TYPE A WEATHER AT VARIOUS STATIONS IN THE UNITED STATES

by

Gerrit Daams

Benjamin W. Helmick

Virgil E. Sandifer

James J. Vonk

A thesis submitted in partial fulfillment of the requirement for the degree of Master of Science in Meteorology.

California Institute of Technology
Pasadena, California
May 26, 1941

ACKNOWLEDGEMENTS

Grateful acknowledgement is made to Dr. Irving P. Krick and Mr. Robert D. Elliott for their assistance in preparing certain fundamental ideas concerning long range forecasting and permission to reproduce drawings of the idealized weather types.

We are indebted to the California Institute of Technology for making available the Airway Teletype reports and to Dr. Irving P. Krick for the use of his weather charts for January, 1937.

TABLE OF CONTENTS

Page

PART I

Section 1.

A. Table of Abbreviations..... i

Section 2.

A. Introduction..... 1

Section 3.

A. Type A Weather at Various Station in the United States.

1. Phase I..... 9

2. Phase II..... 15

3. Phase III..... 23

4. Phase IV..... 29

5. Phase V..... 36

6. Phase VI..... 45

Section 4.

A. Movement of Pressure Centers During Type A Weather of January, 1937..... 55

1. Table I..... 57

2. Table II and Table III..... 60

Section 5.

A. Conclusion..... 67

1. Type A Anomalies (Chart)..... 71

PART II

Section 1.

A. Explanation of the Charts..... 72

Section 2.

A. Idealized map for Type A, Phase I.

B. Actual maps for Type A, Phase I, January 12th and 25th, 1937.

C. Individual Station Charts for Phase I.

Section 3.

A. Idealized map for Type A, Phase II.

B. Actual maps for Type A, Phase II, January 5th and 15th, 1937.

C. Individual Station Charts for Phase II.

Section 4.

A. Idealized map for Type A, Phase III.

B. Actual maps for Type A, Phase III, January 1st and 14th, 1937.

C. Individual Station Charts for Phase III.

Section 5.

A. Idealized map for Type A, Phase IV.

B. Actual maps for Type A, Phase IV, January 2nd and 20th, 1937.

C. Individual Station Charts for Phase IV.

Section 6.

A. Idealized map for Type A, Phase V.

B. Actual maps for Type A, Phase V, January 3rd and 21st, 1937.

C. Individual Station Charts for Phase V.

Section 7.

A. Idealized map for Type A, Phase VI.

B. Actual maps for Type A, Phase VI, January 4th and 10th, 1937.

C. Individual Station Charts for Phase VI.

Part I

TABLE OF ABBREVIATIONS

In the body of the text, Part I, the following abbreviations are used:-

1. Pc--Polar Continental Air
2. Pp--Polar Pacific Air
3. Tg--Tropical Gulf Air
4. Tm--Tropical Maritime Air
5. Mention of degrees has reference to the Fahrenheit scale.

INTRODUCTION

The problem of long range forecasting finds a feasible solution in a study of characteristic and repeated series of synoptic situations. These recognizable processes which are observed to persist through at least one series of their phases and frequently longer are called the types of weather. These types have been classified according to the synoptic situation that each of their phases represent. For each of these types the general weather situation is known, however the details of the frontal passage and the simultaneous phenomena occuring in various parts of the country in their relationship to the phases of each type during each season of the year have not been thoroughly investigated.

It is the purpose of this paper to discuss the weather associated with a winter process called TypeA. Type A is a relatively rare, but nevertheless important weather pattern producing significant anomalies in the weather all over the country. Its major features result from a westward and a northward displacement of the general streamline pattern from its normal position. This displacement of the streamline patterns moves the Pacific Anticyclone into the Gulf of Alaska; giving it a north-

west--southeast orientation of its major axis and it is far more intense than usual. Likewise, the Canadian Anticyclone is now situated in the plateau region west of its normal position. Between these anticyclones there is formed a frontogenetical zone, located on the west coast of Canada, which sends cyclones rippling down the Pacific coast.

Type A weather occurs only during the cold season, as only in winter does the Polar Continental Air of the Canadian Anticyclone become cold enough to be able to form a region of large air mass property gradients when it is displaced westward nearer to the contrasting Pacific Anticyclone. It is this interaction that produces the frontogenetical sector between these two anticyclones. Usually only one cold season in five has a streamline pattern favorable for the formation of Type A for an extended period. Even though the type is rare, the widespread and often record-breaking anomalies produced in the weather make a detailed study of it important.

It usually takes about seven days for a Type A low center to pass from British Columbia down the coast to Southern California, then across the Basin country of the southwest and finally northeastward to the Atlantic coast by way of the St. Lawrence Valley. Thus Type A has been divided into six phases, each represented by a synoptic map of each of the days. Idealized

maps of the phases of Type A are found in part II at the beginning of each section of individual station charts.

Usually only one low center, the α cyclone, passes through the southern Rocky Mountain region to the east coast every six days during the Type A process. This α cyclone traverses the complete path outlined above; the other cyclones are blocked by the high coming southward following the passages of the α low northeastward. Thus the α , or first cyclone of the series, is the only one to pass entirely across the country.

In Phase 1 the α_1 cyclone first appears. It is formed in the frontogenetical sector produced by the new orientation of the Pacific Anticyclone and the Canadian Anticyclone. The next phase or day shows this same cyclone moving southward near the coast of Washington and developing a small rain area. During both of these phases remnants of the preceding six-day cycle may be producing small amounts of precipitation along the Texas coastal region, and along an extended front trailing from the preceding α cyclone that passed through the southern prairies to the Atlantic Coast.

Phase 3 finds the α_3 low moving through the Basin country and producing large amounts of snow in this region. At the same time a polar outbreak is bringing sub-zero temperatures to the midwest. The next day, in

phase 4, the α_4 system is moving east of the Rockies through western Kansas, and producing precipitation of snow, fog, and sleet throughout the central part of the country east of the Rocky Mountains. Polar Continental air to the rear of the α system brings freezing temperatures even to Southern California. Phase 5 shows the α_5 low moving through the Ohio Valley and the Great Lakes regions with rapidly falling temperatures following the passage of the low eastward.

During the sixth day of α_6's existence it reaches the Gulf of St. Lawrence. At the same time abnormally cold weather extends over the Basin and Prairie country. During the remainder of the day or in the next day a new α system is formed in northern British Columbia. This is the first phase of a new Type A series. Following the α cyclone, β, γ, δ, and ϵ cyclones may also form in the same frontogenetical region, but as indicated above only the α system seems to succeed in passing east of the Rockies, as the others tend to fill up in the Basin.

Type A often reverts to Type B due to the rotation of the major axis of the Pacific Anticyclone from a northwest-southeast to a northeast-southwest or an east-west orientation. The orientation of the major axis of a true Type A varies from northwest-southeast to north-south. Type A weather is characterized by below normal temperature and precipitation in the

northern half of the country. This change is the result of the movement of the Polar Continental Anticyclone into this region, bringing lower temperatures, and also causing the cyclones to move with a more southerly trajectory. Because of the short distance from the frontogenetical region, Type A cyclones are not well developed while they move southward along the coast of the Pacific Northwest, and therefore they do not produce much precipitation in this region. Due to the low temperature precipitation in the Northwest is in the form of snow. Usually in phase 3 the cold weather extends all the way down the western coast, and snow may even appear at sea level in Southern California. Because of the trajectory Type A systems bring above normal amounts of precipitation in the Great Basin area and in the central Mississippi and Ohio Valley regions. Following the passages of the ∝ lows eastward, severe cold periods with strong winds prevail. The southern Atlantic coastal region has above normal temperatures and below normal precipitation since the westward and northward displacement of the general streamline pattern brings a southwesterly flow of warm Tropical Gulf air from the Bermuda Anticyclone into this region which is in the warm sector of the cyclones.

Because of the high relative humidities in the Polar Continental air coming southward into the central United States, a slight drop in temperature or a saturated condi-

tion produced by precipitation from overrunning Tropical Gulf air may cause a low cloud condition to form suddenly without much warning over thousands of square miles. Since the temperature is usually near or below freezing at flying levels, icing conditions are severe; likewise flying is frequently very dangerous with ceilings less than two-hundred feet. Often widespread prefrontal fogs form, and they often may extend three-hundred miles in advance of a warm front. In the mid west phase 4 is particularly favorable for this situation with widespread fogs even with winds up to forty miles per hour. Easterly upslope winds, convergence near the fronts, high relative humidities in the Polar Continental air, low frontal slope, and precipitation from overrunning Tropical Gulf air aid in producing these widespread low ceilings and frequent fogs. These are a few generalized features of Type A weather. We will now begin a more detailed account of frontal and air mass effects for each phase compiled from information found in the hourly sequences and the synoptic maps.

To compile this data we chose two representative days of each phase of Type A. These days were chosen from the month of January, 1937, which is the best example of this type of weather. We selected twenty three stations which were ideally situated and at the same time reported fairly regularly on the hourly Airway Teletype Code sequences. Of course there is a scarcity of reports from stations in the eastern part of the

country, so in order to complete the picture of the weather anomalies we are forced to make generalizations from the map data. For each of the stations we plotted graphs of the ceiling, visibity, and temperature changes during the day for each phase of Type A. These stations include Burbank, Oakland, and Seattle on the west coast; Boise, Las Vegas, Phoenix, Salt Lake City, Big Springs, El Paso, Albuquerque, and Cheyenne in the Great Basin and Rocky Mountain regions; New Orleans, Brownsville, and Dallas in the Gulf States; Bismark, Omaha, Wichita, and St. Louis in the Great Plains area; Detroit and Buffalo in the Great Lakes region; Knoxville in the Tennessee Valley region; and Boston and Albany east of the Appalachians. There were no Airway stations reporting regularly in southeastern United States, therefore the correlations for that region were compiled from the synoptic maps.

In addition to the graphs there are included six maps showing the idealized synoptic situations for each phase of Type A; and there are also included twelve maps showing the actual synoptic situation of the days for which we made the detailed study. The map of the idealized phase, together with the maps of the actual situations of the same phase are found in Part II at the beginning of each section of individual station

charts. After this brief introduction we are ready to discuss the data and correlations shown on the graphs for each phase of Type A. The phases will be discussed in order, and the weather and the anomalies produced will be expanded upon for each section of the country.

TYPE A WEATHER AT VARIOUS STATIONS IN THE UNITED STATES

Phase I

Starting with the first phase we find in the idealized picture an intense high in the Gulf of Alaska, a Canadian High west of its normal position extending into the Great Basin country, and a major wave cyclone centered off the coast of British Columbia. We chose January 12th and 25th in 1937 as representative of this phase. The 12th was slightly ahead of schedule with the west coast center of lowest pressure off the coast of northern California, while the 25th was an ideal example of Phase I with the lowest pressure on the morning map off the British Columbia Coast.

