A STUDY OF THE TYPE "B" WEATHER SITUATIONS

Thesis

by

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BIBLIOGRAPHY

1. Lectures and Notes on Type Weather Situations by Dr. Irving P. Krick.

2. Plates 1 to 13 inclusive by Dr. Irving P. Krick.

3. Synoptic Weather Charts, California Institute of Technology.

4. Weather Bureau Meteorology Bulletins.

INTRODUCTION

The purpose of this thesis is to study and classify the daily synoptic weather charts and to develop a system of type weather situations which may be used as aids to long range forecasting. Special emphasis will be placed upon the synoptic charts for the year 1939. As a result of this research, we hope to become more familiar with the types as originally defined by Dr. Irving P. Krick, Meteorological Department, California Institute of Technology, to check thoroughly type "B", to develop additional "B" types and phases where they seem necessary, and to satisfy ourselves that our final types, phases, and anomalies are the best that we can find.

METHOD FOR CLASSIFICATION

Any system of classification of daily synoptic weather charts is satisfactory provided the boundaries are clearly defined and the types check with actual conditions. There is, however, a necessity for uniformity in classification of weather situations in order that all meteorologists may have a standard plan in their study and use of these classifications as aids to forecasting. In order to maintain uniformity and continuity, we have chosen the types, phases, boundaries, criteria, and anomalies as defined by Dr. Krick. The boundaries, types, and phases are shown on Plates 1 - 13. The criteria and anomalies are as follows:

Type "A"

Criteria: Wedge extends from cold high in Alaska southward over North Pacific. Trough along the coast of British Columbia. Generally polar high in east. (winter situation).

Anomalies: Wet on west coast and cold especially in Southern California. Generally cold in east. (winter situation).

Type "B"

Criteria: Semi-permanent Pacific high about 30-130. Semi-permanent Basin high in northern part. Systems enter continent by way of British Columbia.

Regenerate with Foen winds east of Rocky Mountains. Occasionally well developed systems have formed by the time trough reaches Great Lakes and New England regions. Gulf systems seldom form or occasionally every six days. There is generally a high in the southeast oriented NE-SW.

Anomalies: Dry in most of west, especially southwest. Warm with large diurnal range. Dry in southeast and warm except in mid-winter with large diurnal range. Active at Great Lakes, eastern Canada, and New England. Active at east coast. Foehn winds east of Rockies from Montana northward.

Type "C"

Criteria: Systems moving in from Pacific south of latitude 35 or 40. Break down wedge over Southern California. Systems move across south. Good Gulf waves form with heavy precipitation. Generally cold in east with snow far south.

Anomalies: Wet Southern California and southwest. Warm in winter. Wet Gulf, southern Mississippi and Ohio, and southern Atlantic states. Generally cold in winter or fluctuating. Occasionally type "B" in north.

Type "E"

Criteria: Systems moving into continent in Northern

California, Oregon, and Washington. Low pressure centers occur in Basin area, only when wedges are weak and to the south. Low forms east of Rockies affecting central part of country with secondary Gulf wave producing heavy precipitation.

Anomalies: Wet Great Basin and warm in winter. Affects more of North Basin than type "C". Wet southern Great Plains, Gulf, and southern Mississippi and Ohio, central and south Atlantic, east Great Lakes, and New England. Fluctuating temperatures. Cold southeast.

CLASSIFICATION AND STUDY OF SYNOPTIC CHARTS

With the aid of these criteria, the daily 05:00 AM PST synoptic weather charts of the California Institute of Technology for the year 1939 were classified as shown in Plates 14 and 15. It was noted that at times it was necessary to combine two types in order to completely explain the situation. We feel that the "BC" type combination is a true type and that it persists for a period of time. Types "EC" and "BE" were used at times to show the transition between "E" and "C" and between the types "B" and "E". Type "B" was always followed by type "E" or some combination. The greatest periods of uninterrupted type "B" were from May 2 to June 13, from July 19 to August 10, and from September 2 to September 23. The longest period when

not any "B" types were present was from November 6 to December 20.

Yearly and seasonal type percentages for the year 1939 are shown on Plate 16. Type "B" persisted for 180 days and therefore accounted for 49.4% of the weather. Type "E", which persisted for 151 days, was next in importance. Type "B" predominated in all seasons except Autumn, during which season type "E" prevailed. Type "B" persisted for 70% of Summer and only 35% of Autumn.

In order to obtain more representative data, the years 1938 and 1940 were considered. The periods of persistence of type "B" in 1938 and 1939 compare favorably. However, in 1940, type "B" persisted from June 14 to August 30, a period of 77 days, which is approximately two and one half times as long as any period observed in the other two years. See Plate 17. The total number of days that type "B" persisted for these years was as follows:

1938.....181 days.

1939.....180 days.

1940.....220 days.

It is evident from this that type "B" is the most persistent and therefore probably the most important type. The seasonal percentages, as shown on Plate 18, check favorably except in Autumn of 1940, when more than 90% of the weather was type "B". This is almost three times as great as the 1939 percentage. In the Winter of the same year, we found type "B" only 12% of the time which is about one third of

the 1939 percentage. The percentages for the other two seasons compare favorably.

DEVELOPMENT OF THE "B" TYPE

Using Dr. Krick's types and phases in our classification of the 1939 synoptic charts, it was necessary to make interpolations to obtain the daily synoptic situations and allow for seasonal variations. Therefore, we divided type "B" into seasons each with sufficient phases to cover the daily variations for one complete cycle.

We feel that the different seasons overlap, with boundaries quite variable, and for convenience divided the year into the following seasons:

Winter	(February 15 - June 15)
Summer	(June 15 - September 15)
Autumn	(September 15 - February 15)

We studied the type "B" daily synoptic charts and plotted the trajectories of the centers of low pressure in an effort to determine the number of phases necessary for each of these seasons. The positions and trajectories of these cyclones were obtained from the Monthly Weather Review Bulletin. See Plates 19, 20, and 21. An Examination of these plates shows that when we consider a cycle equal to one wave length, or approximately the distance across the United States, the following number of phases are necessary for each season:

Winter.....6

Summer.....9

Autumn.....6

A limitation must be placed upon the amount of detail shown on these types, thus preventing the types from becoming too complicated and inflexible. We have put into our types some details which take care of the more frequent unusual weather situations. At times our types may seem to fail completely. This is partly true, but upon closer examination it will be found that the predominant features of the type do exist. An analysis of the daily synoptic charts, accelerations, decelerations, shifts of the streamlines, polar outbreaks, etc., are some of the factors that complicate the typing of the weather charts in accordance with a set type of daily phases.

Type "B" has certain outstanding features. The Pacific anticyclone is oriented with its axis NE-SW or E-W, forming a wedge which prevents frontal systems from entering the continent farther south than Washington and Oregon. There is generally an extension of this high inland. A series of occlusions move across the northern periphery of this high and enter the continent in Alaska and western Canada. These systems cross the mountains as upper fronts and regenerate on the east side by the interaction of the Pc and Pp air masses. The Bermuda high extends inland in the southeastern part of the country and brings Tg air onshore. Type "B" may be considered as a fair weather type, especially in the Southwest and in the Southeast.

SUMMER "B" TYPE
(Plates 22 - 30)

This type consists of nine phases. Occlusions enter the continent in British Columbia and Alaska producing precipitation as far south as Washington and Oregon. They cross the mountains as upper fronts and regenerate east of the Rockies in Alberta. This is an inactive wave due to the small temperature difference between the Pc and Pp air masses and to the dryness of the Pp air after having crossed the Rockies. This wave deepens southwest of Hudson's Bay from the interaction of the cold moist air from the Bay with the warm air from the continent. It then moves northeastward out through Hudson Strait and into Baffin Bay. About every sixth day Tg moving inward forms a wave in the south central states. This wave produces precipitation as it moves northeastward toward the Great Lakes and out the St. Lawrence Valley. The Southwest, the Great Basin, and the Southeast are dry and warm. The extension of the Pacific high inland is conducive to the formation of a thermal low in Southern California which inducts sea air onshore, and subsequent radiation at night tends to form fog or stratus.

AUTUMN "B" TYPE
(Plates 31 - 36)

A series of occlusions move into British Columbia around the periphery of the Pacific high producing showers along the west coast north of the state of Washington.

These occlusions cross the mountains as upper fronts and regenerate in Alberta. The new wave moves either southeast or east depending upon the presence of a polar outbreak. The eastward moving system has very little effect on the weather of the United States and passes off the map. The southeastward moving system deepens west of the Great Lakes, when supplied with warm air, and swings around and out the St. Lawrence Valley. The movement and trajectory of this system are variable depending on the presence and intensity of a polar outbreak. An additional system of waves forms off the coast of Florida around the periphery of the high. This system of waves follows the eastern coastline and deepens as it moves northward producing precipitation all along the east coast. Sometimes these waves give the typical "Northeaster" for the New England States as the Ta air is drawn around the low and interacts with the Pc air of the continent. With an intense polar outbreak, a wave is sometimes generated in the southwestern part of the country between the Pp and the Tg or Tp air masses.

WINTER "B" TYPE
(Plates 37 - 42)

This type is very similar to the Autumn type with the following exceptions. The Pc and Tg or the Pc and RPc front is farther south due to the more intense polar outbreaks of this season. Waves form along this front and deepen as they move northeastward producing light to mode-

rate precipitation in the New England States. The system of waves found in the Autumn type off the coast of Florida is displaced eastward off the map and does not affect the eastern part of the country.

CONCLUSIONS

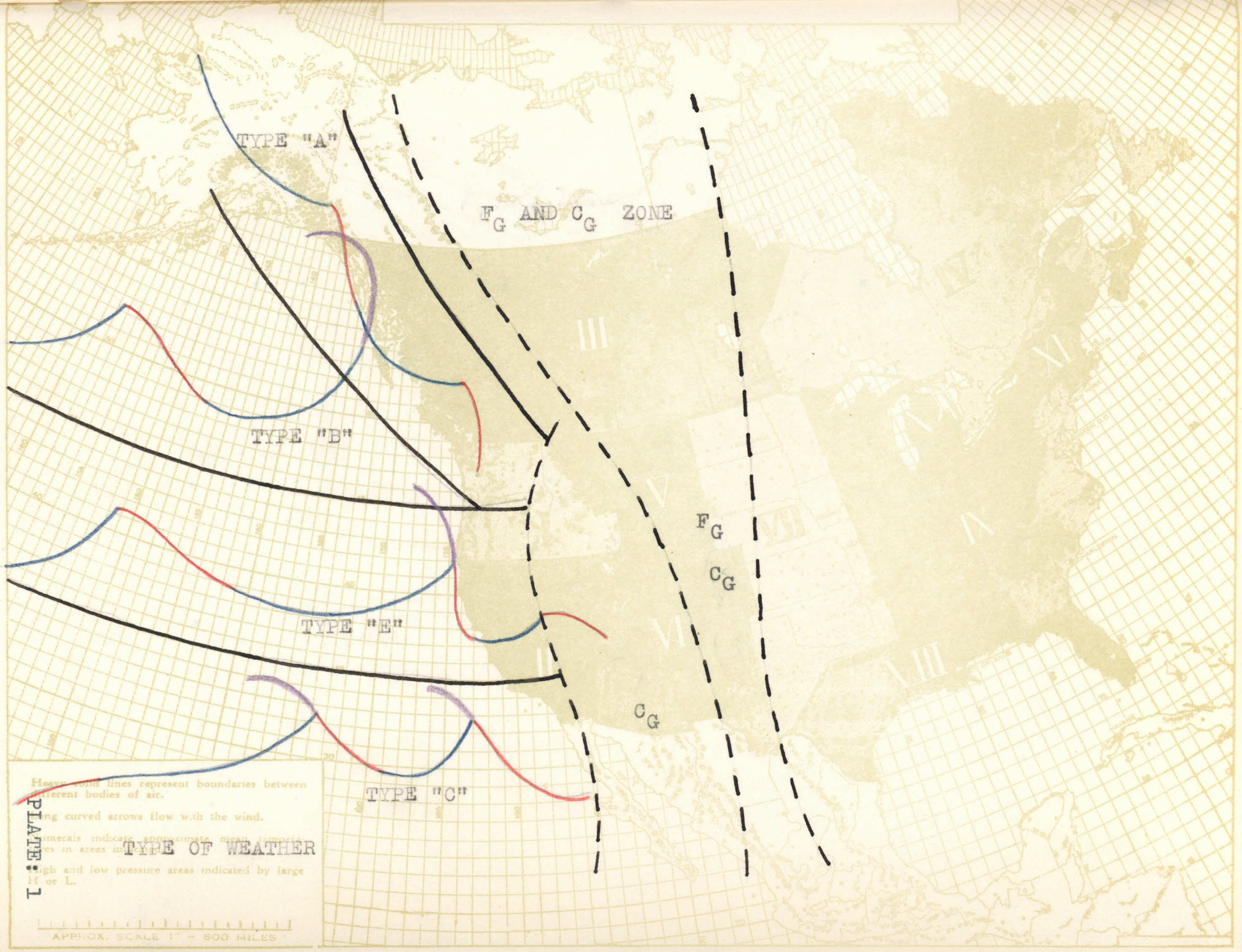
Type "B", since it is common throughout the year, must be very complex to meet varying conditions. During the years of 1938, 1939, and 1940, it was more prevalent than any other type and we feel that it is the predominant type of weather for any year. This type does not give any violent or unusual weather on the west coast, however, as explained in the types for the seasons, it often develops frontal systems in the southwestern states, south central states, along the western side of the Appalachian Mountains, and along the east coast. Normally it is expected that the occluded systems will proceed across the map at rather high latitudes producing relatively small amounts of precipitation, but polar outbreaks and other periodical variations cause more southerly trajectories of these systems and tend to destroy the regularity of their movement. Nine phases were developed for the Summer type when warm moist systems move slower.

We observed that often during a "B" type, the Pacific high takes the shape of a "J" with the wedge extending far northward, and an occlusion moves eastward across this wedge. As the wedge weakens more, the occlusion moves southeastward and produces a "BE" combination. This is merely a transitional type which lasts for a period of one to three days. The western end of the Pacific high increases in pressure, spreads out northward and eastward,

and returns to a "B" type regime. If the Pacific high remains oriented E-W and displaced southward without the increase of pressure and the extension northward, this "BE" combination reverts to type "E".

