIES

1. In its 238th meeting on 8 January 1952, the Joint Intelligence Committe agreed to recommend to the Joint Chiefs of Staff that the Committee be authorized to release J.I.C. 589/1 as a matter of intelligence interest to the U. K. and Canadian Joint Intelligence Committees after the Joint Chiefs of Staff had acted on that paper.

2. This supplemental decision was implemented by the circulation of a corrigendum to JCS 2070/5 on 8 January 1952.

3. This supplemental decision becomes a part of J.I.C. 589/1 and shall be attached among the top pages thereof.

C. R. PECK
W. T. PHILLIPS
Joint Secretariat

S E C R E T
SECURITY INFORMATION
Suppl Dec On JIC 589/1

S E C R E T
SECURITY INFORMATION

COPY NO. 48

J.I.C. 589/1

21 December 1951

JOINT INTELLIGENCE COMMITTEE

DECISION ON J.I.C. 589/1

(Estimate of Soviet Capabilities for the Conduct of Military Operations in Arctic and Subarctic Environments)

NOTE BY THE SECRETARIES

1. In its 237th meeting on 18 December 1951, the Joint Intelligence Committee amended and approved the draft report in the Enclosure to J.I.C. 589/1, subject to such amendments to the Annex to that paper that the Joint Intelligence Group may make in the light of the changes recommended by the Director of Naval Intelligence and the Assistant Chief of Staff, G-2, Department of the Army.

2. The Joint Intelligence Group amended the Annex to J.I.C. 589/1 in the light of the changes recommended by the Director of Naval Intelligence and the Assistant Chief of Staff, G-2, Department of the Army and, on behalf of the Joint Intelligence Committee, has approved that Annex as amended.

3. Accordingly, holders of J.I.C. 589/1 are requested to substitute the attached revised pages i, 4, 5, 6, 13, 17, 19, 26, 27, 31, 40, 45, 46, 54, 55, 58, 60, 63, 66, 67, 75, 82, 83, 85, 86, and 87, reflecting the amendments as approved by the Joint Intelligence Group on behalf of the Joint Intelligence Committee, for the corresponding pages now in that paper, and to destroy the superseded pages by burning.

4. This decision becomes a part of J.I.C. 589/1 and shall be attached among the top pages thereof.

C. R. PECK

W. T. PHILLIPS

Joint Secretariat

S E C R E T
SECURITY INFORMATION

COPY NO. 48

J.I.C. 589/1

20 December 1951

JOINT INTELLIGENCE COMMITTEE

INTERIM DECISION ON J.I.C. 589/1

(Estimate of Soviet Capabilities for the Conduct of Military Operations in Arctic and Subarctic Environments)

NOTE BY THE SECRETARIES

1. In its 237th meeting on 18 December 1951, the Joint Intelligence Committee amended and approved the draft report in the Enclosure to J.I.C. 589/1, subject to such amendments to the Annex to that paper that the Joint Intelligence Group may make in the light of the changes recommended by the Director of Naval Intelligence and the Assistant Chief of Staff, G-2, Department of the Army.

2. Concurrent with the foregoing action, the Joint Intelligence Committee agreed to recommend to the Joint Chiefs of Staff that the Committee be authorized to release J.I.C. 589/1 to the other IAC agencies after the Joint Chiefs of Staff had acted on the paper.

3. Holders of J.I.C. 589/1 are requested to substitute the attached revised page 1, reflecting the approved amendment, for the corresponding page now in that paper, and to destroy the superseded page by burning.

4. This interim decision becomes a part of J.I.C. 589/1 and shall be attached as the top page thereof.

5. Revised pages of J.I.C. 589/1, reflecting the amendments to the Annex of that paper made by the Joint Intelligence Group on behalf of the Joint Intelligence Committee, will be circulated later.

G. R. PECK

W. T. PHILLIPS

Joint Secretariat

S E C R E T
SECURITY INFORMATION

COPY NO. 48

J.I.C. 589/1

4 December 1951

NOTE BY THE SECRETARIES

to the

JOINT INTELLIGENCE COMMITTEE

on

ESTIMATE OF SOVIET CAPABILITIES FOR THE CONDUCT OF MILITARY OPERATIONS IN ARCTIC AND SUBARCTIC ENVIRONMENTS
Reference: J.I.C. 589/D

1. The enclosed draft report, prepared by the Joint Intelligence Group in response tothe directive in J.I.C. 589/D, is submitted to the Joint Intelligence Committee for consideration.

2. The suspense date for action by the individual members of the Joint Intelligence Committee on the enclosed report is set as not later than 17 December 1951.

C. R. PECK,
W. T. PHILLIPS,
Joint Secretariat

A N N E X

ESTIMATE OF SOVIET CAPABILITIES FOR THE CONDUCT OF MILITARY OPERATIONS IN ARCTIC AND SUBARCTIC ENVIRONMENTS

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(Page Revised by Decision On - 21 November 1951)

E N C L O S U R E

D R A F T

REPORT BY THE JOINT INTELLIGENCE COMMITTEE

to the

JOINT CHIEFS OF STAFF

on

ESTIMATE OF SOVIET CAPABILITIES FOR THE CONDUCT OF MILITARY OPERATIONS IN ARCTIC AND SUBARCTIC ENVIRONMENTS
Reference: J.C.S. 2070/3

THE PROBLEM

1. To prepare a reply to the memorandum from the Chairman, Research and Development Board, in which a request was made for an intelligence study of Soviet technical and operational capabilities for the conduct of land, sea and air operations in Arctic and Subarctic environments.

RECOMMENDATIONS

2. It is recommended that:

a. The study in the Annex be noted.

b. The memorandum in the Appendix hereto be forwarded to the Chairman, Research and Development Board.

c. The Joint Intelligence Committee be authorized to release this report as a matter of intelligence interest to the agencies represented on the Intelligence Advisory Committee other than the military Departments, after the Joint Chiefs of Staff have acted on the report.

A P P E N D I X

DRAFT

MEMORANDUM FOR THE CHAIRMAN, RESEARCH AND DEVELOPMENT BOARD

Subject: Study of Soviet Capabilities for the Conduct of Military Operations in Arctic and Subarctic Environments

Reference is made to your memorandum dated 29 August 1951.

The enclosed* intelligence study has been noted by the Joint Chiefs of Staff and is furnished herewith in response to the request contained in paragraph 1 of your memorandum.

* Annex hereto.

A N N E X

ESTIMATE OF SOVIET CAPABILITIES FOR THE CONDUCT OF MILITARY OPERATIONS IN ARCTIC AND SUBARCTIC ENVIRONMENTS

THE PROBLEM

1. To prepare for the Research and Development Board an estimate of Soviet technical and operational capabilities for the conduct of land, sea, and air operations in arctic and subarctic environments.

Definitions of Arctic and Subarctic Areas

2. Arctic - The arctic includes the Polar Basin and the land masses lying between the arctic coast and the continental tree line. For Naval purposes, the arctic is defined as the region in which ice is a serious barrier or hindrance to navigation.

3. Subarctic - The subarctic lies between the continental tree line and the zone of settlements and principal communication networks to the south.

SUMMARY AND CONCLUSIONS

4. The capability of the Soviets to conduct military operations in the arctic and subarctic regions results from their substantial experience in winter warfare rather than from the development of any advanced types of specialized materiel based on scientific studies.

5. Land Operations

a. Most Soviet troops are trained under conditions identical with or approximating arctic and subarctic weather and are acquainted with cold weather survival techniques from childhood. Their protective clothing is adequate and most of their weapons and equipment can be used or adapted for cold weather operations. Moreover, the Soviets have well developed military doctrines for winter warfare.

b. Mobility, however, remains a severely limiting factor in some areas and at certain times of the year. Principally because of the difficulty of re-supply and the scarcity of inhabited communities in the extreme north, the Soviets would probably be limited to the employment of small forces in that region except in the relatively milder and more accessible Murmansk area.

c. In the regions of the western USSR, where the transportation routes are better established and inhabited communities are numerous, the Soviets are capable of mounting large-scale military operations even in weather approximating that of subarctic regions.

6. Sea Operations. By virtue of the extensive Soviet experience in arctic operations, Soviet capabilities for the conduct of surface naval operations in the arctic area are considered to be equal, if not superior, to those of the United States. Reasons supporting this conclusion are:

a. The continuing arctic development program of the USSR has resulted in an extensive system of arctic stations and navigational aids along the Northern Sea Route which permits them to employ this important strategic route for periods as long as three months in some years. This allows the USSR to transfer men and materiel between Western and Eastern USSR as well as to arctic installations enroute. It is believed that, should the need arise, the Soviets are capable of significantly increasing the tonnage moved along this vital route.

b. The indicated stepped-up naval construction program, the acquisition of capable German scientists, technicians and naval officers skilled in arctic operations, and the obtaining of advanced-type German submarines, have all increased the naval warfare capabilities of the USSR in this region.

c. The Soviets have available relatively large numbers of personnel trained in and acclimated to arctic operations, ships capable of conducting arctic operations (including a number of icebreakers substantially in excess of the number possessed by the United States), and extensive knowledge of this area.

d. The chain of fixed polar weather stations along the arctic coast of the USSR gives that country a great advantage, at least initially, over the United States in that these stations provide a more reliable basis for forecasting weather and ice conditions, vital considerations in arctic surface and aerial warfare.

e. The USSR, with greater numbers of icebreakers, experienced skippers and trained crews, has a more favorable basis upon which to build an expanded arctic naval force than does the United States. In addition, the Soviet Union has large numbers of arctic and subarctic inhabitants, accustomed to existing in severe cold, to draw upon.

7. Air Operations

a. Comparison of the relative capabilities of U.S. and USSR aviation forces in arctic operations is handicapped by lack of information concerning current developments in the Soviet Union. One important factor in this comparison is that Soviet practice in conducting air operations does not require that U.S. standards of maintenance, serviceability, and training be met. Another factor is the large number of Soviet airfields located in arctic and subarctic regions. In addition, there are many thousands of Soviet people accustomed to living in these environments.

b. For all its deficiencies, transportation in the Soviet arctic is superior to that available to the United States in the Far North. This facility for supply, plus the Soviet air bases, gives the USSR at least initial advantages in arctic

air operations. In the matter of supply by air, however, the U.S. Air Force is considered to have the greater capability in cargo aircraft, dropping technique and experience.

c. Although Soviet ground aviation equipment and maintenance methods appear crude, they proved to be effective in conducting air operations under conditions of extreme cold. Therefore, the Soviets have at least an equal capability of getting their aircraft off the ground. Once airborne, U.S. propeller-driven aircraft are considered to be qualitatively superior to those of the USSR. In jet-powered aircraft, the capabilities may be approximately equal, except for greater combat proficiency of U.S. pilots in operations with this type of plane.

d. The Soviet Air Force is considered to be greatly inferior to the U.S. Air Force in virtually all aspects of long-range air operations. Soviet Long Range Aviation, in order to increase its combat radius, would probably be staged forward to arctic and subarctic airfields, if only for transient operations. Accordingly, some of these bases will have to be capable of supporting TU-4s. The U.S. Air Force capability to refuel aircraft in flight is believed to be definitely superior to that of the Soviet Air Force. No direct evidence is available on Soviet air-refueling techniques, but such operations are believed to be within Soviet capability.

(Page Revised by Decision On - 21 December 1951)

8. The Soviets are accumulating extensive knowledge of the arctic and subarctic through continuing scientific expeditions, operation of the Northern Sea Route, and maintenance of numerous arctic meteorlogical stations. This knowledge is sure to be of value for military operations in these or in similar areas.

I GENERAL CONSIDERATIONS

9. Everywhere in the USSR, except along the extreme southern boundary, near the Crimea and the Turkmen SSR, the mean January temperature is below freezing. In East Central Siberia, for example, in the Lena River watershed, the mean January temperature is 50 degrees below zero. In contrast, the coldest part of either North America or Greenland has a mean January temperature of only 30 degrees below zero. Because of the these extreme temperatures, it must be considered that the Soviet Union, more than any other major power, has been faced with the problem of the development of techniques to solve the cold weather problem. It would naturally be expected that Soviet developments in this field are well advanced; and it will be found in the discussion which follows that this generally is the case.

10. While the arctic and subarctic regions are generally associated with extreme climatic conditions of cold, snow, and ice, these characteristics are not peculiar to this region. Few battles have been fought in the Far North itself, but combat under severe conditions of cold, snow, and ice has not been uncommon. The winter conditions of the European USSR are noteworthy; for Leningrad, Moscow, Kharkov, and other parts of the USSR sometimes fare worse than subarctic areas in wintertime.

11. For example, the Soviets conducted a winter offensive in the Petsamo Province (the extreme northern sector of the USSR-Finnish border) under conditions far milder, in terms of snow and cold, than those that prevailed during the encirclement of the Germans at Stalingrad, 2,000 miles to the south. The temperature in the Petsamo area, influenced by the Gulf Stream, was as much as 70 degrees warmer than the -20° F. obtaining at Stalingrad during the same time of the year.

12. The unique characteristic of cold in the Far North is not its intensity but its persistence throughout a large part of the year. This fact is basic to an understanding of all the other peculiarities found in varying degrees in the arctic and subarctic areas, such as limited or nonexistent vegetational growth, large fields of ice and snow, very sparse population, and almost complete absence of industry, transportation, and communications. It is these features, rather than the severity of snow, cold and ice, that distinguish military operations under arctic and subarctic conditions from winter operations in the European USSR and similar areas.

13. Table I shows the very great number of days per year on which some of the major populated centers of the European USSR may expect below-freezing temperatures, although only Arkhangelsk, among the areas noted, lies in the subarctic zone.

TABLE I

Number of Days in Year with Average Day and Night Temperatures Below 32° F. and 14° F

Area	Below 32° F.	Below 14° F.
Arkhangelsk	170-180	60-80
Leningrad	130-140	30-40
Moscow	130-150	40-50
Orel and Voronezh	120-130	
Kharkov	100-110	20-30
Kiev	100	10-20
Coast of Black Sea	10-70	Less than 10

II LAND OPERATIONS

Previous Soviet Cold Weather Land Operations

14. Offensive Operations. During World War II the Soviets never undertook full-scale operations with large field formations under exceptionally severe winter weather conditions. However, small unit assaults or reconnaissance in force to rectify their

front line, to secure a favorable jump-off place for a subsequent attack, or to raid advance enemy security posts were carried out under all conditions. Such operations frequently accompanied very adverse weather conditions, such as a whirling snowstorm, enabling the Soviets to enter German trenches and take many prisoners without a shot being fired.

15. For a full frontal attack, the Soviets relied on mass. Waves of ground troops advanced, usually in three echelons, supported by all arms and protected on the flanks by ski detachments.

16. Although techniques improved as the war progressed, these attacks were characterized by a lack of coordination of the various support elements. The ski troops on the flanks often were wiped out while the main advance continued under increasing pressure. The artillery had poor fire control, it was slow in switching its fire, and it was unable to keep up with forward elements, especially during the pursuit phase of an offensive operation. Soviet tanks were often road-bound and advanced overcautiously. They were poorly supported by infantry because of its slow rate of advance and the tendency of the troops to dig in when the going got rough. As a result, armored spearheads frequently were left without support and had to fall back.

17. Ski Troops. Soviet doctrine for the use of ski troops is well developed, and these specialized units were used extensively during World War II.

18. A Soviet ski brigade during the war was composed of 2,800 men. It contained 54 light machine guns, 970 submachine guns, 18 heavy machine guns, 54 antitank rifles, 27 50mm and 51 82mm mortars, and 12 45mm guns.

19. The ski brigades were attached to army commands, and because of their great mobility, independence of roads, and ability to appear suddenly in the enemy's rear ready to attack, were employed for the following missions:

a. In cooperation with airborne units and partisans behind the enemy, to support the line units making a frontal attack by encircling and annihilating the enemy.

b. To destroy headquarters, communications, depots, supply dumps, airfields, bridges, and other installations in the enemy rear.

c. To secure the regrouping of their own units and protect the flanks during an attack.

d. To pursue the retreating enemy independently as well as in cooperation with other mobile forces.

e. To conduct reconnaissance in depth and patrol large areas of the front which are otherwise inaccessible to vehicles.

20. A ski battalion, with the same types of weapons as the brigade, was formed within each rifle division to perform various specialized functions in support of the division. These units usually employed snow shoes rather than long skis, and their physical and mental level, training, and morale were poor by comparison with the picked personnel of the independent ski brigades.

21. Combined attacks by strong ski units were not observed during the war. Rear area raids were usually made by units armed almost exclusively with submachine guns and skillfully utilizing terrain to achieve surprise. During lulls in front-line fighting, the bulk of Soviet ski troops formed the reserve of rifle divisions (ski battalions) and armies (ski brigades).

22. Before the war the Soviets developed motor-sled battalions, intended for support in the attack. They were never observed in combat operations, however, and apparently were confined to securing extended supply routes and maintaining communications. They were limited by terrain and the short daylight period, and their main advantage lay in exceptional speed over snow. The normal load consisting of a driver and either four armed men or 880 pounds of equipment could cover 100 to 110 kilometers (63 to 69 miles) per day under normal winter conditions.