The northern part of the Pacific Coast region is under the influence of an old Pc High on the 12th producing clear, cold weather with temperatures in the 20's all day. The high relative humidities found in the clear cold air reduces the visibility to less than 3 miles all day at Seattle with smoke and occasional ground fogs. There is a low pressure center off the coast of California, but the rain area does-

n't affect the Pacific Northwest. However, on the 25th an intense low of 991 millibars centered just south of Ketchikan with a warm front off the coast causing active rain most of the day at Seattle with ceilings between 1000 and 3000 feet.

The western part of the Pacific Northwest, however, on both dates had clear, cold weather due to intense Pc highs in the plateau. At Boise the temperature on the 12th dropped to -5 degrees Fahrenheit.

The 12th found the California Coast in a precipitation belt with an occluded front off shore. Both Oakland and Burbank had light rain during the frontal passage with the ceilings dropping during passage from 4000 to 600 feet and rising rapidly again to 4000 feet. Since on the 25th the center of the occluded system was off the coast of British Columbia, the California Coast was under the influence of the western edge of the Pc high in the Basin causing the temperature to drop at Burbank to 29 degrees. At both stations the visibility remained about 4 miles most of the day with light smoke reported. The temperature range at Burbank was 30 degrees on the 25th when the weather was clear and cold, and only 8 when an occluded front off shore kept the ceilings low,and,therefore, outgoing radiation was

slight. The clear, cold weather in the California Area on January 25th was a slight deviation from the ideal type which usually has a weak wave cyclone from the previous system in that area.

On both dates the Rocky Mountain Area was under the influence of a high pressure area stationed in that region as in the ideal type. On the 12th Las Vegas, late in the evening, began to show the effects of the occluded front off the California Coast, but there were unlimited ceilings and visibility in the early part of the day. The temperature dropped to 20 degrees on both days. The same type of weather prevailed at Phoenix with minimums near 30 degrees. Albuquerque was also in the cold air with lows around 15 degrees. Salt Lake City, in the center of the Basin high, on both days had subzero temperatures (-5 degrees) and unlimited visibility with smoke reported. Cheyenne also saw the mercury drop with 17 degrees on the 25th.

The West Texas region also had generally clear conditions with minimums of around freezing at El Paso and the mid twenties at Big Springs. The latter had an early morning radiation fog on the 12th, and diurnal ranges of temperature of between 30 and 40 degrees.

On January 12th the Gulf Coast was affected by wave cyclones off the coast while the 25th found the

Pc air pushing the front far enough off the coast to cut off any precipitation. On the 12th fogs were common all the way fron the Ohio River Valley south to the Gulf. Brownsville, Dallas, and New Orleans all reported early morning fogs. All day ceilings remained below 200 feet with visibility less than one at Brownsville and Dallas. At New Orleans the weather Cleared in the afternoon. The other day of Phase I showed the polar outbreak extending its influence further south with freezing temperatures at Dallas, and temperatures in the 40's at New Orleans and Brownsville. Dallas again had fog until noon, while New Orleans in the early morning had light rain and a 400 foot ceiling before the cold front passed followed by 25 mile per hour winds, clearing weather, and rapidly falling temperatures.

Further north, Wichita had early morning fogs on both days. As in the case of the Gulf region, the January 25th map showed clearing and cold weather with minimums of 14 degrees as a result of a polar outbreak, whereas, the 12th remained foggy all day with light snow and temperatures nearly constant at 30 degrees. Omaha and St. Louis were also closed in with temperatures slightly below

freezing. Bismark, being further north, received a fresh supply of Pc air and remained clear with the temperature steadily dropping from 19 degrees on the previous day at midnight to - 10 degrees that night and still dropping the next day. As mentioned before, the 25th had clearer and colder weather with minimums of 14 degrees at St. Louis, Omaha, and -16 degrees at Bismark--the temperature at the latter station being below zero all day.

In the Lake region , Buffalo and Detroit had high west winds (up to 35 miles per hour) with low visibility all day on both maps. Instability snow flurries following the cold front passage the day before kept the ceilings between 1000and 2000 feet on the 25th, whereas, the 12th had scattered clouds throughout the day.

Knoxville, Birmingham, Charleston, Atlanta, Memphis, Cincinnati--in fact, the whole Central and Southern part of the country--had fogs all day on January 12th. The 25th had clearer and colder conditions.

East of the Appalachians the usual wide spread between the tempeature and dew point following a rapidly moving cold front is noticable. Moderate winds with much mixing stirred the lower levels raising the temperature and lowering the dew point at the surface. Minimum temperatures were slightly be-

low freezing.

On both Phase I maps high pressure with minimum temperatures in the neighborhood of -40 degrees are found in the Canadian Northwest at such stations as Fort Simpson. The South Alaska Coast shows a great deal of snow and rain in this phase as the lows moving around the periphery of the Pacific High strike this coast.

PHASE II

The idealized picture of Type A Phase II, as well as the maps we chose as representative of this synoptic situation, is shown in Part II, Section 3 of this thesis. The January 5th map shows the $\prec_1$ low in northern California as it should be with an occlusion from the previous cycle producing some precipitation in the plateau country. On January 15th this low is displaced northward into Washington. The occlusion in the Rocky Mountains Area is also displaced northward with its center located in Montana. Both maps show intense high pressure areas in the midwest and Ohio Valley so that the occlusion often found in that area is shoved eastward off the Atlantic Coast.

The Pacific Northwest on both days was affected by frontal systems slightly to the south with rain extending northward. This agrees well with the idealized phase situation. The overrunning Pp air produced a ceiling around 2500 feet on January 5th, and about 1000 feet with light rain on January 15th. Strong northwest winds up to Beaufort force five caused the

temperatures to lower gradually all day.

An approaching occluded front at Boise causes the ceiling to drop from 6000 to 200 feet in seven hours with light fog and snow late in the evening on January 5th. Snow also fell on January 15th amounting to 0.15 inches of precipitation under the combined effect of warm fronts to the west and to the south. Visibilities were less than a mile on both days as a result of the snow and fog conditions.

The effects of an occlusion off the coast gave Oakland ceilings in the neighborhood of 1000 feet with diurnal temperature ranges on each day of only 5 degrees. Light rain, lasting about four hours, with visibility approximating 5 miles occured during frontal passages. Temperature on both days remained in the forties.

Burbank represents the effects of a slightly northward displacement of the systems from the type situation on January 15th. On this date a high pressure system centered over northern Arizona was extending its stabilizing influence to Burbank with a minimum temperature close to freezing. The situation was different on January 5th with an occlusion off the coast of northern California causing light rain

and 400 foot ceilings as it passed eastward. The ceiling in this case dropped from unlimited to 400 feet in two hours with the frontal passage, and visibility also fell in the same period from 10 to 2 miles with haze.

Las Vegas, like Burbank on January 15th, was under the influence of a northern Arizona high, but it was near enough to a wave cyclone in northern Nevada to produce a high overcast condition. A cold front passage late in the afternoon of January 5th produced four hours of light rain and ceilings of 1500 feet. With the passage of the front the winds veered and increased in velocity from 15 to 35 miles per hour.

Phoenix, being too far south on both days to be affected by the plateau low, and with the high pressure tendency in the region, had unlimited ceilings and visibility. The diurnal range in temperature on both days was more than 30 degrees with the minimum in the mid twenties. Albuquerque had similar conditions to Phoenix with the diurnal range near 40 degrees and minimums close to 10 degrees.

Because of the low pressure tendency in the Central Great Basin Area, Salt Lake City had snow conditions in Phase II. Minimum ceilings during the

frontal passages on both days fell from unlimited to 900 feet in a period of five hours. Temperatures remained in the 20's all day for both examples taken. Surface winds were strong, reaching velocities as high as 35 miles per hour.

The topography and the direction of the wind have an important bearing on the weather to be expected at Cheyenne. The synoptic maps taken to represent this phase show the contrast that can be expected with a change in the direction of the wind. January 5th showed wave cyclones both east and west of Cheyenne, and also slightly to the south producing strong easterly upslope winds. Such conditions favor fog on the east slope of the Rockies. Cheyenne, until the frontal passage of the wave west of the station, had such fog conditions. Also, there was light snow caused by the same conditions. However, after the front passed east of Cheyenne the sky cleared, and the temperature dropped 50 degrees in twelve hours, thus showing the suddenness with which the cold air follows the passage of the front. Cheyenne on January 15th had clear, but not as cold weather, being hemmed in between two occlusions moving eastward.

El Paso and Big Springs, in the West Texas re-

gion, were clear and had unlimited visibility with diurnal ranges of 30 to 40 degrees due to the clearing associated with the high pressure area.

Brownsville had a cold front passage on January 15th with a Pc outbreak shoving the Tg-Pc front further south than was the case on January 5th. The cold front passage dropped the ceilings from 2000 to 300 feet, and visibility was reduced from unlimited to 3 miles with light fog. On January 5th Brownsville was still in Tg air with ceilings 400 feet in the morning and a minimum temperature of 60 degrees.

Dallas and New Orleans, similar to Brownsville, were affected by Tg overrunning on January 5th with occasional drizzle and light fog. Ceilings all day remained at both stations less than 1000 feet, occasionally dropping to 200 feet when fog was reported. New Orleans also reported light rain. Slightly clearing conditions occured in the afternoon with visibility improving to 8 miles, but foggy conditions reformed later in the evening. Temperature range for both stations was less than 10 degrees. On January 15th a cold front passage lowered ceilings in this region to 300 feet with rapidly clearing conditions and falling temperatures after the front passed. At New Orleans

the temperature fell from a maximum of 80 degrees the day the front passed. The winds were strong (up to 35 miles per hour) and from the northwest. Dallas had temperatures below freezing as a result of this polar outbreak. The Great Plains area for the most part was under the influence of Pc air. A wave formation of minor intensity caused slight Tg overrunning but no precipitation on January 5th map. The frontal passage at Wichita dropped the ceiling from unlimited to 1000 feet in one hour with the cloud height continuing to fall to 400 feet. Winds were generally east to south up to velocities of 25 miles per hour. The same effect was noticed at Omaha with ceilings at frontal passages of 400 feet. St. Louis was under the influence of returning Pc air,and the southeast winds at that station kept the visibility all day to less than a mile with smoke. Bismark, under the influence of Tg overrunning cold Pc air,had 400 foot ceilings, and, with the northeast Beaufort force four winds, the visibility was reduced to less than one-half mile due to blowing snow. The overrunning Tg air cut off outgoing radiation,raising the temperature from -30 to -10 degrees, and then varying only one degree from

this figure for the next twenty four hours.

