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QUARTERMASTER RESEARCH & ENGINEERING COMMAND
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TECHNICAL REPORT
EP-34

HANDBOOK OF THULE, GREENLAND, ENVIRONMENT

QUARTERMASTER RESEARCH & ENGINEERING CENTER
ENVIRONMENTAL PROTECTION RESEARCH DIVISION

AUGUST 1956
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NATICK, MASSACHUSETTS

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QUARTERMASTER RESEARCH & ENGINEERING COMMAND, US ARMY
Quartermaster Research & Engineering Center
Natick, Massachusetts

ENVIRONMENTAL PROTECTION RESEARCH DIVISION

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HANDBOOK OF THULE, GREENLAND, ENVIRONMENT

Robert L. Anstey
Geographer

Regional Environments Research Branch

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Foreword to the Second Printing

This report is one of a series presenting environmental conditions at sites where Army testing activities are conducted. The program of test site studies was undertaken to enable test planners to select optimal conditions for scheduling performance tests of the Quartermaster Corps or tests of other Technical Services at selected testing installations. This report deals with the Arctic environment of northwest Greenland, especially the area in the vicinity of Thule Air Force Base. An attempt has been made to present as much of the information as possible in graphic or tabular form. The textual material is intended to supplement the graphs and maps and to describe certain elements of the environment which do not lend themselves to graphic presentation. Thule Air Force Base has an Arctic coastal environment, and provides a testing facility at a higher latitude than regular Department of the Army sites.

Since the initial publication of this report in August 1956, Thule has assumed a role of major importance in the Department of the Army's program of testing under polar conditions. As the doorway to northwestern Greenland through which pass personnel and equipment for most military activities on the icecap, Thule has been the subject of so much interest that the first printing of the report was soon exhausted. For the present edition an additional five years of climatic records were used to revise the section on climate. As the longer record is more reliable, the edition of August 1956 which this replaces should be destroyed. No attempt has been made to revise data for other parts of Greenland, as the most up-to-date records for the various stations on the icecap will be published in a separate report now in preparation. The graphs from the first edition have been left unchanged except for Figures 16, 17, and 18, which were redrawn because the longer record caused material changes in the means or totals.

AUSTIN HENSCHEL, Ph.D.
Chief
Environmental Protection Research Division

APPROVED:

CARL L. WHITNEY, Colonel, QMC
Commanding Officer
QM R and E Center Laboratories

DALE H. SIELING, Ph.D.
Scientific Director
QM Research & Engineering Command

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Abstract

Thule, Greenland, is 700 miles north of the Arctic Circle and has a typical Arctic coastal environment. Although a program of testing is not usually carried out at Thule proper, neighboring areas include numerous sites which are presently used for Arctic testing; examples are the icecap, ice ramp, and the seasonally snow-free coastal area at the edge of the ice.

Climatically the area in the immediate vicinity of Thule Air Base has few advantages over either Fort Greely (Big Delta), Alaska, or Fort Churchill, Canada, for testing cold-weather clothing and equipment. The absolute minimum temperatures at the latter stations are from 10 to 20 (F) degrees lower than at Thule. However, Thule is the doorway to the icecap, where cold-weather testing can be carried on throughout the year. Climatic records from several stations on the icecap indicate that temperatures above freezing occasionally may occur at Camp Century, 100 miles inland. During the long winters at Camp Century temperatures below -60° F may occur. Slightly colder conditions occur farther inland than Camp Century.

While the coastal area may become snow-free for a few weeks during summer, surface conditions on the interior icecap permit testing of over-snow vehicles and equipment throughout the summer. Melting and slush along the icecap's periphery preclude the use of these areas for testing activities during July and sometimes during the first two weeks in August.

HANDBOOK OF THULE, GREENLAND, ENVIRONMENT

1. Introduction

The word "Thule" means the remotest part of the world, but present-day Thule has ceased to be remote. It is now the base of supply for both Arctic weather stations and Arctic testing activities in northwest Greenland. This area was formerly the home of the Thule Eskimos, who

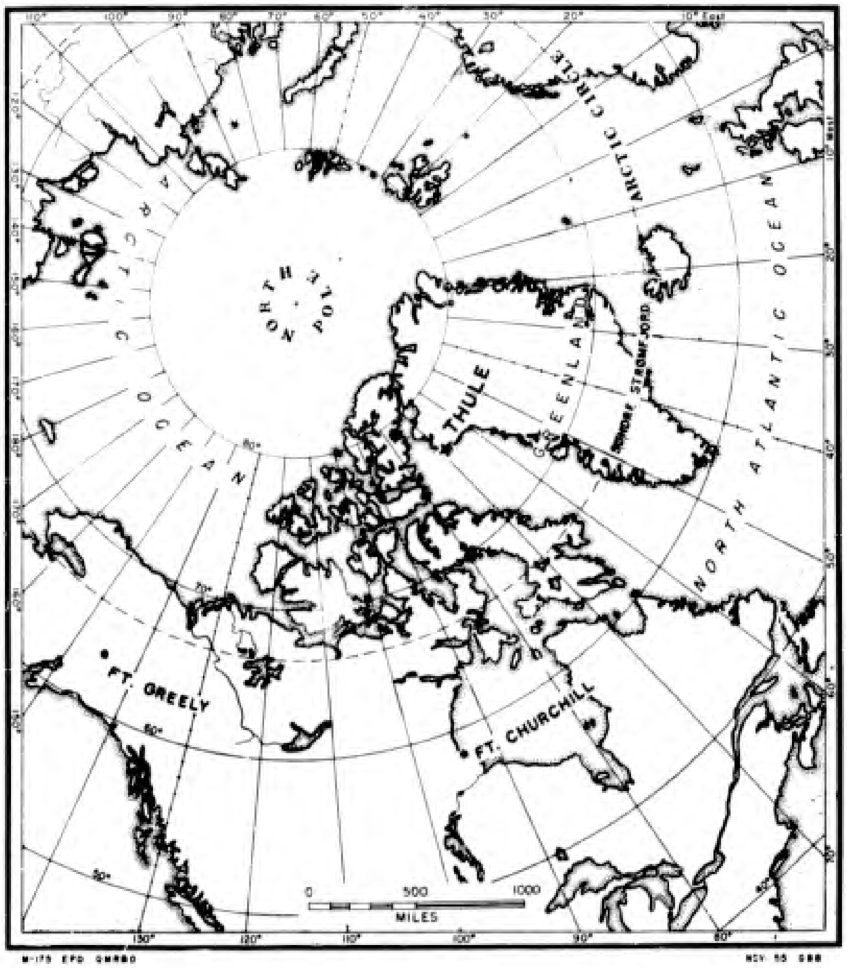

Figure 1. Location of Thule and Other Cold Weather Testing Sites

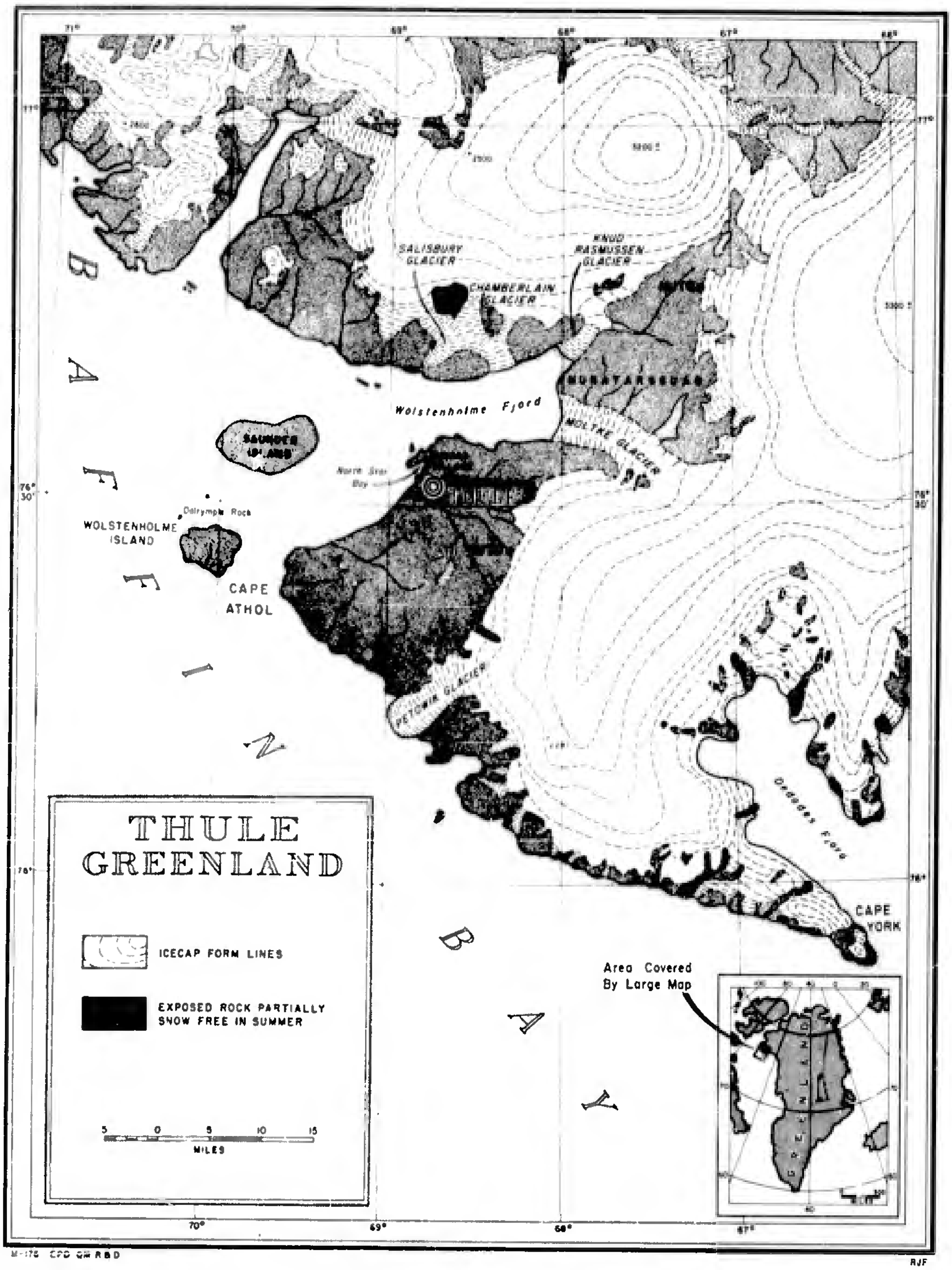
THULE
GREENLAND
ICECAP FORM LINES
EXPOSED ROCK PARTIALLY SNOW FREE IN SUMMER
MILES
SALISBURY GLACIER
CHAMBERLAIN GLACIER
KNUD RASMUSSEN GLACIER
Wolstenholme Fjord
MOLTKE GLACIER
SAUNDERS ISLAND
North Star Bay
THULE
Dalrymple Rock
WOLSTENHOLME ISLAND
CAPE ATHOL
PETOWIK GLACIER
CAPE YORK
Area Covered By Large Map
B A F F I N B A Y

Figure 2.

have been resettled at Kanak, north of Thule. Knud Rasmussen founded a Danish trading post at Thule in 1910, and a weather station was established there in 1946 as a joint enterprise by the US Weather Bureau and the Danish Government. Since 1951 these facilities, together with a ship dock and a flight strip, have been greatly expanded. The location of Thule in relation to the Department of the Army subarctic test sites is shown in Figure 1.

Thule Peninsula has an area of about 1,000 square miles and extends from Wolstenholme Fjord to Dedodes Fjord in Melville Bay, and from Cape Athol east to the icecap (see Figure 2). Other than Thule, the only settlement in this area is Dundas Village, a Danish colony approximately 2 miles north of the Air Base. United States military activities in northwest Greenland are now centered on Thule Air Base, on Thule Peninsula at 76°32'N latitude (the same latitude as southern Spitzbergen) and 68°45'W longitude. It is approximately 700 miles north of the Arctic Circle, and 1758 miles north of St. Johns, Newfoundland.

2. Climate

a. General

Climatically, the Thule area has a true Arctic environment. Winters are long and severely cold, and summers are short and cool. The combination of low winter temperatures, strong winds, and light snowfall makes this a serviceable area for testing equipment under Arctic conditions. Testing on the icecap has the advantage of year-round snow cover, freezing temperatures during every month, and subzero minimum temperatures for ten months or more each year. The difficulties encountered in test operations include: seasonal inaccessibility except by air, the great distance from CONUS, higher costs, clearances from the Danish Government, limited support from other military agencies in the area, and the long period of darkness during the winter. Table I shows a comparison of climatic elements at Fort Churchill, Canada, 19 years of record; Big Delta, Alaska, 9 years; Thule, 11 years; and an icecap station approximately 200 miles east of Thule, 2 years.

b. Temperatures

Mean monthly temperatures at Thule range from a March low of -14° F to a July high of 42° F. Even more significant than the mean temperatures, for purposes of testing, are the extremes experienced each year. (See Figure 3, Appendix A.) An absolute minimum of -47° F has been recorded, and minimum temperatures below -25° F may be expected on an average of 47 days each winter. Temperatures below 0° F may be

Table I

Climatic Comparisons Between
Subarctic Test Sites and Thule Sites

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann.
Mean Temperature (°F)													
Big Delta	- 5	2	12	28	46	56	59	54	44	27	5	- 4	27.0
Fort Churchill	-19	-17	- 6	14	30	43	54	52	42	27	6	-11	18.0
Thule	-11	-13	-14	0	23	36	42	40	28	14	0	-10	11.3
Icecap	-25	-23	-29	-11	3	15	18	17	- 9	-12	-18	-38	- 9.3
Mean Precipitation (inches)													
Big Delta	.27	.18	.18	.75	.58	2.07	3.16	2.22	1.62	.38	.25	.37	12.03
Fort Churchill	.41	.36	.63	.69	.65	1.51	2.81	2.54	1.97	1.50	.78	.56	14.41
Thule	.26	.29	.14	.12	.17	.25	.68	.57	.58	.47	.39	.21	4.13
Mean Wind Speed (mph)													
Big Delta	17	17	10	9	10	9	8	10	10	13	15	14	12
Fort Churchill	15	15	14	14	13	12	11	13	16	17	17	15	14
Thule	9	9	7	7	7	7	7	6	8	10	9	8	8

expected on most days from November through April. (See Table II.) The frequency of extreme temperatures that occurred during a six-year record can be determined for each month from Figures 4 through 15, Appendix A.* Thule is the warmest place in the area, and testing operations on the ice-cap should make provision for temperatures 10 to 30 degrees colder than at Thule.

Although an absolute maximum temperature of 63° F has been recorded at Thule, maximum temperatures of 60° F or higher occur on an average of only once a year. An average of 16 days annually have temperatures exceeding 50° F. Frost may occur at any time during summer, but in the warmest month, July, it normally only occurs three times and some Julys are frost free.

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* The climatic records for Thule in Tables I - IV have been revised for the second printing of the report to reflect the 11 years of record now available. In most cases the graphs in Appendix A were not revised and depict the 6-year record that was available at the time of original publication.

At Camp Century, a little over 100 miles east of Thule by trail and at an elevation of 6,900 feet, maximum temperatures during summer occasionally reach 32° F but are not apt to get much higher. At a former site on the icecap (Table I), approximately 100 miles farther east but only slightly higher, summer thawing is even less likely. Temperatures below zero have been reported every month on the icecap and during the long winter temperatures can be very low, an absolute minimum of -73° F having been reported.