23. Naval Infantry

a. Marine ski detachments were used to help break the Mannerheim Line.

b. Rifle Brigades were trained by numerous practice landings and tanks were employed where possible. In the defense of Leningrad, operations were often suspended because of ice conditions on Lake Ladoga.

c. North of Feodesia landings were made during snow storms and in 5 degree temperatures.

d. Flanks were defended by mobile patrols.

e. Infantry compensated for reduced artillery support by a high degree of maneuverability and by utilizing snow cover to the utmost.

f. Storms were used as cover to achieve surprise.

g. Long halts were avoided on the march.

h. Amphibious operations were directed into port areas rather than to beaches.

24. Proficiency in Cold Weather Techniques. After a poor beginning, Soviet cold weather warfare in World War II improved with the experience gained in successive phases. In the bitter cold of the 1939-1940 winter, the Soviets engaged in the "Winter War" against Finland. After the German attack of 22 June 1941, they again were engaged against Finns as well as Germans in the north, and at the same time fought the Germans each winter in the cold and snow of the western USSR.

25. Early in the first Finnish campaign the Soviets suffered humiliation at the hands of Finland. Their equipment was ill adapted to the conditions of fighting in snow and cold, their mobility was limited and they failed to maintain the extensive flank and rear area protection that is essential to winter warfare. Tactics employed by the Soviets were inadequate; camouflage was seldom used; troops were concentrated in the open; large forces stubbornly pursued an advance even when their flanks were exposed, frequently being surrounded and destroyed; and artillery and armor support often bogged down, leaving infantry units unprotected in the face of Finnish fire.

26. After this war, in which ten Soviets were killed for every one Finn, the Soviets set about improving their cold weather tactics and techniques. Elite troops were intensively trained in ski units and, on the Finnish Front in the later phases of World War II, they rivaled the Finns themselves.

27. The Soviets similarly improved their camouflage discipline. Firepower was increased and improved through better direction and control. Specially trained snipers accounted for 25 to 30 per cent of Finnish casualties during trench warfare. Soviet units no longer hesitated to draw back to prepared lines in the rear when opposed by superior or more advantageously disposed forces. Artillery was made more mobile and flank protection was extended. The coordination of combined arms was improved; tanks were employed in substantial numbers, especially in the late years of the war, and air support to ground units became more effective. Soviet proficiency in winter warfare elsewhere in the USSR conformed to this pattern of gradual improvement.

28. It is significant that the first and most important successes of the Red Army against the Germans occurred in the bitter cold of Russian winter. In the winter of 1941-1942, from

6 December 1941 to 14 April 1942, the Soviets carried out their first major offensive in the area west of Moscow. The following winter, in their large-scale attack from the Stalingrad-Don area in severe cold, the Soviets succeeded in encircling the German Sixth Army at Stalingrad and in overrunning the front of the German allies. In this operation, between 19 November 1942 and mid-March 1943, they created a fluid situation along a 1,000-mile stretch of the Eastern Front and penetrated up to 300 miles toward the west.

29. On Christmas of 1943, the Soviets began an offensive from the area southwest of Kiev. It continued until the thaw started in March 1944 and led to the annihilation of German divisions in the Cherkassy pocket, the encirclement of Tarnopol and of the German First Panzer Army, and a sharp retrograde correction of the German front.

30. These and other winter operations by the Soviets were not streamlined, smooth-working tactical and strategic operations, but they were effective and achieved the desired results. They were characterized by the familiar use of masses of men and material, and success was gained usually at great cost.

31. Soviet cold weather operations, though clumsy, were characterized by ultimate effectiveness. The most important factor of their success was the outstanding ability of the Soviet soldier to adjust to winter conditions.

32. In addition to the physical adaptability of the soldier, the following practices were significant in the Soviet Army's success in winter fighting:

a. Deep penetration by mobile reconnaissance units, including frequent surprise raids on rear bases or on enemy routes of communication.

b. Noiseless, well-camouflaged approaches to enemy positions in the snow.

c. Skillful infiltration by night and retention of territory gained by quick construction of snow positions under excellent camouflage.

d. Speedy moving up of heavy weapons on improvised runners. (Usually ski troops or infantry soldiers using boards stamped three tracks into the snow for the horse and the runners. Since the Soviet combat vehicles were lightly-built and wide-tracked with high ground clearance, they were well adapted for winter movements.)

e. Surprise assaults by tanks suitable for movement in the snow, with tank-mounted infantry troops whose heavy weapons are drawn by the tanks.

f. Immediate use of snow plows to clear the most important supply routes, and the use of light supply vehicles.

g. Good camouflage of all movements, even in rear areas (camouflage paint, covering tracks by trailing boughs, false tracks, taking cover during the day, etc.).

Present Training for Cold Weather Land Operations

33. Routine Rotation. There is no evidence of a conscious effort on the part of the Soviets to train combat troops specifically for arctic and subarctic operations, as distinct from ordinary winter warfare. In most parts of the USSR, the regular yearly cycle of troop training includes exercises in extreme cold. It is believed that for the most part no special techniques or equipment are employed, but rather that ordinary training is continued under these conditions. There is evidence, however, that when the weather is especially bad, training is sometimes either lessened or foregone completely.

34. Estimate of Army Forces Trained in Cold Weather Operations. Five Soviet divisions are currently estimated to be on arctic or subarctic stations, all in the comparatively mild western USSR.

35. Since most Soviet troops come from areas of the USSR having cold winters and have part of their training in winter, it is considered that the bulk of the Soviet Army is prepared for cold weather operations.

36. There are numerous unconfirmed reports of Soviet training exercises under exceptionally severe cold weather conditions. Apparently these are for the purpose of experimenting with new techniques and equipment. The little evidence available goes no further than to point to a continuing Soviet interest in the field, as results are reported to vary from poor to disastrous.

37. The only known Soviet Army troops given regular specialized training for cold weather operations are the ski units developed since the Finnish campaigns of 1939-1940. These troops are not great in number and their operational tactics are not unique. Their advantage lies in exceptional mobility over snow and they can be trained or employed wherever snow cover limits ordinary movement.

Soviet Cold Weather Land Warfare Techniques

38. Attack Procedures

a. Movement. Before the approach march a number of roads and tracks are laid for different types of transportation. Civilian labor may be used to assist the Army in this task. "Column roads" are built for wheeled and tracked vehicles; existing roads are improved, but can only be used by sleds; and "winter roads" are laid alongside them.

"Corduroy roads" of logs and mats are made to allow artillery to deploy. All roads are carefully flagged or marked with painted luminous stakes.

(1) Ice-bridges are made from brushwood which, with water poured over it, remains a solid mass well into the thaw period. For infantry, long planks can be laid across patches of thin ice. Frozen lakes and rivers may be used as airfields.

(2) The standard light sled used during the war by the Red Army was the volokusha. Drawn by two skiers, it can carry one light or heavy machine gun, a mortar, ammunition, supplies, or one casualty. It can also be employed as a firing platform for the heavy machine gun.

(3) Motor sleds, driven by propellers, were extremely effective both as combat vehicles and for transportation. The larger model can carry the driver and either four men with full equipment or 880 pounds of supplies. Sled trains, comprising a tractor and up to six sleds, are employed for transporting supplies. Infantry sometimes operates in armored sleds, drawn by tanks or motor vehicles. Artillery may be mounted on sleds, runners or skis. Much use is made of pack artillery, and horse transportation is often used instead of motor vehicles.

(4) Tanks with specially adapted wide tracks operate successfully in snow up to 20 inches in depth. When the snow is between 20 and 30 inches deep, their use is restricted. They move most easily over freshly fallen snow; a thick crust tends to clog and even break the tracks. They are provided with special equipment, including mats and grousers, for crossing snowdrifts and ice-covered slopes.

(5) Movement in winter is generally slower, as columns are mainly road-bound, except for troops equipped with skis or snowshoes. If the snow is more than 12 inches deep the rate of march is reduced still further. Owing to the difficulty of rapid dispersal in the event of air attack, spacing between columns and echelons is increased by day. Motorized artillery and tanks generally move in independent columns on the best roads; but in very deep snow, in broken country and when enemy opposition is expected, tanks are distributed among the other columns in small groups in order to support the infantry deployment. As tank tracks are clearly visible from the air, armor seldom adopts any but column formation and, if possible, moves during snowstorms. The last tank tows a special roller, a coil of barbed wire or a tree trunk in order to obliterate the tracks. Ski units move in a number of parallel groups, in file or column of fours.

(6) Traffic control posts are equipped with supplies of sand and with snowplows. Ration and warming posts are established on all supply routes. For the prevention of frostbite the extremities of the body are rubbed with grease, feet are bound with paper, infantry move alternately with and without skis, and troops watch each other for symptons. During rests special details keep awake for the sole purpose of turning sleeping men over every 15 or 20 minutes to prevent freezing.

(7) If the state of the roads is bad, halts are madomore frequently but are shorter. There are no long halts. Bivouacs are made in built-up areas, woods, or hollows with protection from the wind. The Soviets, with their long experience, show great skill in setting

up snow huts (igloos) and wind shelters and in digging burrows in the snow. A common shelter known as the shalaski can be constructed very rapidly from branches and twigs covered with snow.

(8) The following data are taken from Soviet manuals:

Rates of March

	Kilometers per hour	Miles per hour
Infantry	3-4	1 7/8 - 2 1/2
Infantry (Snow over 12 inches deep)	2-3	1 1/4 - 1 7/8
Single skier	6-8	3 3/4 - 5
Small ski unit	4-6	2 1/2 - 3 3/4
Large ski unit	3-4	1 7/8 - 2 1/2
Motor sled	20-25	12 1/2 - 15 5/8

The rate of march of vehicles and cavalry is approximately equivalent to that of ski troops.

Days' March (6-7 hours)

	Kilometers	Miles
Infantry	18-24	11-15
Ski unit	30-40	19-25
Motor sled	100-110	63-69

Thickness of Ice

Infantry can cross ice 4 inches thick.
Medium tanks can cross ice 28 inches thick.
Heavy tanks can cross ice 32-40 inches thick.

Thickness of Snow-Tanks

Snow under 20 inches; tanks employed as usual.
Snow 20-30 inches; tanks move only short distances.
Snow over 30 inches; tanks not used.

b. Protection. Protection on the march is provided by groups of ski troops with submachine guns and volokusha (small tractor) towed heavy machine guns, mortars, and antitank weapons. Troops traveling in motor sleds or tank-drawn sleds can also be employed. All protective detachments are accompanied by strong groups of engineers to reconnoiter the ground and organize the clearing and repair of roads for the main body. When a meeting engagement is expected, reconnaissance patrols are put under the personal command of senior officers, who later take charge of the deployment. If tanks are available, a strong tank group moves in rear of the advance

guard. Where stretches of ice have to be crossed, strong antiaircraft and fighter protection is provided and emergency crossing equipment is carried, as there is a danger of the ice being broken by enemy artillery or bomber attacks.

c. Reconnaissance. This is done by troops on skis or, occasionally, snowshoes. Infantry, in sleds drawn by tanks or motor vehicles, can be used for long-range or shock tasks, and motor sled units for raids and patrolling, especially across ice. Dogs are often employed by patrols. Groups of picked men with skis or snowshoes are employed for long-range patrols behind the enemy lines. Infiltration is facilitated by the enemy's reluctance to man trenches in the open ground between strong-points. Members of patrols carefully follow each other's trails, even placing their sticks in the same holes. When returning, however, they use a different route, their old tracks often being mined either by themselves or the enemy. Even in intense cold these troops seldom spend the night in inhabited areas but choose thickets, woods, or gullies and build improvised shelters. Partisans or paratroops were sometimes used in World War II to assist patrols in executing their tasks.

d. Preparation. The assembly area should be close to the jump-off position so that troops are not unduly fatigued before battle by a lengthy and arduous approach. Snow huts and dugouts should be constructed in the assembly area for warmth and protection. In deep snow the jump-off trench is dug very close to the enemy's forward defenses and somtimes even outflanks them. The trenches must be occupied for only a very short time before attack, or the men may freeze to death. For armor, a jump-off position with shallow snow is chosen if possible. Tank approach routes are very carefully reconnoitered and marked. Everything is painted white and personnel are given white camouflage clothing.

(1) Collecting posts are set up close to each other, if possible in huts or villages. Sledges and stretchers on skis are used for the evacuation of wounded, and stretcher-bearers and first-aid parties have skis. Every effort is made to keep the wounded warm with fur rugs.

(2) During artillery and air preparation the main object is to prevent the enemy from getting rest and warmth. In order to keep up constant bombing attacks, landing fields are prepared close to the front. Aircraft are regularly mounted on skis.

c. The Assault. The Soviets take advantage of unfavorable weather conditions in launching tactical assaults with small units. Plans are flexible so that they can be adapted to sudden changes in the weather.

(1) The attack is initiated by shock groups of submachine gunners, who usually operate on skis. The first infantry wave attacks without skis if the jump-off position is close to the enemy's lines, if the snow is less than 12 inches deep or has a hard crust, or if there are obstacles which would make skis an encumbrance. When skis are not worn, squads are detailed to bring them up in the rear of the leading troops. The second and third waves and the reserves nearly always consist of troops on skis, and groups of skiers with support weapons are formed for attacking strong points. The interval between waves is reduced, especially if the snow is more than 12 inches deep.

(2) Close support is provided by the artillery mounted on skis, runners, or sleds, with accompanying detachments of infantry to help them forward. Self-propelled guns and tanks are used in preference to ordinary

artillery. Infantry-support weapons are often sub-allotted to platoons. Armor is not split into small groups but operates in mass. Tanks advance on a broad front, usually in two waves, and as far as possible in a straight line. They generally choose ground where snow is shallow. Tank and mechanized units are given especially strong support by artillery, antitank weapons, and infantry-support weapons, and are always accompanied by ski units.

(3) The favorite maneuver is an outflanking movement by the main forces with a holding action from the front. If an attack is unsuccessful the troops often remain in slit trenches in the snow until nightfall, when they re-group and launch another effort. The protection of re-grouping is one of the special tasks of ski troops.

f. Exploitation and Pursuit. The last phase of the attack is usually a wide outflanking and enveloping movement largely executed by ski troops and motor sleds. Cavalry, tanks, and motorized infantry are employed only if the snow is less than 20 inches deep and if there is an adequate road network. Bold thrusts to the rear by even small ski groups may have decisive results. The skiers receive the closest possible support from armor and artillery. The special task of the artillery is to keep the enemy away from the roads and areas of shallow snow, and efforts are made to attack columns at points where they cannot deploy because of the state of the ground. Aviation is used not only for attacks on rear areas and reserves but also for supporting ski spearheads making deep penetrations beyond the range of their own artillery and in country unsuitable for tanks.

39. Defense Procedures. Strongpoints and "defense focal points" are located, if possible, in wooded countryside with numerous built-up areas for billeting purposes. The main defense line is normally on, or in rear of, natural obstacles; all cover forward of the line is destroyed if possible, so that the enemy's forces, obliged to remain in the open, become weakened by their privations. In the same way it is considered good policy to locate the main defense line, or vital parts of it, on high ground, as enemy troops attacking uphill become exhausted more rapidly.

40. Since troops cannot operate away from shelter for long periods, the maintenance of continuous fire cover for the whole of the ground forward of the main defenses is often impossible; active patrolling is, therefore, maintained throughout the 24 hours by ski patrols. Obstacles and mines are laid in front of the forward position and are sppplemented by defensive fire from artillery and mortars.

41. Reserves are kept under cover in billets or dugouts and are given training on skis to increase their mobility. Ski-runs are often constructed for them in the most likely directions in which they may be employed; these ski-runs are provided with obstacles that can be hastily erected to block them in an emergency.

42. Engineers play a vital role in winter defense; in the preparation of billets, dugouts, and winter camouflage, and in road maintenance along the lines of communication.

43. Artillery (including mortars) has the special task of denying to the enemy the use of roads and villages, forcing him to spend as much time as possible deployed in open country.

44. Routes for tanks are carefully reconnoitered, prepared, and maintained. Measures for warming up tank engines and arrangements for quick starting are constantly under review.

45. Maintenance of Equipment. Little is known of Soviet adaptations of normal maintenance techniques to arctic and sub-arctic weather, beyond the employment of shelters for warming equipment and protecting technicians.

46. Intelligence Operations. Soviet doctrine stresses various means for effecting reconnaissance and intelligence collection. Parachute patrols of two or three persons equipped with a radio were frequently dropped on the Finnish front to observe and report road movements. Ski troops were widely used for rear area and flank reconnaissance. The use of assault reconnaissance to seize and interrogate prisoners was a common practice on the northern front in World War II. Although aerial reconnaissance is exceptionally important in operations over snow, the Soviets had little success in this field against the Finns, possibly due to poor photography and interpretation technique.