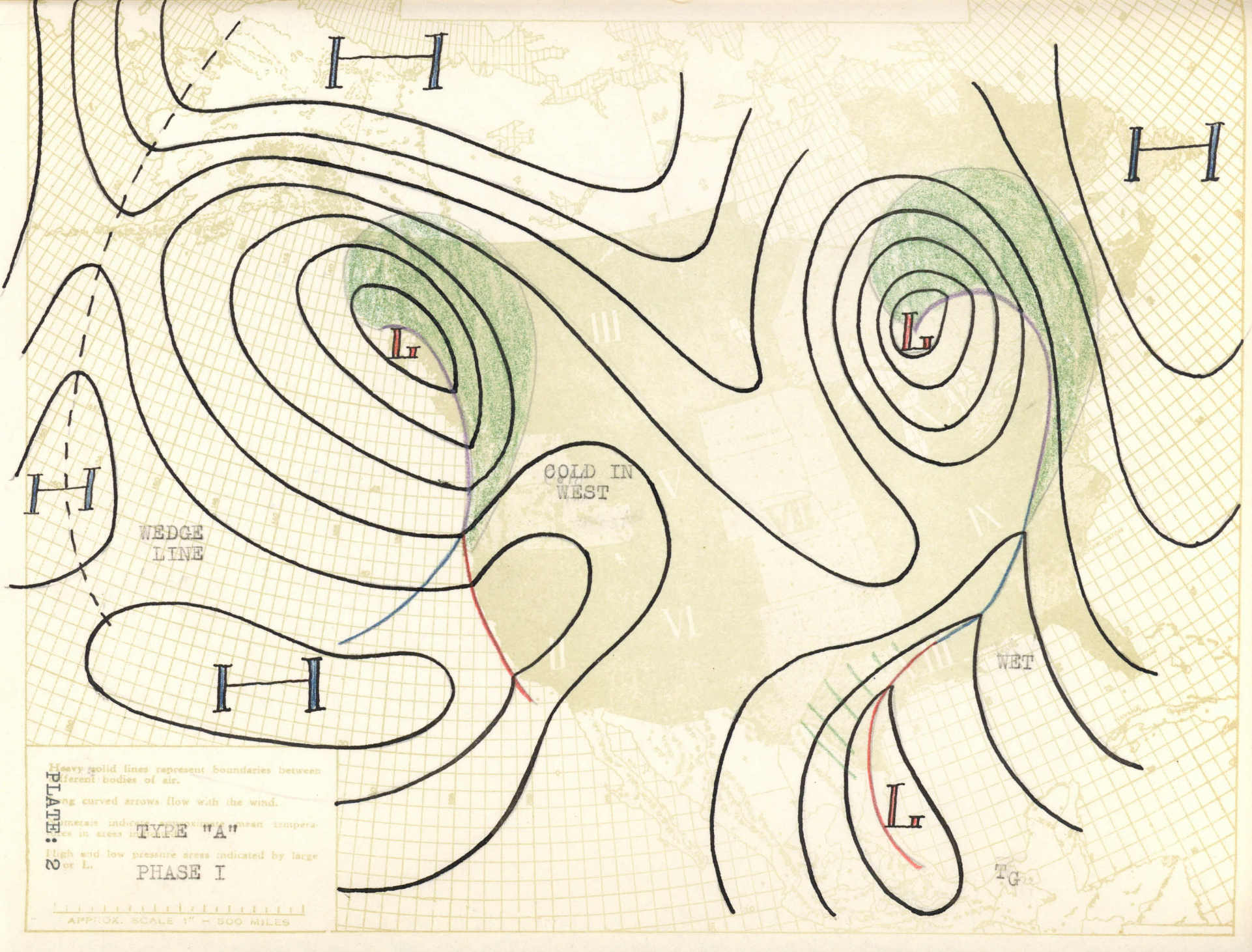
It was noted also that this type generally persisted for shorter periods of time in Autumn and Winter than in Summer, but it almost always persisted for three days or some multiple thereof.

We feel that this study has caused us to become more familiar with the type weather situations, that it will aid us in forecasting, and that our types do check favorably with the daily type "B" synoptic charts.



TYPE OF WEATHER

PLATE: 1



Heavy solid lines represent boundaries between different bodies of air.

Long curved arrows flow with the wind.

Numerals indicate approximate mean temperatures in areas indicated.

High and low pressure areas indicated by large H or L.

TYPE "A"

PHASE I

APPROX. SCALE 1" = 500 MILES

PLATE: 2

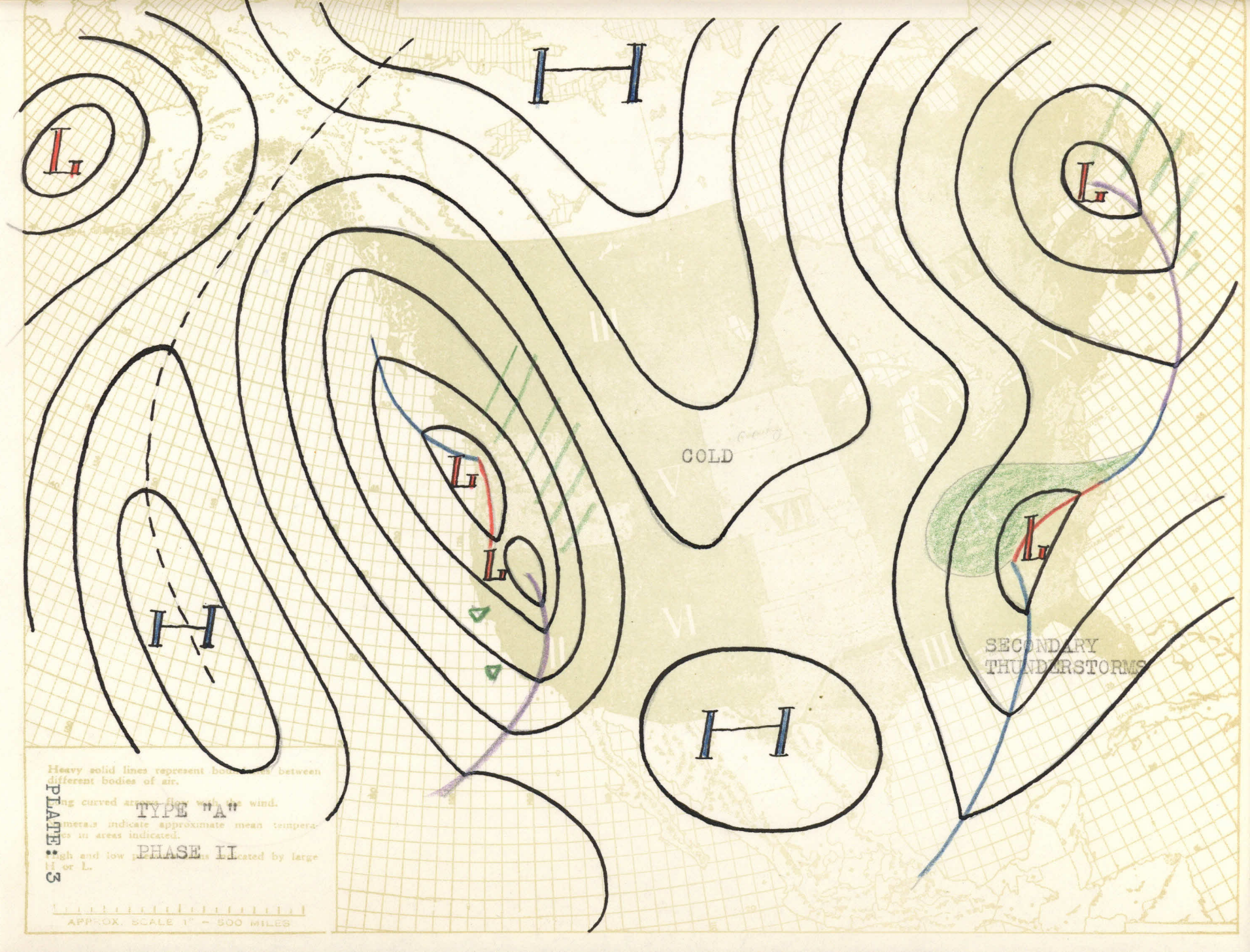
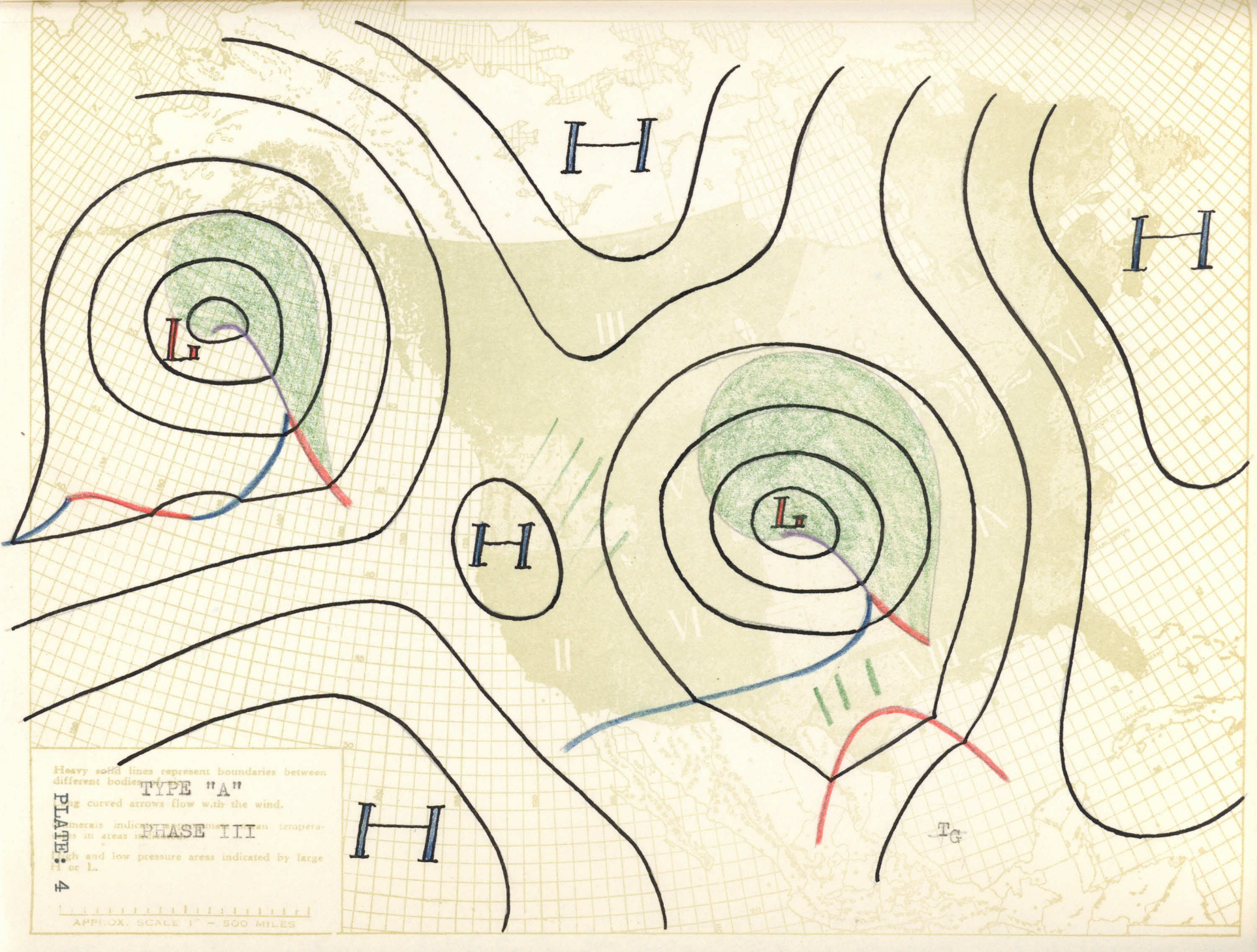

L
H
H
L
L
L
COLD
L
SECONDARY
THUNDERSTORMS
H
Heavy solid lines represent bo
different bodies of air.
ng curved arr
meters indicate approximate mean tempera-
es in areas indicated.
gh and low p
H or L.
TYPE "A"
PHASE II
APPROX. SCALE 1" = 500 MILES

PLATE: 3



Heavy solid lines represent boundaries between different bodies

g curved arrows flow w.th the wind.

merals indic[illegible] temperatures in areas

h and low pressure areas indicated by large H or L.

APPROX. SCALE 1" = 500 MILES

TYPE "A"

PHASE III

PLATE: 4

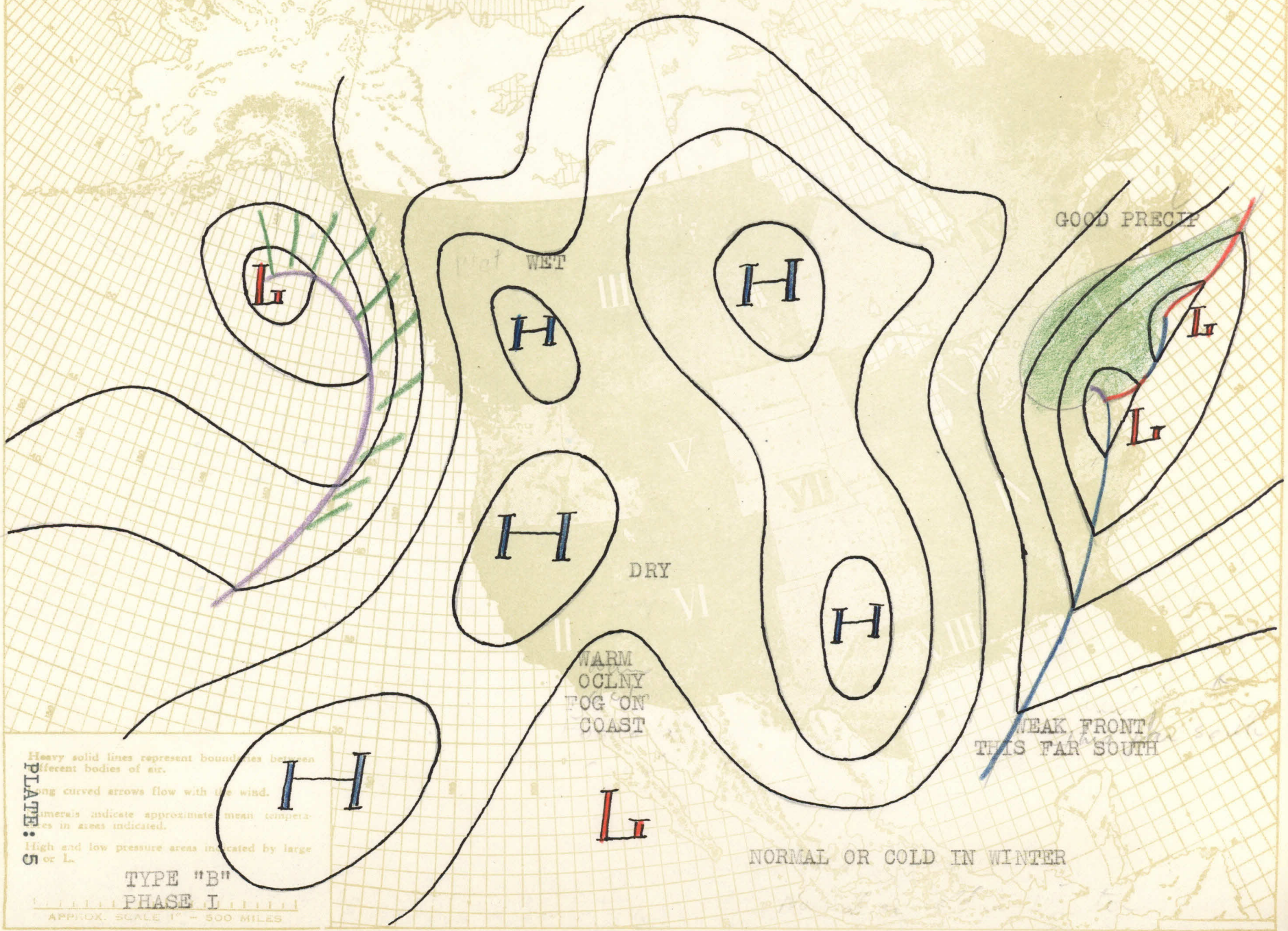

L
H
H
H
H
H
WET
DRY
GOOD PRECIP
L
L
WARM
OCLNY
FOG ON
COAST
WEAK FRONT
THIS FAR SOUTH
L
NORMAL OR COLD IN WINTER
Heavy solid lines represent boundaries between different bodies of air.
Long curved arrows flow with the wind.
Numerals indicate approximate mean temperatures in areas indicated.
High and low pressure areas indicated by large H or L.
TYPE "B"
PHASE I
APPROX. SCALE 1" = 500 MILES