While the mean temperature of the coldest month at Thule Air Base is 5 F degrees higher than at Fort Churchill, at the Icecap site it is 10 F degrees lower than at Fort Churchill. The mean temperature of the warmest month at Fort Churchill is 12 F degrees higher than at Thule Air Base and 36 F degrees higher than at the Icecap site. The differences between Big Delta and the Greenland sites are even greater.

Because the prevailing temperatures at Thule are low, little moisture can be present in the air; therefore, dewpoints are low despite the rather high relative humidities. (See Table IV, and Figure 16 of Appendix A.)

Table II

Temperature (°F)

Thule - Elevation 121 Ft. - 11 Year Record

Month	Mean Daily Max	Record Highest	Mean Daily Min	Record Lowest	Average Number of Days Max. > 50°	Average Number of Days Max. < 32°	Average Number of Days Min. < 32°	Average Number of Days Min. < 0°
Jan	- 4	36	-17	-39	0	30	31	28
Feb	- 5	36	-20	-47	0	28	28	26
Mar	- 6	34	-21	-43	0	31	30	28
Apr	8	41	- 8	-32	0	30	30	24
May	29	46	17	-10	0	19	30	2
Jun	41	62	32	22	4	3	17	0
Jul	47	63	37	27	8	0	3	0
Aug	44	62	35	20	4	0	7	0
Sep	33	49	23	4	0	11	27	0
Oct	20	40	8	-20	0	28	31	6
Nov	8	38	- 7	-28	0	29	30	21
Dec	- 3	35	-16	-37	0	31	31	28
Annual	17.6	63	5.2	-47	16	240	295	163

c. Precipitation

Precipitation at Thule is light. Mean annual precipitation is 4.13 inches, nearly half of which falls as rain during summer. The greatest mean monthly precipitation, 0.68 inches, occurs in July and is essentially all rain although a trace of snow has been recorded in that month.

The mean annual snowfall figure of 30.1 inches at Thule is deceptive, for the area is generally snow-covered from mid-September to mid-May, and a great amount of snow is carried into the area by high winds from the ice-cap, supplementing the moderate local precipitation. In low or protected places, snow drifts may accumulate to a depth of many feet. Snow may fall in any month, and patches of snow may be observed on the sides of the valleys and along stream channels throughout the summer. (See Table III and Figures 17 and 18 in Appendix A.)

Table III

Precipitation (inches)

Thule - 11-year record

	Mean monthly			Mean number of days with		
Month	Precip.	Snow-fall	Snow-depth	Trace or greater	.11" or greater	Measurable snow depth
Jan	0.26	2.3	8.0	17	0.4	31
Feb	0.29	3.3	8.9	14	0.7	28
Mar	0.14	1.6	8.4	16	0.3	31
Apr	0.12	1.6	5.8	13	0.1	30
May	0.17	1.8	2.5	17	0.3	24
Jun	0.25	0.4	0.1	13	0.5	2
Jul	0.68	T	0.0	13	1.5	0
Aug	0.57	T	T	12	1.6	0
Sep	0.58	3.5	0.7	16	1.6	7
Oct	0.47	7.6	2.7	16	1.4	25
Nov	0.39	4.8	5.6	18	1.1	30
Dec	0.21	3.2	7.0	17	0.7	31
Annual	4.13	30.1	4.1	182	9.0	238

d. Wind

Strong surface winds have long been known as the principal weather hazard at Thule. (See Table **IV.**) Although they may occur at any time of the year, they are observed most frequently in late winter and spring. All winds over 45 mph occur in the **quadrant** from east through south, that is, from off the icecap. These strong winds can be **attributed** to the contrast in temperature and therefore in **air** density between the open sea and the cold icecap. At times cold air flows off the icecap and through the valleys gaining speed as its density more sharply contrasts with the warm maritime air of the littoral; under these conditions winds over 100 mph have been reported (although they have not occurred at the weather station.) Loose snow is picked up from the icecap by these winds, and blowing snow results in greatly reduced **visibility**. Prevailing wind directions are from the icecap most of the year but in June,

Table IV

Humidity, Wind, and Cloudiness*

Thule - 11-year Record

Month	Humidity: Mean RH (%)	Humidity: Mean Dew Point (°F)	Wind (mph): Mean Speed	Wind (mph): Prevl. Dir.	Wind (mph): Peak Gust	Cloudiness (% of time): Clear	Cloudiness (% of time): Partly Cloudy	Cloudiness (% of time): Cloudy
Jan	61	-21	9	E	73	50	12	38
Feb	60	-23	9	E	70	46	13	41
Mar	57	-26	7	E	89	54	14	32
Apr	64	- 7	7	E	65	42	13	45
May	74	17	7	E-W	68	33	13	54
Jun	73	29	7	W	58	32	14	54
Jul	75	34	7	W	62	26	14	60
Aug	77	33	6	W	74	28	14	58
Sep	73	21	8	E	76	30	13	57
Oct	73	7	10	E	74	32	13	55
Nov	66	-10	9	E	52	43	11	46
Dec	62	-19	8	E	62	57	10	33
Annual	68	3.7	8	E	89	40	13	47

***Based on hourly observations.**

July, and August air flow is more frequently from the sea, bringing more cloudiness and fog. While mean monthly wind speeds at Thule are lower than at either Fort Churchill or Big Delta, the occurrence of density winds in the Thule area should be considered when planning tests of such items as tentage. (See Figures 19 and 20 in Appendix A.)

e. Obstructions to Vision

In winter, the periods of reduced visibility are mainly related to blowing snow. Fog rarely occurs during the winter months, October through March. With the appearance in spring of open leads in the sea ice west of Thule, and the progressive advance of open water as the temperature gradually rises, the incidence of fog increases. In June and July, fog is reported in the majority of observations either at or within sight of Thule over North Star Bay. It is a rapidly changing condition. Freezing of the water around Thule in September ends the high summer incidence of fog. There is little diurnal variability in fog during June and July because of the relative constancy of incoming solar radiation in these months. Cloudiness data are given in Table IV and Figure 21, Appendix A.

f. Solar Radiation

Situated approximately 10 degrees north of the Arctic Circle, Thule experiences tremendous variation in solar radiation from summer to winter. Beginning on 24 April and continuing until 21 August, each day has 24 hours of sunlight (Fig. 22). From 22 November until 24 January, each day has 24 hours of darkness. Solar radiation received during the period from 2 November to 10 February is insignificant. Average daily total solar radiation (Table V) varies from 2.6 gram calories per square centimeter in mid-February to 624.3 gram calories per square centimeter in mid-June.

3. Terrain and Surface Conditions

Thule is on the fjorded, ice-free, mountainous coast of northwest Greenland. This narrow coastal strip consists largely of glacial topography, but some sections, such as Dalrymple Rock, are unglaciated. Local relief ranges from sea level to 2,900 feet in a distance of approximately 10 miles. The elevation of Thule Air Base is 251 feet, Thule Weather Station is 121 feet, and Thule Take-Off (TUTO) is 1,500 feet above mean sea level. Local relief in the Nunatarsuaq area, 20 miles north of Thule, ranges from sea level to 3,100 feet in 10 miles.

Thule Air Base occupies a small glacial trough, one of seven which radiate from a lobe of the central icecap projecting onto the Thule

Table V

Average Daily Total Solar Radiation

Thule, Greenland

Period of Record: 1 to 3 years, 1949-1951

Unit: gram-calories per square centimeter, horizontal surface

Period	Radiation*	Period	Radiation	Period	Radiation
**2/12 to 2/18	2.6	5/14 to 5/20	586.4	8/6 to 8/12	485.0
**2/19 to 2/25	9.4	5/21 to 5/27	588.3	8/13 to 8/19	302.5
**2/26 to 3/4	33.1	5/28 to 6/3	618.5	8/20 to 8/26	538.1
**3/5 to 3/11	55/7	6/4 to 6/10	583.3	8/27 to 9/2	425.9
**3/12 to 3/18	99.2	6/11 to 6/17	623.0	9/3 to 9/9	202.9
3/19 to 3/25	137.6	6/18 to 6/24	624.3	9/10 to 9/16	162.9
3/26 to 4/1	206.2	6/25 to 7/1	534.4	9/17 to 9/23	136.5
4/2 to 4/8	255.7	7/2 to 7/8	504.1	9/24 to 9/30	103.9
4/9 to 4/15	312.2	7/9 to 7/15	544.4	**10/1 to 10/7	61.0
4/16 to 4/22	403.8	7/16 to 7/22	514.5	**10/8 to 10/14	39.7
4/23 to 4/29	375.7	7/23 to 7/29	422.7	**10/15 to 10/21	28.6
4/30 to 5/6	560.5	7/30 to 8/5	436.1	**10/22 to 10/28	9.6
5/7 to 5/13	555.3				

* Compiled from original Weather Bureau observations for inclusion in EPD Special Report, "An Analysis of the Environment of the Inland Ice of Greenland," by D.H. Miller and B.B. Hull, January 1954.

**By refraction, true sun below horizon.

Peninsula. These valleys were scoured out of the stratified bedrock by small outlet glaciers of approximately the same size as the present live glaciers which can be seen between Cape York and the larger Petowik Glacier; these glacial troughs are 1 to 2 miles wide and 5 to 10 miles long. Some of the former glaciers which scoured troughs in the area between Cape Athol and Moltke Glacier were of the hanging type, while others, as at Thule, probably reached the sea.

Wolstenholme Fjord, 3 miles north of Thule Air Base, is a much larger glacial trough; it is 5 to 8 miles wide and 20 miles long. It was not only the outlet for the former glaciers mentioned above, but also for Moltke, Knud Rassmussen, Chamberlain, and Salisbury Glaciers. As backwasting moved the ice front of the huge Wolstenholme Glacier to its present tributary glaciers, sea water filled the trough which it had cut into the coastal rock. Paralleling the Wolstenholme Fjord is a more shallow trough which is the site of Thule Air Base. It constitutes a ramp rising from North Star Bay in a gradual slope of 100 feet per mile and joining the tops of the mesa-like hills near the edge of the icecap.

The mesa-like hills parallel to the valley in which Thule is situated have elevations of 1,100 to 1,300 feet. Saunders and Wolstenholme Islands in the fjord have the same summit and elevation characteristics as these hills. Mount Dundas (elevation 764 feet), a promontory on the northern side of North Star Bay, is slightly lower than the hills in the area around Thule but has a similar mesa-like summit. The highest elevations in the area are adjacent to the central icecap, forming a rim of mountains that are wholly or partly ice-covered.

The bedrock in this area is Archean gneiss with some syenite drift. These beds dip gently from south to north and east to west. Immediately on top of the gneiss are nearly horizontal Cambrian strata consisting of layers of red or grey sandstone alternating with several types of limestone and shales, which give a banded appearance to the hillsides. This pattern is interrupted by intrusives of Ordovician age in at least six places in the vicinity of Thule.

Frost action disintegrates surface exposures in many places, making classification of the rocks difficult. Surface materials consist largely of the coarse weathered products of the strata together with drift and moraine which have been brought in by former ice sheets. Another result of frost action is the sorting of these materials into stone nets on nearly level ground and into stone stripes on slopes greater than 5 degrees. Individual stone rings vary from 4 to 10 feet in diameter, and the boulders in them are sometimes more than 6 feet long, giving the appearance of a block field (felsenmeere). Stone ring fines constitute the only soils in the area, which are lithosols. There is, however, an abundant supply of gravel for construction purposes.

Local streams are fed by melt water and are, consequently, intermittent. Natural ponds along the valley and at several places near the foot of the icecap are formed in depressions filling with melt water during the summer. In at least two places near TUTO, dams have been constructed on these ponds to facilitate the collection of drinking water.

All of the inland borders of the Thule area consist of glaciers. Moltke Glacier lies to the northeast, the icecap to the east and southeast, and Petowik Glacier to the south. The most accessible of these is the ice ramp at TUTO. Practically all of the Army testing program takes place at the edge of the ice at TUTO and on the icecap.

The ice ramp at TUTO is approximately 2 1/2 miles long and 10 miles wide. Here the elevation increases from 1,500 feet to 2,500 feet above sea level. The surface of the ramp is highly irregular during the summer season, where it is dissected by melt streams from 1 to 4 feet deep, which expose moutonee ice and form slush pools. Deposits of coarse gravel are exposed along the greater part of the ramp foot and at scattered points on the slope. Near these gravel beds on the ice are several acres of cryoconite holes, sometimes called algal pits, which range in size from 1/4 inch wide and 1 inch or less deep to 1 foot wide and 18 inches deep. Each hole is full of water, and the floor of each hole is covered with dark-colored sediment. During winter, deep snow covers the ramp and it has a nearly uniform slope.

The icecap immediately above the Thule area has a relatively level surface with a slight dip to the north and west. The level appearance of the ice increases inland. For example, from the top of the ice ramp to a point 60 miles inland, the elevation increases 4,000 feet, but in the next 60 miles the increase is only 2,000 feet. Directly above the ramp, and extending inland in an easterly direction for approximately 40 miles, the ice consists of long shallow swales which are actually the inland basins of glaciers emptying into Melville Bay to the south or Wolstenholme Fjord to the west. In addition, ice hills rising from 200 to 500 feet above the general level of the ice are seen on inland projections of the coastal mountains. This zone also has the largest number of crevasses of any part of the icecap, except the outlet glaciers.

Extending inland for a distance of 60 miles from TUTO is a zone of summer melting. Slush or green ice can be expected in this zone every year, especially in low spots. Beyond the 60-mile point, slush is rare in summer, and ablation during summer may remove as much as 60 cm of the snow surface, but new snow accumulates throughout the year. The surface of the snow is ridged with sastrugi,* and constantly changes as new snow drifts are formed.

4. Vegetation

The vegetation of the Thule area is a type of tundra. Although more than 120 species of plants have been found in this area, landscapes are barren from mid-August until mid-June. Plants appearing in the brief summer period are usually low, creeping or tufted forms with tough, hard tissue. Nearly all are perennials, enabling the species to survive even if fruiting cannot take place every year. This, in part, accounts for the fact that some species are not reported in every listing. However, a wide range of plants can be seen each summer, including stunted ferns, sedges, cress, rushes, reeds, grasses, mosses, heather, and a dwarf berry.

A few of the plants that constitute the vegetation of the Thule area are distributed throughout the ice-free places along the coast, but most of the others are widely scattered or are found singly in small pockets of soil. Purple saxifrage (Saxifraga oppositifolia) and the Arctic poppy (Papaver radicatum) grow nearly everywhere along the coast. Alpine chickweed (Cerastium alpinum) and Kentucky blue grass (Poa pratensis) are common. Arctic heather (Cassiope tetragona) and the mountain avens (Dryas integrifolia) are perhaps the most numerous plants in the area, for they seem to be able to grow anywhere.

The tallest and commonest tree, the Arctic willow (Salix arctica) does not rise more than three inches from the ground. Although low, it often spreads over a square yard or more of surface area. Many of these trees, with trunks less than an inch in diameter, are more than 50 years old. The soft, fuzzy catkins on their branches rise above the ground higher than the trees themselves. Another willow (Salix herbacea) is about as small a tree as can be found anywhere. It rarely grows more than an inch high, and bears two little leaves and a tiny catkin each summer.

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* Sastrugi are elongated drifts of dense, packed snow. Their lee ends may be fairly high, with an abrupt drop if not an overhang. These low forms should be differentiated from the "Arctic Anvil" type of drift.

In mid-July the willow leaves begin to turn yellow, and a week or two later their orange and brown colors indicate that the season of growth has ended.