47. Of importance in cold regions, as elsewhere, is the intelligence capability afforded the Soviets by the existence of Communists and fellow travelers in most foreign--and potential enemy--countries.

Soviet Equipment as Related to Cold Weather Land Operations

48. Most standard Soviet weapons and other equipment appear to be usable or adaptable for cold weather operations. The limitations of deep snow or mud, however, naturally prevent the full use of Soviet motor vehicles. No wheeled or tracked vehicles specially designed to overcome these difficulties have been reported, although such may exist.

a. Small Arms. The simplicity of Soviet small arms, particularly the submachine gun, contributed to their performance in cold weather during World War II. Some German combat reports attributed the comparative efficiency of Soviet small arms to the looseness of their moving parts. In contrast, the Germans suffered from failure of the bolt action of their rifle to close its breech due to ice formation on the bolt-head, and the MG 34 machine gun was particularly troublesome with the screw threads on its rotating bolt-head. The German MG 43, however, with its new and "loosely fitting" bolt-head, was much more satisfactory, but this, it appears, was more by good luck than as a result of design against arctic conditions.

b. Artillery. The Soviets are well practiced in the use of arctic lubricants for artillery, as well as in the use of special recoil fluids. Their use of artillery is facilitated by the readiness of the troops to improvise skids and transport sleds to overcome the difficulties of movement. Weight of fire with lightness of weapon is achieved to some extent by the employment of large-caliber mortars in forward artillery roles. The Soviets now have 120mm and 160mm mortars for this purpose.

c. Armored Vehicles. The Germans credited the Soviets with maintaining a high degree of readiness of armored vehicles in winter by applying simple and well-known methods. These methods include digging tanks into the snow or ground, covering them with tarpaulin, and heating the enclosure thus formed; the use of special tank heaters and lubricants; and the dilution of lubricants with aviation fuel. Here again the simplicity of the Soviet armored vehicle is a useful contributing factor. Only one type of engine is used for both T-34 and JS-3 tanks and medium and heavy

self-propelled guns, a rugged, 12-cylinder diesel. The Soviets have found torsion-bar suspensions and enclosed spring systems to be the most suitable for winter operations. The Soviet dual-starting systems, electric and pneumatic, are another useful feature in cold climates where the efficiency of storage batteries deteriorates with drops in temperature.

d. Transportation Vehicles. Soviet transportation vehicles are mainly copies of United States World War II vehicles and possess no special advantages for winter mobility. Normal elementary cold weather operating procedures, such as the use of skid chains, cab heaters, and special lubricants and fuels, are employed by the Soviets, but without any outstanding measure of success. A variety of sleds, ranging from individual hand sleds to propeller-driven motor sleds, are used.

e. Transportation Equipment. Standard Soviet railway equipment is generally adaptable for cold weather operations with little or no special modification other than the use of special oils and lubricants. Diesel locomotives require a built-in heating unit for operation in arctic temperatures. There is no indication, however, that the Soviets operate such diesel equipment in arctic areas.

f. Quartermaster. Standard items of Soviet quartermaster issue are adaptable for arctic and subarctic use. Field kitchens, bakeries, and other organizational equipment are modified by placing skis or runners under the wheels or by replacing the undercarriages with sleds. Mechanical simplicity helps prevent breakdown under adverse climatic conditions. For individual use, special-issue clothing and

equipment of efficient design is available. Snowshoes and skis are provided for individual movement. Among the recent research and development programs carried on by the Soviets are the following:

(1) Improved ski waxes.

(2) Rubber de-icer worn between the sole of the shoe and the ski for breaking away accumulations of snow by flexing the foot.

(3) Electric cabinets for drying damp footgear.

(4) Drying of wet footgear by ultraviolet radiation.

(5) Double-wall tents of canvas with heated floors.

(6) Light rubberized silk swimming suits for arctic survival kits.

(7) Double-wall stoves.

(8) Use of skins of sea animals in place of leather.

(9) Special cotton-padd textiles.

g. Engineer. The characteristics of Soviet engineer equipment are comparable with those of the engineer equipment of other modern armies. No information is available on the designing of any special engineer equipment for arctic use except for a tilt igniter rod for an anti-personnel mine.

h. Chemical. Authentic data on the cold weather performance of offensive and defensive Soviet chemical warfare equipment are not available. In view of the fact, however, that the Soviets have conducted scientific investigations in polar regions for many years, it is believed that their arctic equipment for chemical warfare is at least as good as that of any other army.

(1) The performance of the Soviet gas mask in arctic and subarctic environments is considered comparable to that of the United States gas mask, which is quite

satisfactory. Protective clothing may be considered to be quite satisfactory in general, subject to limitations imposed by the quality of the material.

(2) Many war gases may be used under arctic and subarctic conditions with effectiveness. The method of dissemination is more likely to be by aircraft spraying apparatus than by ground contaminating vehicles.

(3) As with other modern armies, the transportation and storage of gas munitions which can be used under arctic conditions by the Soviets do not present any exceptional or unusual difficulties.

i. Medical. It is known that there have been at least five Soviet medical expeditions into the arctic area, during which it is probable that medical equipment items were field tested. No report of the results has become available, however, and there is no evidence to suggest that significant progress has been made in the design of special medical equipment for arctic use.

j. Signal. The design of tactical communications equipment in the Soviet Army is greatly influenced by cold weather conditions, and most standard items of such equipment will function satisfactorily in arctic and subarctic operations. Equipment is simple, functional, and of rugged construction. Laboratory tests on recent models of Soviet radios have revealed unusually good cold weather characteristics. The use of nickel-cadmium batteries is widespread, with their advantages of longer life, smaller internal leakage, practically unlimited shelf-life, and superior cold weather characteristics. Lower drain tubes enable Soviet radios to be operated continuously for approximately 60 hours, compared with 24 hours in similar United States sets. All Soviet tactical radios are built with a counterpoise to eliminate the need for a natural ground.

Logistics in Relation to Soviet Cold Weather Land Operations

49. Transportation. Since snow, mud, ice, and cold militate against ease and swiftness of movement in the Far North, an exceptional strain is placed upon the exceedingly limited roads and railways of the region.

a. Railroads. Sparse population, absence of important settled communities, and limited economic potentialities are the basic factors precluding railroad development in the Far North. Moreover, rail construction and maintenance is especially costly in the region. Great as the difficulties are, however, it is possible to construct railroads in the Far North with special techniques. Maintenance is excessive, and constant surveillance must be maintained over every mile of track so that repairs can be made before rolling stock is damaged. Railroads nevertheless are more practicable for year-round transportation than are highways or cross-country movement. During the fighting on the Kola Peninsula in World War II, the Soviet Murmansk railroad was a principal factor of military power. The fact that the Soviets were able to hold it and keep it open for traffic through most of the war was an important element in their success. Three railroads serve the northern areas of European Russia. The Leningrad-Murmansk railroad has a branch just south of Kandalaksha that connects with Kemi in Finland and with the Scandinavian Peninsula. A branch from Belomorsk, along the south side of the White Sea, connects with the Moscow-Arkhangelsk line. The latter railroad also has a branch from Konosha to Kotlas, connecting with the Kotlas-Vorkuta line, and a branch from Vologada,

connecting with Leningrad. The Kotlas-Vorkuta railroad is being extended (and may be completed) to Kara on the Arctic coast. This last railway has been used mainly for the transportation of coal, but it could be used to support air installations in the Kara region.

b. Highways. Roads are even more difficult to maintain under arctic and subarctic conditions than are railroads. Firm roadbeds are requisite for northern highways, making the scarcity of rock and gravel in some areas a primary problem. In subarctic regions where timber is available, corduroy roads are built. During World War II, corduroy roads over mud and swamp were the most important static improvisation of the Russian campaigns.

(1) In winter, roads require special maintenance service. Snow plows must be kept constantly at hand. Rest stations with warm quarters must be established at short distances along the roads for drivers and maintenance personnel in case a blizzard strikes or motorized equipment becomes stalled. In wartime these are invaluable for use by troop units on the march. Telephone lines must be strung along roads, especially in wartime, with frequent cutoffs so that road conditions and other emergency information can be quickly relayed.

(2) Winter roads, particularly if they are improvised for military purposes, may not have a definite course. Heavy snowfalls and drifts may make regular routes impassable, especially where defiles or roadcuts are filled with snow. The best routes are over windswept heights, avoiding populated localities to reduce the incidence of snowdrifts. Markers are an adjunct of winter roads, and after a blizzard they may have to be moved to a new course if it is better cleared than the old route.

(3) In summertime, roads are severely affected by the thawing of soil moisture and snow cover. The Germans found that even the few Soviet hard-surfaced roads in the North sometimes were impassable during a thaw. Use of roads in the mud period, even though possible to a limited extent, was found to be impractical except during night frosts and early in the season. Continued use turned muddy roads into impassable mires, and the ruts and ridges formed by passing vehicles became cement-hard obstacles after the road dried. The Soviets always traveled alongside roads in the muddy season to preserve their greater usefulness when thoroughly dry. This practice was quickly adopted by the Germans.

(4) "The muddy season", Marshal Timoshenko is reputed to have told Stalin at a military conference in 1941, "even more than the winter, will help to destroy the Germans." Judging from German war reports, this prophecy was well reasoned. All movement was paralyzed, at least during the worst part of the mud season, and special "mud period supply dumps" had to be established. Such supply as could be maintained at all under mud conditions relied on horse-drawn carts and other slow, tedious means.

(5) During the Finnish campaigns, vast trackless wastes were completely ignored by both sides in summer and winter. There were five key roads in this region, and the broad spaces between them remained virtually untouched by the war. Road networks in the USSR are relatively primitive and undeveloped, especially in the Soviet Arctic and Subarctic. Many existing roads are ordinary dirt paths, entirely unpassable by wheeled vehicles during long periods of the year because of

rain or snow. Long-distance movement of passengers and freight by highway is negligible anywhere in the Soviet Union and virtually nonexistent in the Soviet Arctic. Some use is made of caterpillar trains and air sledges in the Soviet Far North.

50. Clothing. The Soviets issue various kinds of special clothing for cold weather fighting, the amount and type depending on the severity of the weather. For mild winter weather, the woolen tunic and breeches, worn beneath the ever-present military overcoat, and woolen-cotton underclothing are considered sufficient. Adjustments to changing outside temperatures are made by the "layering" principle--garments being added or taken off as the situation requires.

a. Various items of standard Soviet issue are suitable for use in cold weather operations. They are as follows:

(1) Standard winter cap (wool) ushanka.

(2) Knitted toque, with extra flap sewn horizontally around it from ear to ear.

(3) Mittens, three compartment type, fur or moleskin lined.

(4) Two-piece cotton padded, quilted suit consisting of jacket (single-breasted, fastening down the center by means of tabs and buttons), and breeches of the same material, fitting tightly around the bottoms of legs. The suit fits loosely and can be worn over either regular winter uniform or the long winter underwear. It is light in weight, suitable for combat, and fairly comfortable at low temperatures.

(5) Sheepskin coat, the shuba, consisting of a leather coat with fur lining, single-breasted, with a wide overlapping at the closing which is fastened by concealed hooks.

(6) All-felt, knee-length boots, the valenki, for wear in dry-cold climates, made of thick rolled felt about one-fourth inch thick in the leg portion but thicker in the foot and sole. They are worn with as many woolen foot-wraps as needed but must remain loose-fitting as a precaution against freezing. For wet cold, a modified form of valenki is worn, having the shoe portion covered with rubber.

b. For extreme cold, maximum protection is provided by the "arctic" uniform which consists of the following:

(1) Heavy cotton quilted jacket lined with reindeer, fox, or dog fur, with a fur-line collar.

(2) Heavy cotton quilted trousers with lining extending four inches below the trouser legs forming a tight cuff, and reaching well above the waist.

(3) Knitted wool turtleneck sweater worn underneath the jacket and trousers.

(4) Arctic overcoat, a one-piece reindeer-skin garment extending down to the ankle. Its sleeves are slitted so that they can be rolled back to expose the hands.

(5) Fur-lined mittens.

(6) Polar fox skin cap with 1½-foot flaps on each side for wrapping as a muffler.

(7) Quilted wool cap lined with imitation fur.

(8) Arctic boots, reaching to the thigh, with felt soles and heels. The shoe portion is made of leather, and the uppers are made of dog or other skins sewn together with the hair portion of one turned toward the leg and that of the other turned out. The boot has a leather strap which buckles over the instep, a leather strap just below the knee, and leather loops at the top for fastening to the belt.

(9) Socks made of sheep or dog skins, worn inside the boots.

c. The "mountain" uniform, which also may be worn in cold weather operations, is a special storm suit made of waterproof and windproof material. It consists of the following: double-breasted, hip-length, loose-fitting jacket; full-out woolen trousers, with two hip pockets. The storm suit is worn over the padded or quilted suit when protection is required from windstorms, snowstorms or low temperatures.

d. Four types of camouflage uniforms are used, as follows:

(1) White, two-piece suit consisting of trousers and jacket with hood.

(2) Mottled green coverall.

(3) Two-piece mottled suit with a hooded cape.

(4) Reversible mottled green-white suit of rubberized fabric.

e. An evaluation of the protective qualities of these special uniforms may be inferred from the fact that cases of frostbite, of which the Soviet Army has very few, are blamed on poor management and carelessness.

51. Shelter. The ability of Soviet troops to make comfortable shelters with little or no special equipment was an important factor in the conduct of winter operations in World War II. For warmth and shelter they used tents, shields, huts, and dugouts. If lumber was not available, dens and various types of huts were built in the snow, using snow, ice, and/or frozen ground. Regulation Soviet equipment and techniques for cold weather shelters are as follows:

a. The standard Soviet winter field tent consists of two one-piece canvas tents, one inside the other. It is supported by one center post and is fastened to the ground

by tent ropes tied to metal pegs frozen into the ground. It is heated by a portable stove.

b. Soviet troops rely heavily on improvising shelters out of whatever is available. Huts of various sizes are made of wooden frames covered with branches, snow, and sometimes shelter halves or tents. The following types of shelters are also known to be used:

(1) Shields of slanted "walls" made from wooden poles or trees covered with snow, branches, or tent canvas. They are of single or double type. Structures are heated by placing two burning logs, one above the other, on the lee side of the single type, or in the center of the double type. These fires are reported to provide a small glow with sufficient heat for 24 hours.

(2) Round huts, constructed from wooden poles and covered by shelter halves, branches, etc. A fire is built within; smoke escapes through a hole in the upper part of the structure.

(3) Dugouts of various sizes covered with logs or unfinished lumber. Fireplaces are improvised at the ends of tunneling upward to the top of the ground to form a chimney.

(4) Snow huts of the igloo type, built from blocks of firm snow. They are heated with fuels such as kerosene or charcoal which do not require a flue.

(5) Snow dens built from lumps of firm snow, or dug in snow drifts and covered with wooden rods or skis, matting, and a layer of snow. The walls and floors are also covered with a layer of brush, matting, or straw. Reportedly, the temeperature inside may be maintained at 2 to 3 degrees above freezing by the warmth of the occupants alone.

c. The Soviet Army has attempted to devise adequate drying shelters for clothing, footgear, etc., by using dugouts with two fireplaces and campfires with steeply sloped shields. The effectiveness of these improvised sheds is not known.

52. Personnel. The Soviet soldier, as an individual, has an exceptional ability to adjust to the circumscription of personal life in warfare generally, and cold weather warfare in particular. His feeling of personal inadequacy to overcome situations, however unpleasant, results in a stolid complacency that is difficult to Western man to comprehend or equal.

53. This Soviet peculiarity is abetted by the physical realities of life in the USSR, which go a long way toward preparing the Soviet soldier for life in the cold of northern wastes.

54. Winter in the USSR generally duplicates the conditions of military operations in cold weather. As far south as the southern Ukraine, intense cold and deep snow greatly restrict normal working and living habits. Before and after the winter season, deep impenetrable mud prolongs the period of enforced inactivity. Most of the Soviet population live in small communities far from cities, and there is a lack of good roads connecting these communities with the cities or even with one another. As a result, isolation, accompanied by inactivity and little or no recreation or entertainment, becomes the rule rather than the exception for life in the USSR.

55. During World War II the ability of the Soviet soldier to live and fight in cold weather was a notable factor making for the ultimate success of Soviet arms. The German soldier felt lost and depressed in the long cold winter nights of the barren north. The Soviet's adaptability to these circumstances gave him a marked advantage in terms of spirit and morale.

56. Physical Limitations. From a military point of view, the physical limitations imposed by arctic and subarctic weather are reflected in increased ration requirements, decreased ability to march and carry loads, and susceptibility to frostbite.

57. A Soviet writer (M. Belyakov) has recommended a daily ration of 5,500 calories for hard expeditionary work, and the quantity of food to be distributed as 160 grams of proteins, 240 grams of fats, and 900 grams of carbohydrates. It is likely that this daily ration, or something approaching it, has been made standard for military groups operating in similar conditions. Soviet literature on the arctic shows that the Soviets have developed antiscorbutic vitamin concentrates out of materials readily available in the Far North, especially coniferous needles. They have reported to have used such concentrates with success in the war against Finland.