The map of January 15th brought clearer and colder air to the prairies. Bismark had a low of -25 degrees with -10 degrees being the maximum for the day. Omaha had a minimum of -6 degrees; Wichita, 9 degrees; St. Louis, 14 degrees. This later date represents conditions in the midwest for Phase II better than the overrunning effect found on January 5th.

The early part of the phase was marked by a cold front passage in the Lakes region on both maps. Instability snow flurries with 1000 foot ceilings and strong northwest winds followed the frontal passage at both Buffalo and Detroit. Further south, in the Tennessee Valley, Knoxville also felt the effects of the cold front passage and the incoming Pc air with falling temperatures all day.

The rapidly moving cold front affected Boston and Albany later in the day with the usual clear, moderately cold weather, and low dew points after the frontal passage. The Southeast Atlantic coast was similarly affected.

On both dates the Canadian Northwest had minimums in the -30's. Cold air from the intense (1045 millibars) high pressure area in the Canadian

Northwest spilled over into the Southeast Alaskan Coast region bringing temperatures at Juneau down to 10 degrees. This is characteristic of the second phase.

PHASE III

In Phase 3 the ∝ low is usually centered in the vicinity of Western Colorado producing general precipitaion in the Rocky Mountain Area. Cold, dry air prevails as a rule on the east of the mountains. January 1st and 14th were selected as best representing this phase and are shown in II-3 of the chart section.

The northwest part of the country had generally clear weather on both the 1st and 14th. Seattle had minimums slightly below freezing, while Boise, being further east, and light snow flurries due to the precipitation area being swung far northward aided by the intense high pressure area to the northward. Ceilings during the day varied between 800 and 4000 feet. The Basin low on January 14th was farther north, centered in southeast Idaho at map time. As the front moved east on that date the ceiling rose from 1500 to unlimited. Snow flurries and light fog were also reported.

A minor wave disturbance off the California coast kept Oakland on January 1st overcast from noon on. Light rain and snow pellets occurred during the

frontal passage. The 14th was scattered most of the day with ground fog and drizzle in the early morning. Burbank was south of any wave disturbance having clear, cold weather and temperatures below freezing in the early morning hours.

The frontal systems of the 14th, being displaced further northward than on the 1st, left Las Vegas, Phoenix, and Albuquerque in old Pc air. As a result the weather was clear and the temperatures cold. Las Vegas had a minimum of 25, Phoenix 33, and Albuquerque 13 degrees. Somewhat similar conditions occured on the 1st at Las Vegas with scattered clouds and low temperatures, but Phoenix and Albuquerque showed effects of the low pressure area to the north. Phoenix early in the day had light rain and ceilings as low as 2000 feet. The weather cleared in the afternoon and remained clear the rest of the day. Albuquerque received high overcast until the front passed when the weather cleared and the temperatures dropped. Winds up to 35 miles per hour followed the cold front passage.

The cyclone to the southeast of Salt Lake City on the 1st, and slightly north on the 14th, gave this city another phase of snow conditions. Temperatures

remained below freezing all day and high winds (25 miles per hour) caused blowing snow and poor visibility. Ceilings around 1000 feet occur while it is snowing.

At Cheyenne strong easterly upslope winds produce snow and fog all day with visibilities less than one mile. Temperature due to the fog remained between 8 and zero degrees all day. The conditions of January 14th was different. Strong northwest winds (Beaufort Force seven in the afternoon) kept the weather clear although an occluded front was approaching from the west.

The West Texas area was again too far south to be influenced by the low pressure area in the Central Rocky Mountain Area. Strong southwesterly winds up to 30 miles per hour prevailed keeping the diurnal temperature range slightly less than in previous phases. Minimums, however, were close to freezing.

Light fog conditions featured the Gulf Coast again in this phase. Only the map data At Brownsville was available, but both dates had early morning fogs. Dallas, with more complete reports, showed ceilings rising on January 1st to 1000 feet with drizzle. The 14th, however, had a cold front passage affecting

Dallas and clearing the weather late in the day. Fog occured during the frontal passage. After the cold front passed the temperature at Dallas dropped from 60 to 27 degrees in twelve hours. This front hadn't passed New Orleans and Brownsville during this phase so the temperatures stayed up.

In the Great Plains area Phase 3 was beginning to show the effects of an intense low moving rapidly northeastward displacing the Pc air. The opposite effect was shown on January 14th with a Pc outbreak clearing out the precipitation belt in the central belt in the central prairies. Omaha had a high overcast until evening at which time the ceiling began to fall steadily. Moderate easterly winds prevailed with visibility about 7 miles all day. St. Louis to the east was clear all day, but the rapidly approaching low caused high overcast that evening. Southeast winds with smoke, as is the rule in that city during the cold season, was noticable all day. Bismark was less affected by the low moving south of the station and had clear weather with subzero temperatures. The effect of the approaching cyclone dropped ceilings at Wichita rapidly from unlimited to 100 feet with drizzle, light rain, and fog during

the warm front passage. Southerly winds of Beaufort force six due to the approaching low kept temperatures in the forties all day.

The Pp high coming down from the interior of Canada cleared off Bismark, Omaha, and Wichita early in the day. St. Louis being to the east was influenced by both a warm front and overrunning to the south and a cold front approaching from the northwest. The convergence in the region kept ceilings under 1000 feet all day with thick fog even at noon. Heavy rain and snow fell during the day with 1.14 inches of precipitation being reported.

Cold Pc air was rapidly moving into the Lake region on the January 1st map. Buffalo and Detroit had near freezing temperatures all day with strong northwest winds up to 25 miles per hour. No instability snow flurries occured with nearly clear skies and visibility between 6 and 8 miles. On the 14th one cold front had passed and another was rapidly approaching, with ceilings midway between the two, of 3000 feet and 600 feet during frontal passage. One-tenth inch of rain occured during the day with temperatures in the low forties but rapidly falling that night as the Pc air begins to force its way in.

East of the Appalachians on January 1st the Pc air was beginning to show its effects. Clear weather prevailed at Boston and Albany with temperatures in the thirties and still dropping with dew points less than 20. A series of lows converging in the St. Lawrence River Valley kept the northeastern part of the country overcast on the 14th and gave light rains. The January 1st map was nearer the ideal Phase 3 in this region as the latter date was behind schedule with low pressure still prevailing east of the Mississippi River.

In the southeast part of the country the map data shows old Pc air down as far south as the Gulf Coast on January 1st. Moderate rain occurred in the Alabama and Mississippi region until noon, then clearing off as the Pc air pushes southward. On January 14th the Tg air occupied this region with minimum temperatures in the sixties.

The center of the Canadian High was near Prince Albert on the 1st with that station reporting a minimum of close to -50 degrees. On the January 14th map the high was displaced slightly west with coldest temperatures below -40 degrees. The extension of the high pressure west into British Columbia also caused temperatures below 20 degrees on the southeast Alaskan coast.

PHASE IV

The idealized situation of Type A, Phase 4 is shown on the map at the beginning of the section of charts in Part II section 5.

The synoptic maps of the 2nd. and 20th. of January, 1937 were chosen one representative of the conditions occuring during this phase. These maps are illustrated with the idealized phase map.

During both days Seattle and Boise are under the influence of a Pc high. The skies are clear and the visibilities are unlimited. The minimum at Boise are about minus 10 degrees being nearly 30 degrees lower than those at Seattle.

On January 2nd. there is a low center off the California coast, which is not part of the idealized picture. The approaching warm front, while only giving Burbank an unlimited ceiling and visibility, brings light rain and snow pellets to Oakland in the early morning. This situation clears up as the high in Washington spreads southward, bringing unlimited visibility and slightly lower temperatures. On January 20th. the Pacific Anticyclone effects these stations, by causing northerly winds, this results in tempera-

tures 20 degrees lower than on January 2nd.

Farther east in the Plateau area the dates we chose ran true to the ideal type situation. Old Pc air contributed the main influence, although on January 20th. a small wave cyclone in southern Colorado showed its effects. The cold front of this wave dropped the ceiling from unlimited to 2000 feet and up again in a few hours. Clear, cold weather followed the passage with freezing temperatures at Phoenix, Las Vegas was effected to a less degree with ceilings during cold front passage of 5000 feet, followed by clearing and colder weather. Albuquerque was south of the wave and only scattered clouds were produced. These stations on January 2nd. were clear and cold with minimums of 20 degrees at Albuquerque and Las Vegas, and 30 degrees at Phoenix.

Salt Lake City received instability snow flurries on both days taken for this phase. The wave disturbance in southern Colorado aided this condition on January 20th. while cold air being lifted by the mountain ranges set off the precipitation on January 2nd. Both days had the visibility obstructed by ice crystal fogs and smoke. Temperatures were extremely low with sub-zero readings.

The Colorado low on the 20th. was swinging the air upslope at Cheyenne producing snow flurries and early

morning fog. As the low system moves east the weather clears, and the northerly component of the wind drops the temperatures rapidly to a minus 22 degrees. Zero temperatures also occurred on January 2nd. with again an early morning fog.

The west Texas region had a cold front passage on both dates with strong west winds and falling temperatures. On January 20th, 35 mile per hour winds at El Paso picked up dust until the visibility was reduced to less than a mile in mid-afternoon. A ground fog occured at Big Springs in the early morning hours before the cold front passage.

Old Pc air was pushing in behind the movement of the low near Omaha at maptime on January 2nd. there was a cold front passage at Brownsville and New Orleans and a secondary cold front passage at Dallas during the day. At New Orleans the ceiling dropped to 300 feet when the front crossed the station with winds shifting from south to north and a velocity of 20 miles per hour. Dallas had dense fog for a short time during the early morning frontal passage but the weather cleared and the temperature dropped immediately after the front passed. The influx of the cold air with strong northwest winds

dropped the temperatures from 55 degrees at midnight the day before to 19 degrees at the same time that night. The map of the 2nd. was a slightly advanced phase in this section.

The map of January 20th more nearly approaches the ideal phase with the cold air not yet approaching the coastal area. New Orleans was in Tg air circulating around the westward extension of the Bermuda High with overcast conditions ranging from 800 to 2000 feet. Dallas on the same day was midway between a rapidly occluding system to the west and a small wave to the east. Early morning fog resulted from the convergence of air in that region. Overcast conditions prevailed all day.

In the midwest the January 2nd example of Phase 4 was slightly ahead of schedule with a cold front passage and resulting in rapidly falling temperatures. The January 20 th map was more nearly in phase and was a major period in the midwest.