PLATE: 5

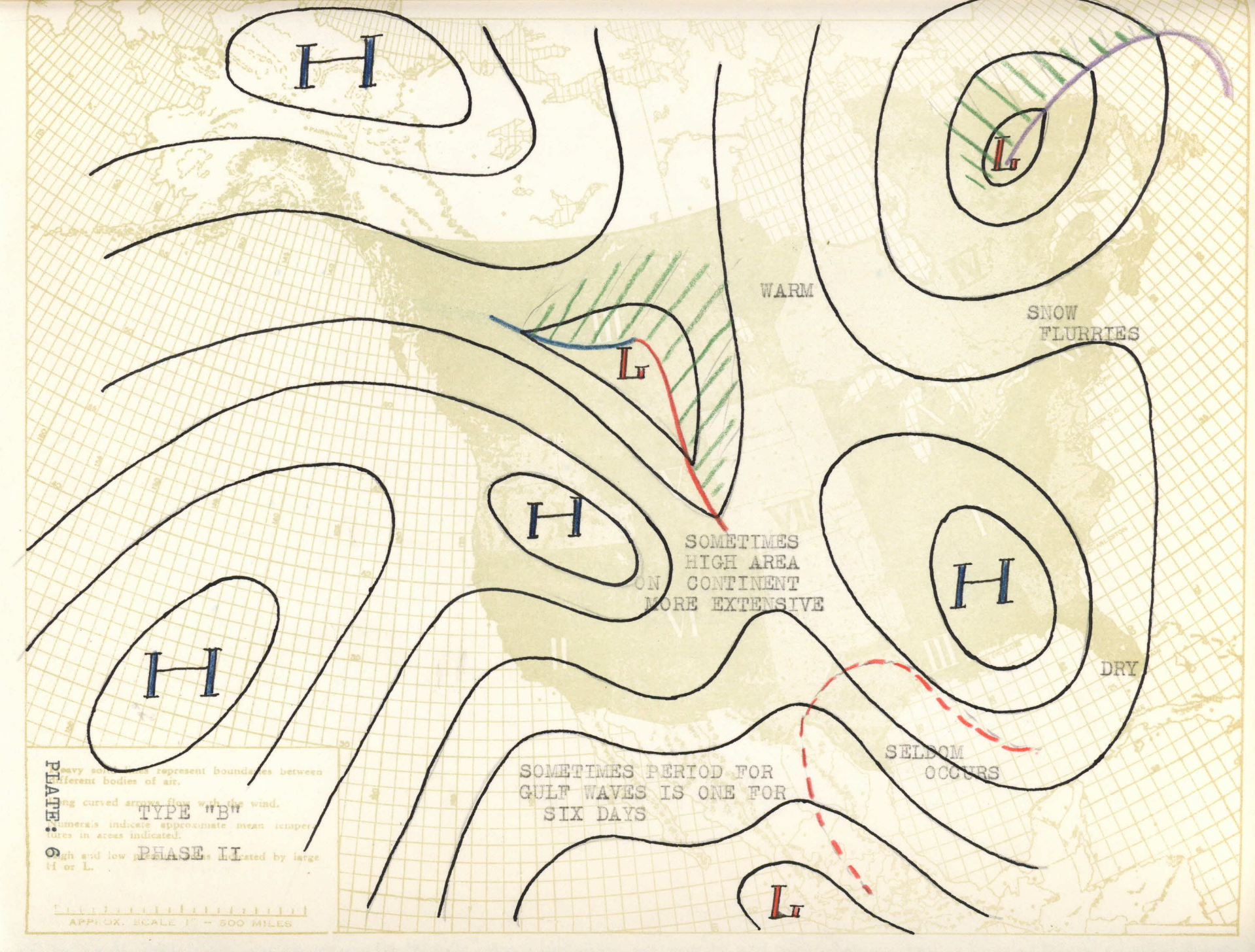


PLATE: 6

TYPE "B"

PHASE II

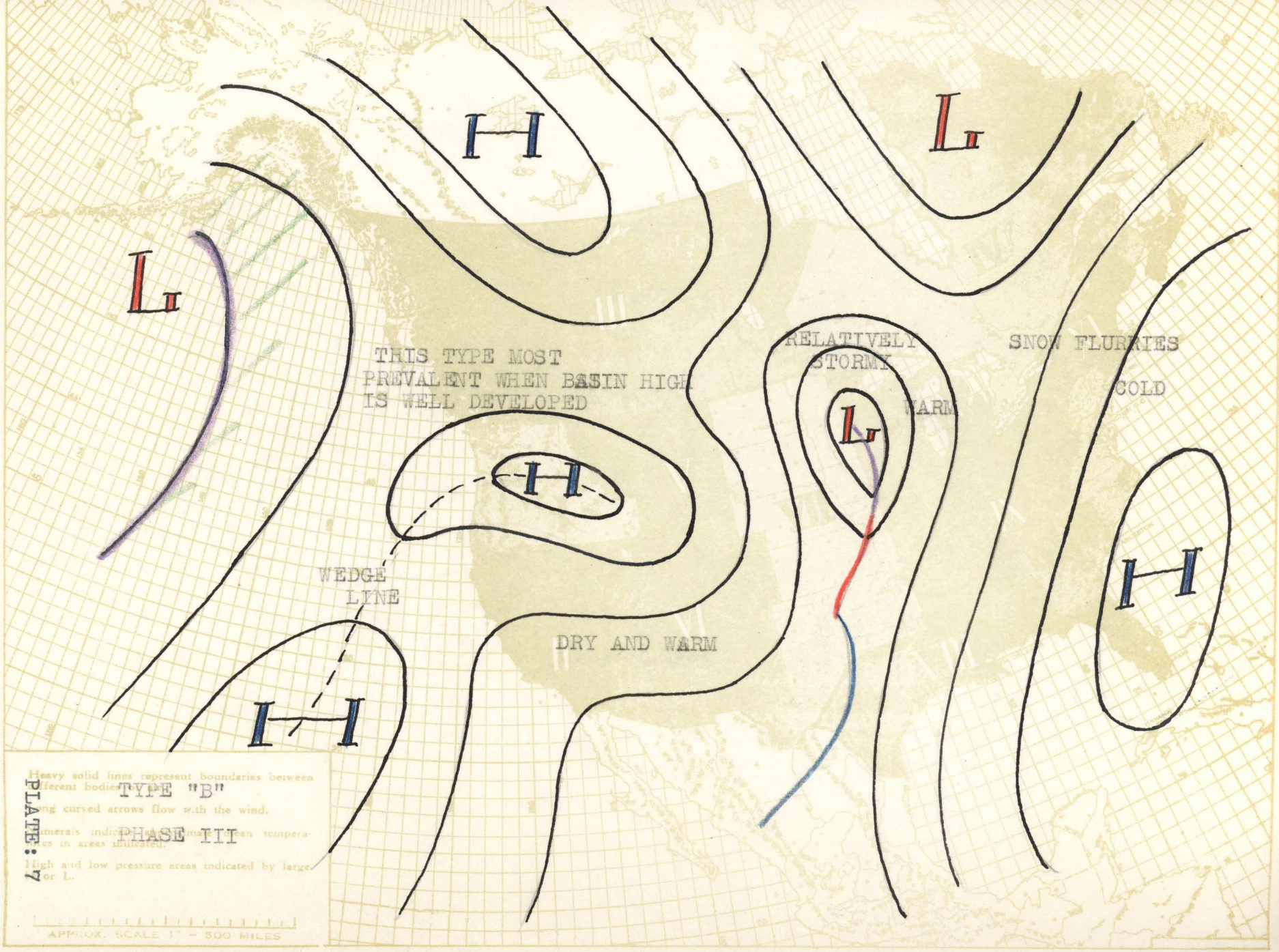
heavy solid lines represent boundaries between different bodies of air.

ing curved arrows flow with the wind.

mbers indicate approximate mean temperatures in areas indicated.

gh and low pressure areas indicated by large H or L.

APPROX. SCALE 1" = 500 MILES



TYPE "B"

PHASE III

PLATE: 7

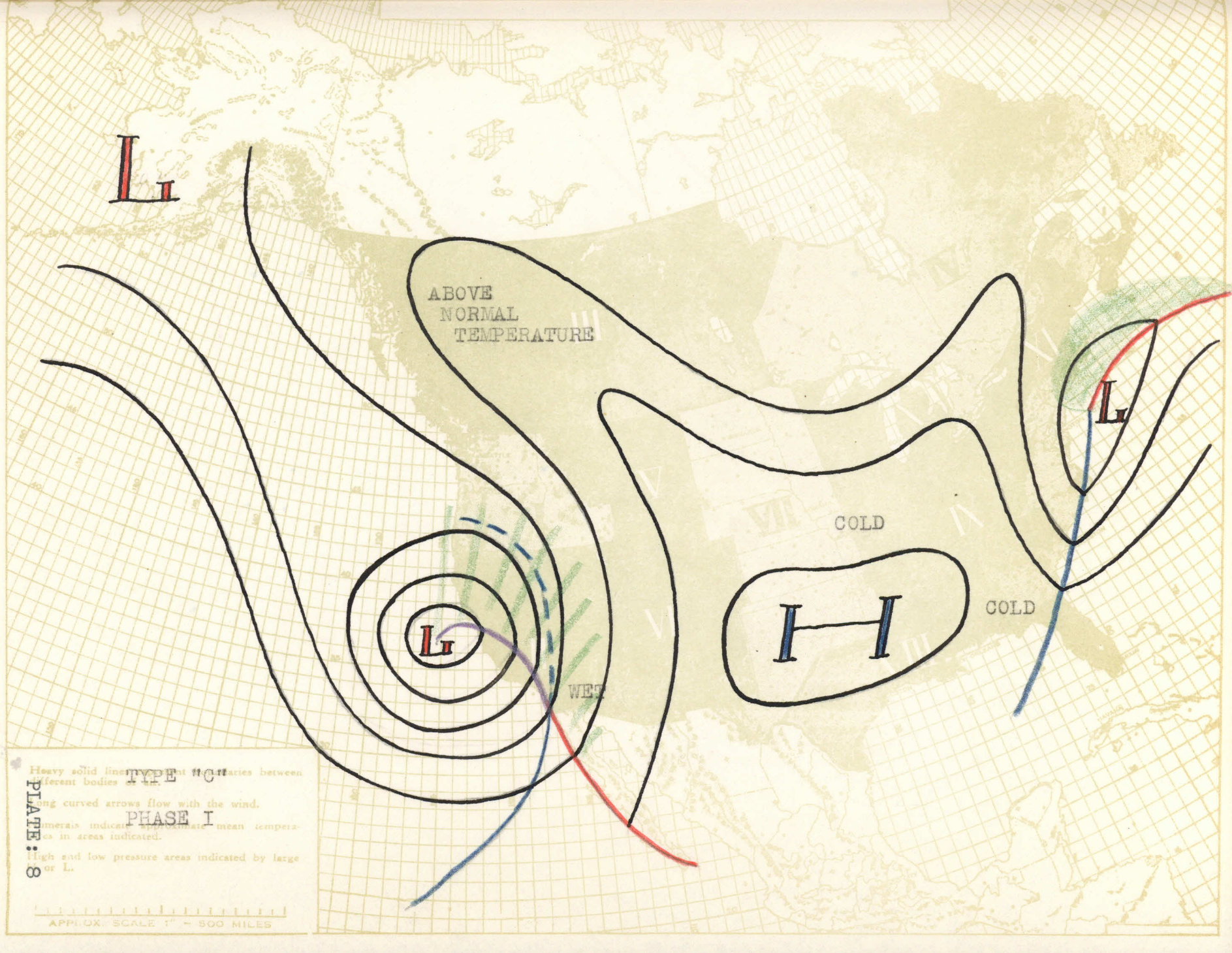


PLATE: 8

TYPE "C"

PHASE I

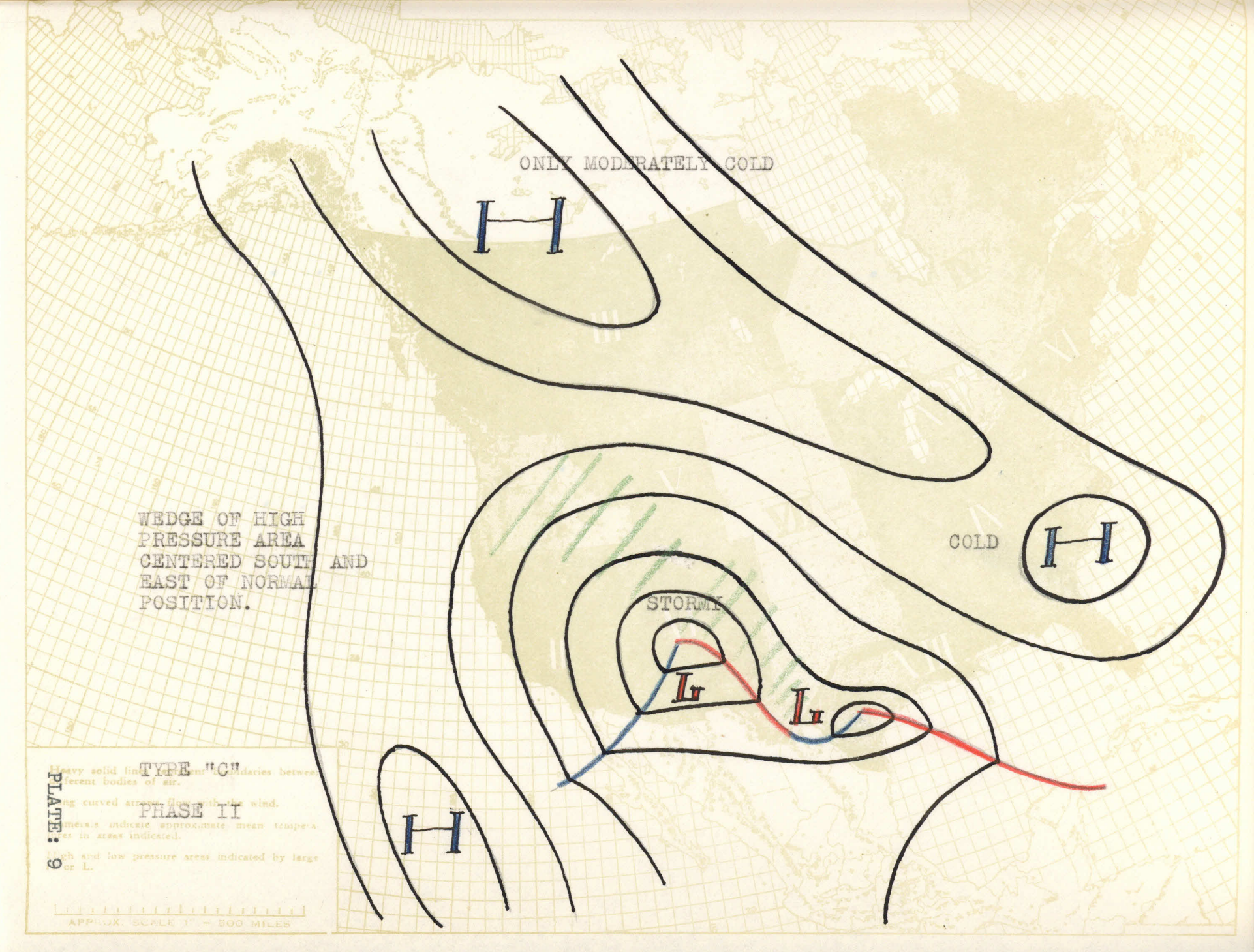
Heavy solid lines represent boundaries between different bodies

Long curved arrows flow with the wind.