Prior to the appearance of new growth each spring, exposed rocks are nearly covered with a black lichen. The first green vegetation to be seen are algal beds and banks of moss near the stream courses. These are also the last forms of vegetation seen each year, when the snows during August and September cover the land and the streams freeze over.

A preventative of scurvy, locally called "scurvy grass" (*Cochlearia officinalis*) is one of the few indigenous plants sometimes eaten by the natives. Another is ***Oxyria digyna***, a small round-leaved plant. In some places edible mushrooms can be found. Arctic timothy (*Alopecurus alpinus* is sometimes used for insulation and as mattress filler.

5. Insects

There is no local problem from mosquitoes, biting flies, or midges, as is common in south Greenland. While several species of insects have been reported in the Thule area during the summer season - June through August - they do not necessitate the use of repellents or protective nets.

6. Acknowledgments

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7. Bibliography

Antevs, E., Maps of the Pleistocene Glaciations, Bull. Geol. Soc. America, 40, 631-720, 1929

Brooks, Charles F., The Ice Sheet of Central Greenland, Geograph. Rev., 13 (3), 445-453, July 1923.

Chamberlain, T.C., Former Extension of Cornell Glacier near the Southern End of Melville Bay, J. Geol., 5 (3), 305, Apr-May, 1897.

Ekblaw, W.E., The Plant Life of Northwest Greenland, Natural Hist., 19 (3), 273-291, March 1919.

Hobbs, W.H., The Greenland Glacial Anticyclone, J. Meteorol., 2 (3), 143-153, September 1945.

-----, and Belknap, R.L., Errors in the Synoptic Weather-Charts Which Cover the Greenland Region, Transactions, Amer. Geophysical Union, 23, 482-490, 1944.

Koch, L., Some New Features in the Physiography and Geology of Greenland, J. Geol., 31 (1), 42-65, Jan-Feb., 1923.

-----, Stratigraphy of Northwest Greenland, Middelelser fra Dansk Geologisk Forening, Bind 5, Hefte 5, Nr 17, pp. 2-21, 1920.

-----, The Physiography of North Greenland, Greenland, Vol I, p. 509, Published by the Commission for the Direction of Geological and Geographical Investigations in Greenland, Copenhagen, 1928.

Miller, D.H., The Influence of Snow Cover on Local Climate in Greenland J. Meteorol., 13 (1), 112-120, Feb. 1956.

Munck, S., Geological Observations from the Thule District in the Summer of 1936, Meddelelser om Gronland, Vol. 124, No. 4, 36 pp.

Salisbury, R.D., Salient Points Concerning the Glacial Geology of North Greenland, J. Geol. 4 (7), 774, Oct-Nov. 1876.

Tarr, R.S., Former Extension of Cornell Glacier near the Southern End of Melville Bay, Bull. Geol. Soc. America, 8, 251-268, Mar. 1897.

USAF, 8th Weather Sqdn., Forecasting Summer Fog at Thule, Greenland, Tech. Memo No. 2, Thule, Greenland, 18 pp., June 1953.

-----, Climatology of Thule, Greenland, Tech. Memo No. 3, Thule, Greenland, 26 pp., July 1953.

-----, Forecasting Strong Winds at Thule, Greenland, Tech. Memo No. 4, Thule, Greenland, 12 pp, August 1953.

USAF, Climatic Center, Uniform Summary of Surface Weather Observations, Thule, Greenland, Asheville, N.C., 1950.

USWB, Climatological Summary, Thule, Greenland, Dept. Commerce, Washington D.C., 38 pp., 1950.

Warming, E., The Vegetation of Greenland, Greenland, Vol. I, published by the Commission for the Direction of Geological and Geographical Investigations in Greenland, Copenhagen, 1928.

Wexler, H., Formation of Polar Anticyclones, Mo. Weather Rev., 65, 229-236, Washington D.C., 1937.

APPENDIX A

List of Graphs and Charts

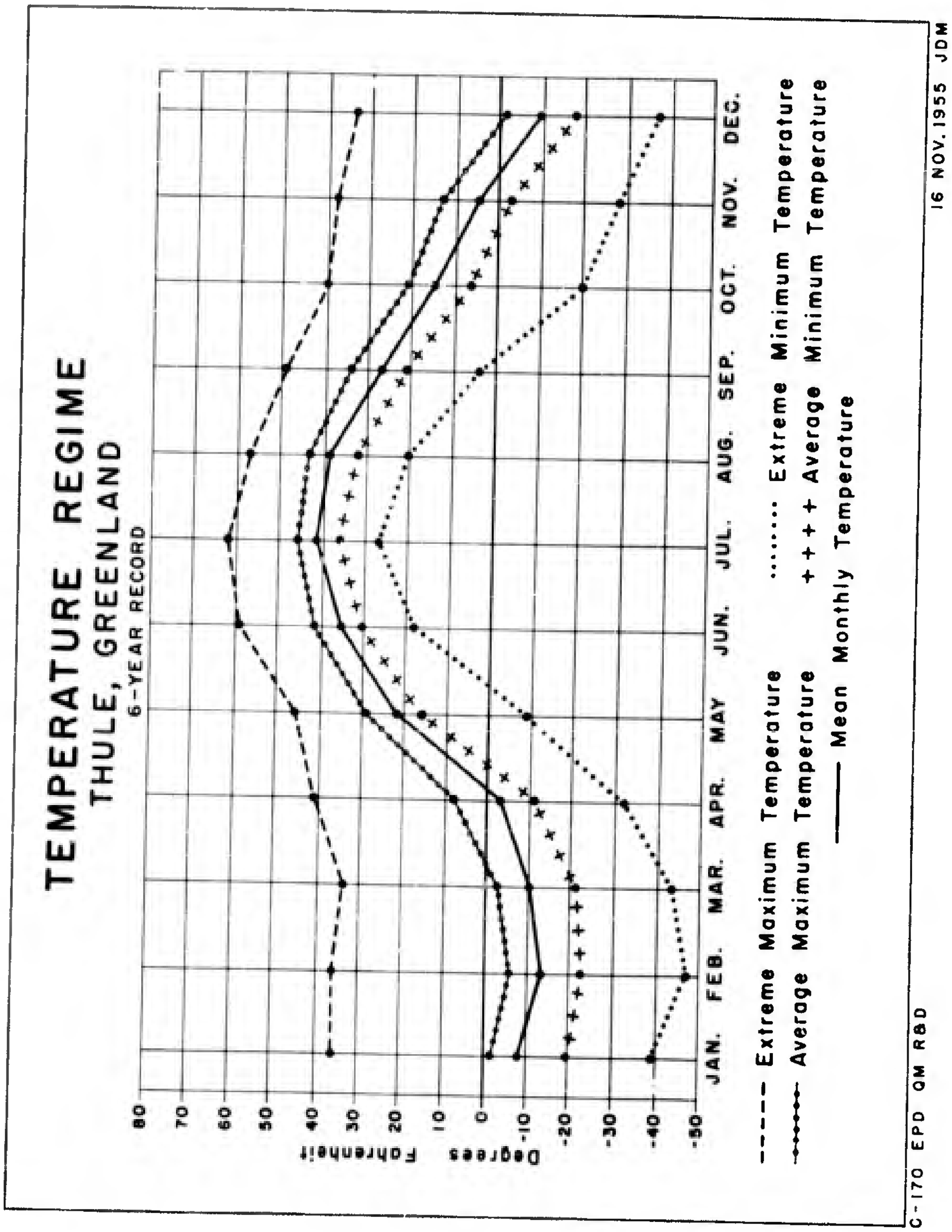
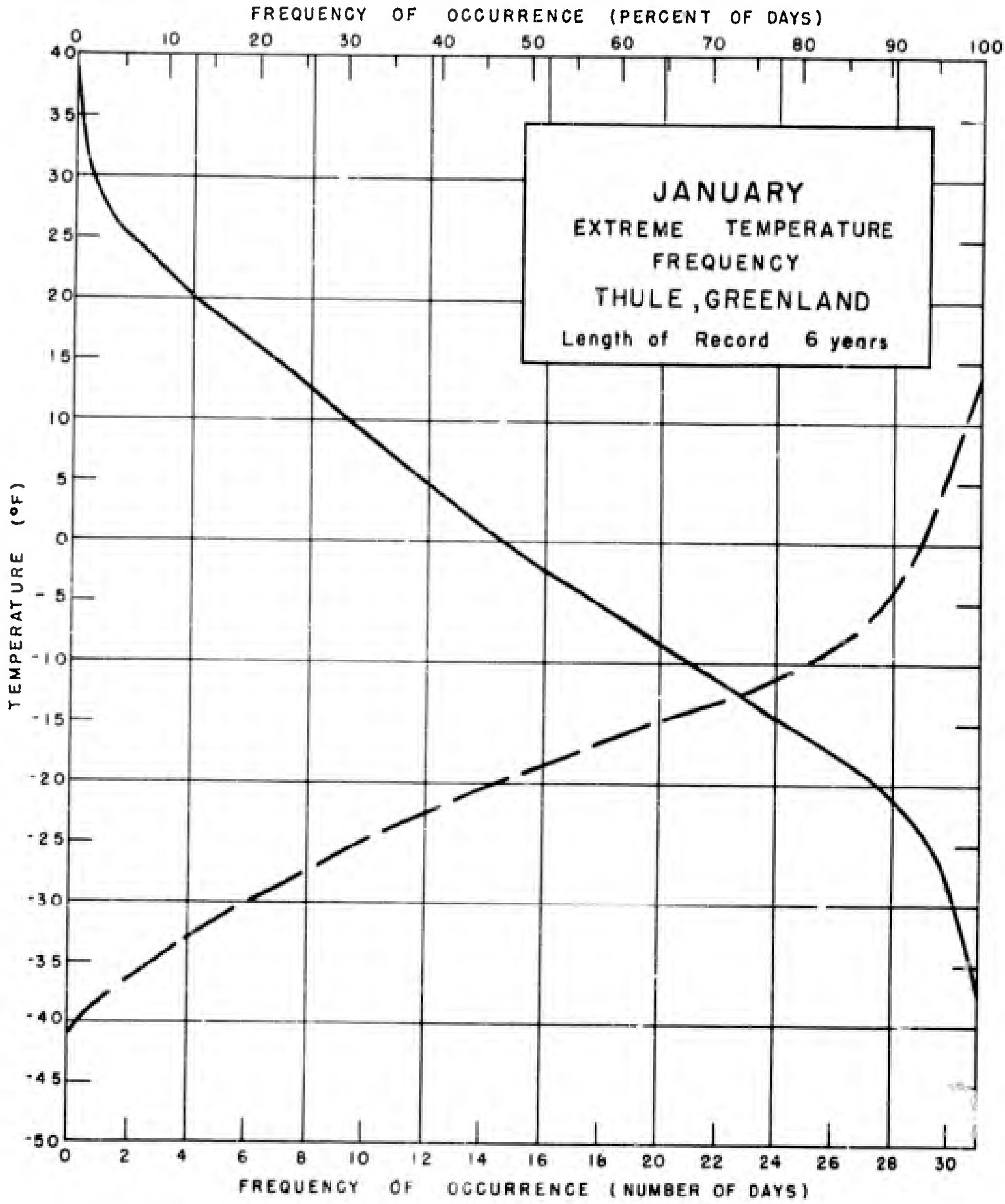

TEMPERATURE REGIME
THULE, GREENLAND
6-YEAR RECORD
Degrees Fahrenheit
80
70
60
50
40
30
20
10
0
-10
-20
-30
-40
-50
JAN.
FEB.
MAR.
APR.
MAY
JUN.
JUL.
AUG.
SEP.
OCT.
NOV.
DEC.
Extreme Maximum Temperature
Average Maximum Temperature
Extreme Minimum Temperature
Average Minimum Temperature
Mean Monthly Temperature
C-170 EPD QM R&D
16 NOV. 1955 JDM

Figure 3.

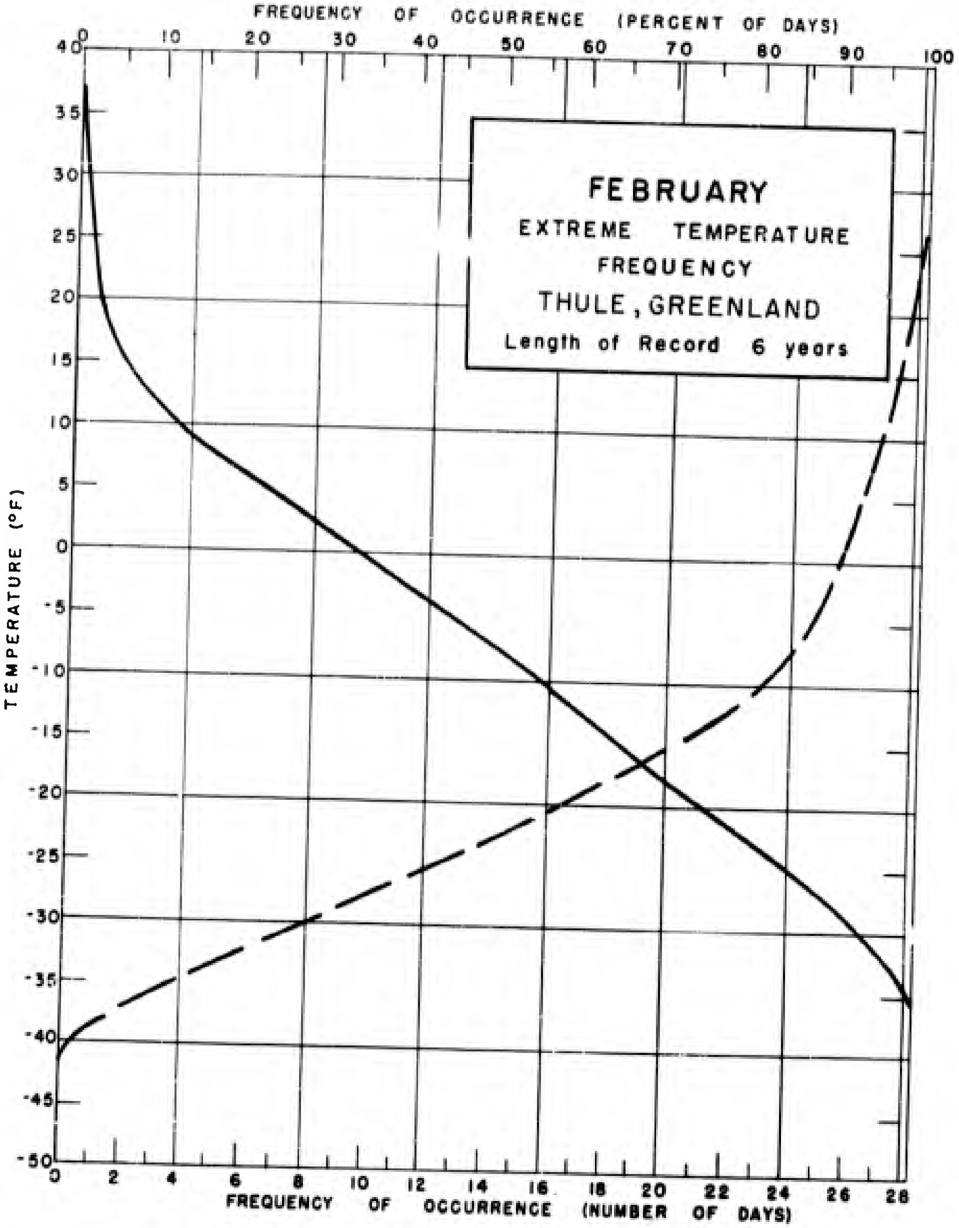


—— Number of days (or percent of days) the daily maximum temperature may be expected to equal or be greater than a particular temperature.