The cold front passage in the early morning of January 2nd produced drizzle and light fog. However, after its passage the weather cleared and the strong winds associated with the system resulted in an afternoon dust storm. Temperatures fell 26 degrees in 3 hours when the Canadian air moved in, and the mercury fell steadily from 46 degrees to 13 degrees. The same effect occured at

Omaha with 45 mile an hour winds from the northwest with temperatures dropping steadily from above freezing to 8 degrees. During the cold front passage the ceilings drop rapidly to 300 feet with 5 hours of snow in the early morning and blowing snow later in the day. Fog occured during the frontal passage with 25 mile per hour winds. St. Louis and Bismark both had blizzard conditions after the frontal passage. The intense low passed south of Bismark backing the winds to the northwest. The precipitation area was swung far northwest, due to the intense high to the northeast. In spite of all day snow and high wind the temperature dropped to minus 16 degrees. St. Louis had snow most of the day with 400 foot ceilings, but cleared off rapidly and cooled with the influx of cold air behind the front late in the evening.

Somewhat similar conditions took place on January 20th. At map time the occluded low system was centered at Omaha with rapid shifts in the wind direction with the passage of the low. A 600 foot ceiling with light snow and less than a 2 mile visibility accompanied the frontal system. Temperatures dropped all day from above freezing to minus 5 degrees.

Early morning fog accompanied the passage of the front at Wichita. Then the temperature began to fall with the mercury steadily decreasing from 38 degrees to 4 degrees. An occluded system to the west and an open wave to the south kept ceilings below 1000 feet in fact zero at noon with dense fog until the occluded system passed. At Bismark the low system caused snow early in the day, but the weather rapidly cleared as the system moved eastward and a high pushed in causing clearing weather and a minimum temperature of minus 18 degrees.

The Lake region on both days was feeling the effects of overrunning Tg air. Ceilings were low with mimimums around 200 degrees. Light rain, fog and snow occurred at various intervals during both days. Buffalo had similar conditions with low ceilings and light rain.

Albany received high overcast on both days due to the rapidly approaching intense low to the southwest. Boston being farther east was influenced by high pressure to the northeast and had clear, cold weather with temperatures below freezing.

The southeast Atlantic Coast on January 2nd received light precipitation in this phase with heavier amounts in the southern Appalachians. Upslope

southerly winds produced fog in this region on both dates. On January 20th the Virginia-North Carolina area received copious rainfalls up to an inch in places.

The Hudson Bay region in Canada had clear, severely cold weather with temperatures below minus 50 degrees and a high pressure center of 1050 millibars.

PHASE V

The idealized picture of Type A Phase 5 is shown on the map in Part II Section 6.

The examples chosen to illustrate this phase are of January 3, 1937 and January 21, 1937. Maps of these dates are also included in Part II Section 6 and thus may be compared with the idealized form to show how they deviate.

Seattle, on January 3rd, instead of having a front just off the coast as might be expected, is being influenced by the Pacific Anticyclone. The ceiling being unlimited in the morning falls steadily to 600 feet in the afternoon at which time light drizzle begins. Visibility varies from 2 to 5 miles due to smoke. The temperature rises steadily from 21 degrees to 35 degrees as the warm Pp air moves in. The low ceilings and light drizzles are due to the instability of Pp air in the lower levels when it moves inland in winter.

January 21st shows Seattle in Pc air with typical wave off shore rushing southward. The sky is overcast, but the ceiling and visibility are unlimited

on the A.M. map. No reports for Seattle came in that day on the hourly sequences, but the afternoon map showed the visibility still unlimited, but the ceiling had dropped to 3000 feet and .02 inches of precipitation had fallen.

Boise on January 3rd is in old Pc air with the Pacific high moving in. The ceiling is unlimited all day and the visibility is 10 miles all day. The temperature variation is from 10 degrees to 31 degrees of a diurnal nature.

Boise on January 21st is in fresh Pc air with the typical wave system just off the coast. Clear and unlimited conditions prevail with far below zero temperatures throughout the day. No reports were available for Boise for January 21st, but the map for that day showed such conditions to be correct.

Oakland and Burbank are both in old Pc air on the southwest side of the Basin high on January 3rd. Both have unlimited ceiling and visibility. The air is continuing on off shore moving into the circulation of the Pacific Anticyclone. The wave system which should be along the Pacific Coast is not present. On January 21 a cold front is along the entire length of the California Coast with the crest of the wave

just south of San Diego. Conditions are clear and unlimited and remain that way throughout the day. Temperature fluctuations are of a purely diurnal nature with freezing mimimum and maximum in the low fifties.

Las Vegas on January 3rd is in old Pc air with clear and unlimited conditions. On January 21st Las Vegas is again in Pc air, but not as old. It is clear and unlimited, and the temperature remains below freezing all day with a mimimum of 14 degrees.

Proceeding on to the Basin and Rocky Mountain states we see both Albuquerque and Phoenix in old Pc air with unlimited ceiling and visibility on January 3rd. There is an open wave to the south in northern Mexico. Temperature fluctuations at both places are of a purely diurnal nature.

Salt Lake City on January 3rd is also in old Pc air. There is a little orographical precipitation with ceiling varying from unlimited to 4000 feet while precipitation is falling. Visibility varies from unlimited to 3 miles due to smoke and precipitation.

The temperature is relatively constant varying from 10 degrees to 20 degrees during the day.

Cheyenne on January 3rd is in old Pc air with unlimited ceiling and visibility. The temperature is rising steadily all day due to compressional heating

and the influx of warm Pp air from the Pacific Anti-cyclone.

On January 21st Cheyenne is in fresh Pc air with clear and unlimited conditions. The temperature falls to a low of minus 22 degrees. There is a trough to the north in Alberta, Canada where frontogenesis is taking place.

Now moving southward to west Texas we find on January 3rd that El Paso and Big Spring are both in an old Pc high with unlimited ceilings and visibilities. There is a wave to the south in northern Mexico bringing up Tm air. Freezing temperatures occur at both stations during the night.

January 21st shows the crest of a wave at El Paso and another wave to the west in southern Arizona. The wave is apparently a dry system as the ceiling and visibility are both unlimited.

Big Springs presents a vastly different picture with a cold front just past and a warm front of the next wave approaching. The ceiling drops from unlimited in the early morning to 300 feet at noon with freezing drizzle, haze, and light fog. The temperature drops steadily all day from 47 degrees in the morning to 20 degrees at midnight. The visibility is variable due to fog and haze.

Proceeding now to the Gulf Coast, at Brownsville, Texas we find old Pc air from a high centered over Oklahoma influencing the station. A wave to the west is causing Tm overrunning which gives a 6000 foot ceiling and unlimited visibility at the time of the morning map. No reports were available as of that date, thus no further details can be supplied. On January 21st there is a rapidly approaching wave system to the northwest. Brownsville is still in Tg air with south winds at morning map time and a 600 foot ceiling and 4 miles visibility, but no other reports are available.

Moving northward to Dallas we find that station near the center of an old Pc high with clear and unlimited conditions on January 3rd and a region of frontogenesis to the west along the eastern boundary of the mountains. On January 21st Dallas is in the center of a wave system with one cold front just past and a second cold front right at the station. The ceiling falls during the morning accompanied by rain, freezing drizzle and light fog causing the visibility to drop to 2 miles. The temperature falls steadily from 54 degrees in the morning to 27 degrees at midnight.

The next station to be considered is New Orleans

which on January 3rd is in old Pc air with a cold front recently passed and clear and Unlimited conditions. It is overcast and the temperature remains in the fifties all day. On the 21st there is a series of waves approaching from the northwest with new Orleans in Tg air with a south wind. The ceiling is 600 feet with 10 miles visibility on the morning map. No other reports were available.

Let us next consider the Great Plains area starting with Wichita. January 3rd shows the station near the center of an old Pc high with unlimited conditions. On January 21st Wichita is in fresh Pc high with waves to the south and southeast. There is snow due to overrunning Tg with variable ceilings. The temperature remains between 10 degrees and 0 degrees all day.

Omaha on January 3rd is in old Pc air with a region of frontogensis to the west along the eastern boundary of the mountains. The ceilings are unlimited and the visibility is 7 miles in the early morning and late night and unlimited at mid-day. The temperature rises steadily from 8 degrees in the morning to 30 degrees the following night. January 21st shows Omaha in fresh Pc air with clear skies. The visibility is 8 miles in the early morning rising to

unlimited during the afternoon, then falling again at night. The temperature is almost constant varying from minus 3 degrees to 2 degrees.

Bismark, North Dakota, the next station, on our list is still in Pc air on January 3rd, but a low system to the northwest in Canada is rapidly approaching bringing in relatively warm Pp air as indicated on the morning map. No further reports were available on January 3rd. Hourly reports were not available on January 21st either, but the A.M. map shows fresh Pc air coming down from Canada with clear and unlimited conditions. The temperature is minus 18 degrees at this time. There is a region of frontogenesis extending through Alberta along the eastern edge of the mountains.

St. Louis, next to be considered, is in old Pc air on January 3rd with some instability snow flurries following the cold front passage, but clearing at noon. The visibility is unlimited at all times and the temperature rises slowly from 20 degrees to 29 degrees. January 21st again shows a cold front just past St. Louis with unlimited conditions until noon; then the ceiling falls rapidly to 500 feet accompanied by light drizzle and light snow for the remainder of the day causing the visibility to drop at the same time

to one mile. The temperature falls steadily from 35 degrees in the morning to 10 degrees at midnight and is still falling due to the incoming fresh Pc air.

Now proceeding to Detroit, Michigan on January 3rd we find that station in old Pc air with a low center 500 miles to the north in Canada. A cold front is just past at the time of the morning map. The ceiling is 2000 feet most of the day, but drops to 600 feet by midnight with instability snow showers. The visibility is variable, unlimited to 3 miles due to smoke and light snow. The temperature falls steadily from 35 to 22 degrees as the cold air comes in. On January 21st an occluded front is about 300 miles past Detroit and a secondary cold front is at the station. The ceiling rises rapidly in the early morning from 600 feet to 8000 feet by 5:00 A.M. and remains unchanged the rest of the day. The visibility varies from 2 to 6 miles all day due to smoke and haze. The temperature drops steadily all day to 23 degrees by midnight due to the influx of cold air.

Buffalo, New York on January 3rd at the time of the A.M. map shows a cold front just past and a secondary cold front rapidly approaching. Instability snow showers occur intermittantly as might be expected. Detailed reports were not available.