58. Soviet doctrine requires special attention to physical conditioning of troops for cold weather. This can only partly compensate for the rapid exhaustion caused by winter conditions, however.

59. Precautions against frostbite are stressed by the Soviets and are well known to most troops. Special care of clothing, observation of fellows, and other measures are maintained by strict discipline. Occurrence of frostbite is severely punishable.

III. SEA OPERATIONS

Analysis of Previous Soviet Cold Weather Campaigns

60. Naval Tactical Doctrines. Soviet tactics and techniques of naval warfare during World War II were inferior to those of the German and Anglo-American naval forces. The Soviets became acquainted with Anglo-American operational procedures during this period and attempted to make use of them. However, in situations where they did not apply Anglo-American tactics, the Soviets seemingly lacked set procedures of their own and operated rather along a "hit or miss" pattern.

61. Soviet naval operations in arctic and subarctic areas during World War II were for the most part confined to submarine attacks off the Norwegian Arctic Coast and the Barents and Kara Seas. Operating with an estimated 20 to 30 submarines, about one-third of which were constantly maintained at sea, they sank 45 to 60 ships, including 12 to 15 escort vessels, losing about 12 submarines in the process.

62. Compared with the Baltic theater of war, Soviet submarines in the Arctic were more active and far more successful. Favorable conditions in this area pointed up their special abilities rather than their weak points. Though the Soviets showed remarkable initiative, a considerable lack of capability was also evident due to insufficient battle operating experience and doctrine. It is true that they had no opportunity to prove their abilities in the course of large-scale operations, since Soviet submarines apparently operated independently of each other, with no close formations (packs) headed up by an accompanying group commander.

63. Compared with present day American operations, cooperation between air and submarine or surface units was virtually non-existent. With the exception of the heavily armed icebreakers, Soviet surface units in the Arctic were even less effective than the submarine fleet. Operations were conducted on a small scale and consisted chiefly of escort duty for incoming Lend-Lease convoys and occasional MTB attack against German convoys along the Norwegian coast. However, both surface and submarine minelaying was carried out with great skill.

64. (Not used.)

65. (Not used.)

66. Although Soviet training, marksmanship, tactics, and warfare techniques in the Arctic were considered poor during World War II on the whole, it must be assumed that the Russians have made every attempt to develop and turn to good use their experiences and knowledge learned during that period. Experience acquired in subsequent operations along the Northern Sea Route, coupled with increased numbers of trained personnel and an expanded naval building program of ships capable of arctic operations (including large numbers of icebreakers) add up to a Soviet capability to conduct naval operations in arctic and subarctic areas on a level which is believed to be equal, if not superior, to that of the United States.

Present Training

67. Routine Rotation. It appears doubtful that the Soviets follow any systematic plan of rotating naval personnel between duty in the Arctic and elsewhere. This conclusion is based upon the known Soviet addiction to excessive specialization of naval personnel, which, at least in the case of officers, is far greater than that of the U.S. Navy. The Soviets definitely recognize that arctic naval warfare requires certain special capabilities. It would be contrary to their normal practice to train large numbers of men in the Arctic and to send them elsewhere to serve.

68. Some rotation, especially of officers, probably takes place. A ship might conceivably move between Leningrad or Vladivostok and Murmansk without any change in personnel. This would provide some cold weather experience for personnel. However, it is not likely that such rotation of vessels would be prompted by the desire to train personnel from warm water Soviet fleets in cold weather operations.

69. Soviet naval personnel are constantly enjoined to study their "marine theater". The implication of this injunction would appear to be that once having been assigned to a certain theater, a Navy man serves out his term in that place.

70. (Not used.)

71. Estimate of Soviet Forces Afloat Trained in Cold Weather Operations. For at least eight years before World War II, the Soviets had ample opportunity to train naval personnel in arctic warfare. The Northern Fleet, based on Arkhangelsk and Murmansk, was created in 1933. In planning its objectives, and in training its personnel, the Northern Fleet was able to draw upon the facilities and experience of GLAVSEVMORPUT (an administrative organization for the operation of the Northern Sea route). The latter was equipped with valuable hydrographic information, icebreakers, a communications network, and ice reconnaissance planes, as well as skilled personnel which could, if necessary, be mustered into naval service.

72. Despite these advantages, it appears that the opportunities to train in arctic surroundings were not fully exploited. At any rate, the Germans who fought the Russians in the Arctic noted evidence of both important capabilities and deficiencies. For example, icebreakers of GLAVSEVMORPUT which were partially mustered into the Navy in 1941 were formidable opponents. Their crews were excellent marksmen with antiaircraft guns, and showed great zeal in pursuing submarines. In general, the Germans found their opponents able to navigate skillfully under arctic conditions, and capable of withstanding the severe climate. Otherwise, Russian personnel appeared to be poorly trained.

73. It appears highly likely that since 1945, the Northern Fleet has sought to remedy some of these deficiencies. A fairly considerable network of naval schools has been established in arctic regions, including those located at Solovetskiy Island, Arkhangelsk, Murmansk, Vayenga, and Petsamo. In addition to regular shore schools for both officers and enlisted men, submarine schools have been reported at both Arkhangelsk and Murmansk.

74. In general, there can be no doubt that the Soviets have trained personnel in the Northern Fleet fitted for arctic warfare as such. On the other hand, it may be doubted that weaknesses demonstrated during World War II have been completely overcome.

Cold Weather Naval Operations

75. Weather Forecasts. Because of the extraordinary conditions which prevail in the Arctic, adequate weather forecasts are essential to the successful operation of naval forces in this area. By keeping continuous observations of meteorological conditions, adequate forecasts and recommendations can be made with good reliability. An extensive system of weather stations has been established by the Soviets along the Northern Sea Route for this very purpose.

76. The use of aircraft in daily weather reconnaissance flights, the location of automatic weather stations in remote northern areas and the establishment of surface stations on ice islands, can contribute appreciably to more accurate weather forecasting. The employment of submarines within the polar ice pack opens enormous vistas with respect to weather forecasting within the Arctic region. All of these means for gathering weather information are believed to be well within the capability of the USSR.

77. Maintenance of Equipment. The Soviets have demonstrated a capability to maintain equipment for air and sea operations in extremely low temperatures. This capability has presumably been increased since World War II. However, daily maintenance will require some kind of shelter, and periodic inspections and major repairs will involve moving vessels and aircraft, if possible, to bases where the work can be done.

78. Mobility. Naval operations in the Arctic obviously are limited by prevailing ice conditions. The Soviets, perhaps more than any other nation in the world, have been keenly interested in

the study of naval operations in Arctic ice. From their diligent research and experimentation in this field, the Soviets have acquired a vast fund of arctic "know-how", which they have put to practice. The most notable of these accomplishments is the Northern Sea Route, the development of which emphasizes their capability of moving naval forces through arctic regions despite the many navigational difficulties. This capability is, of course, circumscribed by the availability of icebreakers and the limits of the navigational season.

79. Navigation. Navigation in Arctic waters differs substantially from that of other oceans. In this region, tips of the warm equatorial currents meet cold water flowing from the Polar ice cap and cause peculiar stratification of the water. The cooling of the air over the ice results in strange fogs, mirages and distorted pictures. During certain periods of the year, celestial navigation is extremely difficult because of cloud cover, lack of visibility of the horizon, and uncertain corrections for atmospheric refraction in the high latitudes. The proximity of the North Pole creates appreciable alterations of compass deviation. Difficulties with gyro-compasses also have been reported.

80. Radio communication suffers considerably from magnetic storms over the arctic regions. Moreover, particular caution must be exercised in navigating along the ice edge and rocky coasts which have been scantily surveyed. Varying currents and inaccurate depth data on charts pose additional problems to dead reckoning navigation. However, the Soviets probably have equipped their units with better and more accurate hydrographic materials than those which are available to foreign mariners.

81. Radar has tremendously increased the capabilities of navigating and piloting under bad weather conditions. Radar, as well as SONAR, provides a means of ice detection under conditions of reduced visibility. On the fringes of the pack and in areas

where icebergs may be encountered, surface search radar will detect icebergs at distances sufficient to avoid collision. The Soviets are known to be producing radar and are believed to be capable of producing equipment similar to the U.S. LORAN and SHORAN.

82. The navigation of submarines under ice is an especially difficult problem. The Soviets undoubtedly are engaged in studying special means and methods of underwater navigation. U.S. Naval studies of submarine underwater navigation probably will indicate possible Soviet methods. One promising U.S. method is an inertial system which should provide an accurate track (with a position accuracy of one mile) for a period of as long as 48 hours after leaving a reference point. Another method under investigation by U.S. Naval forces involves the use of deep-water detonations from specifically located reference points at specific times. This latter method may permit positions to be determined with an accuracy of approximately five to ten miles. A third method under investigation by U.S. forces involves the use of very-low-frequency transmitters and may be operated concurrently with scheduled radio broadcasts without interference thereto.

83. U.S. studies have revealed that very-low-frequency transmission allows reception by submarines while submerged to antenna depth of about 22 feet, thereby making it unnecessary for the submarine to surface in order to obtain a fix. Furthermore, since VLF is not susceptible to disruption by ionspheric disturbances, complete reliable coverage of Arctic areas can be provided. Present U.S. LORAN facilities do not provide such coverage, nor can the frequencies employed be received while the submarine is submerged. It is presently estimated that this VLF navigational system (RADUX) should have a range of 3,000 miles with a five-mile accuracy 50 per cent of the time, and a ten-mile accuracy for 95 per cent of the time. It will not be available to U.S. forces

before 1954. In conclusion, if the submerged navigation problem can be adequately solved, the extensive use of submarines in the Arctic is indicated.

Soviet Naval Equipment as Related to Cold Weather Operations

84. General. There is no information available on special fittings to naval vessels or their equipment for operations under arctic or subarctic conditions.

85. The Soviet Northern Fleet currently includes the following:

2 Modern Light Cruisers	3 Obsolescent Medium-Range Submarines
8 Modern Destroyers	6 Modern Coastal Submarines
6 Obsolescent Destroyers	340 Conventional Type Aircraft
5 Obsolete Destroyers	1 Gunboat
3 Modern Coastal Destroyers	31 Submarine Chasers, Large
3 Coastal Minelayers	38 Submarine Chasers, Small
17 Minesweepers	116 Motor Torpedo-Boats
9 Coastal Minesweepers	29 Motor Torpedo-Boat-Chasers
3 Auxiliary Minesweepers	6 Infantry Landing Ships
13 Miscellaneous Auxiliaries	4 Utility Landing Ships
29 Modern Ocean Patrol Submarines	2 Medium Landing Craft

86. There is a certain reinforcement potential in the form of transfers from the Baltic and Pacific Fleets. Local facilities can produce destroyer type vessels and below; cruisers and other large warships still have to be drawn from other fleets or forces. Coastal patrol and coastal warfare types could be converted from small merchant ship types.

87. In the merchant marine field, the Soviets appear to believe that generally small vessels are best suited and used in the Arctic region, with a maximum safe draft of 25 to 30 feet. This limitation is dictated by the shallow waters of the Arctic Sea coast and by ice which tends to trap and crush deep draft ships under certain

wind and other weather conditions. One voyage per season per ship into the area to any considerable distance is believed to be the turnaround time for arctic maritime operations--despite a few outstanding exceptions reported over the years.

88. It is difficult to determine how much cargo the Soviets transport or can transport over the Northern Sea Route. Despite some seasonal fluctuations, it had been deduced that in recent years about 100 thousand gross tons of shipping operate in Western Arctic waters, mostly to and from Murmansk and Archangel. A lesser amount, perhaps 50 thousand gross tons, entered and exited the arctic area though the Bering Straits in the east. The subsequent total of about 150 thousand gross tons would be capable of moving, in and out combined, 500 to 600 thousand metric tons of material annually. This is the figure claimed and last reported in 1939 by the USSR. Therefore, it is believed that little progress has been made toward increasing significantly the use of the Northern Sea Route--plans and claims to the contrary notwithstanding.

89. Specialized equipment and standard gear used for specialized purposes are essential to successful arctic operations. Foremost in this matter are icebreakers. The USSR has at least 27 known icebreakers of 1,000 gross tons or more, totalling almost 80 thousand gross tons, and many small icebreaking tugs, 20 of which are ex-U.S. ships provided under Lend-Lease. The total of icebreaking vessels (including merchantmen strengthened for ice navigation) may amount to 70 or 80 ships totalling almost 100 thousand tons gross-most of which could be disposed in arctic and subarctic.

90. Although Soviet Arctic base development dates back to the early 1920's, it was not until the Northern Sea Route Administration (Glavsevmorput) was established in 1933 that the project was given increased impetus. Exact figures on the number of bases are not available, but various estimates set the maximum and minimum at

350 and 200, respectively. These bases include everything from small outposts to relatively large repair facilities.

91. Aircraft form an important link in the chain of services needed to herd merchant ships through the Arctic. The number of aircraft cannot be estimated from available reports, which mention as few as 300 and as many as 2,700.

92. Other equipment, such as radar for ships and aircraft, probably is available in sufficient quantities if the Soviet leaders consider such an expenditure sufficiently important.

93. Hydro-Icebreakers. As early as 1946 the Russians had effected improvement in the performance of icebreakers by employing three water jets to cut ice in advance of the ship. By means of pumps, sea water is delivered, at about 3,000 lbs/sq.in. to the ice approximately 30 feet ahead of the stem through flexible pipes with the nozzle 20 to 24 inches above the ice. Water issues from the jet at about 600 ft/sec., but the quantity required is not known. With ice up to 5 feet thick, the speed of the breaker is above 3 knots. With ice thickness of 5 feet to 6½ feet, where normal breakers cannot get through, the hydro-icebreaker passes at 2 to 3 knots.

94. Rockets. There is little evidence of the Soviet equipping any major vessels with rocket launchers. A small gunboat has been equipped with the Katushya launcher, but this type vessel is suitable for use only in river and coastal waters. Should the Soviets equip their vessels with rockets for bombardment use in Arctic areas, the launcher itself would not be affected to any prohibitive degree. Their launchers are of simple construction, not automatic, and require a minimum of lubricants.

95. As for the rocket propellants, the Soviets prefer nitroglycerinic powders, using both ballistites and cordites. The latter were used in World War II, were of simple specifications and similar to U.S. and British powders. Availability of raw materials and ease of production seemed to be prime Soviet considerations and overshadowed actual refinements to the composition of their powder.

96. In general, it can be said that the known Soviet powders have a cold weather performance similar to U.S. and British World War II types. Due to the fact that the army maneuvers in cold weather areas and uses rockets in large numbers, it is certainly a probability that the Soviets have done and are doing experimentation in cold weather propellants. There is insufficient evidence to date, however, to indicate the present status of their development in this field.

97. Guided Missiles. A few unconfirmed reports state the Soviets have tested the launching of V-1 type missiles from submarines of a fleet maneuvering in arctic water and based at Archangel. Although the reports are unconfirmed, it is likely that the Soviets have given serious thought to cold weather effects of operation with V-1 missiles, and possibly some other types.

98. Underwater Ordnance. There has been no information on the extent of cold weather tests conducted by the Soviets on underwater weapons. However, it is most probable that they have investigated the effectiveness of these weapons under various cold conditions.

a. Mines. It has been reported that moored contact mines were laid in the Murmansk-Arkhangelsk region during World War II. It is not believed that moored contact mines would be used in locations where ice conditions exist. Likewise, it is felt that acoustic mines would be ineffective in these areas. Therefore, the most logical

type to be encountered would be the magnetic mine. However, as has been stated previously, there is no information available on which to assess the Soviet capabilities in this field.

b. Torpedoes. The Soviets undoubtedly have test fired torpedoes in arctic areas from both above-water and submerged tubes. It is assumed that they are capable of operating above-water tubes in the temperatures encountered; also submerged firing should pose no serious problem. The torpedoes themselves might be sluggish in their operation and improvements in known operational torpedoes can be expected.

c. ASW Weapons. The only known Soviet antisubmarine weapons are the U.S. type ahead-thrown weapons and conventional depth charges. In this field the Russians, being proficient in land rockets, most probably have the same capability with ahead-thrown weapons as they do with their Army rockets. Topside handling and maintenance of depth charges might cause the Soviets some trouble; but appreciation of the fact that the Russian Navy operates in cold climates leads to the assumption that topside maintenance problems most probably have been fully investigated and corrective measures studied.