Numerals indicate average mean temperatures in areas indicated.

High and low pressure areas indicated by large H or L.

APPROX. SCALE 1" = 500 MILES


ONLY MODERATELY COLD
H
WEDGE OF HIGH PRESSURE AREA CENTERED SOUTH AND EAST OF NORMAL POSITION.
COLD
H
STORM
L
L
H
TYPE "C"
PHASE II
PLATE: 9
Heavy solid lines represent boundaries between different bodies of air.
Long curved arrows show path of the wind.
Numerals indicate approximate mean temperatures in areas indicated.
High and low pressure areas indicated by large H or L.
APPROX. SCALE 1" = 500 MILES

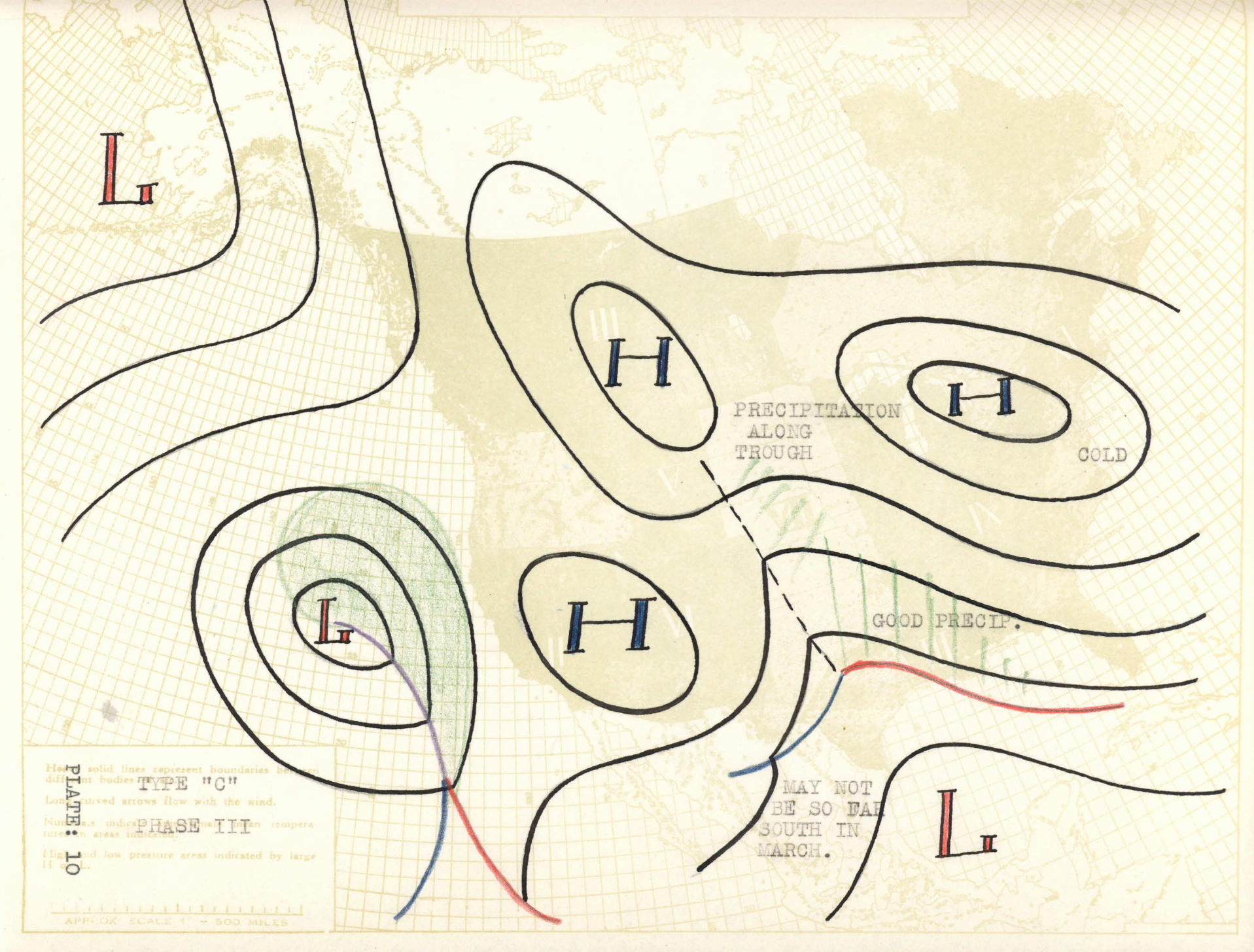
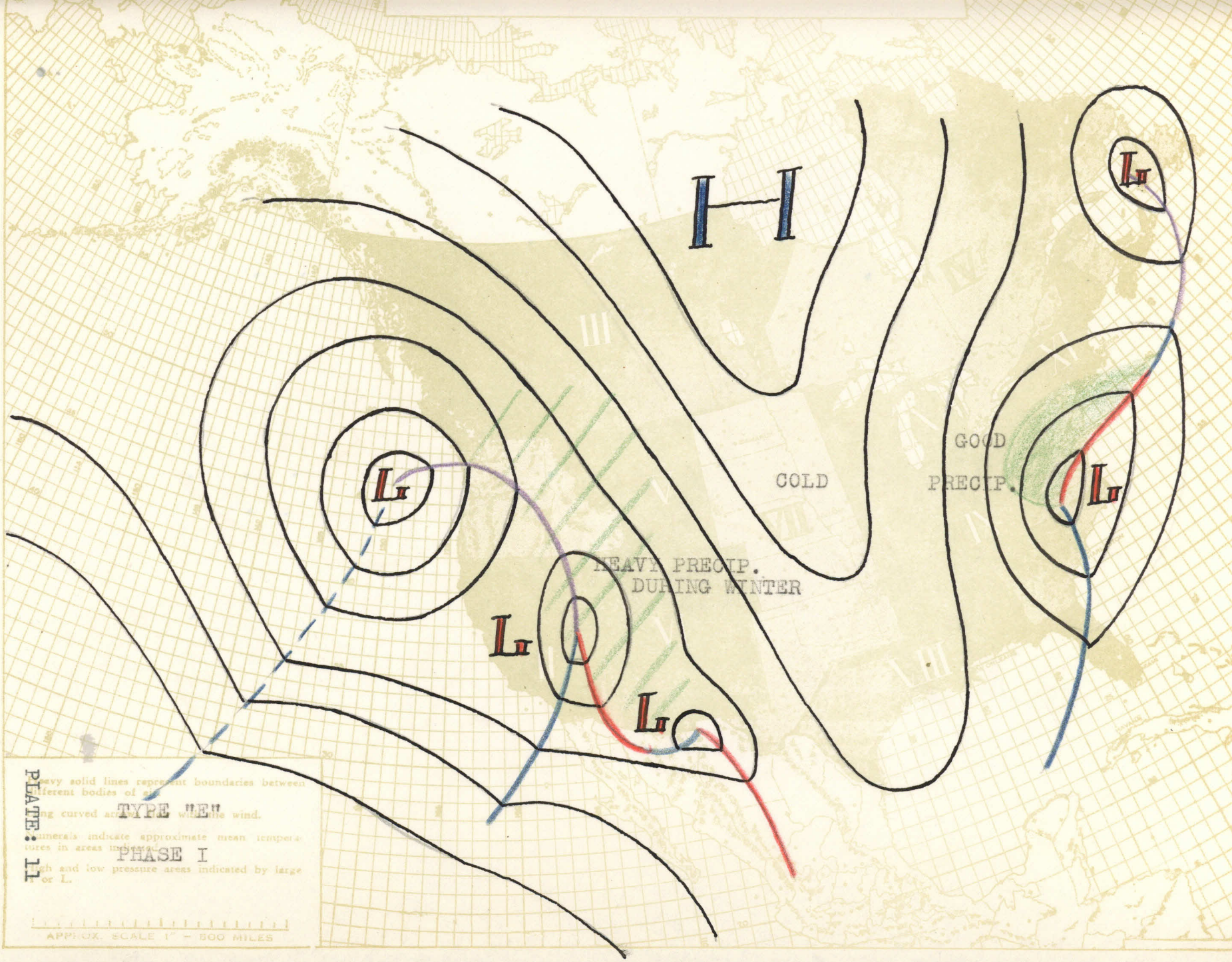

L
H
H
PRECIPITATION
ALONG
TROUGH
COLD
L
H
GOOD PRECIP.
MAY NOT
BE SO FAR
SOUTH IN
MARCH.
L
TYPE "C"
PHASE III
APPROX SCALE 1" = 500 MILES

PLATE: 10


H
L
L
L
L
COLD
GOOD
PRECIP.
HEAVY PRECIP.
DURING WINTER
PLATE 11
TYPE "E"
PHASE I
APPROX. SCALE 1" = 500 MILES


POLAR OUTBREAK
BEGINS SOMETIMES
PRECIPITATION
BEGINS
WEDGE
CLEARING
S. CALIFORNIA
TYPE "E"
PHASE II
Plate: 12
APPROX. SCALE 1" = 500 MILES


H
H
H
H
L
L
L
MODERATE OR
HEAVY PRECIP.
NEVER A
BIG BASIN
HIGH
HEAVY PRECIP.
AND
THUNDERSTORMS
TYPE "E"
PHASE III
PLATE: 13
APPROX. SCALE 1" = 600 MILES

LISTING OF ALL TYPES FOR THE YEAR 1939

TYPE "A"

Date Started	Date Ended	Days Persisted	Days since Last occured	Went Into
Feb. 2	Feb. 9	8	?	E

TYPE "B"

Jan. 8	Jan. 19	12	?	BC
Jan. 21	Jan. 23	3	1	E
Feb. 15	Feb. 17	3	22	BE-BC
Feb. 20	Mar. 4	13	2	BE-E
Mar. 14	Mar. 22	9	9	E
Mar. 28	Apr. 1	5	5	E
Apr. 5	Apr. 10	6	3	E
Apr. 14	Apr. 16	3	3	E
May 11	May 13	3	24	E
May 23	June 13	22	9	E
June 18	June 26	9	4	E
June 30	July 2	3	3	E
July 9	July 12	4	6	E
July 19	Aug. 10	23	6	E
Aug. 14	Aug. 23	10	3	E
Sept 2	Sept 23	22	9	BC
Oct. 1	Oct. 4	3	7	E
Oct. 8	Oct. 15	8	3	E
Oct. 19	Oct. 23	5	3	E
Oct. 27	Nov. 6	11	3	E
Dec. 20	Dec. 21	2	43	BC

TYPE "BC"

Jan. 20	Jan. 20	1	?	B
Feb. 19	Feb. 19	1	29	B
May 4	May 8	5	74	B
Sept 24	Sept 30	7	138	B
Dec. 22	Dec. 24	3	82	E

PLATE: 14

LISTING OF ALL TYPES FOR THE YEAR 1939

TYPE "E"

Date Started	Date Ended	Days Persisted	Days since Last occured	Went Into
Jan. 1	Jan. 7	7	?	B
Jan. 24	Feb. 1	9	16	A
Feb. 10	Feb. 11	2	8	EB
Mar. 7	Mar. 13	7	23	B
Mar. 23	Mar. 26	4	9	EB
Apr. 2	Apr. 4	3	6	B
Apr. 11	Apr. 13	3	6	B
Apr. 17	May 3	17	3	BC
May 14	May 22	9	10	B
June 14	June 17	4	22	B
June 27	June 29	3	9	B
July 3	July 8	6	3	B
July 13	July 18	6	4	B
Aug. 11	Aug. 13	3	23	B
Aug. 24	Sept 1	9	10	B
Oct. 5	Oct. 7	3	33	B
Oct. 16	Oct. 18	3	8	B
Oct. 24	Oct. 26	3	5	B
Nov. 7	Dec. 19	43	11	BC
Dec. 25	Dec. 31	7	5	?

TYPE "BE"

Feb. 12	Feb. 14	3	?	B
Feb. 18	Feb. 18	1	3	BC
Mar. 5	Mar. 6	2	14	E
Mar. 27	Mar. 27	1	20	B

TYPE "EC"

May 9	May 10	2	?	B

PLATE: 15

TYPE PERCENTAGES FOR 1939

Type "A"	8 days	2.18%
Type "B"	180 days	49.40
Type "BC"	17 days	4.65
Type "E"	151 days	41.40
Type "BE"	7 days	1.90
Type "EC"	2 days	0.52

SEASONAL PERCENTAGES

WINTER: (Dec. 21 to Mar. 21)

Type "A"	8 days	8.90%
Type "B"	39 days	43.30
Type "BC"	5 days	5.55
Type "E"	32 days	35.60
Type "BE"	6 days	6.65
Type "EC"	0 days	0.00

SPRING: (Mar. 21 to June 21)

Type "A"	0 days	0.00%
Type "B"	44 days	47.80
Type "BC"	5 days	5.42
Type "E"	39 days	42.41
Type "BE"	1 day	1.09
Type "EC"	3 days	3.27

SUMMER: (June 21 to Sept 21)

Type "A"	0 days	0.00%
Type "B"	65 days	70.70
Type "BC"	0 days	0.00
Type "E"	27 days	29.30
Type "BE"	0 days	0.00
Type "EC"	0 days	0.00

AUTUMN: (Sept 21 to Dec. 21)

Type "A"	0 days	0.00%
Type "B"	32 days	35.10
Type "BC"	7 days	7.70
Type "E"	52 days	57.20
Type "BE"	0 days	0.00
Type "EC"	0 days	0.00

PLATE: 16

"B" TYPES FOR THE YEARS 1938 AND 1940

1940

Date Started	Date Ended	Days Persisted	Days since Last occured	Went Into
Jan. 14	Jan. 17	4	?	E
Mar. 1	Mar. 7	7	43	EC
Apr. 18	Apr. 18	11	31	C
Apr. 30	May 1	2	11	E
May 5	May 28	24	3	E
June 4	June 11	8	6	E
June 14	Aug. 30	77	2	E
Sept 19	Sept 22	4	19	E
Nov. 27	Dec. 8	12	65	BC-C

1938

Jan. 3	Jan. 12	10	?	E
Jan. 20	Jan. 27	8	7	E
Feb. 21	Feb. 27	7	25	E
Mar. 24	Apr. 2	10	6	E
Apr. 6	Apr. 14	9	3	E
Apr. 20	Apr. 22	3	5	E
May 1	May 18	18	8	E
May 31	Aug. 23	24	12	E
Sept 9	Sept 16	8	16	E
Sept 24	Sept 30	7	7	E
Oct. 3	Oct. 8	6	2	E
Oct. 12	Oct. 28	17	3	E
Nov. 2	Nov. 27	26	4	E
Dec. 5	Dec. 11	7	7	E
Dec. 22	Dec. 27	7	10	E