On the 21st an occluded front followed by a secondary with another wave to the south off the Atlantic Coast causes moderate rains in the region east of the Appalachians. Albany had 800 foot ceilings, on the morning map while Boston as in the case of January 3rd had fog and precipitation due to the onshore circulation. From Florida northward the Atlantic Coast was fog bound all day on the 21st due to the old Pc air being trapped under overrunning Tg air, and the precipitation from this air saturating the layer beneath it. Scattered rains occured in this region on the 3rd. A Pc high stationed over the Saskatchewan area brought minus 50 degrees temperatures to this region. The southeastern Alaskan Coast was influenced by occlusions drifting around the intense high in the gulf of Alaska and received moderate rains.

PHASE 6

The idealized picture of Type A, Phase 6 is shown on the map in Part II-7.

The examples chosen to illustrate this phase are of January 4, 1937 and January 10, 1937. These maps are also illustrated in Part II-7 and may be compared with the ideal picture to show deviations from the idealized conception. Seattle on January 4th shows a small occluding wave just north of the international boundary in British Columbia with the cold front sweeping down toward Seattle. Ceilings are from 800 feet to 2000 feet during the morning hours with light rain falling, but then drop rapidly to 300 feet with snow as the front moves in.

Seattle on January 10th shows a low center with an occluded front to the south off the California coast. Seattle itself is in returning old Pc air, giving clear and unlimited conditions. Unfortunately reports for Seattle were not available for this date, so we had to surmise what conditions existed from the weather map drawn for that day. These two reports for Seattle for January 4th and 10th show extremely different conditions for the same phase of Type A, but it is our opinion that

the January 10th condition is more representative of Phase 6 while the January 4th example is somewhat off phase for that particular geographical region.

Let us now move inland to Boise where on January 4th we find Pp air (warm) influencing the station with the low system just north of the international boundary as before mentioned. This causes the ceiling to drop steadily from unlimited to 1000 feet with instability snow showers late at night. Lowering ceilings and snow cause the visibility to drop from unlimited to one mile. During this same time the temperature rises steadily from an early morning low of 15 degrees to a high of 31 degrees at midnight clearly indicating the heating effect of the Pp air. We wish to repeat that we do not consider this January 4th situation of Type A Phase 6 for the Pacific northwest region too well chosen, but we think it may prove useful as an example of what may occur.

Boise on January 10th presents a far different picture showing the station in old returning Pc air which we believe to be truly representative of the phase. The ceiling varies between unlimited and 1000 feet due to lifting and instability in the air

mass giving light snow and light fog. The temperature reached a low of 13 degrees during the day.

The Southern Pacific Coast represented by Oakland and Burbank on January 4th is also influenced by the Pacific Anticyclone with clear weather. The visibility is somewhat hampered by smoke at Burbank. The characteristic frontal systems which should be along the coast for this phase are not present. On January 10th, however, we do find an occluding wave all along the California coast which is bringing precipitation. Conditions are still clear and unlimited on the 7:30 E.S.T. synoptic map for that date, but inasmuch as the hourly sequences did not come in for Oakland and Burbank on January 10th, we cannot show exactly how ceiling, visibility, and temperature behaved, but we can say with a fair degree of accuracy that the front moved in rapidly giving low ceilings, precipitation, and falling temperatures as the cold air moved in behind the front.

Now going to the Basin and Rocky Mountain area we find on January 4th that Las Vegas is also influenced by the Pacific Anticyclone. Conditions are clear and unlimited. The temperature dropped to 22

degrees on this date at Las Vegas.

On January 10th Las Vegas is in old returning Pc air, which is truly representative of the phase, giving clear and unusually cold conditions. Temperatures remained below freezing most of the day with a minimum of 12 degrees.

We find on January 4th that Albuquerque, Salt Lake City, Phoenix, and Cheyenne are all influenced by warm Pp air due to the on shore movement of the Pacific Anticyclone giving generally clear and unlimited conditions throughout the entire area. On January 10th these stations are all in old Pc air with a region of frontogenesis along the eastern boundary of the Rockies. All stations show clear and unlimited conditions. Temperature fluctuations are great and of a purely diurnal nature. The January 10th map shows practically ideal conditions for Type A phase 6 for the Basin and Rocky Mountain area.

Proceeding to El Paso we find that conditions are practically identical for January 4th and January 10th. In each case it is an old Pc air mass with clear weather and unlimited visibility. The temperature varied in a purely dirunal fashion from

the middle fifties to the twenties.

Big Spring, Texas on January 4th is in old Pc air with southerly winds. There is an open wave about 300 miles south in northern Mexico producing a high overcast, but the temperature diurnal was still 57 degrees to 30 degrees. On January 10th we have a similar wave to the south and this time also, Big Spring is in old Pc air, but we have northerly winds and ceilings are between 300 feet and 1000 feet all day.

Proceeding on to Dallas on January 4th we find the station in old Pc air with a wave to the south near the Mexican border. The ceiling is unlimited but overcast with the visibility variable from 7 to 10 miles. Temperatures fell during the night to below freezing with an early morning mimimum of 28 degrees.

On January 10th Dallas is again in old Pc air, but the winds are northerly. The same wave set-up to the south exists, but ceilings are between 400 feet and 1000 feet all day and the visibility is from 7 to 8 miles. The temperature remained below freezing all day with a low of 22 degrees.

At Brownsville, Texas we find on January 4th the warm front of an open wave right at the station. The ceiling drops from 4000 feet to 800 feet with

the frontal passage yielding a small amount of precipitation, then rises again to 2000 feet. Light fog is present in the early morning with 2 miles visibility. Brownsville on January 10th is again in old Pc air with moderate northerly winds and a cold front recently past. The temperature is way down to 38 degrees, but unfortunately no reports were available on that date to give more complete information.

New Orleans on January 4th is an old Pc air with the crest of a wave 200 miles to the south in the Gulf of Mexico. The ceiling is unlimited in the morning falling steadily to 1500 feet by midnight yielding precipitation due to over-running Tg. The temperature rises steadily from 49 degrees in the early morning to 63 degrees late that evening. On January 10th New Orleans is again in Pc air with a cold front right at the station. The ceiling is 500 feet with unlimited visibility. The temperature is 69 degrees at 7:30 EST but will fall rapidly due to the cold air coming in behind the cold front and should give temperatures near freezing as indicated by 38 degrees at Brownsville, but we cannot substantiate this as we have no reports for New Orleans on this day. The wind is south at map time and north on the cold side of the front showing that the cold air has not yet moved to New Orleans.

On January 4th the situation in the midwest deviates from the idealized Phase 6 in that there is a moderately deep cyclone of 985 millibars in northern Minnesota with a warm front extending into the Texas panhandle. Pc air is moving in as the low moves eastward. The system being connected with another cyclone over the Hudson Bay really represents a picture of an advanced Phase 6 displaced somewhat southward. Therefore St. Louis has a dry warm front coming from the west, and consequently the ceiling remains unlimited. The visibility is variable due to smoke. On the 10th, however, St. Louis is located just north of a series of waves rippling to the northeast. Although there were no airway reports for St. Louis for the day it can be seen from the synoptic map that in the morning there are showers from the overrunning Tg throughout the region at some distance north of the front. The ceiling was 1200 feet, and the visibility 8 miles.

At Wichita on January 4th the warm front passes in the morning and the cold front approaches late in the day. The ceiling remains unlimited, but the visibility drops to 8 miles when the warm front passes. On January 10th Wichita is in the center of an old Pc high. Tg overrunning produced a low overcast condition. The wind is north due to the anticyclonic circulation.

At Omaha on January 4th the warm front in the morning and the cold front passes in the afternoon. During the dry warm front passage the ceiling remains unlimited; visibility at 7 miles. The temperature rises to 40 degrees in the early afternoon, but the approaching cold front causes a rapid drop to 12 degrees. On January 10th Omaha is near the center of a Pc high. Consequently it is clear and the visibility is 1 to 4 miles, being reduced by smoke. The temperature fell to a minimum of minus 15 degrees.

Bismark is west of a low system and a cold front has just passed the morning of January 4th. The Pc outbreak coming down brings clearing conditions and sub-zero temperatures. The minimum temperature reached was minus 20 degrees.

Near the Great Lakes, Detroit on January 4th is just east of the low system moving to the northeast. Lifting of the Tg air resulted in a 300 foot ceiling early in the morning, but as the dry warm front approached the ceiling rose to unlimited. Smoke makes the visibility variable. On January 10th Detroit is in a Pc high with clear weather. Visibility is 10 miles, but smoke drops it to 2 miles at midnight. Temperatures drop to minimums of 20 degrees.

Buffalo is still farther to the east of the approaching cyclone on January 4th. Overrunning Tg produces a high overcast, with occasional instability showers. A wave system running up the Atlantic Coastal region produces high overcast at Buffalo, which is in a high Pc on January 10th.

Knoxville in the Tennessee Valley is in a Pc high on January 4th. The sky is clear, and the visibility is unlimited. The temperature is in the thirties. The true Phase 6 pattern of January 10th shows a wave system running northeastward through the center of Tennessee. There are no reports, but the synoptic map indicates intermittant precipitation at the station with fog in the frontal region.

In the New England States, Albany on January 4th is in a Pc high with clear and cold conditions. On January 10th, with the waves passing slightly to the east it is overcast with light snow falling.

There is a wave 200 miles east of Boston. On January 4th this center passed through during the night bringing early morning fog and rain.

The southeast section of the country on January 4th is influenced by a Pc(old) high. This area is gen-

erally overcast with light precipitation near a front which passes through Florida. The temperatures are all about 40 degrees north of the front, with temperatures in the high sixties in southern Florida. The temperatures during the day rise about 10 degrees. Visibilities north of the front are about 8 miles or greater; south of the front in Tg air, they are less than 2 miles, being limited by fog conditions. On January 10th, the southeast Atlantic coastal region is in Tg air, with waves passing along the eastern side of the Appalachian Mountains . The temperatures are in the sixties. Upslope winds are producing fogs resulting in visibilities less than one mile. The ceilings are very low.

On January 4th there is an intense high of 1053 millibars located near Fairbanks, Alaska and extending over Alaska and northwestern Canada. The region is generally overcast with scattered air-mass snow showers. The ideal Phase 1 has a low center where this high appears. Thus the situation of January 4th represents an advanced Phase 6 which really corresponds to Phase 1 for this northwest region. On January 10th the Pacific Anticyclone is centered in the Gulf of Alaska and extends over the southern part of Alaska with a low center south of the Aleutians on the west side of the anticyclone.