99. Surface Weapons. The Soviet Navy operates in arctic waters as normal routine and can be expected to have acquired extensive knowledge of the ordnance problems engendered by extremely cold weather conditions. It is assumed that cold weather equipment has been incorporated in most Soviet Fleet units, as interchangeability of vessels between fleets is necessary. Thus, it is logical that the Soviet Fleet units are well versed in cold weather techniques.

a. The surface weapons of the Soviet Navy are of rugged construction and as simple design as modern

requirements of naval warfare permit. The result of this carefully devised program is relatively easy maintenance and dependable performance under all fleet operating conditions. An example of Soviet cold weather conditioning of fleet units is the use of enclosed mounts for the 37mm antiaircraft batteries in contrast to U.S. standard practice of open 40mm mounts.

b. It may be assumed that the surface ordnance problems of the Soviet Navy are identical with those of the U.S. Navy. Extensive tests in the Arctic have proved U.S. problems to be more those of personnel comfort and safety rather than any serious mechanical failures. If proper winter lubricants are used in the various systems, guns and fire control equipment will function satisfactorily, provided that firing circuits and controls are waterproof and well maintained. Adequate heating of gun mounts and directors is the big problem with U.S. vessels operating in the Arctic. It is assumed that Soviet vessels are better heated than current U.S. fleet units. Another problem in U.S. units, in connection with the above-mentioned heating of mounts, is the waterproofing of gun ports, where canvas bloomers have proven inadequate in heavy sea conditions accompanied by ice formation. The Soviet solution to this problem is not known.

c. The over-all capabilities of Soviet naval surface weapons for Arctic warfare are better than those of current U.S. weapons, as the USSR has operated extensively and routinely in the Arctic areas. Soviet personnel are thoroughly indoctrinated in Arctic operations techniques. It is believed that Soviet weapons are better protected and easier to maintain in operating condition in the Arctic than those of any other seapower.

100. Naval Communications Equipment. Soviet naval communications equipment is far simpler than that of the U. S., but normal performance is fairly comparable. Established circuits, distinguished by simplicity, versatility, and low power input requirements, are featured in Soviet communications sets. The equipment so far known is less rugged than that of the U. S. Navy and is far more sensitive to the effects of wide temperature variations, high humidity, shock, vibration, fungus growth and salt spray than comparable U. S. equipments.

101. (Not used.)

102. The local oscillator in the Soviet Navy's PURGA-45 receiver provides temperature stability of 0.035 per cent/degree Centigrade as compared to the U. S. Navy RBB/RBC stabilities of 0.001 to 0.003 per cent/degree Centigrade. To provide calibration needed due to excessive temperature changes, the Soviet set is provided with a simple built-in frequency meter.

103. On the other hand, Soviet specifications and written test procedures appear rather rigid even in comparison with ours. The PURGA-45 instruction book, previously cited, mentions stability requirements down to -40° Centigrade. This is ten or twenty degrees colder than normal U. S. Navy requirements. A recent set of specifications for "electronics equipments in ships subject to authority of the USSR Ship Registry" indicates that receivers must be capable of operating at a temperature of -40° Centigrade without permanent damage or impairment of operation. Of course, whether Soviet equipment meets these and other rigorous Soviet specifications is doubtful.

104. There is, however, some indication of improved component design. The best example is the KV-M receiver, a copy of the Hammerlund Super-Pro. Although no particular or original cold weather protection is apparent, general improvement of component design over earlier sets is evident. This receiver is being evaluated by another agency.

105. The other possible development with arctic implications is Soviet interest in the very low frequencies. Receivers are available for operation down to 12 kilocycles and there appears to be a common requirement for shipboard and submarine receiving equipment in this band. The implications of this are fully outlined elsewhere. Since the preparation of this report, there has been further evidence of receiver design in this band, though no such signals of Soviet origin have been intercepted. These frequencies are very attractive in arctic regions where the Aurora ruins higher frequency reception.

106. Electronics. There is no recent intelligence indicating Soviet electronic approach to the Arctic navigation problem. Continued interest in medium frequency direction finding is evidenced by their standard use of such gear on all their fleet units. Intelligence reports have indicated Soviet interest several years ago in a hyperbolic navigation aid similar to low frequency LORAN. There have yet been no Soviet signals intercepted of this type. Either the system has not enjoyed high priority, or they are saving it for wartime.

107. It is considered very likely that the Russians are in a position to utilize our own navigation aids. Outside of that and the possible long-range hyperbolic aid discussed above, reliance upon celestial aids and direction-finding is most probable. There is no evidence of naval electronics work other than that mentioned above with cold weather implications. It is believed that the developments most worthy of watching for cold weather implications

are the very-low-frequencies, possible for communications and/or navigation.

108. General Design Characteristics. There is no detectable difference in design or equipment between naval vessels stationed in the Arctic and their sister ships serving in other ocean frontier zones of the USSR.

109. With regard to the Soviet merchant marine, research and planning to improve ice navigation and to increase seaborne trade in the Arctic apparently are still in progress. Some merchant vessels acquired recently have been provided with additional strengthening; this applies particularly to a large number of fishing trawlers--which are potential escorts, minesweepers and coastal cargo vessels. Larger and more powerful icebreakers are on order and perhaps one super-icebreaker is actually under construction in the USSR. In addition, many scientific expeditions have been sent into the Arctic; a reported 400 investigations were to have been conducted between 1947 and 1951.

Logistics in Relation to Soviet Cold Weather Sea Operations

110. Oceanways. As related to merchant shipping, the Arctic navigation season (for complete transits) usually extends from mid-July through September. Under optimum conditions it might cover as much as five months, possibly June through October. The east (Bering Sea) and west (North Atlantic Ocean) approaches to the Arctic Sea are open longer. This means that vessels could stage in those approaches before the arctic season and increase effectually the total time available; for example, ships can start moving from the Baltic in April and May in time to reach the Arctic to coincide with the arrival of warm weather, thus extending the season a month or two. However, even in August, some ice is found in the form of bergs and floe (packs) which necessitate assistance from icebreakers.

111. The same limitations outlined above apply in general to the transit of naval vessels via the Northern Sea Route.

112. Lateral transport of supplies to bases or operating units along the Siberian coast may be accomplished by the use of the "Northern Sea Route" which connects European Russia with eastern Siberia via the Arctic waters. This route, with western anchors at Arkhangelsk and Murmansk and eastern terminus at Vladivostok, is about 7,000 miles long.

113. The navigational season on the route is confined to approximately 2½ months (mid-July through September), although it is possible in some years to make fair progress during most of October. Observation of the state of the ice from aircraft before and during the navigational season is one of the essential conditions of successful shipping operations. Bases for air reconnaissance have been established along the entire route and in addition large Soviet icebreakers carry one or two aircraft.

114. There is no known fixed operational pattern for merchant shipping in the Arctic. Vessels can proceed singly or in groups. They follow courses dictated by depth of water and ice conditions, usually following a route that may be considered as coastal. Local deviations are made, not only as imposed by these factors but as recommended by aerial reconnaissance of ice-free areas ahead. Not many vessels make complete transits of the Arctic Sea route. The majority operate from either end (Murmansk-Archangel in the West and Vladivostok in the East) to some point along the coast and then return to the starting point. The main arctic ports served are those in Svalbard and at the mouths of the great Siberian rivers--the Pechora, Ob, Yenisei, Khatange, Lena, Kolyma and Anadyr. Icebreakers are essential to the operations.

However, rather than tie up icebreakers in continuous escorting, they are disposed along the route at bases provided with radio equipment, and they are dispatched as required to escort or extricate vessels caught in pack ice.

115. Beginning in 1931, ships have succeeded in completing the through passage from Arkhangelsk or Murmansk to the Bering Sea, or the reverse journey, during each season in periods varying from six to twelve weeks. In 1936, from 11 to 14 ships completed the trip all the way from Leningrad to Vladivostok. Sometime about 1939, a Soviet icebreaker completed a journey from the White Sea to the east and back in one season. The fastest trip was made in 1940 by the German auxiliary cruiser "Komet" (3,300 tons), with Soviet icebreaker assistance and under particularly favorable ice conditions. Passage was made from Novaya Zemlya to Bering Strait in less than 20 days.

116. (Not used.)

117. (Not used.)

118. Inland waterways provide the only surface means of transportation between the Arctic areas of the Siberian coast and the industrial sections to the south and west. Flowing north from the southern borders of Siberia, the Ob, Irtysh, Yenisei, and Lena Rivers with their tributaries provide the link from the Trans-Siberian Railroad to the Arctic Seas. The Soviets have spent considerable effort in developing these water routes and adequate loading facilities are available at the rail junction points of

Omsk, Novosibirsk, Krasnoyarsk and Irkutsk. Limiting the use of these routes is the severe cold which restricts navigation to the period of May-June to October-November. While it is impossible to estimate the freight capacity of these rivers, it is safe to say that it would probably require an entire summer to build up a base for a major Arctic operation assuming a river were the only means of transport. However, it would be possible to maintain an established naval or air base without too much drain on normal traffic.

119. Farther to the west, connecting the Leningrad-Moscow industrial area and the Baltic Sea with the White Sea, is the Baltic-White Sea Canal. Its strategic importance lies in its value as a transfer route to the Arctic for ships of the Baltic Fleet and (after the completion of the Volga-Don Canal in 1952) the Black Sea Fleet. Ships up to destroyer size can transit the Baltic-White Sea Canal, a trip of 4 to 5 days during the months of May through October. Thus, a large-scale northern operation could be organized during the summer months without detection.

120. Clothing. Reports have been received that the following items of clothing are generally issued to Russian crews on ships of the Northern Sea Route: Goatskin, knee-length coat, fur inside, with high collar; goatskin helmet leaving only the eyes exposed; knitted cap worn inside helmet; felt knee-high boots; high, heavy woolen stockings; large, soft-soled, sheepskin slippers for wear inside boots; heavy, canvas coated pants tied at ankles; canvas padded jackets tied at wrists and neck; goatskin mittens, fur inside; knitted gloves for wear inside mittens; heavy knitted long underwear; extra sheepskin bed blanket for each man; flannel shirts and one sleeveless leather jacket, sheepskin lined.

121. It is highly unlikely that all of these items are in the possession of each man of the Northern Fleet, since most personnel of the latter are stationed west of Novaya Zemlàya, on the Barents

and White Seas, where weather is less severe. It may be assumed, however, that where necessary, the Soviets will at least attempt to supply their Arctic personnel with clothing similar to that just described.

122. Personnel. The morale problem for Soviet Naval forces in the Arctic is of a somewhat different nature from the morale problem in American forces. Because of the general nature of the Russian climate and the relative unattractiveness of Russian civilian life, it may be expected that the average Russian will be far less inclined to find Arctic conditions intolerable than would his American counterpart. Moreover, an elaborate "political" organization exists in all the Russian armed forces which is prepared to deal severely with any signs of disaffection which might appear.

123. On the other hand, the Soviets employ other than merely negative measures to sustain morale. In the Northern Fleet, as elsewhere, each naval base has its own "Navy Club". This club usually has facilities such as an auditorium for films or theatrical productions; game room for chess, checkers, dominos, etc.; billiard room; library; athletic facilities; and study room, containing materials on weapons, tactics, or technical subjects such as radio and electricity.

124. Soviet Naval personnel engaged in arctic duty are definitely far better off than those of the Air Force and Army. Constant shelter aboard ship is obviously available. Medical facilities and logistics are probably superior in view of the extensive arctic operating experience the Soviets have acquired over the space of many years.

125. Morale, therefore, should be far less a problem in the Soviet Arctic Fleet. Psychiatric conditions should be definitely minimal since environmental adaptability is easier with a well-

integrated group, closely associated and constantly under ideological and patriotic instruction.

126. Physical limitations offer no particular problem for Soviet Naval personnel operating in the Arctic except physical confinement aboard ship and prolonged exposure during watches on deck and superstructures. The latter is easily solved by limiting exposure by shortening time periods for such duties.

127. Mental and physical fatigue is in all probability a small hazard in view of the standard routine in force aboard Soviet vessels. There is no reason to believe that arctic routine differs except to shorten watches where exposure to cold is involved. Insomnia in the Arctic, due to long Polar day and night periods, is a well-known problem for civilian, Army and Air Force personnel. It is the forerunner of all neuro-psychiatric disorders by producing fatigue and promoting undesirable moods and accentuating personality defects. However, in general, naval personnel having access to living quarters wherein light can be controlled are therefore less prone to insomnia.

128. Facilities (See Naval Facility Chart following paragraph 135) Except for the Far East area, any Soviet Arctic naval operation will have to be staged from the European Arctic coasts and will be dependent upon the only ports of significant size, Arkhangelsk and Murmansk. Arkhangelsk has a handling capacity of 28-30,000 long tons per 20 hour day (or about 15,000 actual) and Murmansk has a capacity of 7-8,000 long tons or in practice about 4-5,000. It is estimated that railroads in and out of the ports could supply the area as rapidly as ships could be loaded and moved from the port. None of the other transport links from the coast to the industrial areas will contribute significantly. In the Far East area, there are several small capacity ports including Petropavlovsk and Provideniya through which Arctic naval operations could be staged during the navigable period of the year.

129. Few shipyards are located in the arctic and subarctic area. It is known that the Molotovsk Shipyard, located about 20 miles west of Archangel, and the Krasnaya Kuzmitsa Yard, about immediately north of the same city, are in the perma-frost area. Both yards are reported to have heating sheds for personnel assigned to outside work during the winter months. Although special clothing is supposedly furnished their workers, it is believed to be rather inadequate. Welding is done indoors during cold weather. Molotovsk has covered building ways providing for temperatures above the minimum allowed for welding--even when outside temperatures drop to -40° and 50° F. All major shops at Molotovsk are connected by railroad. Steam and water lines are protected in heated underground tunnels. Icebreakers stationed at this yard keep access lanes open during the winter months. It is believed that new construction is so planned that no launchings occur during the winter--although they could probably be carried out with special preparations.

130. Underwater repairs to ships have been accomplished in the Arctic without the use of conventional drydocks. To be able to repair plating below the waterline, the ship is purposely left to be frozen in the ice. By cutting top sections of the ice next to ship's hull, the thinner areas of ice refreeze from the underside and build up successive layers of bouyant ice under the ship. Repetition of this process physically lift up the hull after which a working space can be cleared adjacent to the hull area to be repaired. According to reports, even the keel can be reached by this method.

131. Requirements of fuel and lubricants for the Northern Fleet operating forces under wartime conditions will be about 981,000 long tons for one year. There are facilities at Murmansk and Arkhangelsk to adequately handle these fuel requirements, assuming rail and port installations are not damaged.

132. (Not used.)

133. Munitions. Soviet powder train time fuzes, such as have been encountered in Korea, may be better for cold weather operations than mechanical time fuzes, which have replaced powder train fuzes in the U. S. Navy. Likewise, VT fuzes are subject to more permature bursts due to peculiar weather conditions, snow flurries, heavy fogs, etc., of the polar regions.

134. Gun propellants are largely unaffected by cold although initial velocities and resultant ranges are decreased by cold weather.

135. Primers and detonators have functioned normally in previous polar tests.

PORT-VLADIMIR - Sheltered anchorage; advanced base for submarines, minesweepers, and torpedo boats; extensively fortified.

POLYARNYY - Naval operating base for destroyers, submarines, minesweepers, minelayers, motor torpedo boats, and patrol craft. All-year navigation.

VAYENGA - Naval operating base for destroyers and escort vessels. Submarine training center. All-year navigation.

GUBA TYUVA - Auxilliary naval base for minesweepers and patrol craft.

MURMANSK - Major commercial port and industrial center. Principal naval supply depot and repair base. Good berthing facilities, but limited anchorage. Port capacity 7,000 tons. All-year navigation.

KANDALAKSHA - Shipping port for lumber, minerals, canned fish, and iron castings. Limited berthing facilities and anchorage. Port capacity 1,000 tons. Closed from November to May.

GUBA KOVDA - Sheltered anchorage; lumber-shipping port.

BELOMORSK - Important industrial and commercial center exporting lumber and pulp. Northern terminus of Stalin Canal. Good berthing facilities, but unsuitable anchorage. Port capacity 1,500 tons. Closed from November to May.

KERET' - Sheltered anchorage; lumber-shipping port.

KEM' - Lumber - shipping port. Fair berthing facilities and anchorage. Port capacity 3,000 tons. Closed from November to May.

SOLOVETSKIY - Sheltered anchorage; seaplane base; fleet anchorage.

ONEGA - Shipping port for lumber. Fair berthing facilities, but no close-in anchorage. Port capacity 3,000 tons. Closed from November to May.

PECHENGA - Outlet for nickel mines in vicinity. Fair berthing facilities and several good anchorages. Port capacity 1,200 tons. Probable all-year navigation.

BUKHTA OZERKO - Sheltered anchorage; small torpedo boat base.

GUBA TERIBERSKAYA - Sheltered anchorage; fishing harbor; military outpost; patrol craft base.

GAVRILOVO - Open anchorage; fishing harbor.

GUBA BOL'SHAYA PIR'YA - Sheltered anchorage; lumber-shipping port.

GUBA PON'GAMA - Excellent anchorage.

YOKAN'GA - Naval anchorage and advanced patrol base.

MEZEN' - Fishing harbor; military outpost.

ARKHANGEL'SK - Principal port on Arctic Coast. Important naval supply depot and repair base. Good berthing facilities and unlimited anchorage. Port capacity 28,000 tons. Closed from November to May.