PLATE: 17

1938, 1939, 1940 "B" TYPE SEASONAL PERCENTAGES

WINTER: (Dec. 21 to Mar. 21)

1938	32 days	35.55%
1939	39 days	43.30
1940	11 days	12.20

SPRING: (Mar. 21 to June 21)

1938	61 days	66.41%
1939	44 days	47.80
1940	53 days	58.69

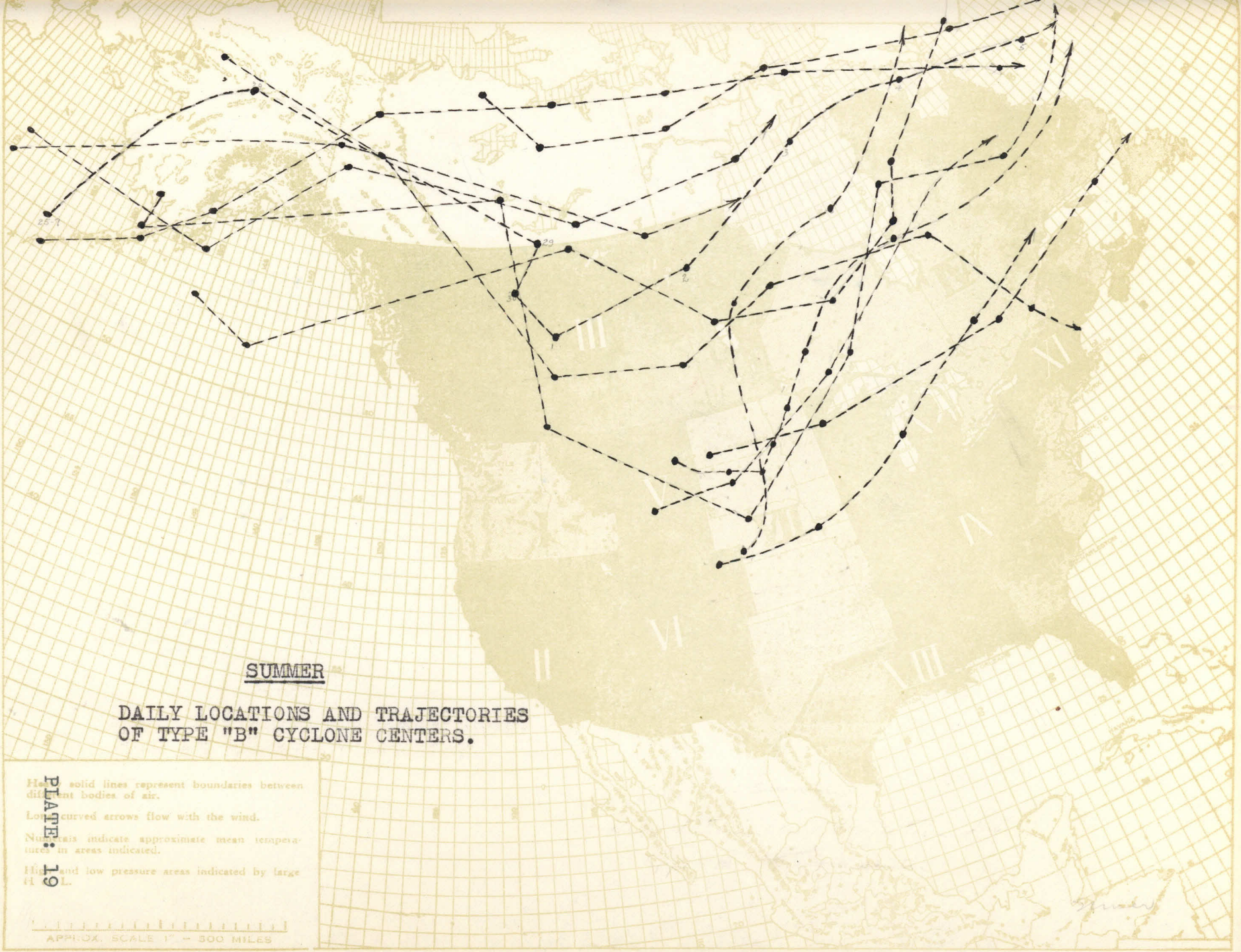
SUMMER: (June 21 to Sept 21)

1938	71 days	78.02%
1939	65 days	70.70
1940	73 days	80.22

AUTUMN: (Sept 21 to Dec. 21)

1938	17 days	15.60%
1939	32 days	35.10
1940	83 days	91.21

PLATE: 18



SUMMER

DAILY LOCATIONS AND TRAJECTORIES
OF TYPE "B" CYCLONE CENTERS.

Heavy solid lines represent boundaries between different bodies of air.

Long curved arrows flow with the wind.

Numerals indicate approximate mean temperatures in areas indicated.

High and low pressure areas indicated by large H and L.

APPROX. SCALE 1" = 300 MILES

PLATE 19

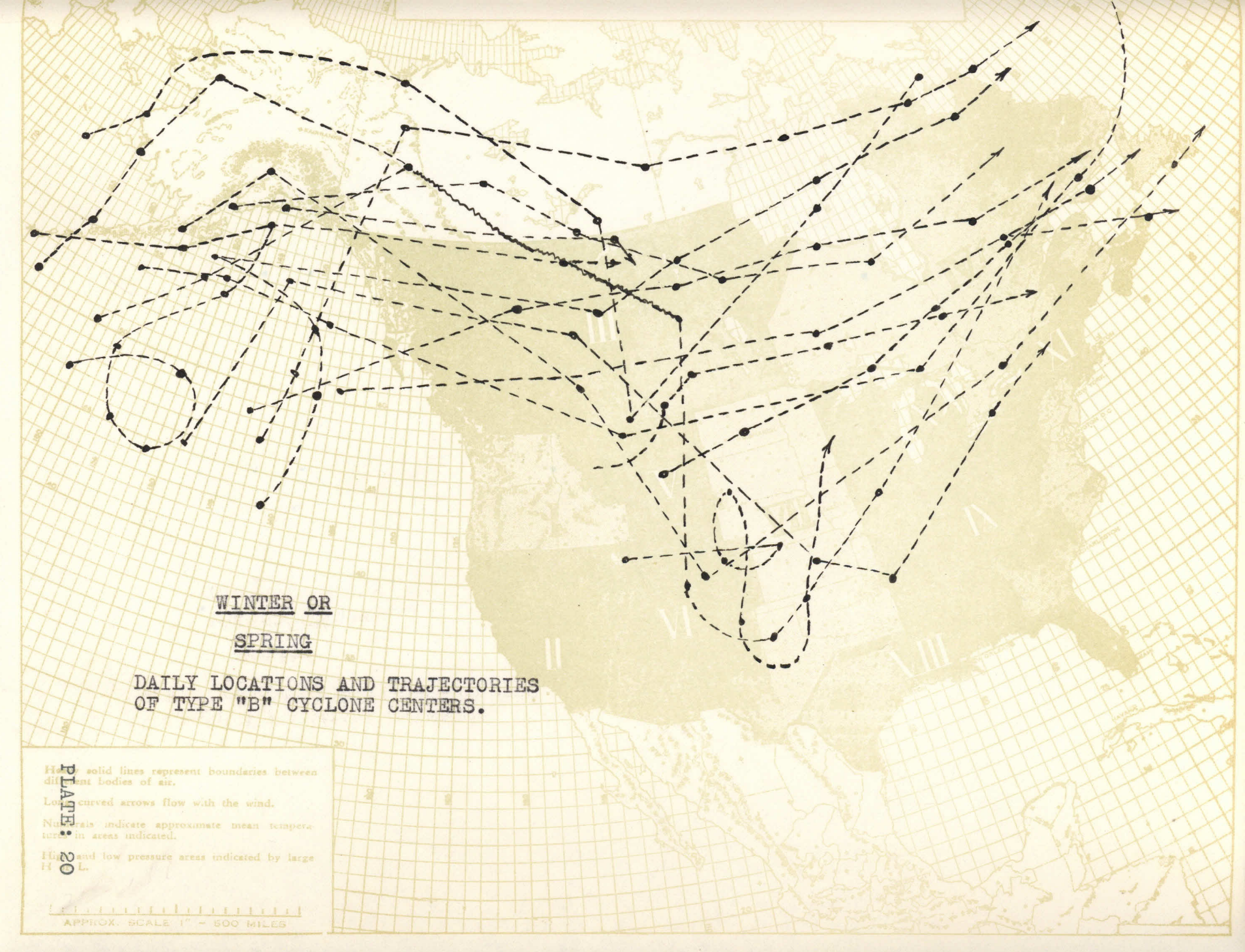
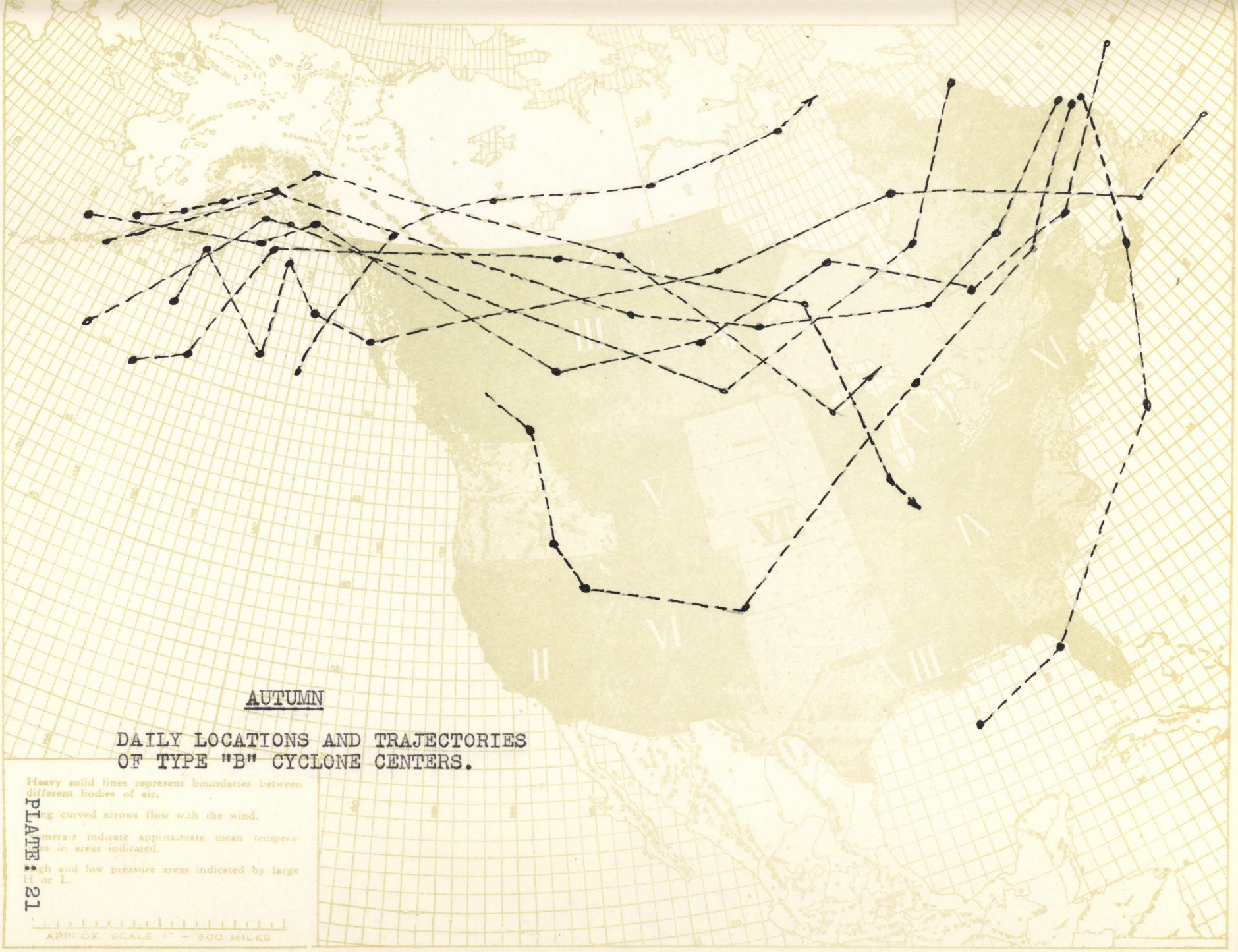

WINTER OR
SPRING
DAILY LOCATIONS AND TRAJECTORIES
OF TYPE "B" CYCLONE CENTERS.
Heavy solid lines represent boundaries between different bodies of air.
Long curved arrows flow with the wind.
Numerals indicate approximate mean temperature in areas indicated.
High and low pressure areas indicated by large H and L.
APPROX. SCALE 1" = 500 MILES

PLATE 20



AUTUMN

DAILY LOCATIONS AND TRAJECTORIES
OF TYPE "B" CYCLONE CENTERS.

Heavy solid lines represent boundaries between different bodies of air.

...g curved arrows flow with the wind.

...therms indicate approximate mean tempera-...es in areas indicated.

...gh and low pressure areas indicated by large H or L.

APPROX. SCALE 1" = 500 MILES

PLATE: 21

PLATE: 22

SUMMER "B" TYPE

PHASE I

APPROX. SCALE 1" = 500 MILES

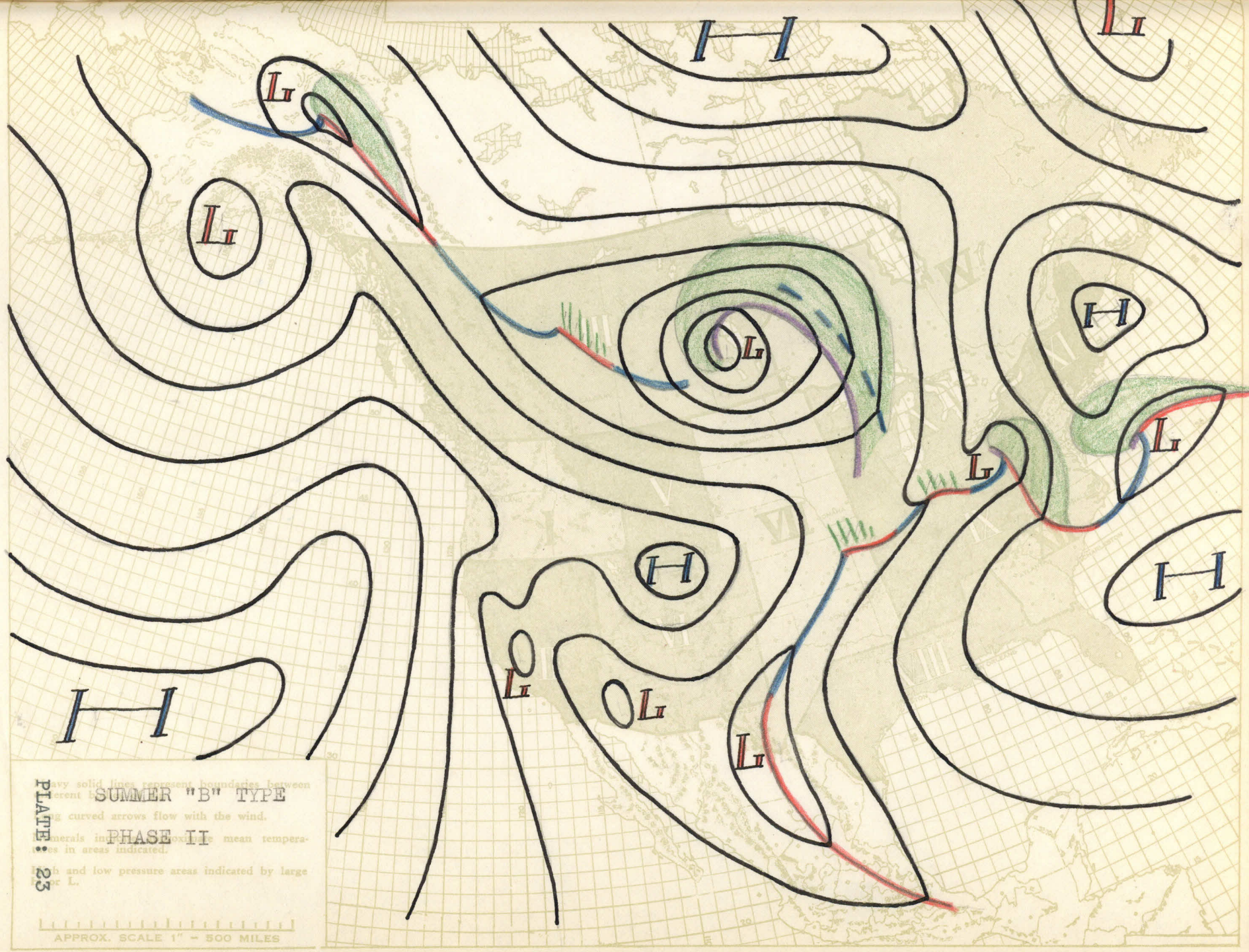


PLATE: 23

SUMMER "B" TYPE

PHASE II

Heavy solid lines represent boundaries between different [illegible]

Long curved arrows flow with the wind.