— — Number of days (or percent of days) the daily minimum temperature may be expected to equal or be less than a particular temperature.

Example: A maximum temperature of 13°F or greater may be expected to occur 8 days during January.

Figure 4.

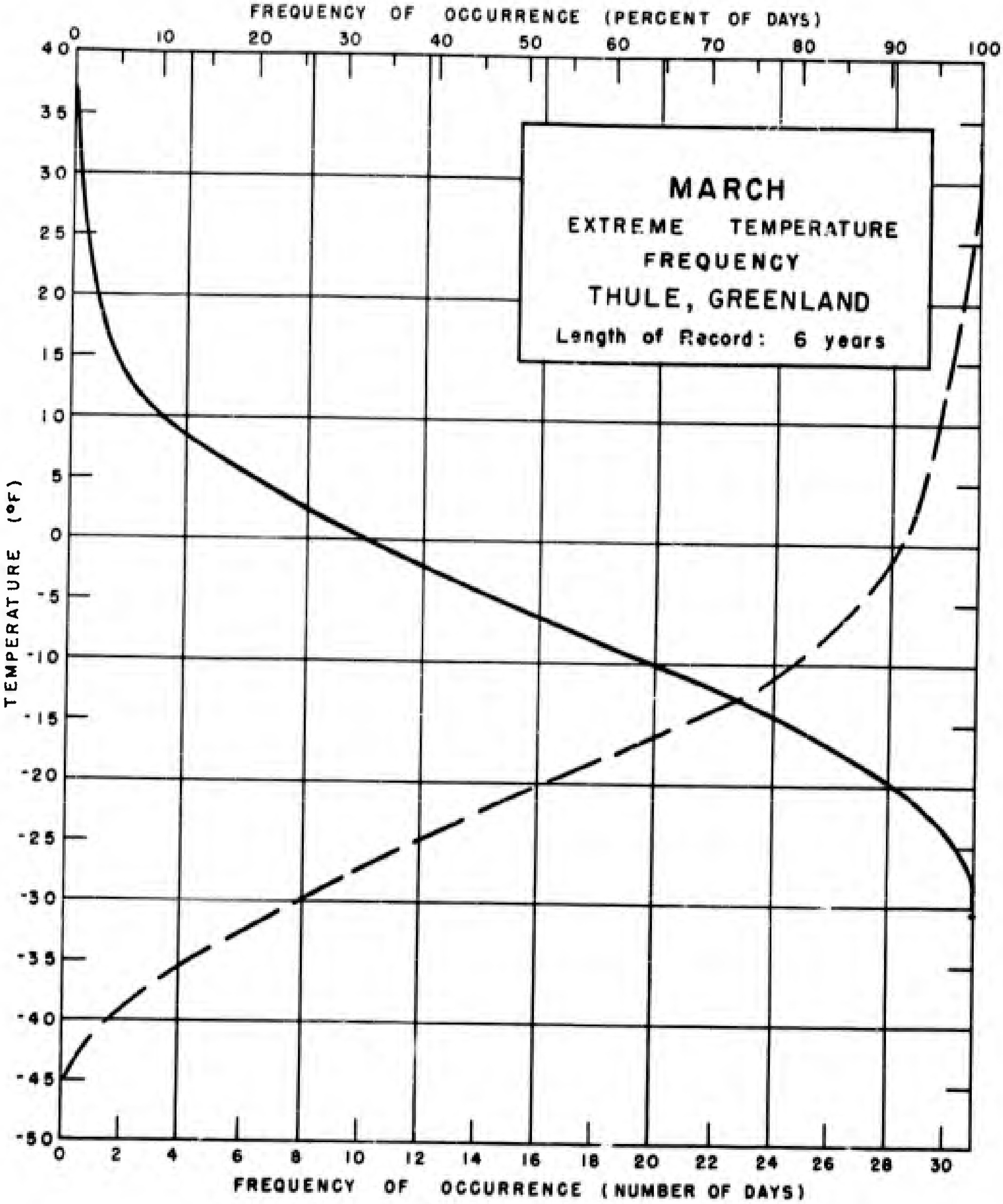


—— Number of days (or percent of days) the daily maximum temperature may be exp[illegible] to equal or be greater than a particular temperature.

— — Number of days (o[illegible] [illegible]cent of days) the daily minimum temperature may be expect[illegible] to equal or be less than a particular temperature.

Example: A maximum temperature of 0°F or greater may be expected to occur 10 days during February.

Figure 5.

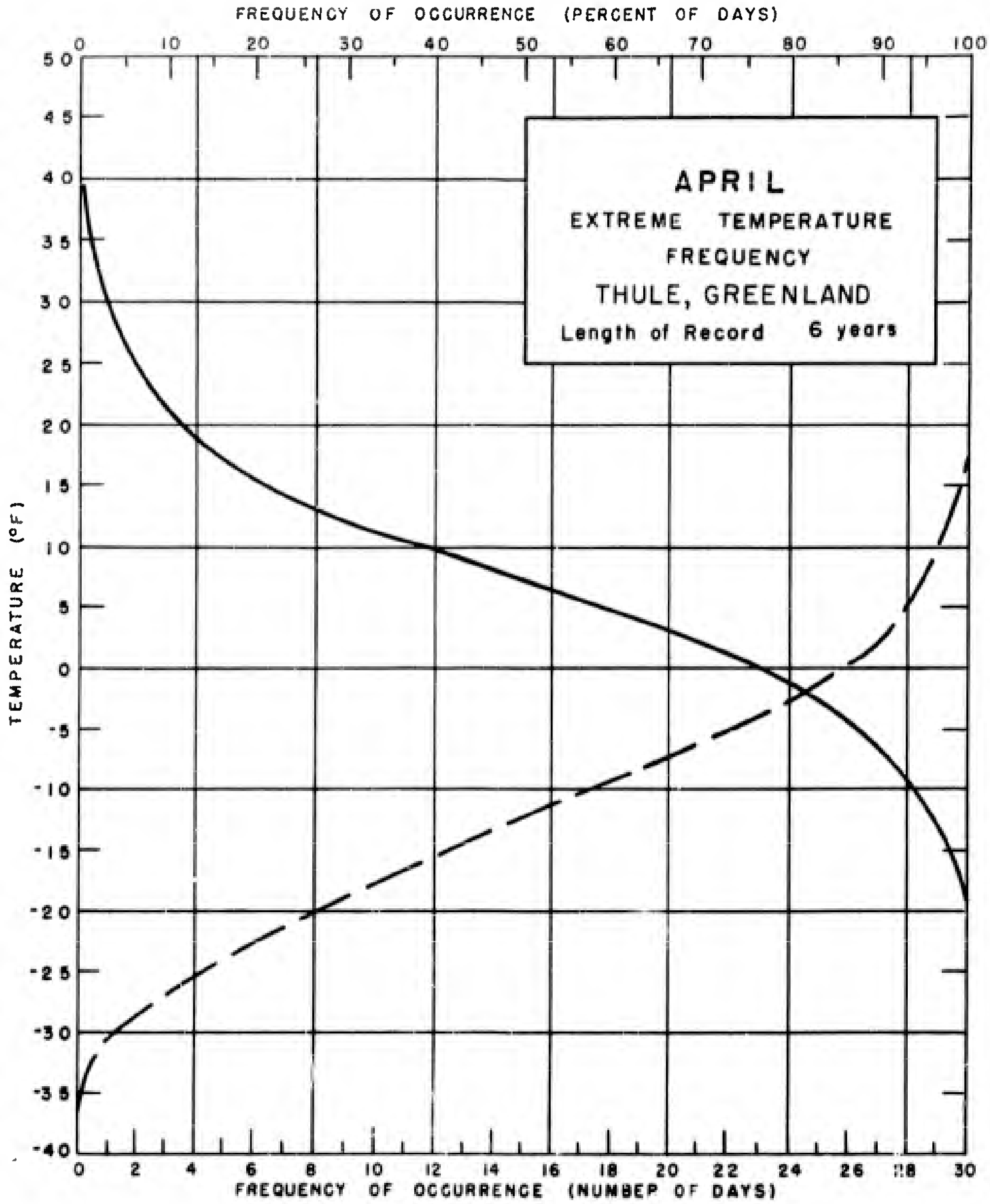


—— Number of days (or percent of days) the daily maximum temperature may be expected to equal or be greater than a particular temperature.

— — Number of days (or percent of days) the daily minimum temperature may be expected to equal or be less than a particular temperature.

Example: A maximum temperature of 3°F or greater may be expected to occur 8 days during March.

Figure 6.

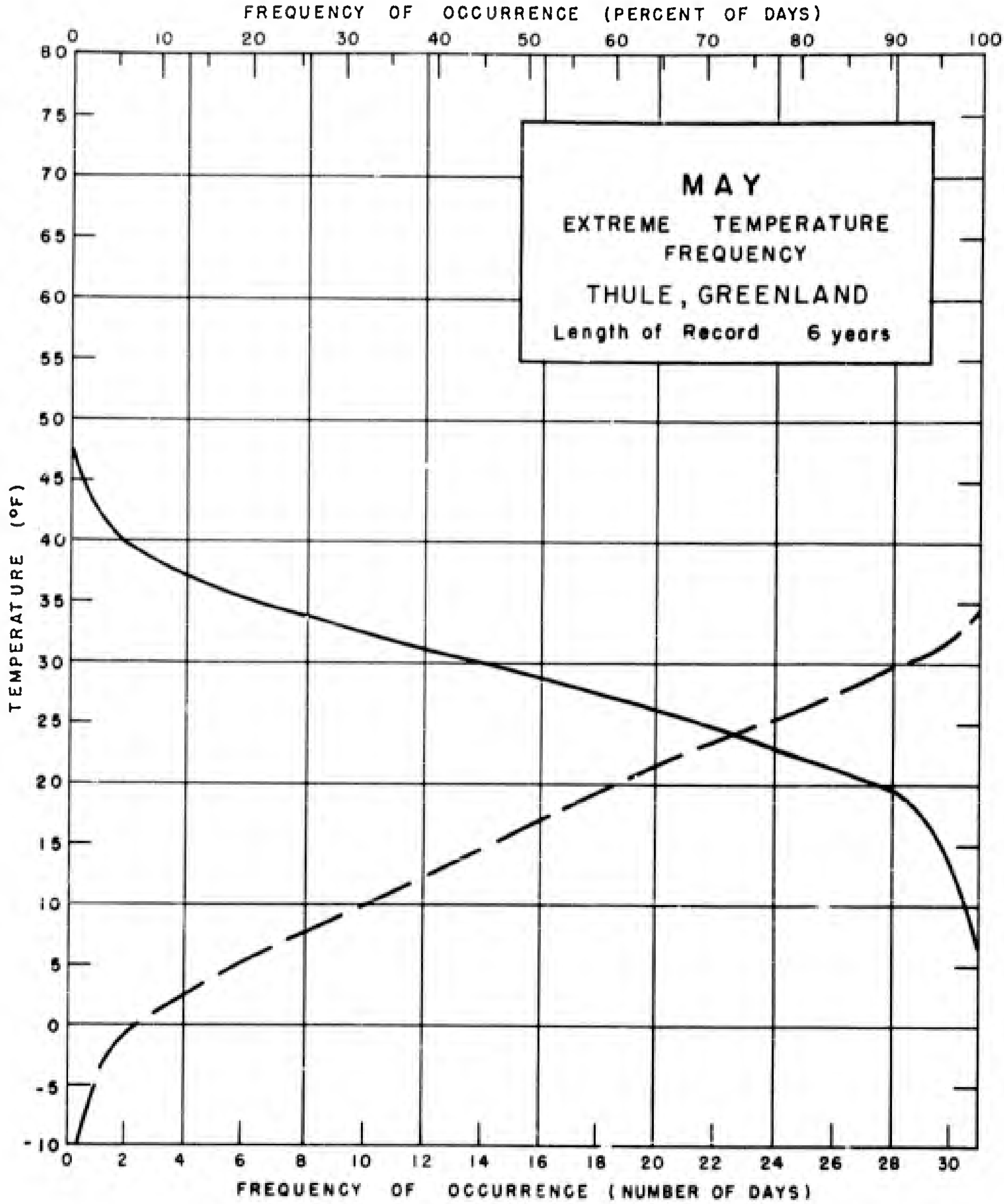


—— Number of days (or percent of days) the daily maximum temperature may be expected to equal or be greater than a particular temperature.

— — Number of days (or percent of days) the daily minimum temperature may be expected to equal or be less than a particular temperature.

Example: A maximum temperature of 14°F or greater may be expected to occur 8 days during April.

Figure 7.

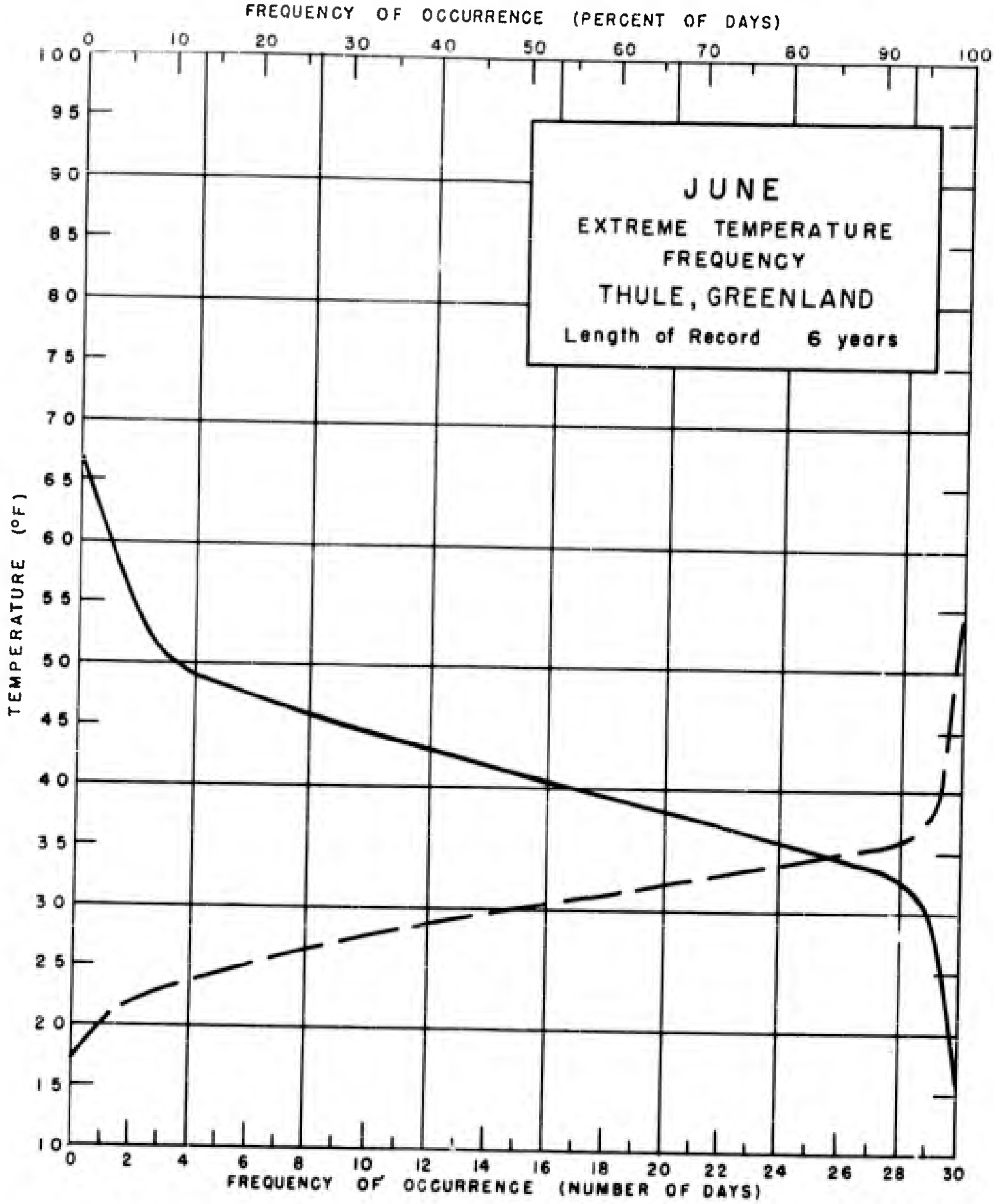


—— Number of days (or percent of days) the daily maximum temperature may be expected to equal or be greater than a particular temperature.