MOLOTOVSK - Well protected semi-artificial harbor. Site of large modern naval shipyard. Good berthing facilities, but limited anchorage. Port capacity 2,500 tons. Can usually be kept open all year.

UNSKAYA GUBA - Sheltered anchorage.

GUBA BELUSH'YA - Excellent anchorage; advanced naval operating base.

OSTROV VAYGACH - Sheltered anchorage.

KHABOROVO - Open anchorage.

AMDERMA - Partly sheltered anchorage; lumber, mining, and fishing center.

NAR'YAN-MAR - Unsheltered anchorage; shipping port for coal and lumber; advanced naval operating base.

OVYY PORT - Sheltered anchorage; transshipment port; fishing enter.

KOZHEVNIKOVO - Sheltered anchorage; newly developed oil port.

DIKSON - Coaling and provisioning base for Northern Sea Route. Submarine base. Fair berthing facilities and anchorage. Port capacity 1,200 tons. Closed from October to July.

DUDINKA - Port of shipment for coal, iron ore, and nickel concentrate. Naval meteorological station. Limited berthing and anchorage facilities. Port capacity 1,000 tons. Closed from October to July.

IGARKA - Transshipment port for ocean-going vessels. Naval meteorological station. Limited berthing and anchorage facilities. Port capacity 1,500 tons. Closed from October to July.

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PROVIDENIYA - Fueling and provisioning base for N sea route. Polar station and 2 radio stations. Minor naval base. Port capacity 1,150 tons. Closed Nov-May.

ANADYR' - Medium-sized sheltered anchorage. Fishing and industrial center. Oil storage. Repair shops.

RYRKARPIYA - Partly sheltered anchorage; winter harbor; air base.

PEVEK - Partly sheltered anchorage; coaling station for Northern Sea Route.

AMBARCHIK - Open anchorage; sea outlet for Kolyma River area. One of main Northern Sea Route ports.

BUKHTA GLUBOKAYA - ... plant. Weather station. ... station. Border patrol. Small craft repair.

ZALIV KORFA - Proba... marine base (summer).

KARAGA - Large shelt... ural harbor. Possible ... base (summer).

GUBA BELUSH'YA - Excellent anchorage; advanced naval operating base.

OSTROV VAYGACH - Sheltered anchorage.

KHABOROVO - Open anchorage.

AMDERMA - Partly sheltered anchorage; lumber, mining, and fishing center.

MAGADAN - Manufacture of aircraft, cellulose, and heavy machinery. Port capacity 1,350 tons. Closed Dec-May. Minor naval base.

TIKSI - Sheltered anchorage; transshipment port on Northern Sea Route.

KOZHEVNIKOVO - Sheltered anchorage; newly developed oil port.

OKHOTSK - Small craft repair. Submarine base (summer). Landing field. Radio station. Weather station.

PROLIV ASLANBEKOVA - Unlimited open anchorage. Landings for oil field. Oil storage.

VIYAKHTU - Pacific Fleet naval and air base. Repair shops. Power station. Radio station.

ZALIV CHAYVO - Unlimited open anchorage. Seaplane base. Airfield. Bunkering. Radio station.

RYBNOVSK - Small craft repair shops. Power station. Radio station. Many small craft.

ZALIV URKT - Unlimited open anchorage. Seaplane base. Airfield. Oil storage and bunkering. Radio station.

MOSKAL'VO - Oil port for Ohka field. Small fair-weather anchorage. Closed October to June.

DIKSON - Coaling and provisioning base for Northern Sea Route. Submarine base. Fair berthing facilities and anchorage. Port capacity 1,200 tons. Closed from October to July.

DUDINKA - Port of shipment for coal, iron ore, and nickel concentrate. Naval meteorological station. Limited berthing and anchorage facilities. Port capacity 1,000 tons. Closed from October to July.

IGARKA - Transshipment port for ocean-going vessels. Naval meteorological station. Limited berthing and anchorage facilities. Port capacity 1,500 tons. Closed from October to July.

AYAN ZALIV AYAN - Large fair anchorage. Small craft repair shops. Oil barrel storage. Warehouses. Landing field. Seaplane anchorage. Power plant. Radio station.

NIKOLAYEVSK - Transfer port for Amur River and coastal traffic. Secondary naval base. Port capacity 2,100 tons. Closed Nov-May.

ZALIV NIKOLAYA - Huge well-sheltered anchorage. Lighters.

MARIINSKOYE - Base for Amur River Naval Detachment.

DE-KASTRI - Transfer port. Minor naval base. SE terminus of land and sea routes to Amur River. Port capacity 1,150 tons. Closed Dec-Apr.

KOMSOMOL'SK - Inland (Amur River) port. Secondary naval base. Leading metallurgical and important heavy-industry center. Port capacity 1,200 tons. Closed Nov-Apr.

MALMYZH - Base for Amur River Naval Detachment.

NAR'YAN-MAR - Unsheltered anchorage; shipping port for coal and lumber; advanced naval operating base.

OVYY PORT - Sheltered anchorage; transshipment port; fishing enter.

SVOBODNYY - Base for Amur River Naval Detachment.

BLAGOVESHCHENSK - Base for Amur River Naval Detachment.

SRETENSK - Base for Amur River Naval Detachment.

LENINSKOYE - ... River Naval Det...

IMAN - Base for ... Naval Detachme...

THE ARCTIC REGIONS

PROVIDENIYA - Fueling and provisioning base for N sea route. Polar station and 2 radio stations. Minor naval base. Port capacity 1,150 tons. Closed Nov-May.

ANADYR' - Medium-sized sheltered anchorage. Fishing and industrial center. Oil storage. Repair shops.

RYRKARPIYA - Partly sheltered anchorage; winter harbor; air base.

PEVEK - Partly sheltered anchorage; coaling station for Northern Sea Route.

AMBARCHIK - Open anchorage; sea outlet for Kolyma River area. One of main Northern Sea Route ports.

BUKHTA GLUBOKAYA - Power plant. Weather station. Radio station. Border patrol station. Small craft repair.

ZALIV KORFA - Probable submarine base (summer).

KARAGA - Large sheltered natural harbor. Possible submarine base (summer).

UST-KAMCHATSK - Unlimited open anchorage. Industrial Center. Transfer point for river shipping. Several oil tanks. Small shipyard.

PETROPAVLOVSK-KAMCHATSKIY - Principal transhipment port. Shipbuilding and major ship repair. Secondary naval base. Port capacity 3,250 tons. Closed Jan-Mar.

MAGADAN - Manufacture of aircraft, cellulose, and heavy machinery. Port capacity 1,350 tons. Closed Dec-May. Minor naval base.

PROLIV ASLANBEKOVA - Unlimited open anchorage. Landings for oil field. Oil storage.

VIYAKHTU - Pacific Fleet naval and air base. Repair shops. Power station. Radio station.

ZALIV CHAYVO - Unlimited open anchorage. Seaplane base. Airfield. Bunkering. Radio station.

RYBNOVSK - Small craft repair shops. Power station. Radio station. Many small craft.

ZALIV URKT - Unlimited open anchorage. Seaplane base. Airfield. Oil storage and bunkering. Radio station.

MOSKAL'VO - Oil port for Ohka field. Small fair-weather anchorage. Closed October to June.

KASHIWABARA-WAN - Border patrol base. Several oil tanks. Bunkering.

MUSASHI-WAN - Canning center. Numerous warehouses and cannery buildings.

TIKSI - Sheltered anchorage; transshipment port on Northern Sea Route.

OKHOTSK - Small craft repair. Submarine base (summer). Landing field. Radio station. Weather station.

ALEXANDROVSK - Unlimited open anchorage. Coal port and trade center.

AMBETSU - Weather station. Power station. Landing strip.

SHIKUKA-HAKUCHI - Unlimited open anchorage. Airport 11 mi. NW. Warehouses. Cold storage plant. Cellulose plant. RR shops. Many tugs and lighters. Closed November to May.

ESUTORU - Manufacture of explosives. Port capacity 4,250 tons Closed Dec-Mar.

MAOKA - Transportation and communications center. Paper manufacturing. Port capacity 3,600 tons Closed Dec-Mar.

TENNEI ETOROFU-SHIMA - Medium-sized fair anchorage. Naval base under construction.

AYAN ZALIV AYAN - Large fair anchorage. Small craft repair shops. Oil barrel storage. Warehouses. Landing field. Seaplane anchorage. Power plant. Radio station.

NIKOLAYEVSK - Transfer port for Amur River and coastal traffic. Secondary naval base. Port capacity 2,100 tons. Closed Nov-May.

ZALIV NIKOLAYA - Huge well-sheltered anchorage. Lighters.

MARIINSKOYE - Base for Amur River Naval Detachment.

DE-KASTRI - Transfer port. Minor naval base. SE terminus of land and sea routes to Amur River. Port capacity 1,150 tons. Closed Dec-Apr.

ŌTOMARI - Important commercial port and RR terminus. Minor naval patrol craft base. Port capacity 7,000 tons.

HONTO - Minor naval patrol craft base. Distribution center of supplies from Vladivostok. Port capacity 3,200 tons. SAKHALIN'S sole ice-free port.

TOMARIORU - Unlimited open anchorage. Chemical factory. Outlet for coal mine.

KOMSOMOL'SK - Inland (Amur River) port. Secondary naval base. Leading metallurgical and important heavy-industry center. Port capacity 1,200 tons. Closed Nov-Apr.

MALMYZH - Base for Amur River Naval Detachment.

KHABAROVSK - Unlimited anchorage. Principal Amur River Flotilla base and Naval Hq. Far East. Small craft building and repair. RR center. Road to Vladivostok. Closed October to January.

BUKHTA GROSSEVICHA - Submarine and torpedo boat base.

SOVETSKAYA GAVAN' - Expanding major naval base and important commercial port. Good berthing. Industrial center. Port capacity 9,500 tons.

SVOBODNYY - Base for Amur River Naval Detachment.

BLAGOVESHCHENSK - Base for Amur River Naval Detachment.

SRETENSK - Base for Amur River Naval Detachment.

LENINSKOYE - Base for Amur River Naval Detachment.

IMAN - Base for Amur River Naval Detachment.

BUKHTA TETYUKHE - Copper, lead, zinc mines. Small craft shipbuilding and repair. Power station. Closed November to March.

ZALIV VLADIMIRA - Large, fair anchorage. Submarine and torpedo boat base. Chemical plant. Power plant. Closed November to March.

VLADIVOSTOK - Principal commercial port. Major naval base. Heavy-industry center. Excellent berthing. Port capacity 18,500 tons.

TROITSA (VOYAT) - Naval operating base for destroyers, submarines, and patrol craft.

ZALIV OL'GI - Unlimited good anchorage. Naval air station and submarine base. Power plant. Closed November to April.

NAKHODKA - Growing major commercial port. Secondary naval base. Industrial center. Adequate berthing. Port capacity 10,500 tons.

BUKHTA GAYDAMAK - Small craft repair shops. 2 power stations. Radio station. Closed January to March.

GNOMONIC PLOTTING CHART
Radius of Projecting Sphere 76.868 cms.

IV. AIR OPERATIONS

Past Soviet Preparations and Research for Arctic Air Operations

136. The Soviets' work in arctic flying is probably their outstanding contribution to nonmilitary aviation. Their investigations have included: navigation in arctic regions, survey of ice conditions in the Arctic, including the drift of ice, its thickness and quality; the landing of aircraft on ice; the use of airplanes to search out the most practical leads for surface ships and the establishment of a network of numerous stations for meteorological and other scientific purposes. Their more spectacular achievements include transpolar flights, the landing and maintenance of the Papanin "drifting expedition", and the rescue of the Schmidt scientific expedition near Wrangel Island.

137. Since the last war, there have been various indications of Soviet interest in pursuing research and investigation relating to air operations in the Arctic.

138. A few other points are worth noting: Soviet exploration of the Arctic by aircraft began in 1929 with their first flight over the eastern part of the Siberian Arctic; in 1934, a systemati geographic exploration of Siberia was initiated; in 1937, two Soviet aircraft flew nonstop from Moscow to North America to pione a proposed transpolar airway; in 1938, ice exploration was begun; in 1946, the airbase at Tyllyr was completed. This base, at the mouth of the Lena River and about two-thirds the distance from Nordvik, (at the mouth of the Khatanga) and Tiksi, is important because, in addition to providing an alternate field for Khatanga, Nordvik, or Tiksi, it also serves as a base for planes engaged in ice reconnaissance in the Laptev Sea.

139. These four bases--Khatanga, Nordvik, Tyllyr, and Tiksi--about which little information is available, are well placed for mounting strategic air attacks against North America. From them,

the Great Circle routes pass close to the "pole of inaccessibility", over areas where detection would be most difficult. By crossing the Canadian Archipelago and Hudson Bay, Soviet long-range bombers might not be detected until near their targets.

Analysis of Previous Soviet Cold Weather Air Operations

140. Tactical Doctrines. The Soviet Air Force was designed, organized, and employed primarily as an instrument of immediate and direct support of the Soviet Army. Experiences in World War II tended to intensify this conception. Since World War II, however, the Soviets have given greatly increased attention to development of long-range aviation and an air defense system--two aspects of balanced air power which had previously been of less concern to the USSR.

141. Proficiency in Cold Weather Techniques. In the Russo-Finnish War, cold weather did not hamper flying as much as the clouds did. Even during periods of continuous temperatures of -30 to -40 degrees Farenheit, there was intense flying activity. Heavy cloud formations, such as prevailed in December 1939, prevented air operations entirely or in part, owing to Soviet deficiencies in instrument flying.

142. Both the Finns and the Soviets used frozen lakes as landing fields. The heavy snow was packed by large rollers and no real difficulties were experienced at these makeshift bases. The Soviets customarily based their twin-engine bombers on these lakes, and operated some of their four-engine bombers (the TB-7 or PE-8 -- an aircraft with maximum gross weight of 80,000 pounds) from them during the severe winter of 1939-1940.

143. The Finns found it necessary to equip all fighter planes with fully retractable skis for landing on snow or ice. The Soviets had this equipment on their twin-engine bombers as early as 1939, and reportedly had developed the retractable landing gear

of their I-153 fighter so that wheels or skis could be used interchangeably with a minimum of conversion operations. At the beginning of World War II, many Soviet aircraft were equipped with either fixed or retractable skis for winter or arctic operation. Later, however, the Soviets apparently reconsidered that idea and simply used special tires on their conventional landing gear.

144. The Soviets combated cold weather engine-starting by starting the aircraft motors periodically and keeping them idling for some time. During World War II, engines were started every hour, and the Soviets provided special insulation against low ground temperatures.

145. Although the ground equipment and operating methods used by the Soviets in maintaining their aircraft at very low temperatures appear primitive, the Soviets acquired considerable experience in this field during World War II. Most Soviet major offensives launched in winter were powerfully supported by their air forces. The Soviets carefully observed all west-to-east movements of cold fronts and, from their warmer area, launched maximum air attacks against the Germans who, in their colder area, were unable to start their aircraft motors and, consequently, were unable to counter the Soviet attack with any air action. These operations subsequently involved considerable ground maintenance at temperatures of -40°F.

146. The air forces of the USSR have had more experience in large-scale operations at very low temperatures than the air forces of any other nation. Undoubtedly, these operations have been studied and analyzed in great detail for the development of doctrines, techniques, materiel, and equipment for military operations in arctic and subarctic environments.

Present Training

147. Several million people inhabit the arctic and subarctic regions of the USSR. Consequently, there is a large reservoir of manpower accustomed to living under the prevailing conditions, and procurement of acclimated personnel constitutes no great problem for the Soviets. The availability of personnel combining climatic adaptation with special technical skills might present more of a problem.

148. Routine Rotation. There is no confirmed evidence of rotation of troops to arctic areas for arctic training, although general Soviet practice of rotating air units would be expected to involve some units based in northern regions. The training of Polish youths for the Arctic Air Force has been reported.

149. Estimate of Soviet Aviation Forces Trained in Cold Weather Operations. Information is lacking upon which to base an estimate of Soviet aviation forces (including naval aviation) trained in cold weather operations. The estimated military air strength in the military districts north of 60 degrees north latitude represents only a small portion of the total air forces of the Soviet Union. In the northwestern part of the Soviet Union, the greatest concentrations of aircraft are in the White Sea and Arkhangelsk Military Districts.

150. At the opposite extremity of the Soviet Union, in Eastern Siberia, the estimated air order of battle shows a considerable number of aircraft. However, most of them are based south of 60 degrees north latitude. Direct evidence of at least one Soviet fighter regiment in Northeastern Siberia has been obtained, and there may be others.

151. Aside from air units geographically deployed in arctic regions, it must also be noted, of course, that winter conditions throughout great parts of the remainder of the Soviet Union are

rigorous, so that normal winter operations in these areas would constitute cold weather training for large numbers of Soviet air personnel.

Cold-weather Operational Capabilities

152. The primary mission of Soviet air power presently based in the Arctic is believed to be basically defensive. Aside from the staging of aircraft into outlying Arctic areas for offensive strikes in the event of war, it is probable that the basic Arctic air mission will remain predominantly defensive until communications facilities are improved enough to provide the tremendous logistic support necessary for sustained offensive air warfare.