Numerals indicate mean temperatures in areas indicated.

High and low pressure areas indicated by large H or L.

APPROX. SCALE 1" = 500 MILES

PLATE: 24

SUMMER "B" TYPE

PHASE III

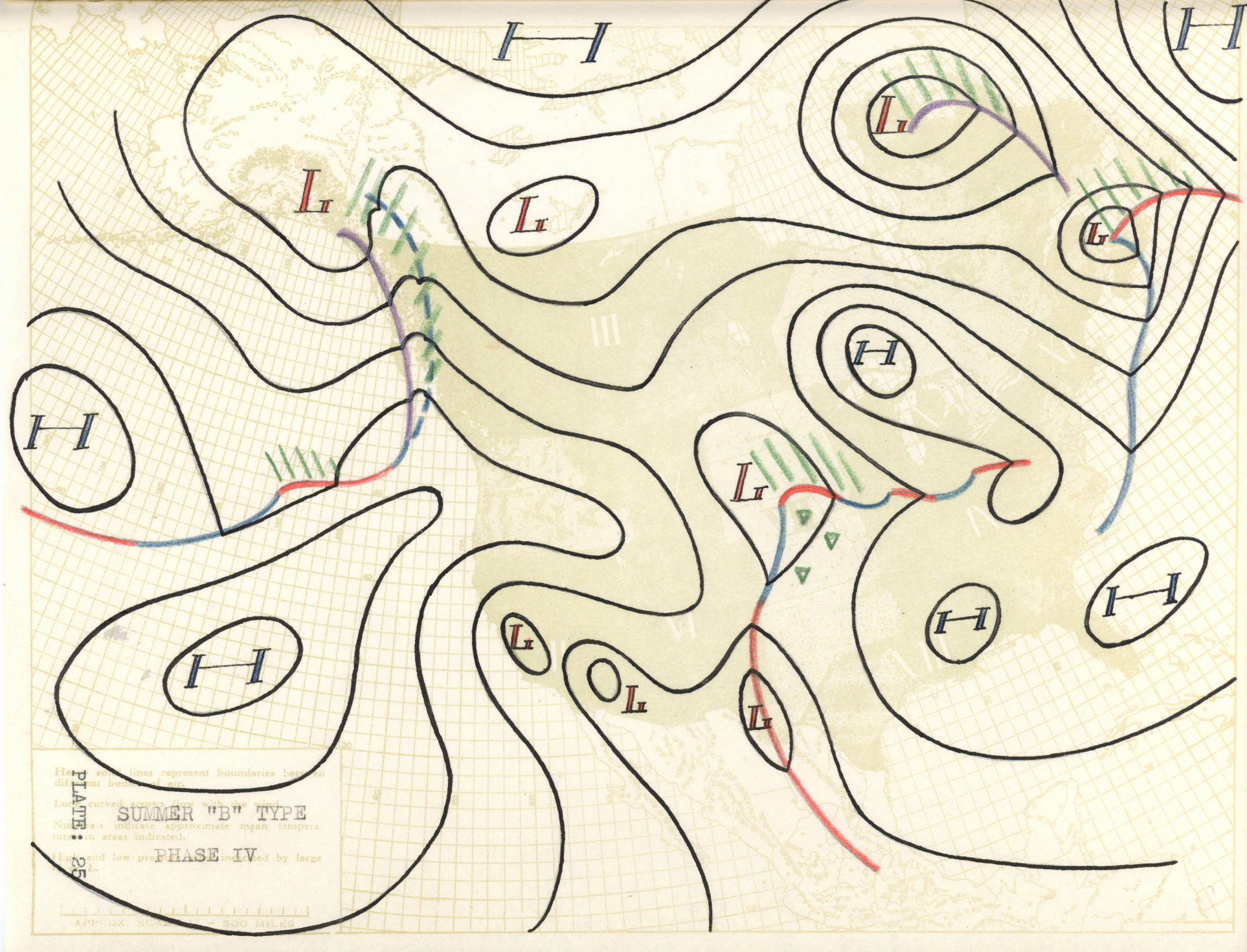


PLATE: 25

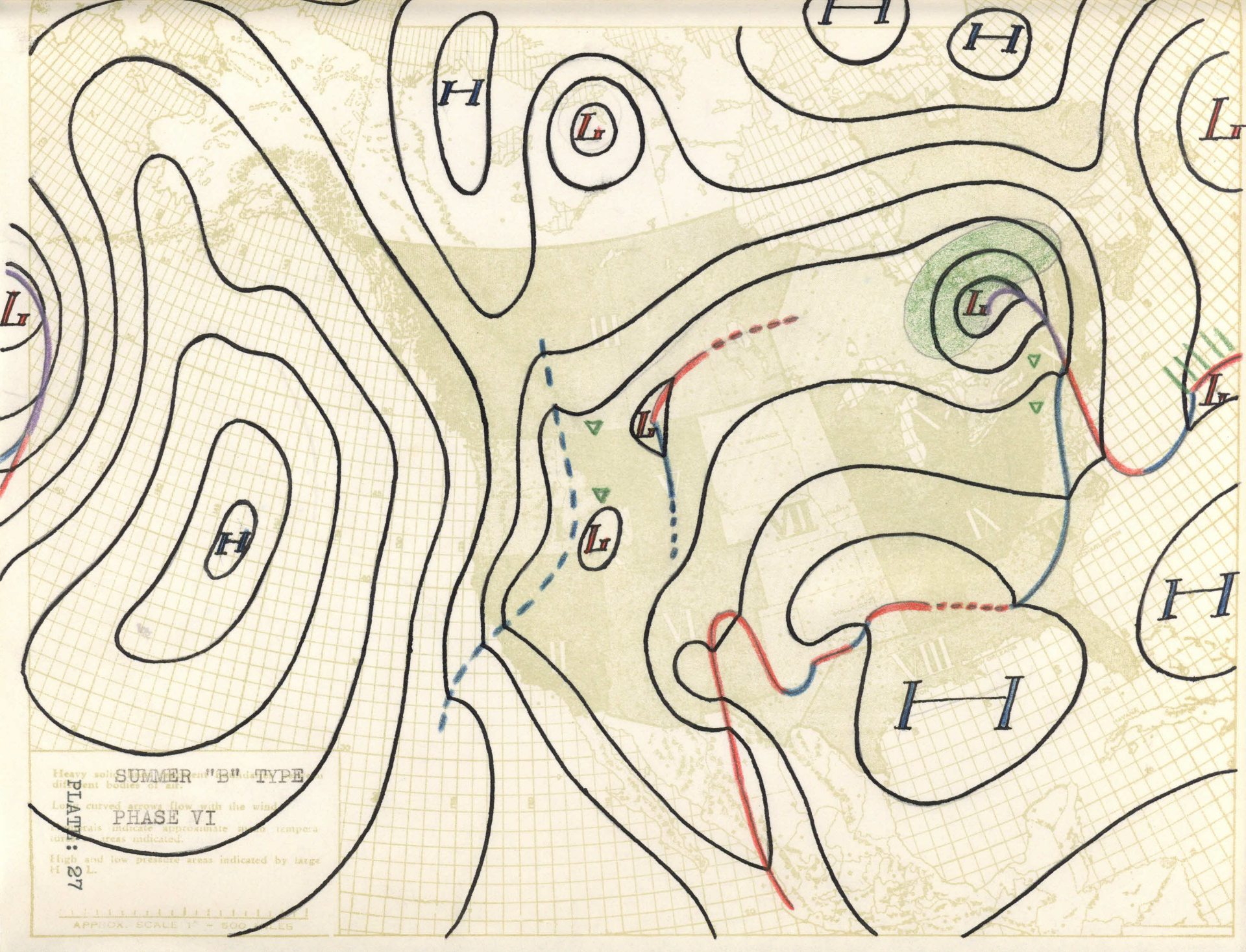
SUMMER "B" TYPE

PHASE IV

PLATE: 26

SUMMER "B" TYPE

PHASE V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SUMMER "B" TYPE
PHASE VI
PLATE: 27


Heavy solid lines represent boundaries between different bodies of air.
Long curved arrows show with the wind.
Numerals
High and low pressure areas indicated by large H and L.
SUMMER "B" TYPE
PHASE VII
APPROX. SCALE 1" = 500

PLATE 28


PLATE 25
SUMMER "B" TYPE
PHASE VIII
APPROX. SCALE 1" = 300 MILES

PLATE: 30

SUMMER "B" TYPE

PHASE IX


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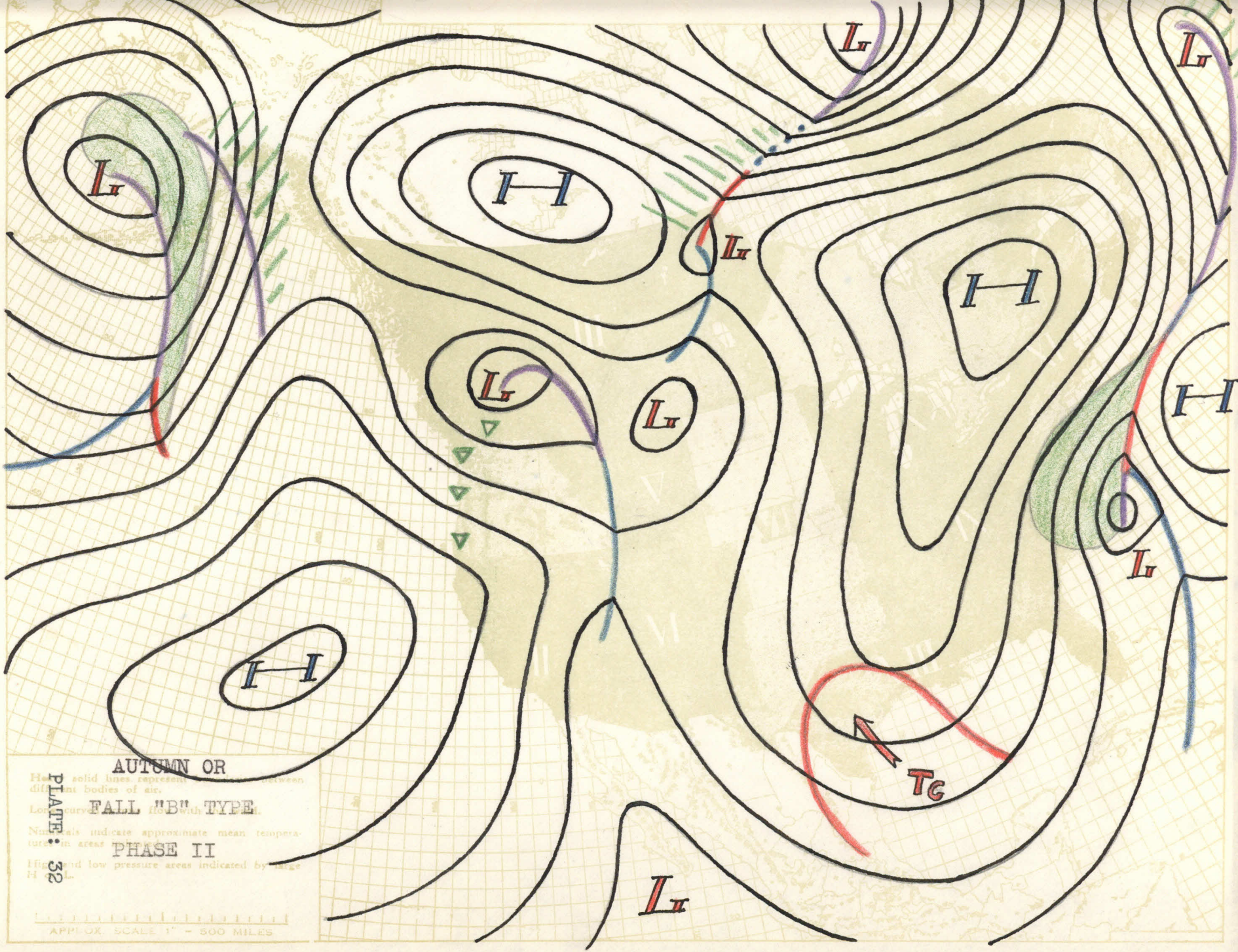
AUTUMN OR
FALL "B" TYPE
PHASE I
PLATE: 31
APPROX. SCALE 1" = 500 MILES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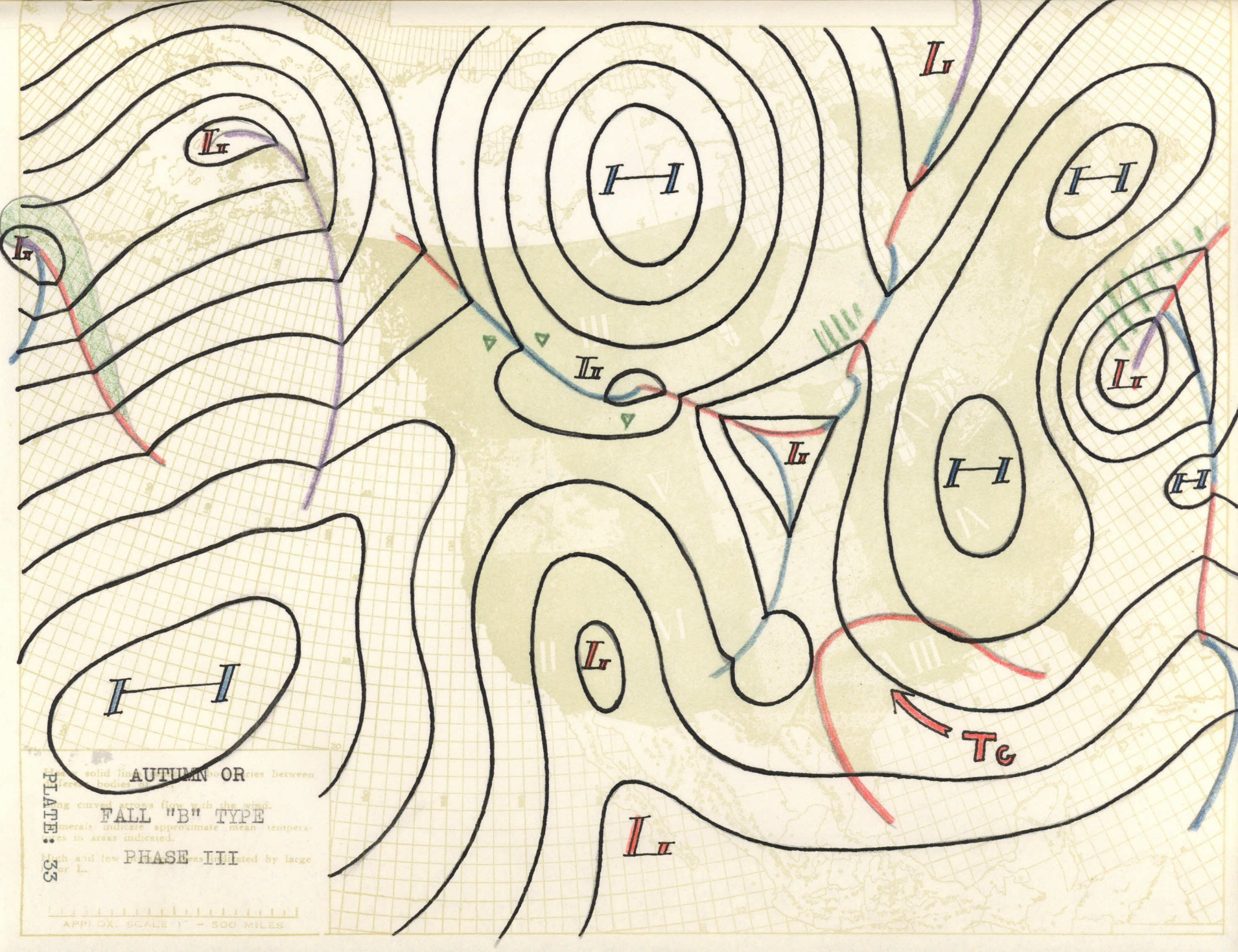
AUTUMN OR
FALL "B" TYPE
PHASE II
PLATE: 32
APPROX. SCALE 1" = 500 MILES