— — Number of days (or percent of days) the daily minimum temperature may be expected to equal or be less than a particular temperature.

Example: A maximum temperature of 34°F or greater may be expected to occur 8 days during May.

Figure 8.

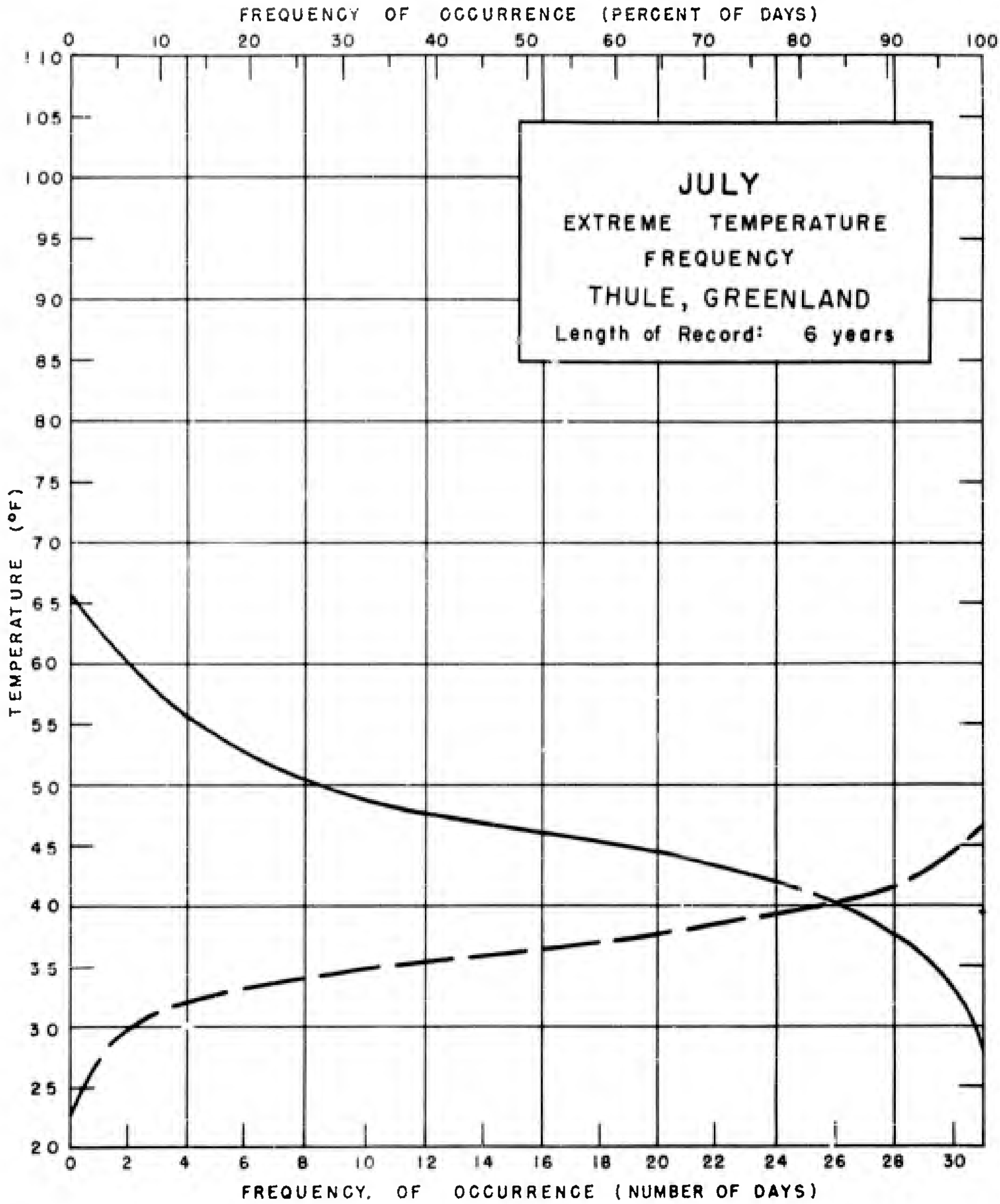


—— Number of days (or percent of days) the daily maximum temperature may be expected to equal or be greater than a particular temperature.

— — Number of days (or percent of days) the daily minimum temperature may be expected to equal or be less than a particular temperature.

Example: A maximum temperature of 36°F or greater may be expected to occur 23 days during June.

Figure 9.

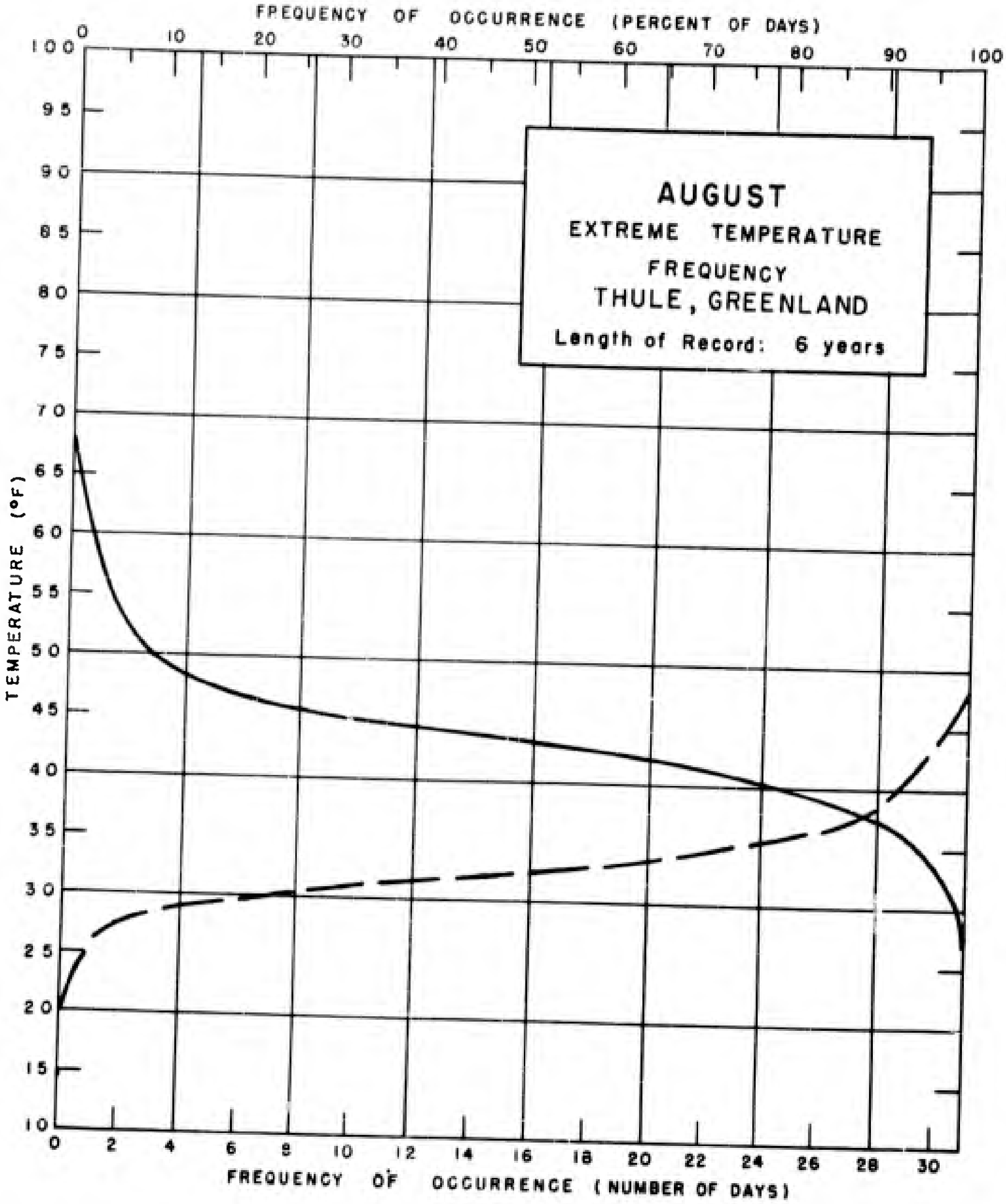


—— Number of days (or percent of days) the daily maximum temperature may be expected to equal or be greater than a particular temperature.

- — — Number of days (or percent of days) the daily minimum temperature may be expected to equal or be less than a particular temperature.

Example: A maximum temperature of 46°F or greater may be expected to occur 15 days during July.

Figure 10.

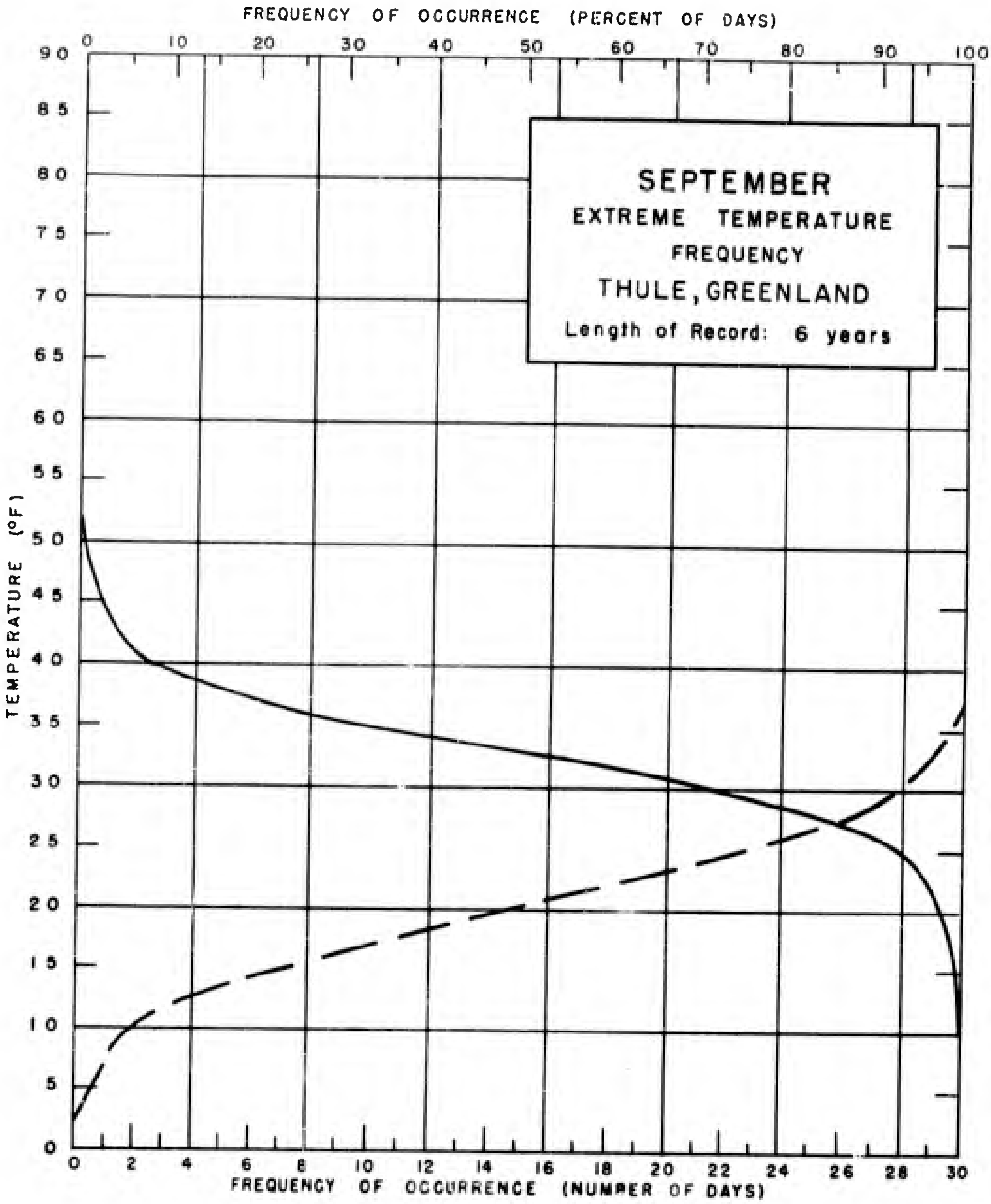


—— Number of days (or percent of days) the daily maximum temperature may be expected to equal or be greater than a particular temperature.

– – Number of days (or percent of days) the daily minimum temperature may be expected to equal or be less than a particular temperature.

Example: A maximum temperature of 46°F or greater may be expected to occur 8 days during August.

Figure 11.

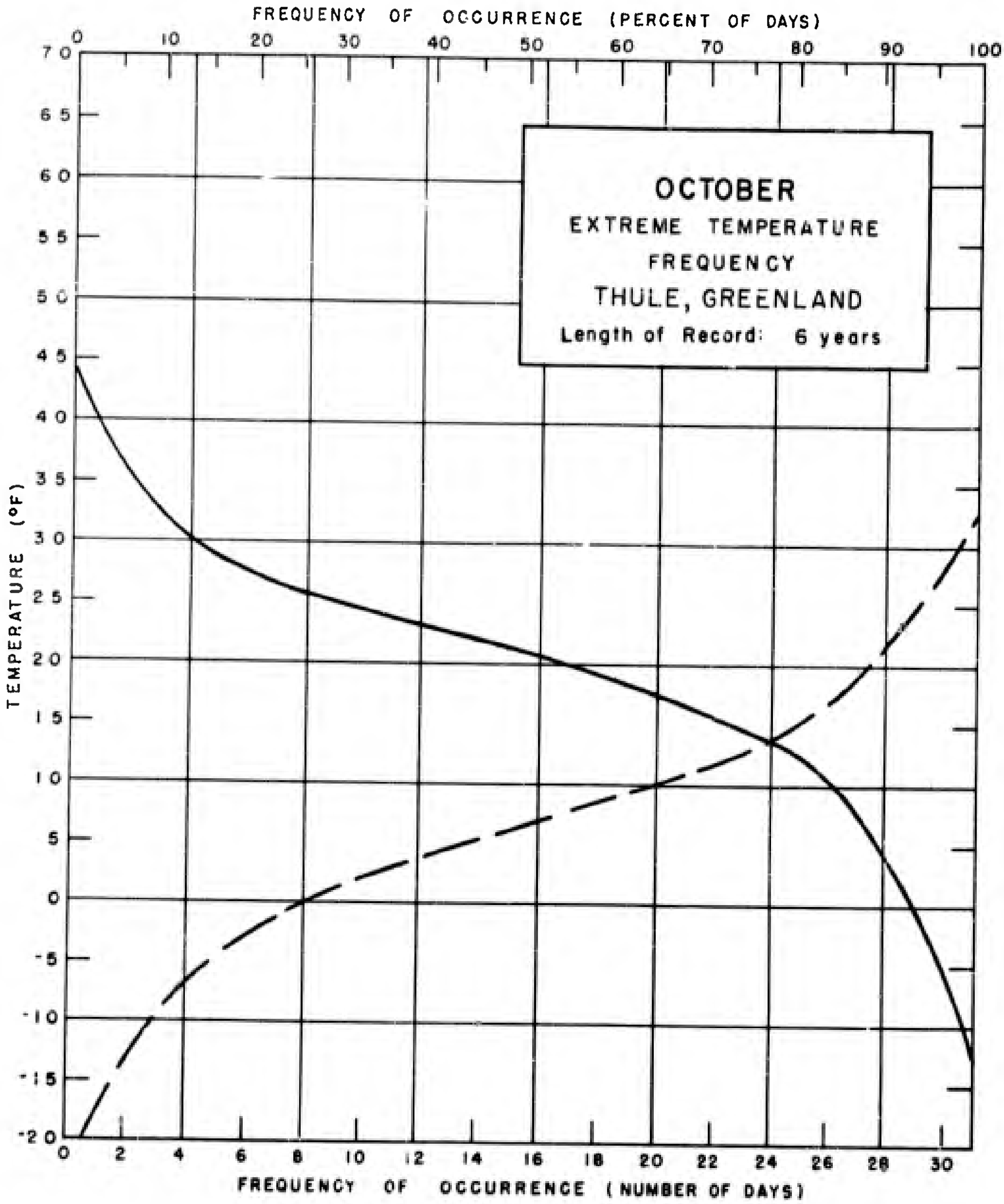


—— Number of days (or percent of days) the daily maximum temperature may be expected to equal or be greater than a particular temperature.