153. Warfare Techniques. Except for the Long Range Aviation, the offensive elements of the Soviet Air Force are organized and trained primarily for close support of their ground forces. The use of propeller-driven planes for tactical support purposes is difficult under arctic conditions. Nevertheless, the Soviets have, in the past, demonstrated their capability to conduct such operations. This capability would be enhanced if the Soviets used jet-powered aircraft for close-support missions, a use that is indicated by recent reports of Soviet exercises.

154. Weather Forecast. The Soviets have had long experience in arctic meteorology and reportedly have developed an extensive network of both attended and unattended radio stations that transmit weather, current, and ice information. It would be possible for the Soviets to establish more of these stations if their requirements should so dictate. The use of weather-reconnaissance aircraft, and possibly submarines, would also assist in weather forecasting. The Soviets undoubtedly have considerable capability in this field, and they could increase this capability.

155. Maintenance of Equipment. The Soviets have demonstrated a capability to maintain equipment for large-scale air operations in extremely low temperatures. This capability has presumably been increased since World War II. However, daily maintenance will still require some kind of shelter, and periodic inspections and major repairs will involve flying the aircraft, if possible, to bases where the work can be done.

156. Mobility. It is considered that the Soviets have the capability for supplying and getting their aircraft off the ground. Once airborne, the operation of an airplane in arctic environment is not materially different from its operation in temperate zones.

157. Airborne Operations. The rigorous arctic and subarctic terrain, weather, and climate, the great distances and extreme paucity of land transportation, as well as the difficulty of conducting ground operations--all combine to emphasize the importance of airborne operations in these areas.

158. The Soviets have had considerable background experience applicable to airborne operations in the Arctic. In May 1937, the Papanin expedition was air-dropped at the North Pole. During its nine months of drifting on the ice pack, it was supplied by four-engine planes which landed on the ice. Little is known concerning present Soviet training for military airborne operations in the Far North. However, it is known that in the postwar period, considerable attention has been devoted to training for large-scale airborne operations. There are now estimated to be some 100,000 qualified paratroopers on active duty in the Soviet Union, and air-transportable troops probably number another 100,000.

159. (Not used.)

160. Intelligence Operations. The Soviets' capabilities for intelligence operations are difficult to assess. The indigenous population is an important factor in operations within their own territory. The vast amount of knowledge of arctic and subarctic areas that the Soviets have acquired from numerous expeditions is also an important factor. However, these areas impose unusual problems: the settlements are few and far between, and the population density is insufficient for obtaining covert intelligence; the territory is vast and there are few accurately charted, identifiable landmarks. The wind-blown snow, a highly effective natural camouflage for immobile objects, sifts into crevices and distorts appearances and merges landscapes until familiar things and terrain are unrecognizable from the air; photo reconnaissance is relatively ineffective during part of the year because of clouds and fog, and because shadows of the snow cover have little relation to the true shapes of blanketed objects. The seasonal variations of daylight and darkness, and also the conditions of climate and weather, restrict intelligence operations, and detailed maps are almost completely lacking. Owing to long experience in exploration and in living in arctic and subarctic environments, the Soviets probably have greater capabilities than Westerners for conducting intelligence operations in these regions.

161. Navigation. Aerial navigation of the polar regions is difficult. Radar, Loran and Shoran have tremendously increased the capability to navigate in bad weather. The Soviets have done considerable experimentation and research on navigational aids and could probably develop facilities of this kind.

162. Since World War II, the Soviets have acquired and adopted more efficient navigational equipment than they had at that time. They have the necessary theoretical knowledge for successful polar navigation. Consequently, they could probably navigate in the arctic air with the equipment now available to them.

Soviet Aviation Equipment as Related to Cold Weather Operations

163. In general, Soviet equipment is rough and crude compared to Western-manufactured equipment. This is partly because the Soviets aim for simplicity of design and operation to compensate for the generally low level of education and technical training in their armed forces. On the whole, this cruder and more rugged equipment is more workable under arctic conditions than are its western counterparts.

164. Aircraft Equipment and Weapons. The turbojet-propelled fighter or interceptor appears to be the type of aircraft most readily adaptable to arctic operation. The power unit is relatively simple, compared to the conventional type engine. It can be started easily when cold, and consistently good starts have been obtained at temperatures as low as -56° F. This type of engine can be maintained in a permanent state of readiness with considerably less ground equipment than is necessary for conventional engines. Since the Soviets have placed great emphasis on jet aircraft development and production, it is logical that they would employ aircraft of this type in future arctic and subarctic operations.

165. Among special problems on which no information is immediately available with regard to Soviet solutions are: the freezing of cockpit instruments; the stiffness of operation of the moving parts of automatic weapons and other material due to cold lubricants; the improper functioning of equipment and the leakage of fluids due to differences in the contraction of

materials; the failure of bomb fuzes, instruments, weapons, and equipment due to the freezing of condensation therein or thereon; and the distortion of moving parts having close tolerances.

166. Communications. The difficulty of constructing and maintaining land lines for communications has forced the Soviets to rely upon radio. In 1946, approximately 270 radio stations of various types were listed as located north of 60 degrees north latitude in Russia. This does not include amateur stations that have been reported as far north as Wrangel Island and Novaya Zemlya. Reports indicate that the Soviets have instituted a chain of unattended stations that will transmit weather, current, and ice information. During the summer of 1945, U. S. aviators ferrying aircraft to Siberia from Alaska noted that homing beacons every 600 miles constituted the main form of navigational aid in that area. The Soviet capability for radio communication is in 1951 much greater than formerly, and it is considered adequate for military operations.

167. Electronics. The Soviets received a considerable quantity of radar equipment from the United States and Great Britain during World War II. In addition, they captured or otherwise acquired a great deal of German equipment. Since then, the Soviets have benefitted from the work of German scientists and technicians taken to the USSR and have produced radio and radar equipment of their own. They are known to have radar installations in the Murmansk, Chukotski, and Kamchatka areas. The Soviets have the capability of installing networks of radar early-warning stations in arctic areas, but obtaining the numerous trained technicians required to operate these stations may be a difficult problem.

168. General Design Characteristics. The Soviets' concentration on simplicity in all items of materiel and equipment makes for standardization and facilitates production and maintenance by semiskilled labor, training of low-caliber personnel, and logistics. Although some of the materiel and equipment used in the Russo-Finnish War and in World War II is now obsolescent, information on Soviet research, development, and production for its replacement is far from complete.

169. However, particularly as a result of intelligence acquired during the Korean campaign, it is now considered that Soviet technical advances have been more rapid in a number of fields than had previously been expected. Improved engine technology, as demonstrated by the modified Soviet version of the Nene jet engine, is one example. Considerable advance has also been made in the electronics field.

170. Soviet radio-communications equipment adheres to accepted foreign design and construction practices. However, it does not follow that late designs of Soviet electronic equipment are inferior to U. S. types. Soviet-made equipment captured in the Korean campaign conclusively demonstrates that the Soviet electronics industry made great strides in the period from 1949 to 1951. Formerly, Soviet receivers contained German, American, and Soviet parts, and thus indicated shortages; but recent receivers have only Soviet components of good design. Available information on the Soviet electronics industry indicates that, although this industry may not be large, it is producing communications equipment that is well engineered, comparatively cheap, easy to maintain, and which meets Soviet operational needs.

Air Logistics in Relation to Soviet Cold Weather Operations

171. Airways. The Soviet Arctic is serviced from Murmansk to Uelen (on Bering Strait) by a net of airlines and a system of airports along the Arctic coast and inland, principally along the navigable rivers. Both civil and military air transports operate in the Arctic. Traffic is relatively light, and scheduled flying is hampered by weather, lack of navigational aids, absence of emergency fields between widely separated stops, and inadequate facilities at the airports. Since the last war, there have been indications of a fairly extensive Soviet effort to improve airfield and navigation facilities in arctic areas, although again the results achieved are not known in any detail.

172. Air Facilities. Throughout the vast territory of the Soviet Arctic, there are suitable airfield sites. In winter, the many frozen lakes in arctic and subarctic regions afford an almost unlimited number of usable airfield sites. In summer, many of these lakes could be used for seaplane operations. Since airfield locations in this area are determined by economics rather than geology, and since the economic development of the Soviet Arctic is concentrated along the great Siberian rivers, it is anticipated that airfield development, both commercial and military, will be confined to these arteries of transportation and along the coast.

173. Practically all of the land north of 60° presents serious obstacles to airfield construction. Most of it has a subsoil that is permanently frozen to varying depths and undergoes varying degrees of thaw in summer. Nevertheless, the Soviets have found ways to cope with the permafrost, and much of the material required to construct simple airfields is either locally available or can be transported down the Siberian rivers to the sites. Sand

and gravel are thought to be present throughout most of the Arctic, and timber for wooden surfaces can be floated down the rivers if it does not exist at the site. Even the raw materials for cement and asphalt surfaces are available near a few sites, notably at Ukhta and Yakutsk.

174. At some northern Soviet airfields, such as fields which have actually been observed in the Archangel area, practically all installations, including most living quarters, are underground. In winter, airplanes can land almost anywhere on the ice and snow, whether equipped with wheels or skis. Snow removal from airstrips is not always necessary. It is known that the Soviets have used snow rollers with good results. Frequently, no preparation of a landing area is required. Temporary bases can therefore be established quite easily in advanced areas. In summer, conditions are quite different, there being practically no landing areas except at permanent or semipermanent bases. It is known that the Soviets have been able to use float-planes in summer and ski-planes in winter in the Arctic.

175. Supply. All supplies and munitions for arctic air operations must be procured from the industrial areas of the countries involved. In Western Russia, this area lies between 50° and 60° north latitude -- approximately 1,000 nautical miles nearer the North Pole than a comparable area in the United States. Nevertheless, the length of the Soviet lines of communication, plus the manifold difficulties presented to their supply organizations by the conditions prevalent in arctic regions, would force them to construct large storage facilities close to the theater of operations. This would be an added burden because of the construction requirements for this storage.

176. In general, the problems of supplying air operations in arctic and subarctic areas are less serious than those for ground operations. Permanent and semipermanent air bases will tend to be located where logistical support is readily available. Consequently, there will be more facilities of all kinds at these bases.

177. In summer, logistic support of air bases along the Arctic coast and the Siberian rivers may be simplified by using water transportation. However, the logistical problems of outlying units will be magnified. The frozen soil and permafrost prevent the melting snow and ice from draining, and this causes extensive floods. The soft ground, swamp-like after spring thaws, forces sleds to be used in some areas in summer as well as in winter. Summer is also the worst season for flying in the Arctic, especially for reconnaissance and ground-supply. Nevertheless, logistics for air operations will be less adversely affected in summer than will those for ground operations. Another main effect of the summer season--insects--will be felt in reduction of efficiency of personnel.

178. Ground operations in arctic and subarctic terrain will indirectly affect air operations in that more supply and evacuati by air will be required by ground troops. In winter, cargo plane can be landed almost anywhere and unloaded; but in summer, most of the supplies will have to be air-dropped. Similarly, evacuati will be fairly simple in winter but difficult in summer. To overcome the difficulties imposed by the terrain and the lack of landing facilities in summer, the extensive use of helicopters for liaison, reconnaissance, observation, and supply and evacuati would appear to be one solution. It is not known what specific progress the Soviets have made in the development and production of helicopters, although it is known that some have been produced and nine helicopters of a new model were demonstrated in the July 1951 Air Show in Moscow.

179. Clothing. The Soviets, who have had considerable experience in living and working under arctic and subarctic conditions, have developed special clothes that permit a certain amount of outside work at very low temperatures. The Soviets' capability to clothe their aviation forces properly is considered adequate.

180. Personnel. Acclimation is not a major problem for the Soviets. It is probable that the Soviets would, insofar as practicable, use people accustomed to living and working under arctic and subarctic conditions. In fact, Soviet manuals on arctic operations skip all reference to living in the Arctic and plunge directly into other matters.

181. The Soviets have ample manpower for air operations in arctic and subarctic environments, but even if they use people acclimated from birth, physical limitations will still apply. The principal limit on the number of troops that the Soviets can concentrate is their logistical capability to maintain them.

182. Fuel and Lubricants. Large quantities of fuel are required to heat personnel shelters, hangars, workshops, aircraft engines, cockpits, etc., in addition to the fuel necessary for operating power plants, mechanized equipment, and the aircraft themselves. The use of different kinds of fuels and lubricants complicates the supply problem. The Soviet Union has the capability to produce the fuels and lubricants for air operations in arctic and subarctic environments, but its supply capability will depend upon its transport capability. (See also pages 80-88)

183. Munitions. Like foods, fuel, and lubricants, the Soviets' capability to supply munitions to their air forces will depend upon their capability in transportation.

184. All of these items--food, fuels and lubricants, munitions--can be furnished to the air forces more readily than to the ground forces because the airbases will be located on supply routes. However, the sparse transportation facilities of northern USSR, and the long periods when mud restricts overland communications, would force the Soviets to stockpile in the area large quantities of all items needed for military operations in the Far North. As an example, it is estimated that the stockpiling required for mounting a long-range operation from such an area as Northeast Siberia would require about 45 tons of supply of all items per medium bomber aircraft involved.

V. SOVIET DEVELOPMENTS IN FIELDS RELATED TO COLD WEATHER OPERATIONS

185. Research Expeditions. Soviet knowledge of the arctic and subarctic regions has been acquired principally through the medium of two organizations: the Main Administration of the Northern Sea Route (GLAVSEVMORPUT), and the Arctic Institute. Up until 1938 when it was reorganized, GLAVSEVMORPUT controlled all Soviet territory north of 62° N. Latitude. The Arctic Institute, which was organized as part of GLAVSEVMORPUT, has in the thirty years of its existence, published more than 1,000 volumes dealing with all phases of arctic life and is estimated to have sent out more than 400 expeditions dealing with such subjects as hydrography, meteorology, hydrometeorology, cartography, oceanography, etc. Announced Soviet plans for 1950 included 540 expeditions to the arctic regions.

186. Hydrology. Soviet hydrological studies of the arctic regions date from 1920 when surveys were made of the hydrometrical properties of water, determination of ice conditions, and charting of currents, as well as gravimetrical observations. During the period from 1921 to 1937, there were many recorded voyages to the Arctic for the purpose of collecting hydrological data.

187. Prior to 1932, however, no hydrological work was done ashore at polar stations. Beginning with that date, hydrologists were sent for the first time to stations scattered throughout the arctic region. Furthermore, classes were instituted by the Arctic Institute to provide trained hydrologists for Arctic service. In 1935, in Moscow, special courses were opened for training hydrologists, while in Leningrad similar courses were begun in the Institute of Hydrography. In 1937, plans called for 95 expeditions into the north, chiefly for hydrologic work. No recent information is available but the number of hydrologists stationed in the Arctic doubtlessly has been greatly increased, and there is every reason to believe that the study of hydrological conditions has been intensified.

188. Hydrography. During the period from 1921 to 1933 more than 20 hydrographical expeditions were sent out to survey the areas of the Arctic region and to prepare charts for all the Arctic seas. A Soviet report dated 1937 indicted that during the two previous years more than 140 astronomical points had been placed on the map along the Arctic coast and the lower parts of the rivers, and that topographical surveys of the coast had covered about 12,000 kilometers, not counting aerial surveys. By the end of 1937, more than 70 charts had been issued, and in 1938, sailing directions for the Laptev Sea and Chuckchee Sea were published. The East Siberian Sea Pilot followed in 1939.

189. Hydrographic surveys are being conducted by hydrographers attached to polar stations as well as by personnel stationed aboard icebreakers engaged in expeditions. Personnel for hydrographic work has been provided by the School of Hydrography which came into being in 1920, as well as by a branch of GLAVSEVMORPUT known as the Institute of Hydrography.

190. It is known that in 1939 hydrographic work was proceeding on a considerable scale. There were at least eleven ships assigned to this work, including two icebreakers. These vessels were engaged in taking soundings, preparing charts and photographing islands and bases. All available sources point to increased hydrographic activities in the postwar period.

191. Cartography. No reliable estimate can be made of the extent to which the Soviets have mapped non-Soviet northern areas such as Alaska or Canada, but it can be assumed that they have a substantial knowledge of those regions. Little is known of the mapping of the half of the Far North which is in or projects northward from the USSR. The charting and sounding of the Northern Sea Route, especially emphasized in the Fourth Five Year Plan, has been an ambitious postwar project and some results were probably achieved. An atlas of the Soviet Arctic was planned for publication by the Arctic Institute in 1948. The absence of reviews in the Soviet press and journals may indicate, however, that this work has not yet been published.