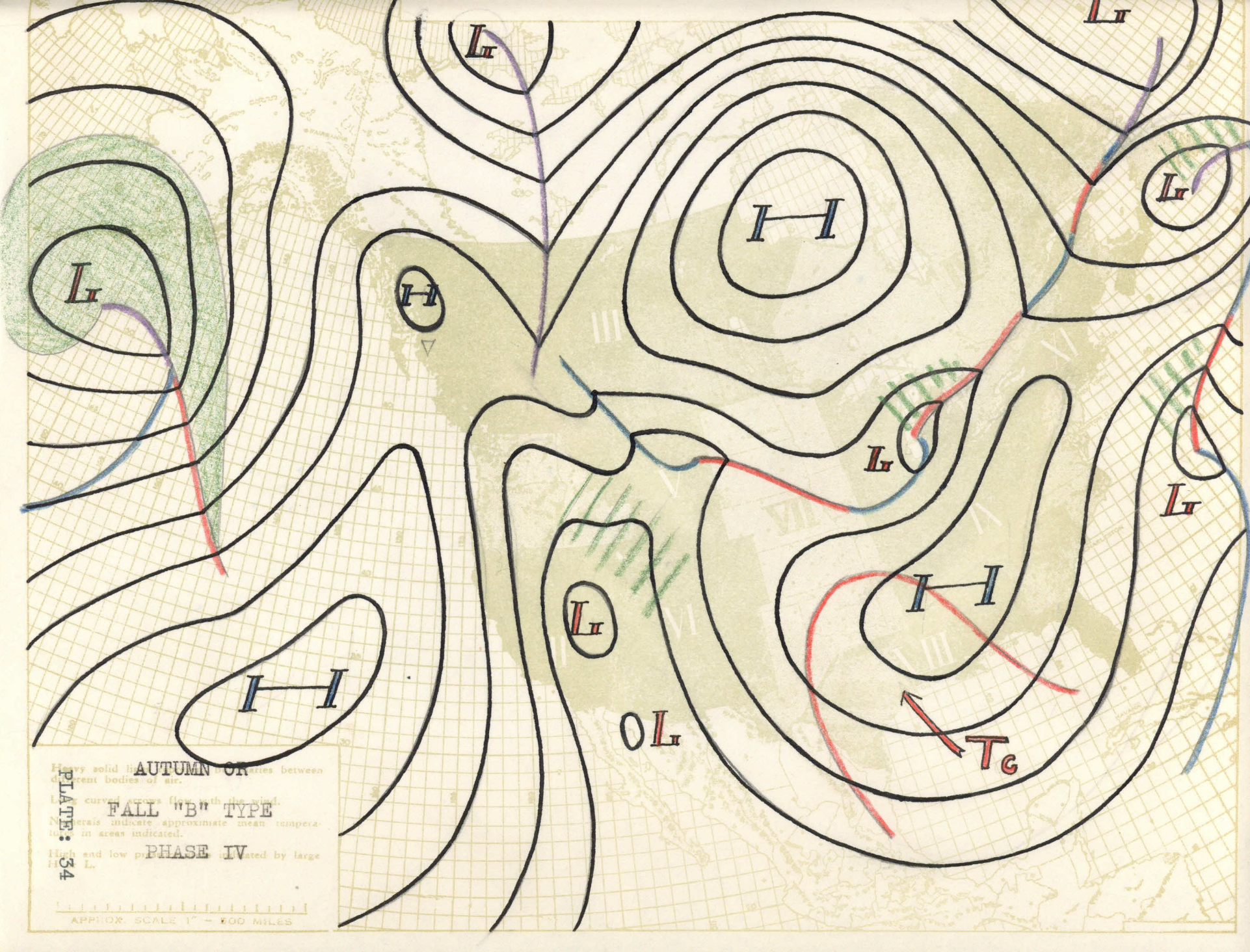
AUTUMN OR

FALL "B" TYPE

PHASE III

PLATE: 33

APPROX. SCALE 1" = 500 MILES



AUTUMN OR

FALL "B" TYPE

PHASE IV

PLATE: 34

Heavy solid lines indicate fronts between different bodies of air.

Light curved arrows flow with the wind.

Numerals indicate approximate mean temperatures in areas indicated.

High and low pressure centers indicated by large H and L.

APPROX. SCALE 1" = 700 MILES

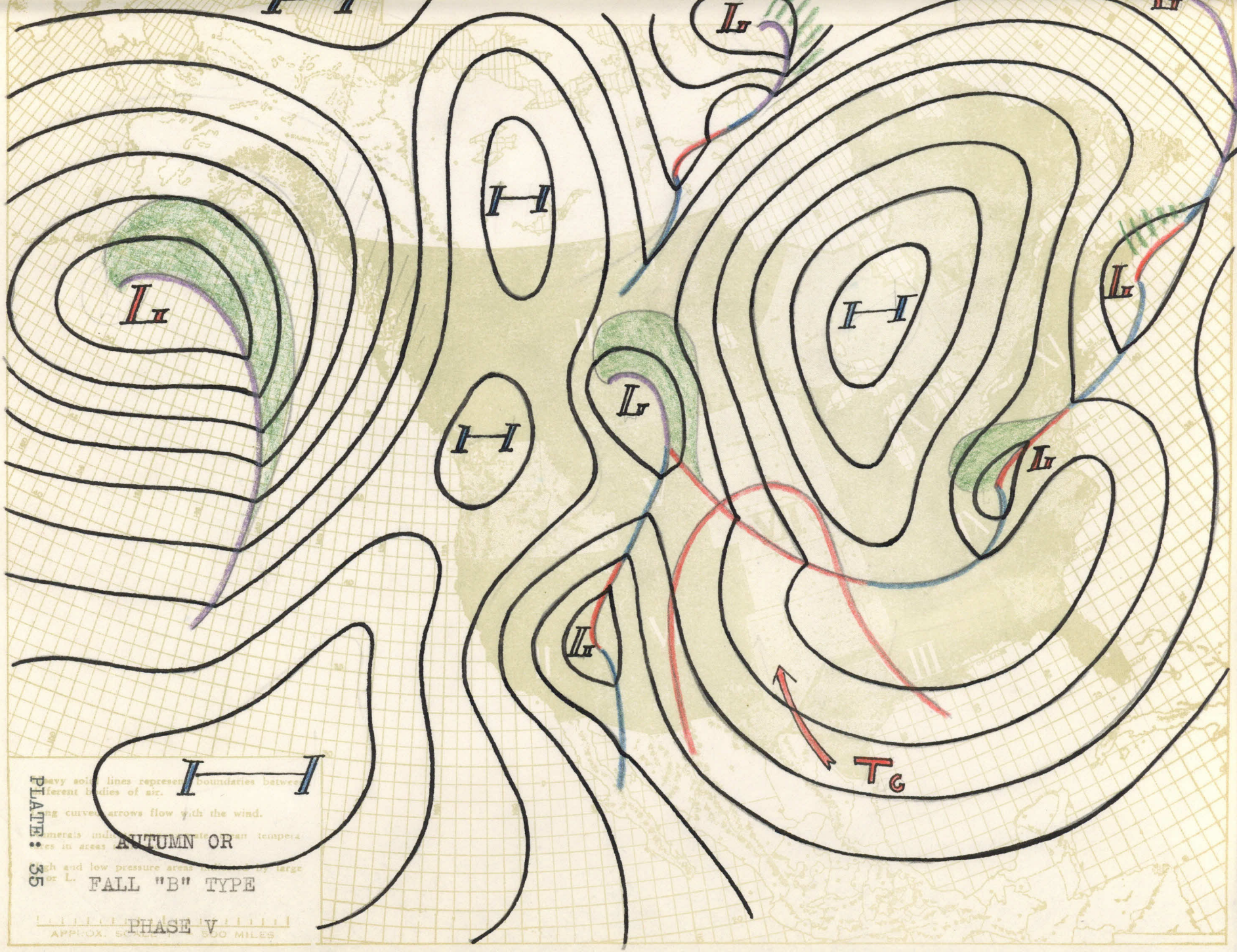


PLATE: 35

AUTUMN OR
FALL "B" TYPE

PHASE V


PLATE: 36
AUTUMN OR
FALL "B" TYPE
PHASE VI
APPROX. SCALE 1" = 500 MILES

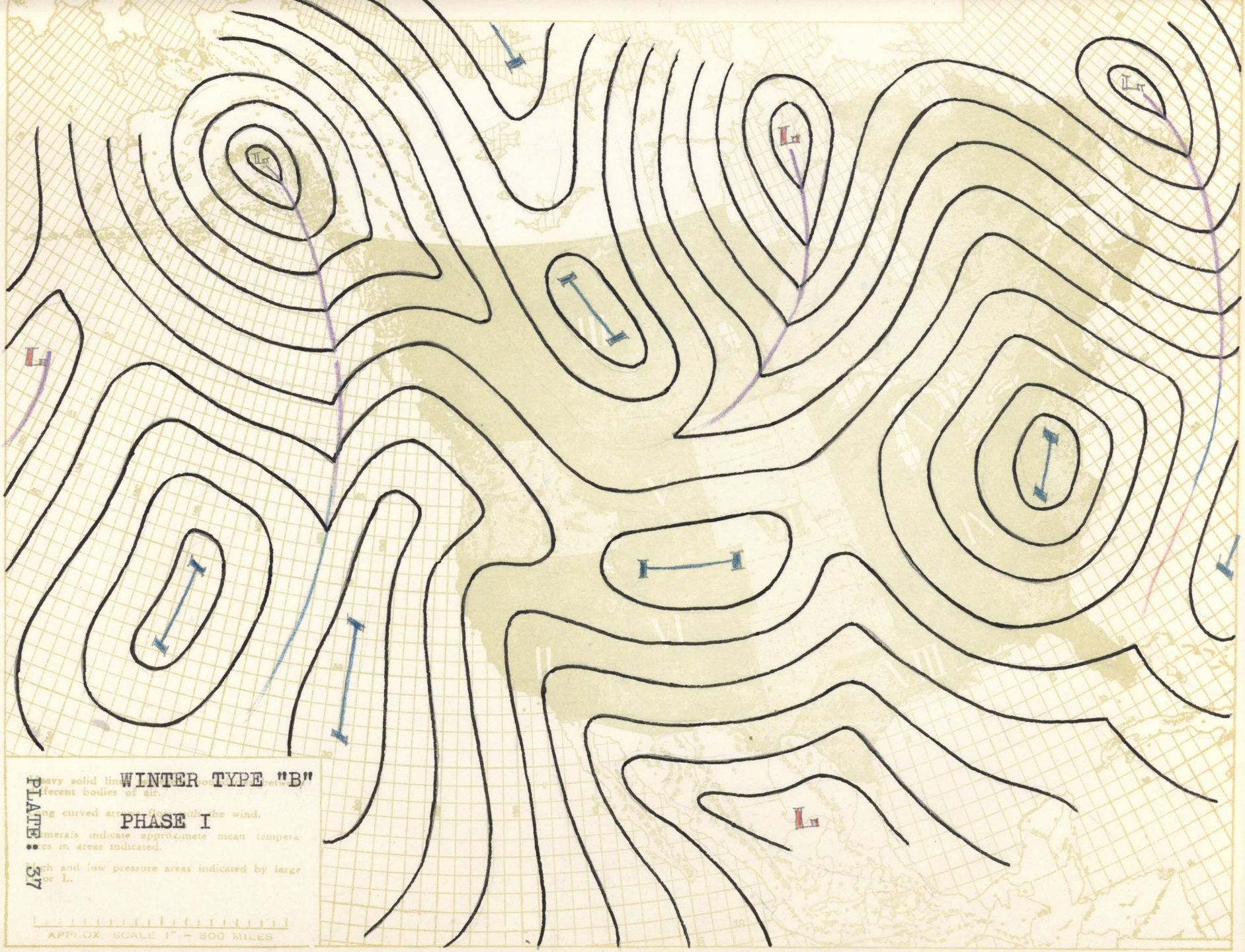


PLATE: 37

WINTER TYPE "B"

PHASE I

Heavy solid lines ... different bodies of air.

Long curved arrows ... the wind.

Numerals indicate approximate mean temperatures in areas indicated.

High and low pressure areas indicated by large H or L.