— -— Number of days (or percent of days) the daily minimum temperature may be expected to equal or be less than a particular temperature.

Example: A maximum temperature of 36°F or greater may be expected to occur 8 days during September.

Figure 12.

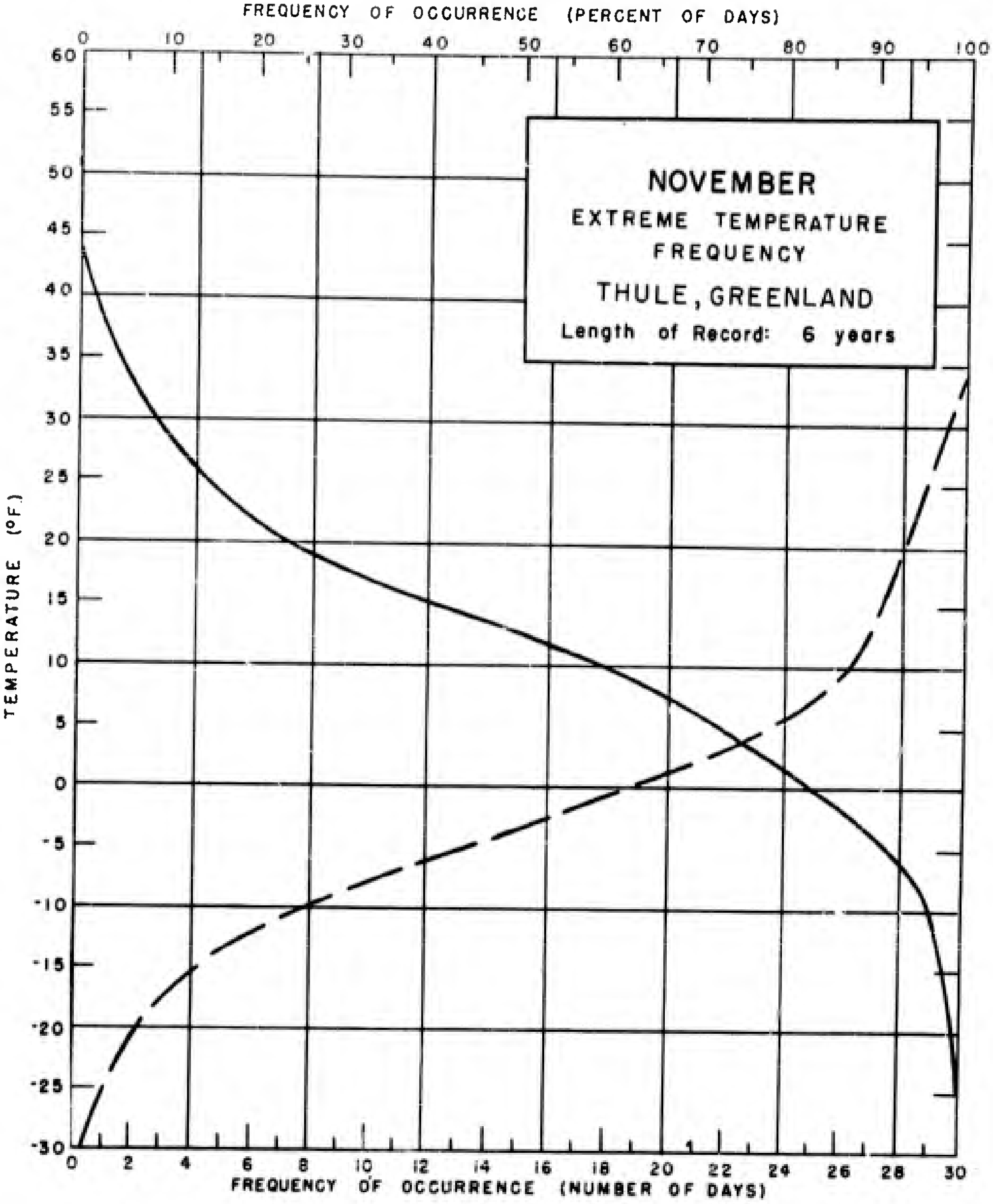


—— Number of days (or percent of days) the daily maximum temperature may be expected to equal or be greater than a particular temperature.

— — Number of days (or percent of days) the daily minimum temperature may be expected to equal or be less than a particular temperature.

Example: A maximum temperature of 26°F or greater may be expected to occur 8 days during October.

Figure 13.

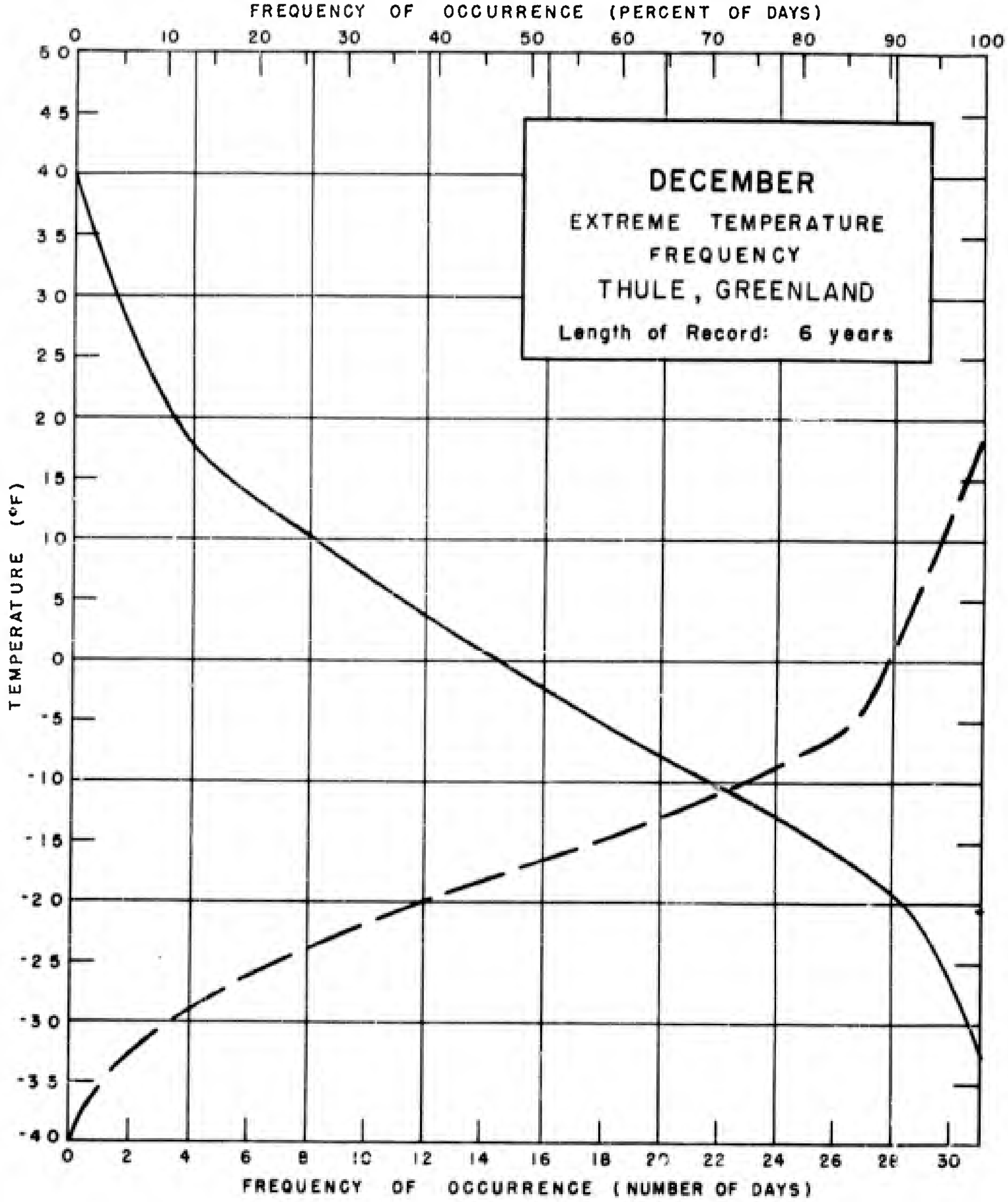


—— Number of days (or percent of days) the daily maximum temperature may be expected to equal or be greater than a particular temperature.

– – Number of days (or percent of days) the daily minimum temperature may be expected to equal or be less than a particular temperature.

Example: A maximum temperature of 19° F or greater may be expected to occur 8 days during November.

Figure 14.



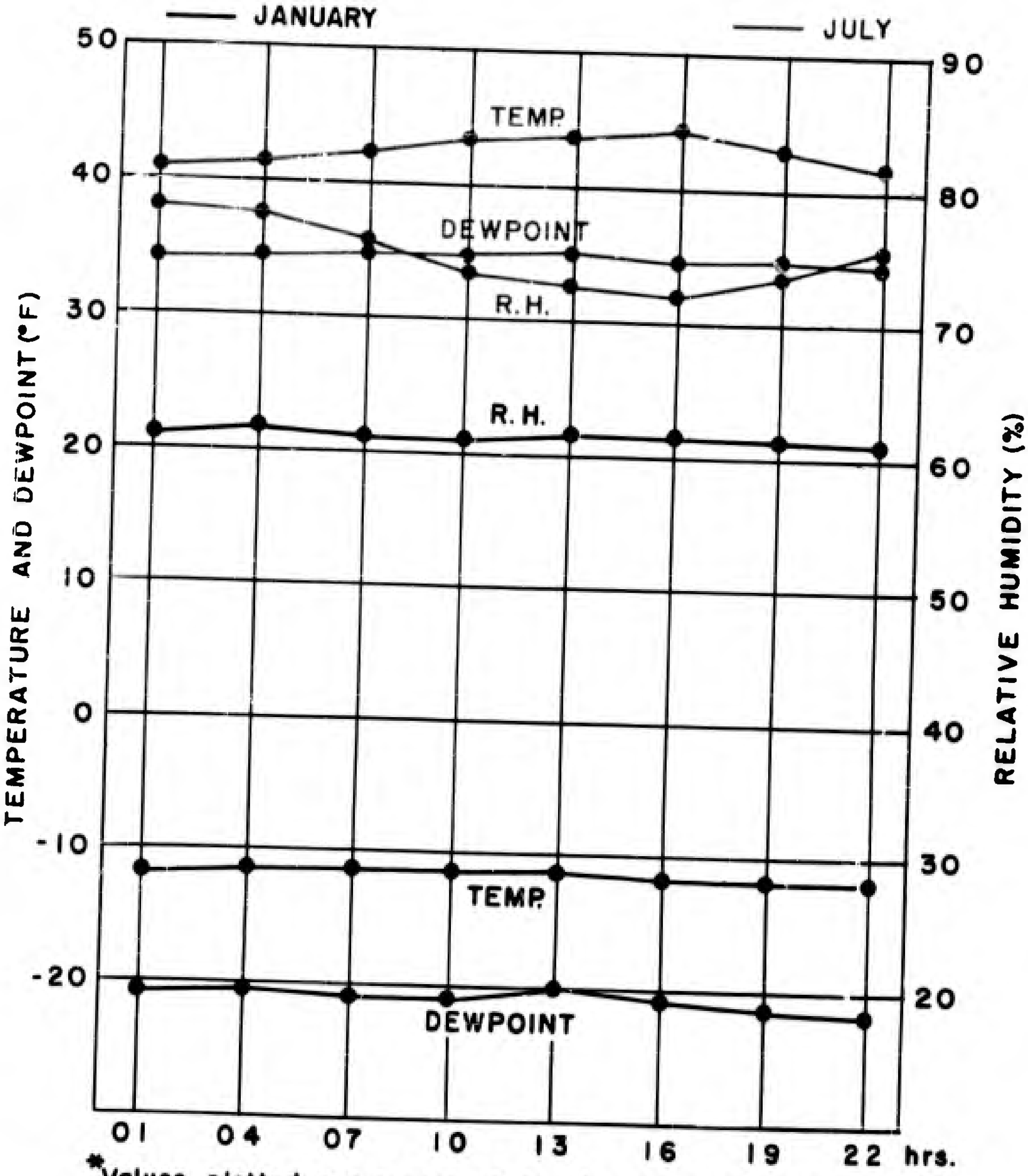
—— Number of days (or percent of days) the daily maximum temperature may be expected to equal or be greater than a particular temperature.

— — Number of days (or percent of days) the daily minimum temperature may be expected to equal or be less than a particular temperature.

Example: A maximum temperature of 10°F or greater may be expected to occur 8 days during December.