192. Known Soviet plans or proposals concerning topographic surveying call for implementing and extending the standard 1:100,000 program. There are definite indications that topographic surveys at large scales are already under way or are being planned in areas of the arctic and subarctic. It is known that the 1:200,000 surveys once employed for sparsely populated, unexplored regions have been discarded in recent years. Proposals or plans are reported that call for sharp areal increases in large-scale surveys: 1:25,000; 1:10,000; and even 1:5,000. A new system of position designation was used by the Soviets in 1937-1938 to facilitate navigation in the Arctic. In this system the customary meridians and parallels are supplemented by a flat and rectangular grid which is then used in navigation as a frame of reference.

193. It is known that the Soviets use the Gauss-Kruger projection for latitudes south of 75° - 80° North, and it is presumed that they are now using a polar stereographic projection for latitudes north of 75° - 80° North.

194. Meteorology. Prior to 1929, the geophysical work in the Soviet Arctic was limited to sporadic meteorological observations from ships engaged in various expeditions. Shortly thereafter, a permanent Floating Weather Bureau was organized and by 1933 there were six weather ships with ten permanently designated observers. About the same time, a special division, the Central Administration of Hydro-meteorology, began the publication of a "Weather Bulletin" containing data on ice movements and weather forecasts.

195. By the end of 1935, fifteen meteorological stations had been established in the Arctic. This number had increased to more than eighty in 1947. Among the matters under study at the latter date were: observations on growth of winter crops, freezing properties of soils, run-off, chemical composition of water, mechanical composition of alluvia, field and office hydrographic works, ice-measuring and snow-measuring surveys, layout of datum points, production of sleet observations, etc.

196. The Arctic Institute has conducted classes for aerologists for a number of years. The Institute is said to have designed a drifting, automatic radio-meteorological station by means of which it planned to organize a regular meteorological service in the whole of the central polar basin in the postwar period. Numbers of these stations were to be dropped or installed so as to provide wide coverage and make possible the drafting of dependable synoptic maps.

197. Polar Stations. The real development of polar stations did not get underway until 1933, when GLAVSEVMORPUT was established. Prior to that time, there had been only outposts and observation

points scattered throughout the arctic region. With the inception of the new organization, these stations began to render meteorological and radio services and to survey natural resources north of latitude 62° N. Hydrological and hydrographical work was commenced for the first time together with ice prognostication and magnetic studies.

198. The number of polar stations grew from 16 units in 1933 to 51 such stations by the end of 1935. There were reportedly 57 polar stations in 1937 with more than 1,000 persons wintering annually in the Arctic. By 1947, the number of stations in operation had increased to about 85.

199. (Not used.)

200. Medical Research and Development. It appears that USSR Naval Medical development has encountered little difficulty in solving nutritional, protective, environmental, psychological, sanitation and treatment problems aboard all vessels operating in the Arctic. It is obvious that shipboard personnel have access to warming facilities and hot food. Watches in the open can be suitably arranged depending on weather and temperatures. Physical effort is usually not exhausting. Recreational facilities, while limited, such as reading, moving pictures and radio, can be provided to fill in off-duty hours.

201. A few reports and translations of independent investigators and research institutes indicate that special attention is being devoted to the physicological effects of frostbite, its prevention and treatment. Available material indicates a first class effort

is being made in these studies. However, as late as 1950, it is stated that while much valuable research has been done by Sovie clinicians and pathologists in recent years on frostbite, there is still much more to be done.

202. Cold-chamber studies are recommended, indicating a step in the proper direction. The existence of cold-chambers in military or governmental medical research facilities has not been confirmed but it is safe to assume that such installations are present in view of the known efforts of U.S., British, Finnish, Swedish, Norwegian and Danish groups engaged in cold climate studies. Furthermore, the disastrous experience (50 per cent casualties) of the Soviet Polar Divisions in the Arctic in one year has probably stimulated medical research efforts toward prevention of deaths due to arctic disease conditions, snow-blindness and freezing. In addition, Soviets have access to the recent development of such research on the part of the Finns and Germans. It is most likely that a definite program concerning arctic medical research is now in force through cooperation of military and governmental medical research institutes.

203. Vitamin studies in the Arctic are being pursued on a continuing basis, especially Vitamin C. The value of other vitamins is well-known and while their empirical use is evident, it is entirely probable that more research is being done.

204. Nutritional studies have been a continual effort with no particularly brilliant findings for the record. In view of the high fat preference in the Soviet dietary, some unusual developments might occur that may be of interest to the U.S.

Fuels and Lubricants

205. Gasolines. The Soviets should experience no serious arcti difficulties due to technical deficiencies in their gasolines. Al grades have freezing points below -75°F. Use of engine heaters or straight-run low boiling petroleum distillates as primers in cold

starting is standard practice with the Russians. Their research literature hints that they may have developed an additive to prevent the formation of ice crystals in water containing gasoline at low temperatures. Their relatively crude refining industry is adequate to keep cloud points well below the minimum standards.

206. Gasoline has always been short in the Soviet Union, so that arctic limitations in this respect will be more economic than technical. Economic necessity has prompted that country to concentrate on the development of gas-turbine and diesel power, the required fuels for which are easier to produce. Many reports indicate that the increasing use of substitute fuels such as propanes and butanes, wood chips, etc. for civilian and industrial use to release greater quantities of gasoline to the military services.

207. Straight run gasolines may be stored indefinitely. Storage of the more unstable cracked gasoline beyond six months is inadvisable due to gum formation under conditions of normal temperatures. The effect of prolonged low temperature storage, particularly in the presence of their standard wood resin gum inhibitor, is unknown.

208. Due to the great change in volatility with temperature, the Russians emphasize the necessity for producing "seasonal" gasolines. It is known, however, that they successfully use the less volatile ligroins in the Arctic, but volatile primers are required for starting.

209. The use of gasoline to start jet engines at very low temperatures is standard with the Russians. They give considerable evidence that gasoline may become a standard gas-turbine fuel in the Arctic because of its dependability and ease of maintenance. Major engine modifications will be essential, however.

210. Synthetic gasolines from coal and lignite are expected to become increasingly important for the Soviets. Both East German and domestic Russian hydrogenation plants have been in production for some time. Much of the product of these plants is unsuitable for high-octane aviation blends. Unless this is diverted to auto-transport consumption, it would make excellent arctic gas turbine fuel. The synthetic aviation grade gasolines which are produced by these plants is expected to be the equivalent of the old German C-3 fuel which had an approximate 96/150 rating.

211. Kerosenes. Until 1946, most Russian ligroin and tractor kerosenes were straight-run distillation products. These are now being blended with heavier thermal cracking products, which increases both octane rating and supply. Chemical refining of the kerosenes is often times limited only to alkali treatment due to shortages of sulfuric acid. Fuels, so refined, are expected to introduce sulfur and gumming problems when used at low temperatures. Storage time for straight-run Russian kerosene is unlimited.

212. Published research indicates that sulfurous Russian crudes such as Second Baku, may be used to produce high quality Siberian diesel fuels (Cetane No. 70) and kerosenes (Octane No. 75). Success with this raw material will be dependent upon Soviet ability to practice industrial multi-stage countercurrent extraction of distillates with sulfur dioxide.

213. Ligroin (248° - 446° F boiling range) and kerosene (302° - 599° F boiling range) are used as fuels for carburetor engines in the subarctic by the Russians. These engines may be started and warmed up on gasoline. However, the Soviets have standardized on using engine preheaters or the more favored light

gas generator type CG-1, which uses methane, ethane, or propane for starting fuel. These engines are equipped with special exhaust-gas preheaters for the fuel-air intake mixture. Water injection is reportedly used on the low speed, large cylinder tractor engines to reduce antiknock requirements. The Soviets advise against the use of thinned kerosene and ligroin fuels because of motor oil dilution and increased fuel consumption.

214. Soviet gas-turbine kerosene, boiling in the 302° - 572° F range is usable down to -40° F. It is manufactured only from paraffin base crudes. At extremely low temperatures, gasoline must be used for starting, but the Russians claim that new nozzle designs will eliminate this problem. Jet kerosene containing ice crystals is not used. There is no evidence of a gas-turbine grade kerosene shortage in the Soviet Union.

215. Diesel Fuels. Diesel fuels will not be a problem for the Soviet Navy. Even in arctic waters, the sea temperature, and hence bunker temperatures, can never fall much below ∤ 32° F without freezing. The German grades were successful in Norwegian waters having pour points of only ∤32° F. and later in the war, ∤41° F.

216. Russian diesel fuels in general are unrefined straight-run petroleum distillates. Some fuel for submarine diesels is reportedly being distilled from Estonian oil shales.

217. Russian crude oils are capable of yielding low pour point fuels when required. These so-called winter grades are derived entirely from low paraffin base crudes. The Uskine, Koschagyl, Ukhta, and Shor-Su fields provide fuels with pour points ranging from -75° to -22° F. Many other fields provide diesel fuels with pour points in the range of -22° to -5° F.

218. The Soviets emphasize the need for "seasonal" diesel fuels; both winter and summer specifications are provided. They claim that the pour point of diesel fuels must be 5° to 10° lower than ambient temperatures for satisfactory low temperature operation. This applies mainly to high-speed diesel engines, unequipped with preheaters and special filtration systems. The slower speed, large cylinder engines are so equipped, and have been known to operate the year round on summer grade fuels in the subarctic regions.

219. East German, and possibly Russian, coal hydrogenation plants are producing low temperature synthetic diesel fuels. The Schwarzheide plant is reported to be producing a -22° F pour point product at a cetane number of 70-75. Similar fuel was produced in Germany during World War II from 50:50 blends of mineral oil derived from asphaltic crudes and selected Fishcer-Tropsch fractions. The Boehlin hydrogenation plant is reportedly producing a -75° F synthetic diesel fuel, but this is probably only in small quantities for use as a compass fluid.

220. Boiler Fuels. Soviet boiler fuels are adequate for arctic naval use. These are generally made up of the residues from the thermal cracking process. Mention is made that the Central Asian tarry petroleums of high sulphur content are also used. Straight-run mazut is permitted for boiler fuel only in emergencies because of its great value as a lubricant raw material. Use of Soviet boiler fuel in the arctic and subarctic regions is limited only by the heating facilities, generally live steam, of transporting equipment.

221. Fleet mazut, GOST 1626-44, is intended for marine boilers. Maximum pour points of +23° to +41° F are specified for various grades of this fuel. Maximum allowable sulphur is three per cent when the fuel is derived from sulphurous crudes, such as from

Second Baku, which are generally characterized by their low viscosity. Up to two per cent water is tolerated in Fleet mazut for storage purposes, but must be reduced to one per cent before transference aboard ship.

222. Lubricants. The USSR produces a selection of lubricants which are considered adequate for her purposes in arctic operations. As a class of materials they possess low viscosity index in general as compared with our better refined lubricants and are therefore usable over only relatively short ranges in temperature. The higher grade aviation types, particularly with additives and pour point depressants, are comparable to American lubes except in the temperature range of serviceability.

223. The Soviets have published lubricant specifications which include all the physical properties necessary for arctic operations on land and sea. In these specifications and handbooks, the philosophy of "seasonal" products is dominant. However, many observers have reported that in Russia the specified grades are often unobtainable when needed. In such cases the ability of the acclimated Russians to improvise with the primitive means at hand is impressive. Engine oil dilution with gasoline is accepted practice as is the continuous running of engines to keep their low grade lubricants warm and fluid. Short engine life and heavy fuel consumption appear to be accepted penalties for working in the arctic climate.

224. Only select petroleum crudes from the Surakhan, Karachukhursk, Dosser, Sagiz, Makat and Groznyy districts are acceptable for the production of aviation and low temperature arctic oils. The "oily mazut" fractions are vacuum distilled and the distillates are then subjected to contact neutralization, acid refining and selective solvent refining. The paraffin

distillates such as those from Surakhan are further subjected to solvent dewaxing with propane and naptha at low temperatures (27° - 46° F below the specified pour point of the end product). The common Russian selective solvents are furfural and nitrobenzene. The arctic lubes which have been analyzed to date thin down rapidly at high temperatures. This indicates that there is a shortage of solvent refining equipment in the Soviet Union.

225. All used lubricating oils are reprocessed in the Soviet Union for use in their former applications or for less important chores. No more than 25 per cent reprocessed oil is tolerated in aviation oils. Winter grade Soviet aviation oils are allowed up to 40 hours engine time, as compared to 5-10 hours for summer grades, before reprocessing.

226. In order to compensate for low viscosity index and severe shortages in modern refining equipment and skilled labor, the Soviets have concentrated heavily on the development and use of lube oil additives to reduce pour points and improve viscosity-temperature properties. In order to lower pour points by 25° to 45° F, they favor from 0.5 to 2.0 per cent of various types of chlorinated paraffins condensed with aromatic hydrocarbons and phenol (Paraflow, Paraflow Extra, and Santopour), and refined oxidation products of petroleum. Laboratory analysis of Soviet oils tends to confirm this. All viscosity index improvers (Oppanol, Paraton, and Superol) appear to be based on polyisobutylene.

227. The MZS and MZ lubricating oils are examples of the best low temperature lubricants produced by the Soviets who consider them superior for cold weather starting. Their viscosity indices are about 80 which can be improved to about 100 with additives. These oils have pour points of -22° F and -8° F respectively without the addition of pour point depressants.

228. An example of a suitable arctic marine oil lubricant is GOST 2022-43 which has a pour point or /32° F. This is compounded of less than eighty per cent of refined mineral oil and blown vegetable oils such as from colza or mustard seeds. A great disadvantage with this product is that it emulsifies readily with water. The Russians have been unable to improve on this lube oil.

229. One East German plant has been reported several times to be concentrating its polyethylene research on the arctic lubrication problems of gas-turbines, though the winterization of tanks and vehicles is also stressed. The Soviets believe that the low temperature lubrication problem for gas-turbines is considerably less difficult than for reciprocating engines. This is rather significant in view of their reported interest in the "low work factor" polyethylene oils.

230. Hydraulic Fluids. The Soviets are willing to use two grades--winter and summer--of mineral oil based hydraulic fluids. Consequently, they have an aircraft hydraulic fluid which is operational down to -76° F in their lift, control, and most brake systems. Soviet research is concentrating on very light paraffinic stocks containing special viscosity index improvers of the polyisobutylene type including Vinypol, Superol, and Exanol. The Soviets do not regard nonflammability as an essential property for hydraulic fluids.

231. In connection with apparent Russian interest in the olefin polymers, one German polyethylene oil grade "V-120" shows promise as a low temperature fluid. Its pour point is below -85° F and has a high viscosity index calculated at 96. However, it is relatively volatile and is not flame proof.

232. One sample of Russian-made fluid taken from a Czechoslovakian RD4 type aircraft was analyzed to consist of a napthene base. It possessed a viscosity index of 87 and a pour point -69°F.

233. The Soviet literature has described one Soviet winter grade fluid as consisting of forty per cent glycerine, forty-five per cent ethyl alcohol, and fifteen per cent water. This is deficient in low temperature properties, but it works exceptionally well with natural rubber seals.

234. Greases. The Russians manufacture a wide variety of greases, which according to specifications, would be particularly useful in the arctic and subarctic regions. GOI-54, at 2-5866-40 is a high stability lubricant grease for artillery and aircraft operating in the temperature range -76° F to +149° F. It is an alkali-acid free product made from a mixture of refined vaseline and ceresin.

235. Aviation lubricant NK-30, ST 2-5865-40 is a special low temperature product prepared from a Dosser field vaseline blended with a calcium base soap. It is usable at -76° F. Similarly, other low temperature aviation and artillery greases are prepared from highly refined oils thickened also with ceresin and lead stearate and activated with triethanolamine.

236. Winter lubricant KV is a low temperature grease containing light mineral oils and medium salts of the higher fatty acids such as castor oil and hydrogenated fats.

237. Instrument Lubrication. Vaseline oil MVP is manufactured from Dossor and Sagiz petroleum. It has a pour point of -76° F, and it is manufactured especially for the low temperature lubrication of instruments and controlling devices. Similarly, a spindle oil type AU is manufactured from choice, low pour point petroleum crudes for special instruments. It is usable to -48° F.

238. Coolants, De-Icers, and Antifreeze. Soviet antifreezes consist of ethylene glycol-water mixtures. Glycerine is sometimes included for aircraft. Russian aircraft operating instructions refer to the use of ethylene glycol-water mixtures as coolants for operations down to -68° F. Denatured ethyl alcohol antifreeze compound, of the automobile radiator type, is a common Soviet de-icing fluid for aircraft.

S E C R E T
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NOTE BY THE SECRETARIES

to the

HOLDERS OF J.I.C. 589/1

(Estimate of Soviet Capabilities for the Conduct of Military Operations in Arctic and Subarctic Environments)

CORRIGENDUM

1. At the request of the originators, holders of J.I.C. 589/1 are requested to make the following changes to that paper:

a. Pages i - iii - insert heading "ANNEX" at top of page i; and insert pages i - iii after page 2.

b. Substitute the attached revised pages 5, 9, 10, 12, 21, 2 29, 38, 39, 40, 41, 51, 54, 55, 56, 57, 58, 73 and 79 for the corresponding pages now in that paper and destroy the superseded pages by burning.

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