THE MOVEMENT OF PRESSURE CENTERS DURING THE TYPE A WEATHER OF JANUARY, 1937

It is found that by classifying synoptic maps according to their phase of Type A consistent correlation of weather in every part of the country cannot always be made. Though such correlations are generally true because the weather patterns are in agreement in type and phase, such a classification neglects the important phenomena of the polar air outbreaks to the south. Since these polar outbreaks have an important effect on the energy available in the frontogenetical process, and since they force southward a frontal line, the paths and the intensity of cyclones may be altered from the standard pattern. The Pc outbreaks occur in a cycle of about three to five days, and, therefore, they usually are not in step with the Type A cycle, which is a process of about six days. However, since both the Type A cycle and the Pc outbreak cycle occur, these processes must be able to act in natural harmony. The process and frequency of the Type A cycle

is conditioned by the frequency and type of the polar outbreaks. Therefore the complete idealized Type A cycle must synchronize with a particular arrangement of about one and one-half cycles of the Pc outbreak cycle. When these cycles are arranged so that they do not go together, deviation from the idealized phases takes place. Type A may be so disarranged for about two-thirds of the period of its existence.

There are also Pp outbreaks which displace the anticyclone in the Gulf of Alaska and then assume that position themselves. During January, 1937 this displacement occured twice with an interval of seventeen days between outbreaks.

Table I represents a study of the movements and orientations of the pressure centers during January, 1937. In this table the effects of these movements are indicated by the resulting phase of various parts of the country and of the synoptic map as a whole. Short comments on the weather pattern are given for each day. All of the information was obtained from the 7:30 A.M. Eastern Standard Time Synoptic maps.

TABLE I

In this table phases are given for the general map pattern, for the Pacific and the coastal region west of the Rockies, for the Great Plains region west of the Mississippi Valley to the Rocky Mountains, and for the region east of the Mississippi Valley.

The following abbreviations besides the regular air mass symbols are used: P2 as for phase 2; NE-SE as an axis orientation; N as for north or northern; Sward as for southward; G. Lakes as for Great Lakes; G Alas for Gulf of Alaska; U. S. for the United States; G. Plains for the Great Plains and other similar combinations. Also 4* for four plus or an advanced phase 4 pattern which is not yet a phase 5.

Incomplete sentences may be used to condense material.

DATE	PHASE Gen'l	Pac. Area	West of Miss	East of Miss	COMMENTS
1936 Dec. 25					E-W Pacific high. Fronts in G Alas from Alaska to Basin. Pc high in E Canada and in SE U.S.
26					Fronts forced out of G Alas, Pp high N-S; fronts go to Basin. Pp high into Alas from NW. Pc high going off E coast.
27	4	4*	4*	4*	Pp high NNW-SSE. Systems stop on W coast. Pc high NW Canada, extension cuts off waves going thru G Lakes. All systems slightly N.
28	5	5*	5*	5*	New Pp high going NE on W coast of Alas. Low in SW P5*. Pc high thru G Lakes. Low in E is P5*.
29	1	1,6*	6*	6*	Pp high has NS orientation. Pc high in Alas forces fronts into Canada.
30	2	2	1	1	Pp high NW-SE. ∝low is P2. Pc high is P1*. E is P1*
31	2	2*	2*	2*	Pp high is NNW & SSE. W coast low in P2*. Pc high NW Can. Central low is P2*.
1937 Jan. 1	3	3*	3*	3*	Pp high N-S. Old Pc high force frntal line thru Cent. U.S.
2	4	4*	4*	4*	Pp high NE-SW. Lows from SW into Alas; lows from W to North. Mex. Pc high in W Basin. E is P4*
3	5	5	5	5*	Pp high to S at U.S. lat. No W low to S as in P5. Pc high spread in U.S. All highs displaced to S. Lows to W Can. N-Pc high follows Alas low to E.
4	1,6*	1,6*	6*	6	Pp high more Wward than Nward. FG sector in G Alas. New Pc high forces fronts thru N G Plains. New Pc High in midW Can.
5	2	2	2*	3	Alas high & SE extension force coastal low & front Sward into P2. Sward lows thru cent. U.S. FG sector in G Alas.
6	3	3	3	4	High in S Alas displace evrythg Sward. Low in G Plains goes Sward. Fast moving low in E.
7	3	3*	5	5	Pc extension into G Plains hinders passage of SW lows.
8	4	4-	4*	5	New Pp high goes E SW of Alas. SW lows stall. Pc high extends to Tex. Lows from E Tex. NE to P4* position. (Minor lows)
9	1	1*	6	6-	New Pp high in G Alas forces occluding wave off B.C. coast. Old Pc high into Basin. Low in N. Can. with Pc high behind.
10	2,6*	2*	6	6*	New Pp high in G Alas, N-S. Pac. occluding low in P2*. N Can. wave occluding, cold front bulges Sward.
11	3	1-,3-	3	6*	Pp high in S stops lows in SW. Pc air follow cold frt in Can.
12	1	1, 3-	1	1	Pc air covers W Can. Low crosses Hudson Bay. Occluding waves produced in NW. Front in N U. S. E displaced Sward. Lows in SW.
13	2	2	2-	2-	New Pc high in NW. Low goes NEward from Pc extension.
14	3	3-	3-	3-	Coastal low stays in Basin. Fronts frcd thru mid U.S. Pc high extension in G Basin. Systems in E continue.
15	2	2*	3	3*	Old Pp high into NW Can. Pc extension stops western systems. No fronts on NW coast.
16	3	3	3	4-	N Pc high follows Alas low. Old Pp high in W Can. NW lows go thru Wyo. Pc high in E U.S.
17	1	4,1-	5*	5*	Pp high NW-SE.; Pc high in W Can. Wave forming in NW. No waves in mid-continent; waves along S U.S. G Plains lows go NE thru G Lakes.
18	2	2	2-	6	Waves Sward on W coast. Old Pc high in G Plains.
19	3	3	3	3	Pc high to W Cent. Can. Old Pc high forced further Eward.
20	4	4	4	4	New Pc high down W Can. follg old Alas low. No lows on B.C. coast.
21	5	5-	5	5*	Fast Pc high in NW U. S; sets west out of phase; forces E low to P5*.
22	1	1-	6	6	New Pp-Pc high follows Alas low. Pc high in W central U.S.
23	2	2	3	6*	Pc high in NW Can; forces Alas low to SE.
24	2	2-	2-	2e	New Pp high (NW-SE) force old Pp to SE; sends waves to SW. Pc high forces frontal line Sward; forces W low into P4.
25	1	1,2-	5*	5-	New and old Pp highs divide in W Can.; forcing occluding lows Sward into P1*. Pc high cleans out cent. U.S. New low in western Pac. follows new Pp high.
26	2	2*	3	3	Pp highs are split. Both go SEward. Old Pc forces fronts off E U.S. High to E & Basin high to S hold western lows.
27	2	2*	3	4	New Pc high in NW Can. forces fronts to mid U.S. Lows go E from NW U.S.
28	2	2	3	4*	Pc air over G Alas; FG sector in G Alas. P5 low occluding on W coast. Pp high more Sward. Pc high extension forces fronts to S; prevents movement Eward of lows.
29	5	5	5-	5-	No Pc high in NW react with Pp. Pp high NWward into Alas. Pc high forces fronts to S U.S.
30	2	1* (NW U.S.)	4	4	Pp high, tail in G Alas, In Alas going SEward forces P1 low on W coast. E is in Type A configuration; Pac. not in Type A configuration; W in P1* pattern. No Pc air coming Sward.
31					Type A breaking up. Pac. lows from SW enter B.C. coast.

From Table I and the synoptic maps tables were made showing the position day by day of the important map features. Table II shows the day by day position of the frontal zone forced southward by the Polar Continental outbreaks. The dates are indicated under four columns for location in Central Canada, on the boundary between Canada and the United States, in the middle of the United States and in the southern and coastal regions of the United States. The orientations of these fronts are generally between northeast-southwest and east-west.

Table III shows the outbreaks, position, and orientation of the Polar Pacific Anticyclones. The dates are given for the first appearance of the new Pp high to the west of the anticyclone in the Gulf of Alaska; its movement to the east just south of the Aleutian Islands; its east-west position in the middle Pacific; its orientation while in the Gulf of Alaska, being given for northwest-southeast, north-south, and northeast-southwest; its position at the latitude of the United States; its position off the California coast; and its position south of California. Also the dates of the movement northwestward to Alaska; The split of the Pp Anticyclone into two parts, one in Alaska and the other in the Gulf of Alaska with both moving southeastward; and too

the movement around western Alaska, through Alaska, and eventually southeastward through Canada are given. The Columns are given abbreviated headings for simplification. Three listings of the same date in Table III as for January 8th indicates that a new Pp high is passing eastward just south of the Aleutians, and that the old Pp high is displaced southward to the latitude of the United States and has a northwest-southeast major axis.

TABLE II

Position of Frontal Zones Forced Southward by Polar Continental Outbreaks.

Position, Orientation, and Movement of Polar Pacific Anticyclones.

DATE	Cen. Can.	U.S. and Can. Bnd.	Mid. U.S.	South U.S.	Gen'l Phase	Coming West of Aleutians	Passing South of Aleutians	In Pacific E-W
1936		23-26						23-25
December	Type A		27		4			
	Begins			28	5			
	29				1			
		30			2			
			31		2			
1937			1		3			
January				2	4			
	3				5			
		4			1,6+			
			5		2			
			6		3	6		
				7	3		7	
	8			8	4		8	
		9		9	1		9	
				10	2,6+			
	11				3			
		12			1			
		13			2			
			14		3			
		15		15	2			
			16		3			
			17		1			
	18			18	2			
		19			3			
			20		4			
				21	5			
	22				1			
		23			2	23		
			24		2		24	
				25	1			
				26	2			
		27			2			
			28		2			
				29	3			
				30	2			
Type A Ends	31							
February	1-2							
		3-4						
	5							
		6-7						

TABLE III

In Gulf of Alaska NW-SE	N-S	NE-SW	Down to U.S.Lat	Off South Cal.Coast	South of Calif.	Moved to SW Alas.	Pp High Splits in Alas Move→SE	All of Pp High into Alas.Move SE to U.S.
			23-25					
26-27								
	28							
29			29					
30			30					
	31							
	1							
		2						
			3					
			4					
5			5					
6								
7								
8			8					
			9					
	10			10				
11						11		
12						12		
	13		13			13		
	14		14			14		
15								
16								
17								
18								
	19							
		20						
	21							
	22							
23								
24								
25						25		
26							26	
27							27	
28						28		
29						29		29
30								30
								31
								1
								2

It is interesting to note, as indicated in Table III, that in the fourth phase of both major cycles, and only then, did the Pacific Anticyclone assume a northeast-southwest axis orientation. (January 2nd and 20th). This situation slightly resembles Type B, except that the high in the continent is moving south from the north and did not come from the Pacific into the Basin, and the Pacific high is north of the Type B pattern. Three to four days after this unusual axis orientation occurred, and only on these two occasions, a new Pp high, which tended to displace the Pacific Anticyclone in the Gulf of Alaska, appeared to the southwest of Alaska. On the first occasion, January 6th, the new Pp high displaced the old Pp high in the Gulf of Alaska. Following the arrival of a new Pp high on January 23rd, both Pacific anticyclones had a tendency to be displaced northward around western Alaska and southeasterly through Canada; a movement which eventually forced the Pacific Anticyclone out of the Gulf of Alaska and permitted cycles to enter the region, thereby destroying the Type A weather pattern.