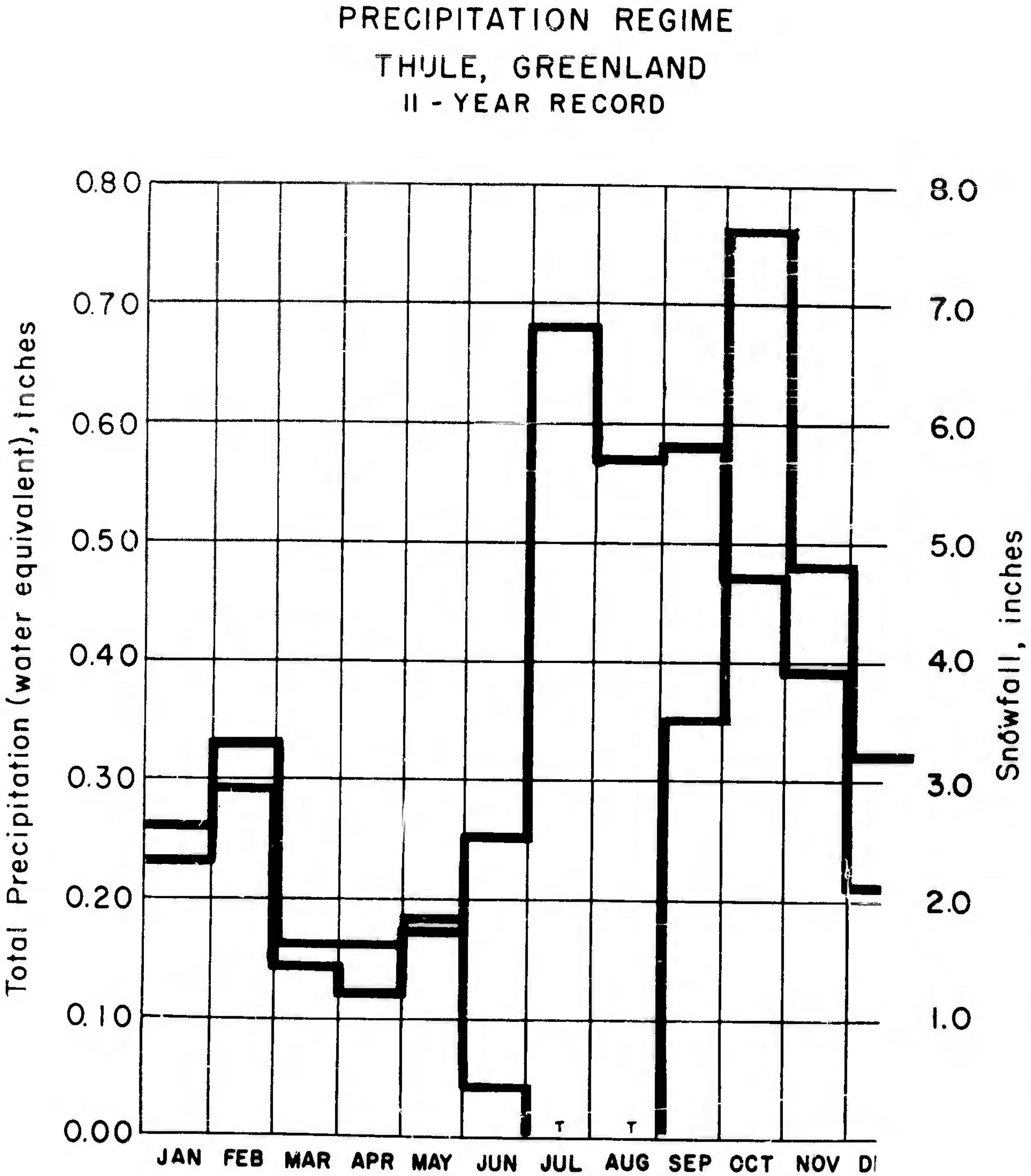
Figure 15.

AVERAGE HOURLY* TEMPERATURE,
DEWPOINT, AND RELATIVE HUMIDITY
JANUARY AND JULY
THULE, GREENLAND
8-YEAR RECORD



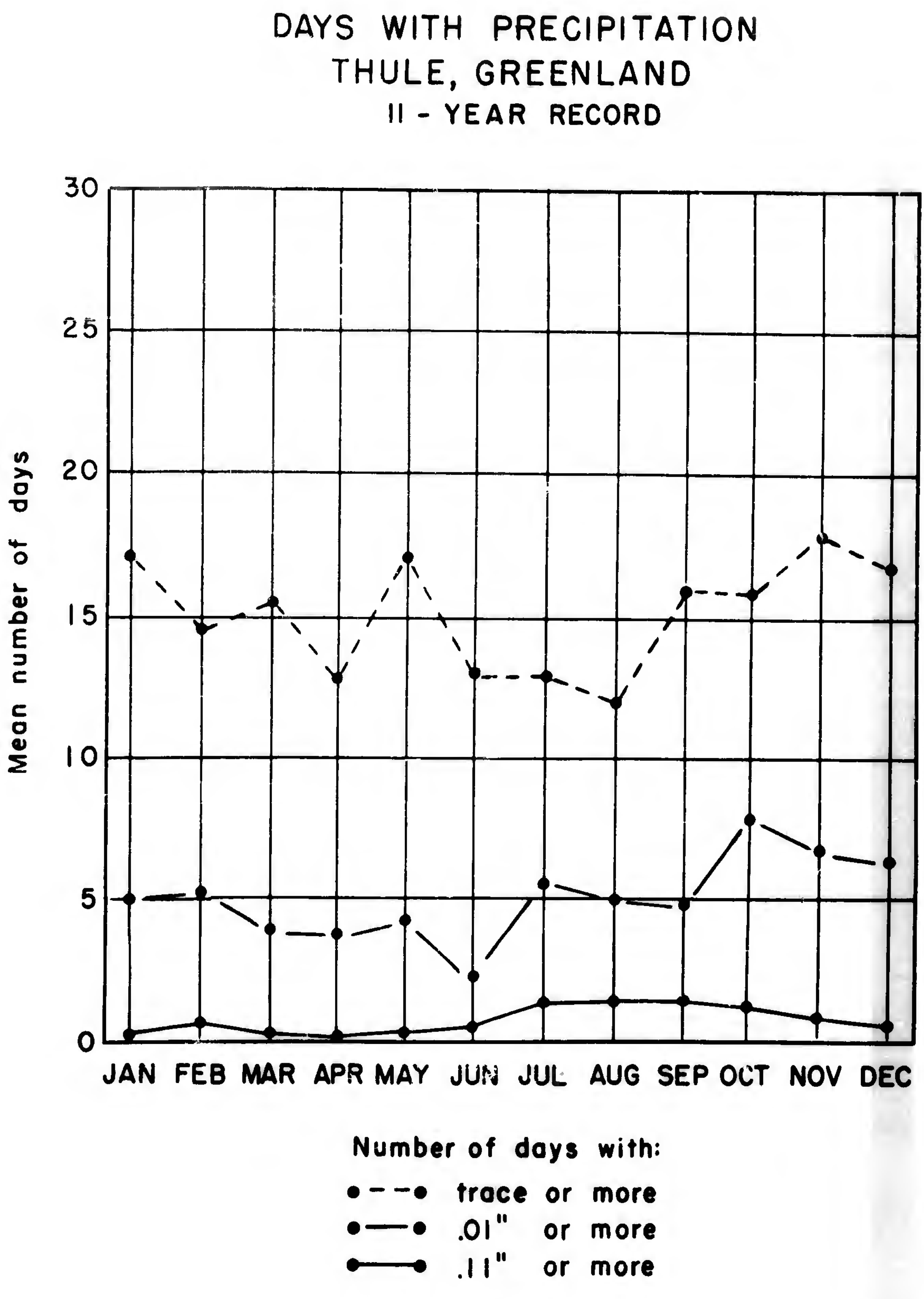
*Values plotted are means of hourly observations for each 3-hour period

Figure 16.



PRECIPITATION REGIME
THULE, GREENLAND
11 - YEAR RECORD
Total Precipitation (water equivalent), inches
0.00
0.10
0.20
0.30
0.40
0.50
0.60
0.70
0.80
Snowfall, inches
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DE
T
T

Figure 17.



DAYS WITH PRECIPITATION
THULE, GREENLAND
11 - YEAR RECORD
Mean number of days
30
25
20
15
10
5
0
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
Number of days with:
trace or more
.01" or more
.11" or more

Figure 18.

SURFACE WIND ROSES

THULE, GREENLAND

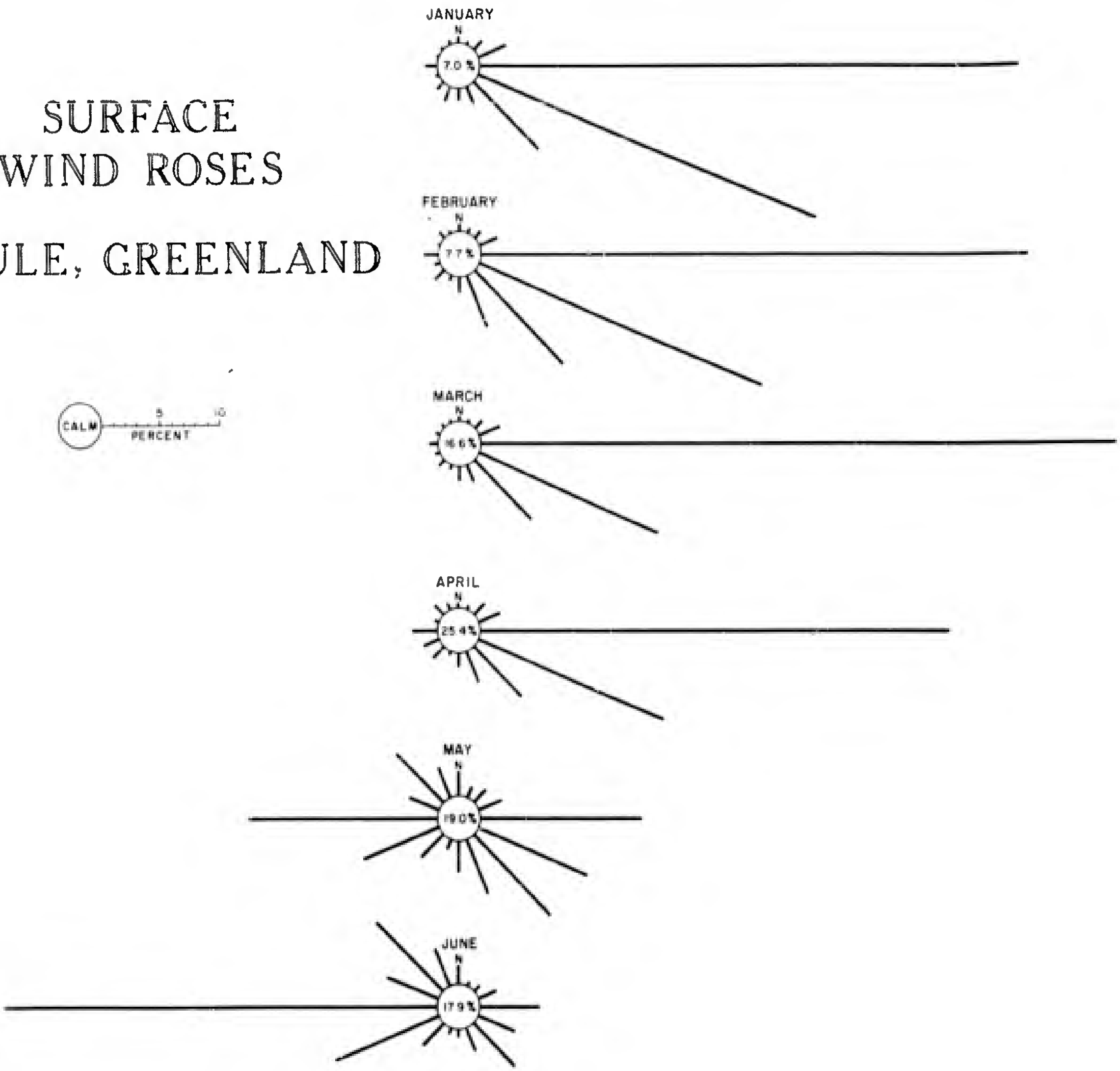


Figure 19 a.

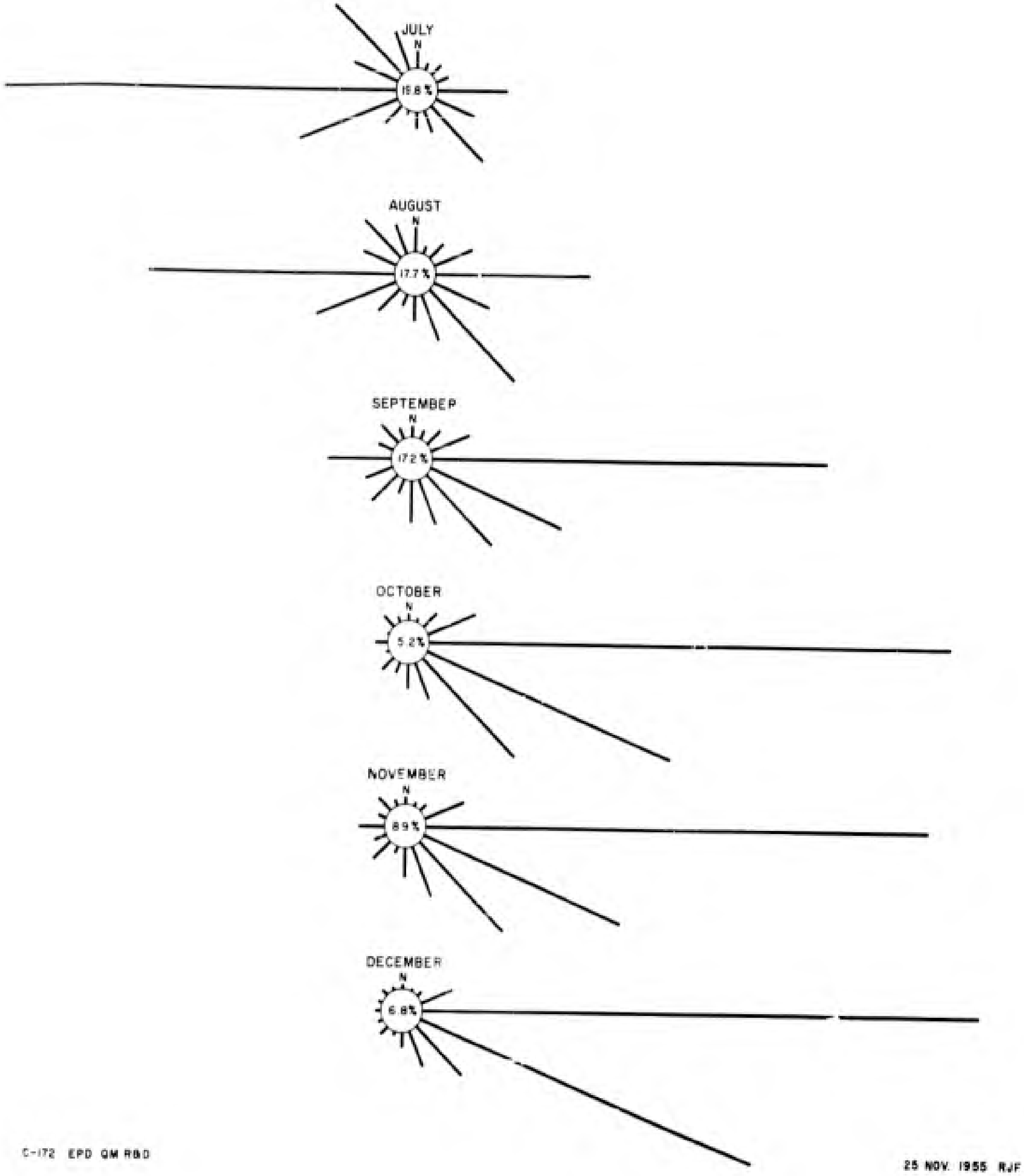

JULY
N
15.8%
AUGUST
N
17.7%
SEPTEMBER
N
17.2%
OCTOBER
N
5.2%
NOVEMBER
N
8.9%
DECEMBER
N
6.8%
C-172 EPD QM R&D
25 NOV. 1955 RJF

Figure 19 b.