APPROX. SCALE 1" = 500 MILES

WINTER TYPE "B"

PHASE II

PLATE: 38

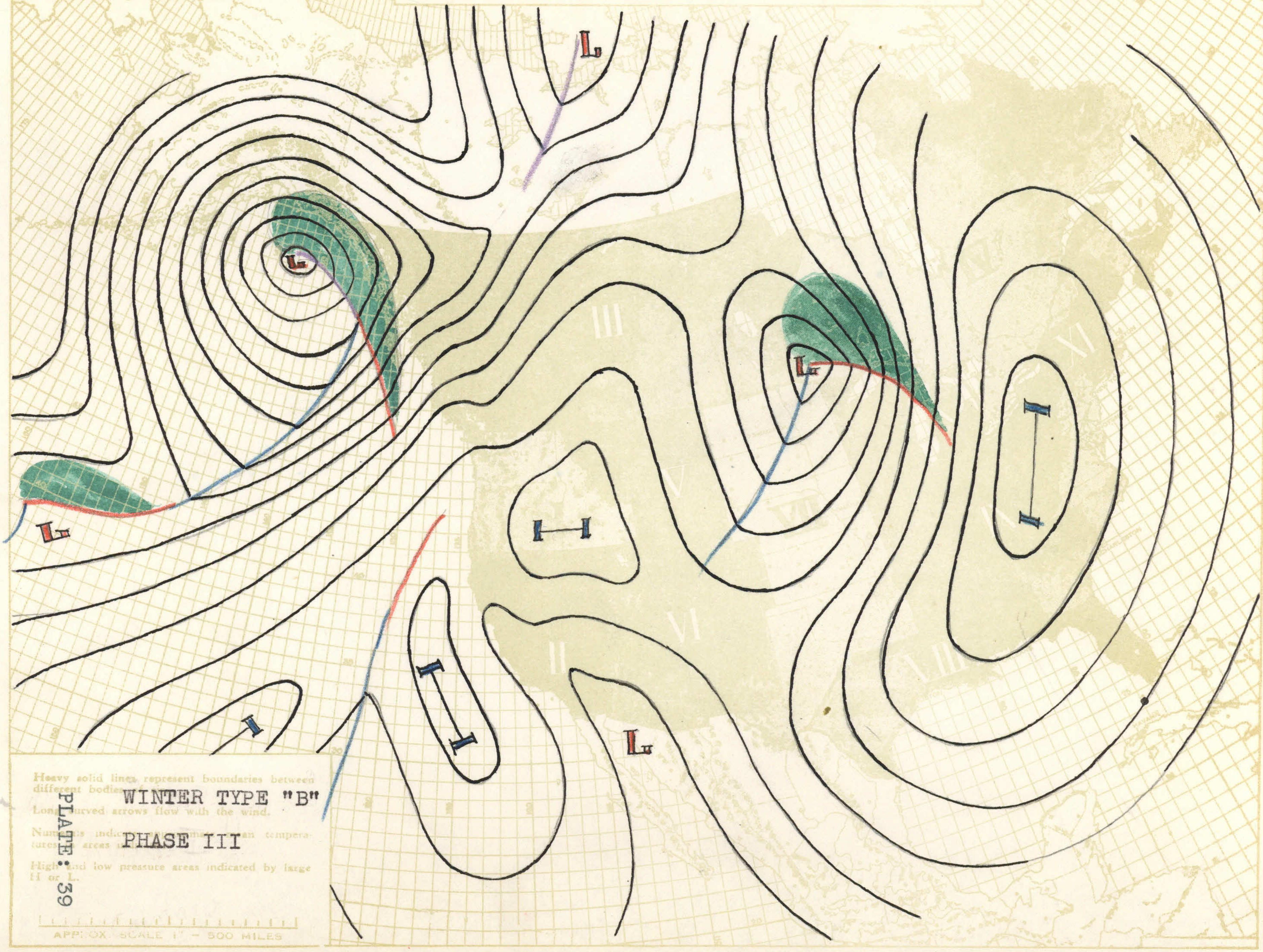


PLATE: 39

WINTER TYPE "B"

PHASE III

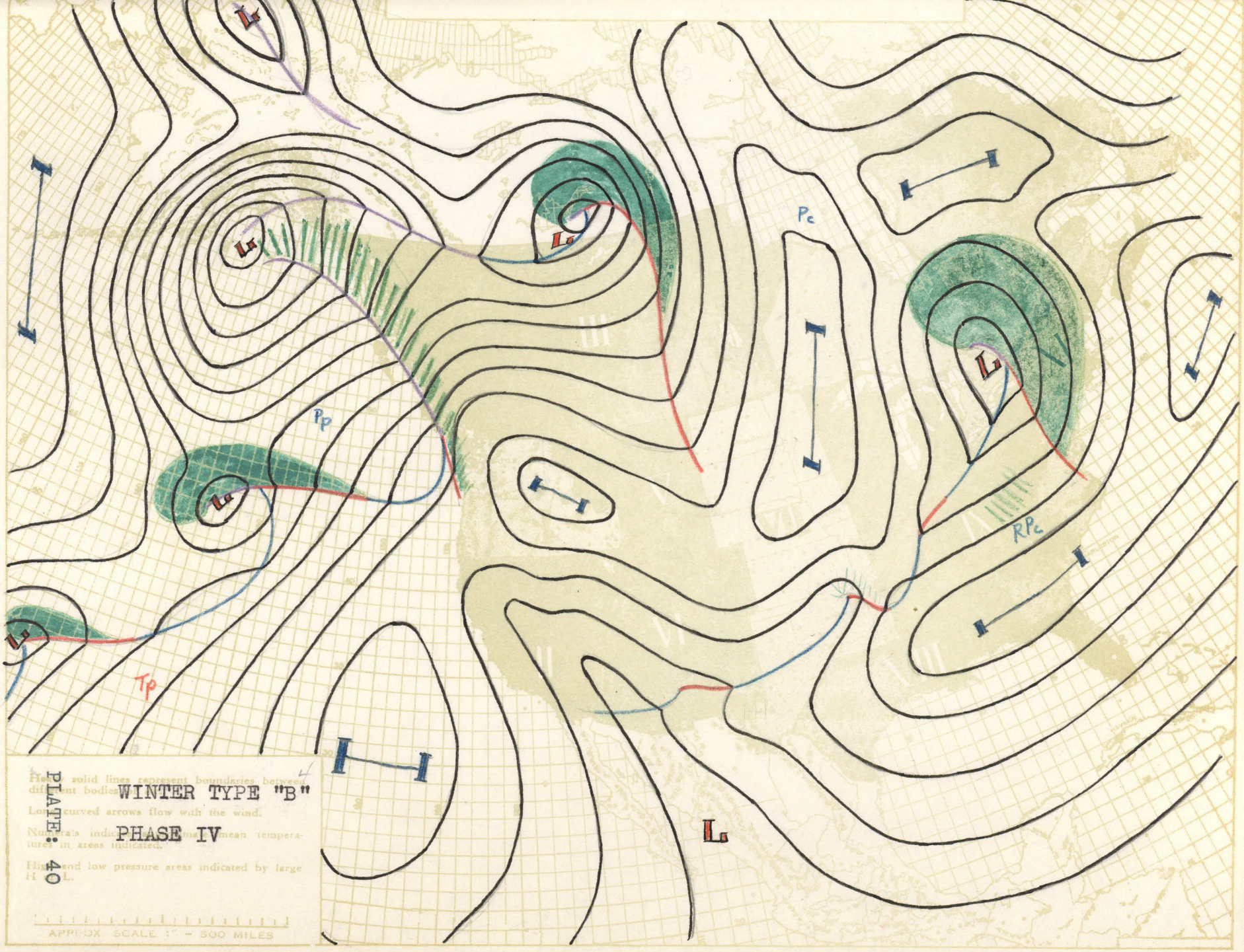


PLATE: 40

WINTER TYPE "B"

PHASE IV

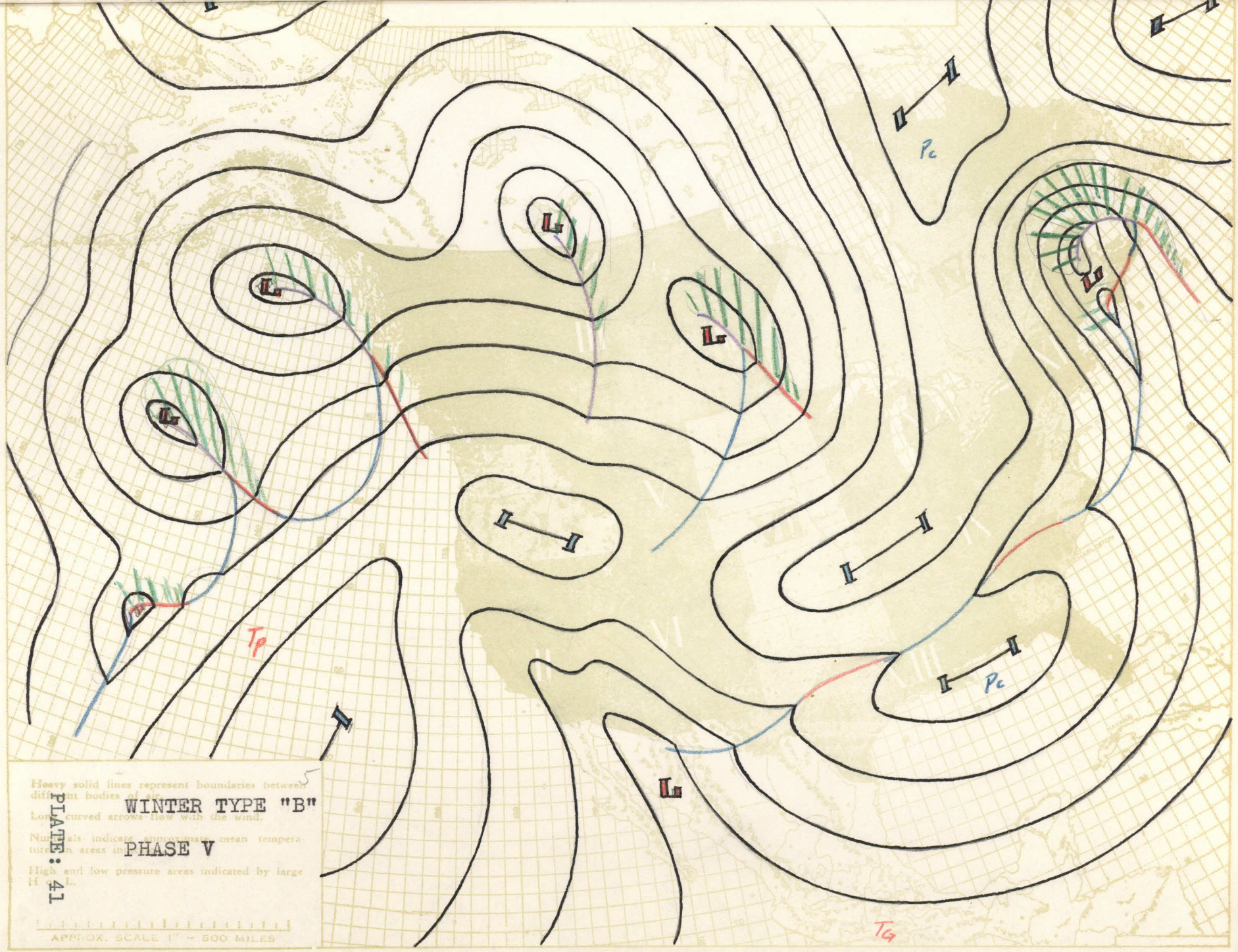
Heavy solid lines represent boundaries between different bodies

Long curved arrows flow with the wind.

Numerals indicate mean temperatures in areas indicated.

High and low pressure areas indicated by large H & L.

APPROX. SCALE 1" = 500 MILES



Heavy solid lines represent boundaries between different bodies of air.

Long curved arrows show with the wind.

Numerals indicate approximate mean temperatures in areas indicated.

High and low pressure areas indicated by large H and L.

APPROX. SCALE 1" = 500 MILES

WINTER TYPE "B"

PHASE V

PLATE: 41

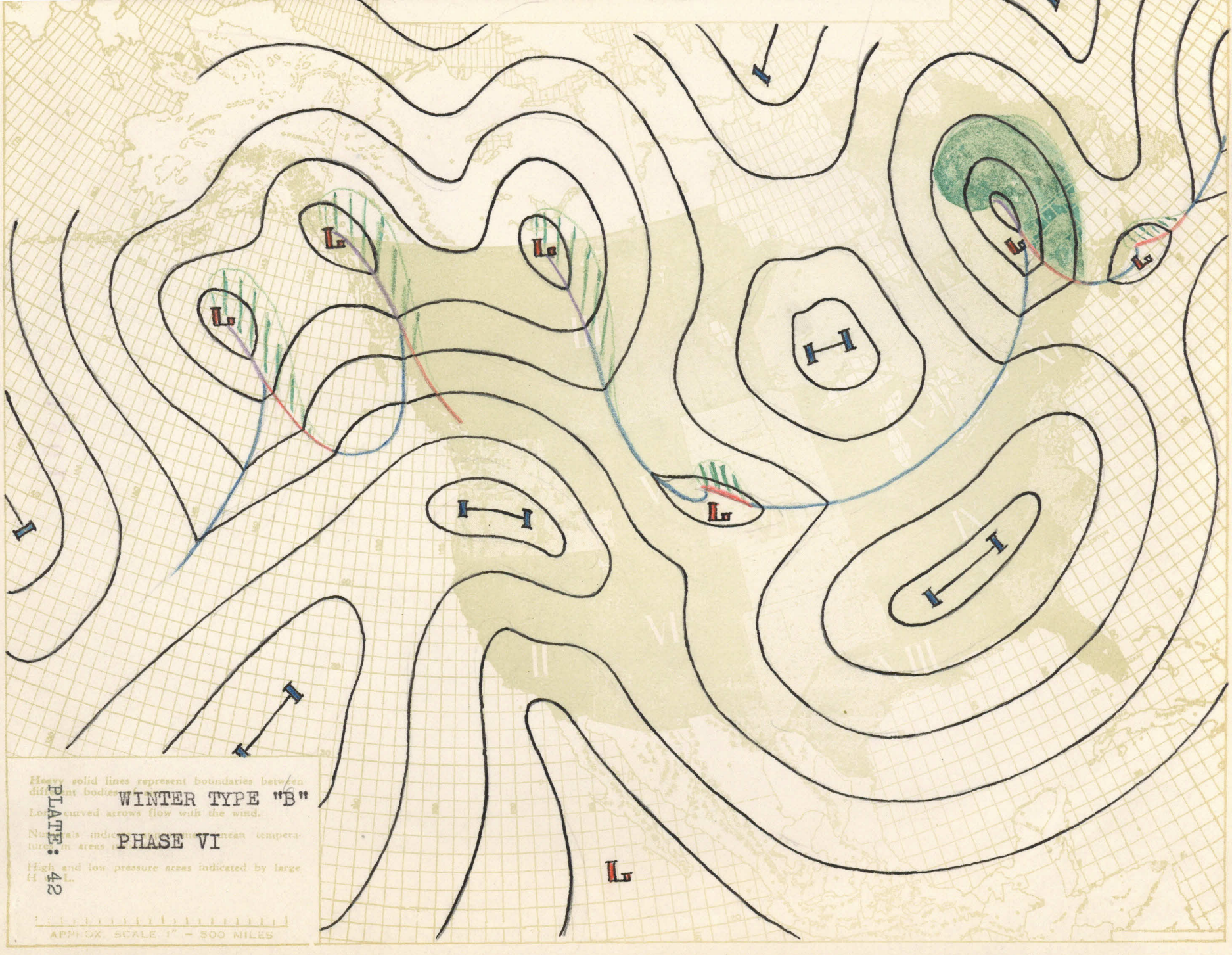


PLATE: 42

WINTER TYPE "B"

PHASE VI