On the first occasion of the displacement of the Pacific Anticyclone by a new Pp high, the old Pp high moved southward and eastward until it was south of

California and west of Mexico, where it remained for about five days. While this process took place, no new Pc high went down western Canada to the United States for several days. A new major cycle began twelve days after the new Pp high came to the Gulf of Alaska, and during this interval minor cycles occurred. It might be inferred from this that a waiting period was necessary in which the new Pp anticyclone in the Gulf of Alaska could draw up heat and moisture from tropical regions in order to be able to have sufficient contrast with a Pc high in Canada. But since cyclones on the western coast were about as well developed during the minor cycles as during a major cycle, the contrast in air mass property seems to be nearly the same all the time. Since most of the minor cyclones were stopped by a Pc high in the United States, it seems that the position and movement of Pc outbreaks with respect to the position and movement of new cyclones on the western coast must be considered.

As already stated, the period of the Type A cycle and the period of the Pc outbreak cycle are not the same; and during the idealized Type A process these two cycles work together in the proper phase relationship in which about one and one-half of the Pc outbreak cycles take place for the whole Type A cycle. Once a

major cycle has occurred it is improbable that another should occur immediately afterward because the phase relationship between these two cycles of different periods no longer permits the cycles to develop in unison.

In Table I, and from the synoptic maps, one finds that each Pc high forces southward a frontal zone. It is the nature of the Type A streamline pattern to tend to cause these frontal zones to conform with the idealized Type A configuration. The further south a high forces a frontal zone the longer becomes the wave trajectory, and the more Tropical Gulf air is drawn into the frontal wave. Northern drier cyclones thus pass to the east faster than do the slower, moist cyclones of the south, which also have a longer trajectory. Therefore northern low systems preceding each Pc high tend to cause the eastern part of the country to advance in phase with respect to the rest of the country.

When the Pc highs arrive in central United States, they tend to block the eastward passage of low centers coming down the Pacific coast to the southwest. This occurs primarily during the minor Type A cycles. In Table II, which indicates the position of fronts in the central part of the American continent, we find the tendency for the frontal position to be indicated in

the south after the major cycles. When the Pc high blocks the eastward movement of cyclones, there is again a tendency for the western part of the country to be retarded in phase with respect to the rest of the country. Therefore, if an cyclone of Type A is to cross the country, and if the whole weather pattern is to remain in phase, the cyclone must pass eastward just as a Pc high comes southward to the west of it. Thus, the necessary synchronous relationship between the Type A and the Pc outbreak cycles can be appreciated.

Type A is therefore seen to be a process in which the streamlines are displaced westward and northward thereby tending to produce an idealized six-phase wave cycle upon which is superimposed a Pc outbreak cycle with a period of three to five days. Each frontal zone preceding the Pc outbreaks is caused by the streamline pattern to approach the ideal Type A configuration. How successfully they occur depends upon the relationships between the phase of the Type A cycle and the phase of the outbreak cycle.

As already stated, after the Pp high moved into the Gulf of Alaska after the first major cycle not Pc high had gone southward in western Canada for a period

longer than the usual Pc outbreak cycle. This may indicate that the Pp and Pc outbreaks have a common origin. Since this left a relatively low pressure in Canada, contrary to the usual anticyclones, there was a stagnation on the American continent from January 7th and 10th. Two anticyclones in western and central United States stayed in the same position for about four days, after which a new Pc high began to force them off the continent. Therefore, the reoccurrance of the major cycle not only requires a proper phase relationship between the Type A and the Pc outbreak cycles, but a Pc high of sufficient intensity is necessary.

On January 23rd, when the second Pp high tended to displace the Pacific Anticyclone, a high entered Canada and passed southeastward. As the new Pp high came near Alaska both Pp anticyclones showed a tendency to go northwestward into Alaska. In the first attempt only the new Pp high got into Alaska, thus preventing the union of the two, or the displacement of the old Pp high. Then both highs moved southeastward for a few days, the one in Alaska passing into western Canada, the other moving in the Pacific. About three days after the first attempt northward, the old Pp high succeeded in entering the continent

around western Alaska, and eventually went southeastward to the United States. This movement left the Gulf of Alaska vacant and lows moved in from the southwest into southern British Columbia. Thus at the end of this Type A month the weather pattern changed to Type E.

Since a complete period of minor cycles between two major cycles occurred only once during this month, no comparison could be made with another period of minor cycles. Therefore, conclusive statements regarding the relation of the Pc outbreaks to the minor cycles are not possible. It must be kept in mind, while using the information above, that the description of the processes and the conclusions reached are those related to the type patterns occuring in January, 1937.

CONCLUSION

It has been our purpose to show by means of charts, maps, and tables the weather anomalies that may occur in the various phases of Type A weather. In the discussion on Part I Section 8 we attempted to point out how the charts and maps, although not always representing ideal phases, are still useful when an understanding of the deviations from the ideal phases occurs.

The general conclusions in this section seem to point out that when Pc outbreaks occur in the midwest the western low pressure systems are blocked by the high pressure to the east, and the phases in this section of the country get behind schedule; whereas those systems east of the high are speeded up and get ahead of schedule. The frontogenetical effect between the intense Pacific High and the high pressure in the Plateau tends to produce a very southerly course for the Type A low pressure systems. However, before this high moves down from the Canadian northwest, lows may for a time take a more northerly course. Being drier and having a shorter trajectory these systems often advance in phase with respect to the systems in the rest of the country. However,

the tendency toward a southerly path is well observed.

Although the positions of the lows, fronts, and highs as mentioned before may vary from the ideal type, thus throwing the phases slightly ahead or behind schedule, certain phases are characterized by certain types of weather in particular regions of the country. The table following this summary shows how the precipitation and cold spells tend to occur only in certain phases for each region.

It is seen that the Pacific Northwest has clear, cold weather during Phase 4, with precipitation centered about Phase 2. The cold phases for the Southern Pacific area are 6 and 1 with Phase 3 the precipitation phase. The Southern Plateau area also has a Phase 3 maximum for precipitation, while the northern Rocky Mountain area also has a maximum then, but phases 1, 2, and 6 also produce significant precipitation. Phases 4, 5, and possibly 1 are cold in this northern mountain area with Phase 2 coldest in southern regions.

The western Gulf states are affected by wave disturbances in the Gulf of Mexico and receive quite a bit of precipitation in all phases except possibly 2 and 4. The Polar outbreak has a maximum southern extension in phases 6 and 3, and these are the cold

phases in this region. In fact, phases 6 and 3 are the cold, dry ones in all regions east of the Rocky Mountains.

The 3rd and 4th phases contribute the most precipitation to the western prairie states, while phases 4 and 5 lead in the region from the Mississippi River to the Appalachians. East of the Appalachians phases 5 and 6 have the most precipitation. These are the main temperature and precipitation anomalies for each phase in the United States.

The prevalence of widespread fogs associated with the frontal systems has already been mentioned. Phases 3 and sometimes 1 have extensive fogs in the midwest. The western Gulf Coast has an unbelievable number of early morning fogs occurring in any one of the first four phases. The Atlantic Coast and especially the Southern Appalachian region have significant fog conditions during phases 4 and 5. The fogs were associated most noticably with the movement of the warm front, of the α low eastward. Cold front and purely air mass radiation fogs were also common.

Warm front passages east of the Rockies were characterized during Type A by a gradual lowering of the ceilings to 200 feet with rain, snow, and pre-frontal fogs common. Cold front passages were far more abrupt

with ceilings dropping from unlimited to a few hundred feet and then the weather clearing--all in a space of two or three hours in some cases. The influx of Canadian air behind the rapidly moving α system in cases dropped the temperature 40 degrees within a few hours.

It is hoped that the material gathered and discussed in this thesis will be of some value in long range forecasting when a Type A situation occurs. However, the forecaster must keep in mind that the information obtained was largely limited to the well defined Type A patterns of January, 1937. Therefore, anomalies produced in the weather during less intense Type A cycles may deviate somewhat from the information herein discussed.

TYPE A ANOMALIES

(Precipitation and Temperature)
January, 1937

STATION	BE	PD	OA	BU	LQ	AB	PH	SL
Phase 1	0.62							0.04
Phase 2	0.26	0.93	1.95	Mod.				0.04
Phase 3		1.17	0.73			0.06	0.10	0.92
Phase 4					T		0.31	
Phase 5								
Phase 6	0.05	0.40	0.11					
Total	0.93	1.60	2.79		T	0.06	0.41	1.00
Cold Phase	4	4	4	6	6,1	2	2	5,3
Minimum	-12	14	25	22	10	-5	22	-18

STATION	DV	DL	JI	NO	XW	OH	RK	LS
Phase 1		.06	.06					.14
Phase 2					.46			
Phase 3	.22	.17	1.68	2.16	1.30	.77	.33	1.56
Phase 4		.14			.83	.30	.11	
Phase 5		.06	.06	.06		.53		1.30
Phase 6		.04	.23	.51	.40			.38
Total	.22	.47	2.05	2.73	2.63	1.60	.44	3.38
Cold Phases	4,1	6,3	6,3	6	6	6, 3	6,3	6,3
Mimimum	-16	20	38	48	40	-16	-24	4

STATION	BW	TM	LKA	PPA	HQ	FX	KX	DO
Phase 1	.70	.08	1.87	.20			1.38	.93
Phase 2					1.24	2.75		
Phase 3			.50	.98		.10	1.42	.35
Phase 4	.28				2.68		2.43	1.20
Phase 5	.26			.18		.27		.36
Phase 6	1.20	.26	.10				.84	
Total	2.44	.34	2.47	1.36	3.92	3.12	6.07	2.84
Cold Phase	3	---	3,4	6,3	---	2	6	3
Mimimum	15	---	-16	-46	---	-18	28	10

Note:- The amount of precipitation for each phase of Type A during January, 1937 is given. Also the coldest phase for the month and the minimum temperature observed during the month are given.