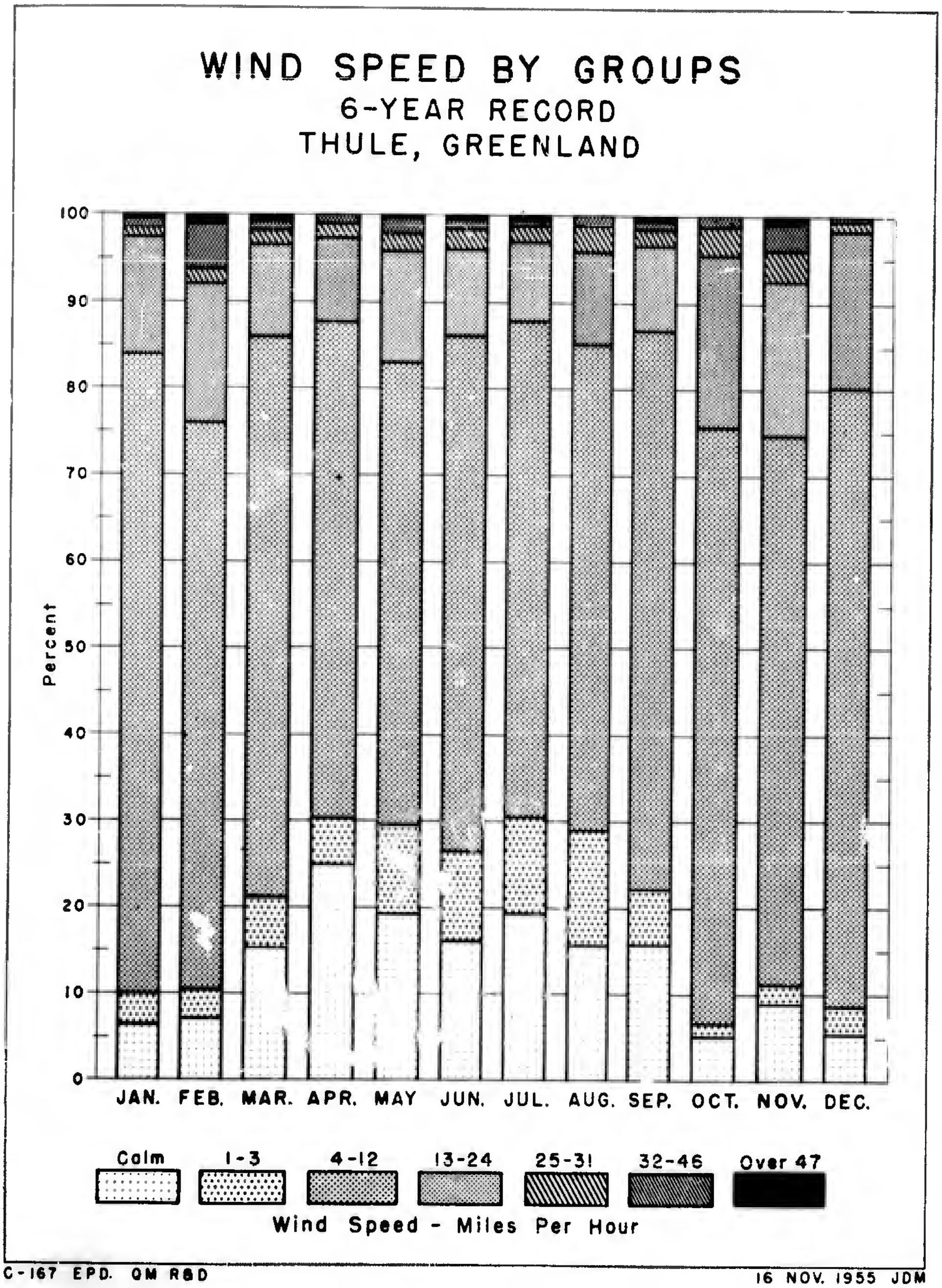
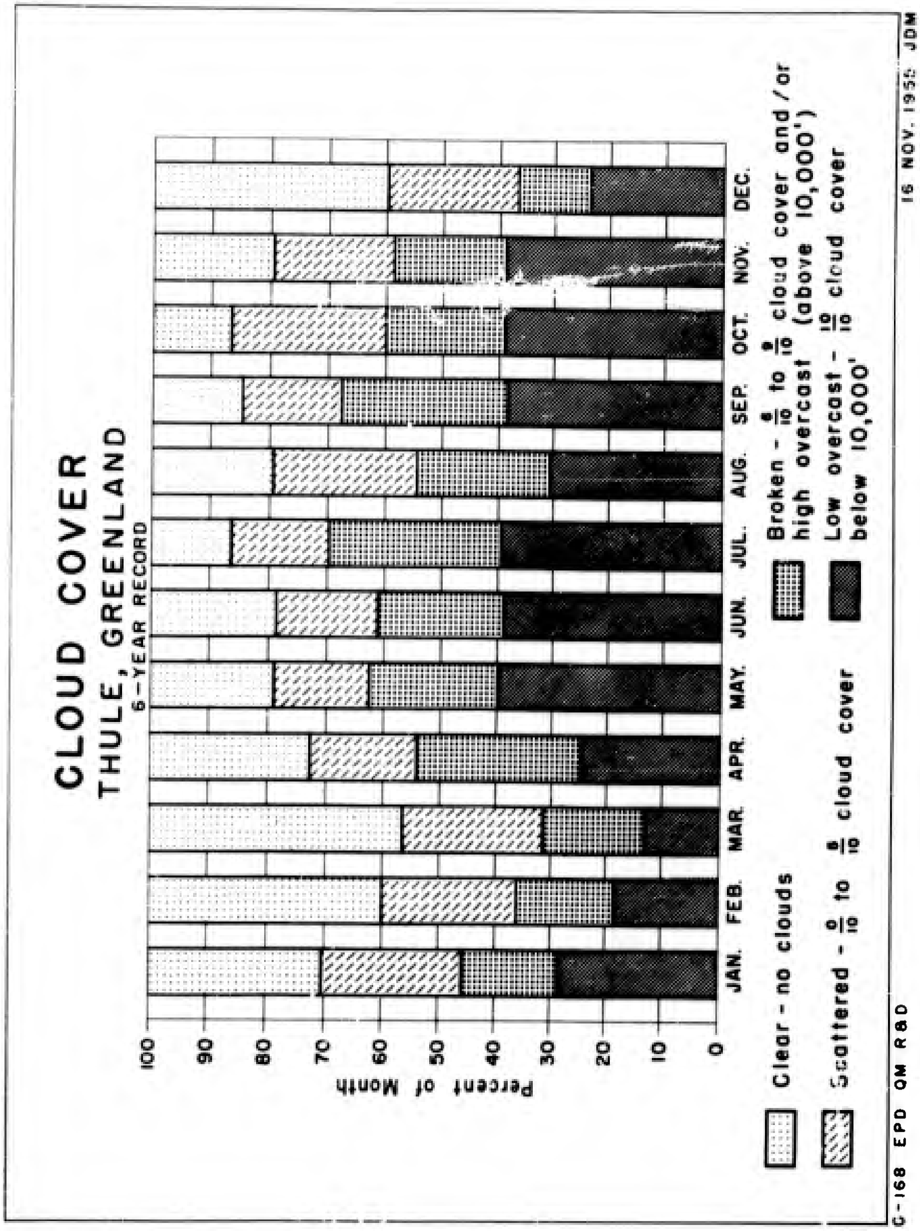

WIND SPEED BY GROUPS
6-YEAR RECORD
THULE, GREENLAND
Percent
0
10
20
30
40
50
60
70
80
90
100
JAN.
FEB.
MAR.
APR.
MAY
JUN.
JUL.
AUG.
SEP.
OCT.
NOV.
DEC.
Calm
1-3
4-12
13-24
25-31
32-46
Over 47
Wind Speed - Miles Per Hour
C-167 EPD. QM R&D
16 NOV. 1955 JDM

Figure 20.



CLOUD COVER
THULE, GREENLAND
6-YEAR RECORD
Percent of Month
100
90
80
70
60
50
40
30
20
10
0
JAN.
FEB.
MAR.
APR.
MAY.
JUN.
JUL.
AUG.
SEP.
OCT.
NOV.
DEC.
Clear - no clouds
Scattered - $\frac{0}{10}$ to $\frac{5}{10}$ cloud cover
Broken - $\frac{6}{10}$ to $\frac{9}{10}$ cloud cover and/or high overcast (above 10,000')
Low overcast - $\frac{10}{10}$ cloud cover below 10,000'
G-168 EPD QM R&D
16 NOV. 1955 JDM

Figure 21.

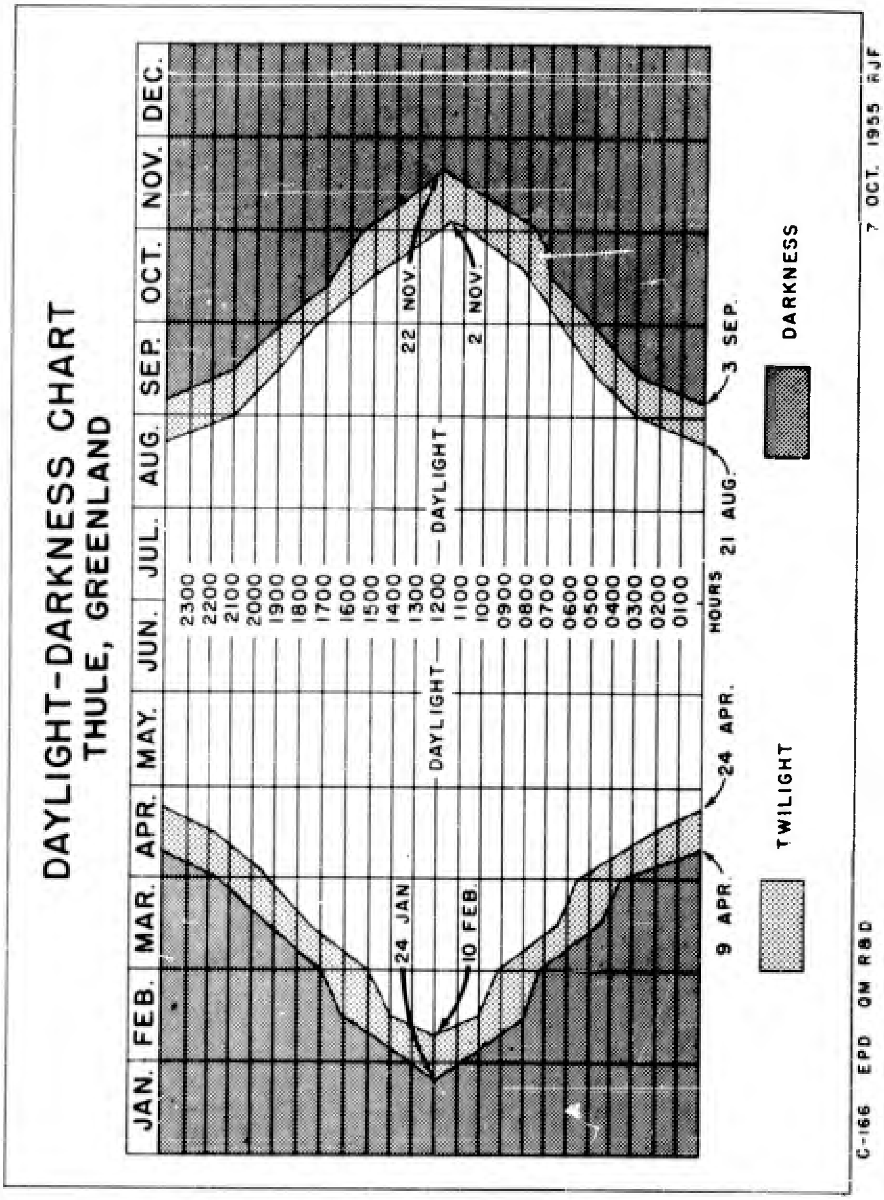

DAYLIGHT-DARKNESS CHART
THULE, GREENLAND
JAN.
FEB.
MAR.
APR.
MAY.
JUN.
JUL.
AUG.
SEP.
OCT.
NOV.
DEC.
2300
2200
2100
2000
1900
1800
1700
1600
1500
1400
1300
1200
1100
1000
0900
0800
0700
0600
0500
0400
0300
0200
0100
HOURS
DAYLIGHT
DAYLIGHT
24 JAN
10 FEB.
9 APR.
24 APR.
21 AUG.
3 SEP.
22 NOV.
2 NOV.
TWILIGHT
DARKNESS
C-166 EPD QM R&D
7 OCT. 1955 RJF

Figure 22.

APPENDIX B

Photographs

Figure 23. North Star Bay in July. The table mountain in the background is Mount Dundas.

Figure 24. The Thule Trough in July. This picture was taken from a point near the south rim of the valley, looking east toward the icecap.

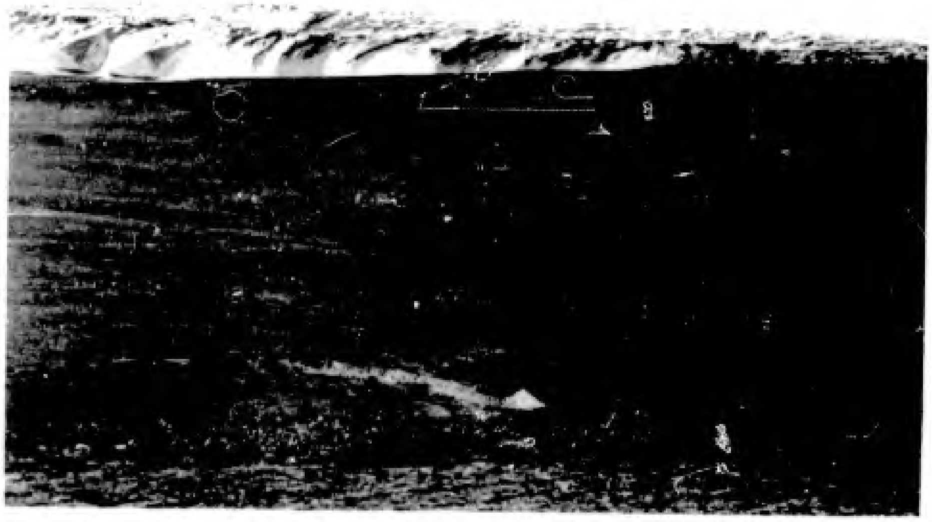


Figure 25. Moraine at the edge of the icecap near TUTO in July. Notice the ground deposits on the ice.

Figure 26. Thule barracks area in April. These buildings were erected on blocks three to four feet above the ground surface.

Figure 27. TUTO in August, showing the ice ramp in the background and new snow.

Figure 28. Snow accumulation in April at the same spot as shown in Figure 27.

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Quartermaster Research and Engineering Center, Natick, Mass.
HANDBOOK OF THULE, GREENLAND, ENVIRONMENT, by Robert L. Anstey.
August 1956. 42 p., illus. (Technical Report EP-34) Revised March 1961

Thule, Greenland, is 700 miles north of the Arctic Circle and has a typical Arctic coastal environment. Although a program of testing is not usually carried on at Thule proper, neighboring areas include numerous sites which are presently used for Arctic testing; examples are the icecap, ice ramp, and the seasonally snow-free coastal area at the edge of the ice.

Climatically the area in the immediate vicinity of Thule Air Base has few advantages over either Fort Greely (Big Delta), Alaska, or Fort Churchill, Canada, for testing cold weather clothing and equipment. The absolute minimum temperatures at the latter stations are from 10 to 20 (F) degrees lower than at Thule. However, Thule is the doorway to the icecap, and the Icecap station, 200 miles east of Thule, has lower temperatures than either of the above sites. The average temperature of the coldest month according to the brief 2-year record at the Icecap station is 6 (F) degrees lower than at Fort Churchill, and the average temperature of the warmest month is 36 (F) degrees lower than at Fort Churchill. Maximum summer temperatures may be expected to reach 32°F on only eight days each year at the Icecap station.

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