Part II

EXPLANATION OF THE CHARTS

The charts represent the change in such weather elements as winds, ceilings, cloud cover, visibility, obstructions to visibility, and temperature as reported for picked weather situations of Type A, as reported in the Airway Teletype reports available at the Institute for the month of January, 1937. Each set of graphs represent the effect of two synoptic situations of the same phase of Type A, but of different dates, on a particular station. The phase of Type A and the station considered, designated by letters according to those used in the Airway Teletype Code, are indicated at the upper right hand corner of the page.

Each station is placed at the center of a map above the graphs, and the map is of the same scale as that used for the synoptic chart at the California Institute of Technology. The fronts and precipitation areas of the two dates considered are indicated and labeled as they existed at 7:30 A. M. Eastern Standard Time of the dates considered. The

graph begins twelve hours before and ends twelve hours after the date of the phase, thus covering a period of forty eight hours. The hours are numbered from one to twenty-four.

The dates of each of the two situations of the same phase are placed above the wind arrows of the respective situations. The wind arrows of one date are of the same color as the lines of the graph of the same date. Each vertical column of four dots is for the winds of the same situation; the top dot being for the last twelve hours of the preceding day; the middle two being for the first and last twelve hours of the situation considered; the last dot for the first twelve hours of the following day. The barbs indicate wind force of the Beaufort Scale. A new arrow is put down whenever the wind direction changes forty five or more degrees, or when the wind force changes by Beaufort two or more. The time of change is indicated next to the barbs. Between arrows or barbs of different times the wind is understood to have remained within the limits indicated from the time of the earlier arrow until the time of a new one.

The ceiling is graphed on a logarithmic scale labeled in hundreds of feet from zero to ten thousand

feet. Precipitation and cloud cover are indicated by symbols used in the Airway Teletype Code, and is placed along the ceiling graph. Two lines of the same color represent different layers of clouds as reported.

The visibility is graphed on a linear scale labeled in miles from zero to twelve miles. Obstructions to visibility are indicated by proper symbols placed along the visibility graph.

Temperature is graphed on a linear scale covering a range of sixty degrees Fahrenheit.

Arrangement of Charts

1. Pacific Northwest

   A. Seattle, Wash.
   B. Boise, Id.

2. Southern Pacific Coast

   A. Oakland, Calif.
   B. Burbank, Calif.

3. Basin and Rocky Mountain Area

   A. Las Vegas, Nev.
   B. Phoenix, Ariz.
   C. Albuquerque, N. M.
   D. Salt Lake City, Utah
   E. Cheyenne, Wyo.

4. West Texas

   A. El Paso, Tex.
   B. Big Springs, Tex.

5. Gulf Coast

   A. Dallas, Tex.

B. Brownsville, Tex.
C. New Orleans, La.

6. Great Plains Area

A. Wichita, Kan.
B. Omaha, Neb.
C. St. Louis, Mo.
D. Bismark, N. D.

7. Great Lakes Region

A. Buffalo, N. Y.
B. Detroit, Mich.

8. Tennessee Valley

A. Knoxville, Ky.

9. North Atlantic Coast

A. Boston, Mass.
B. Albany, N. Y.

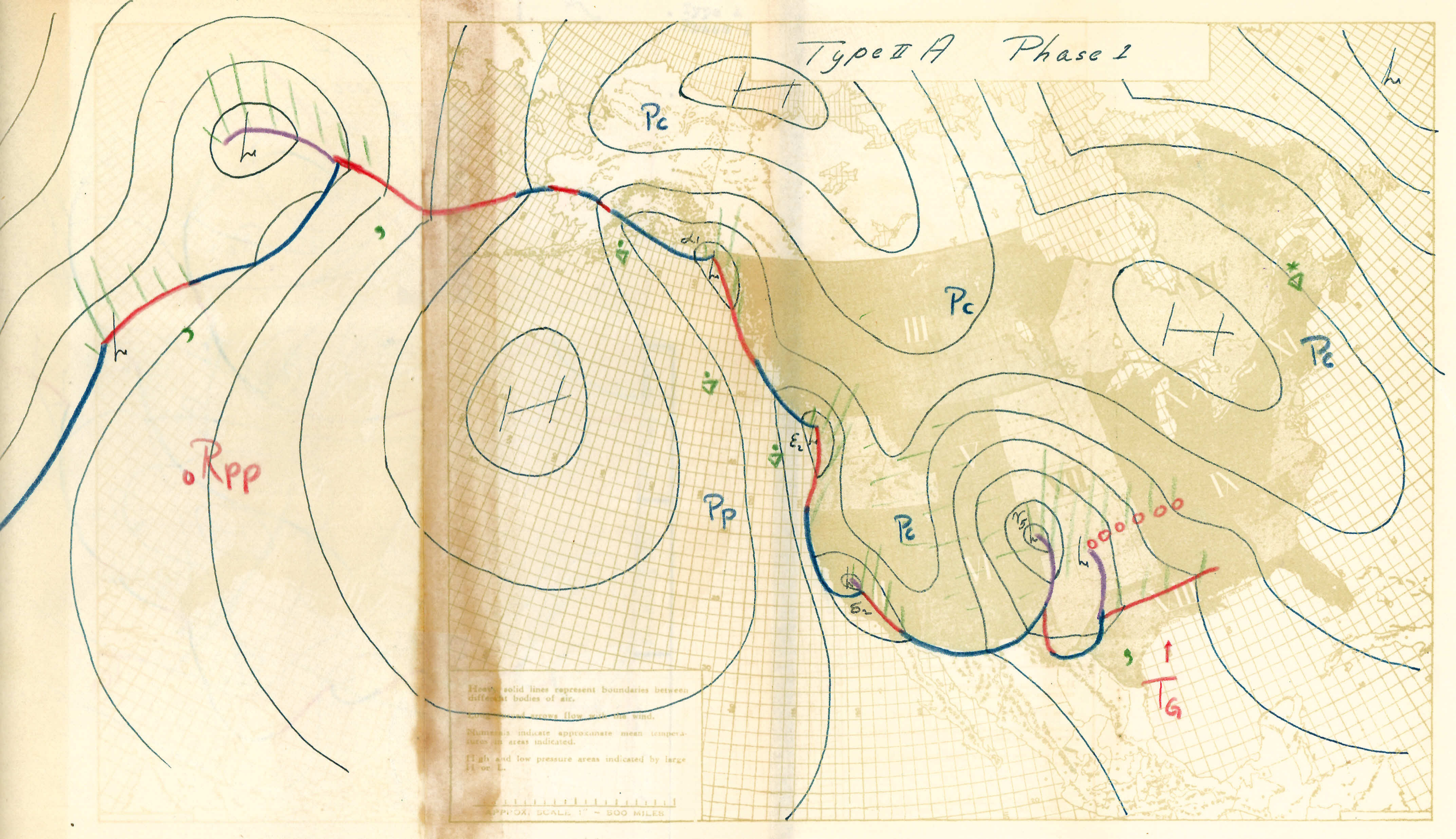
10. Southeast United States

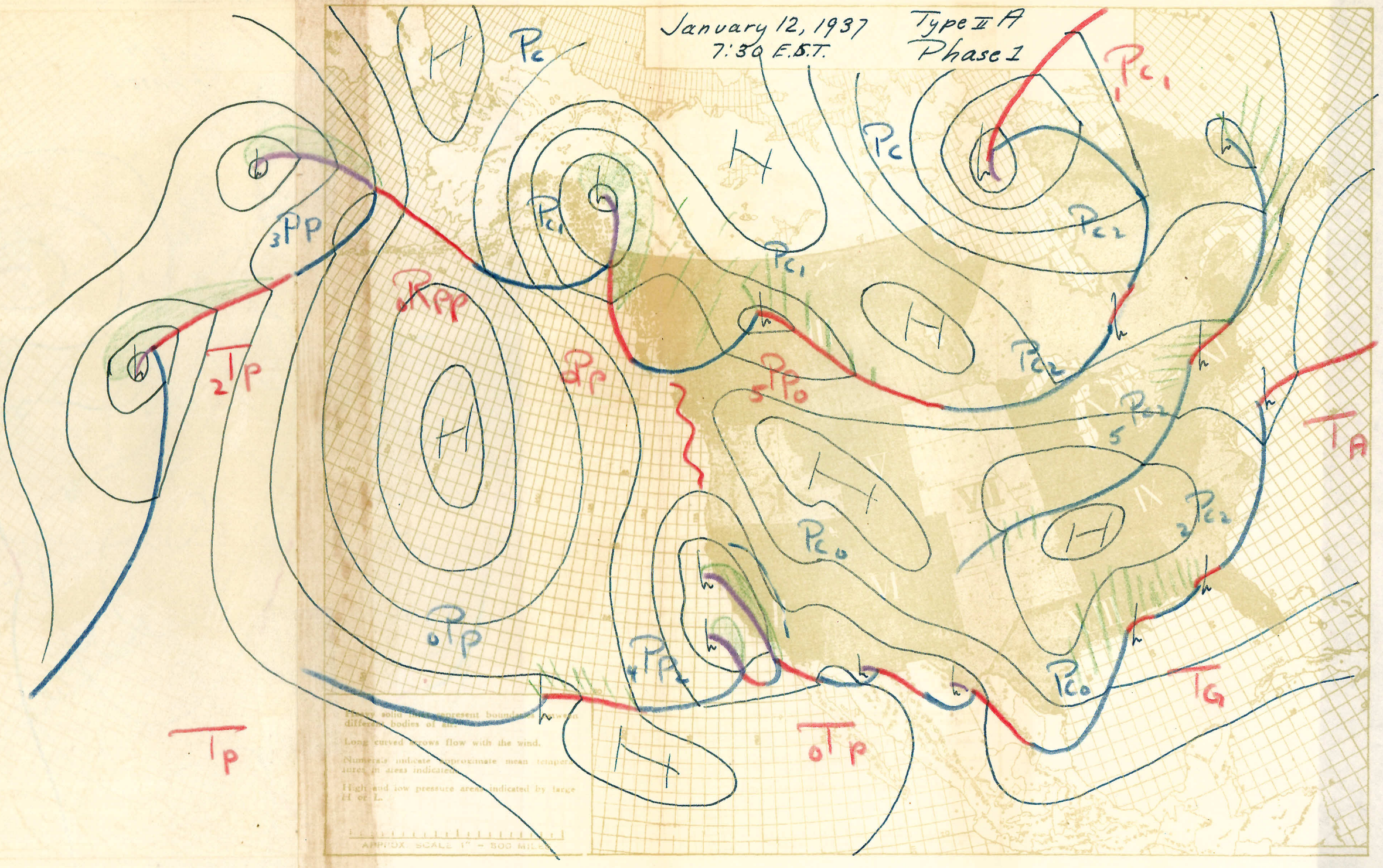
from maps.

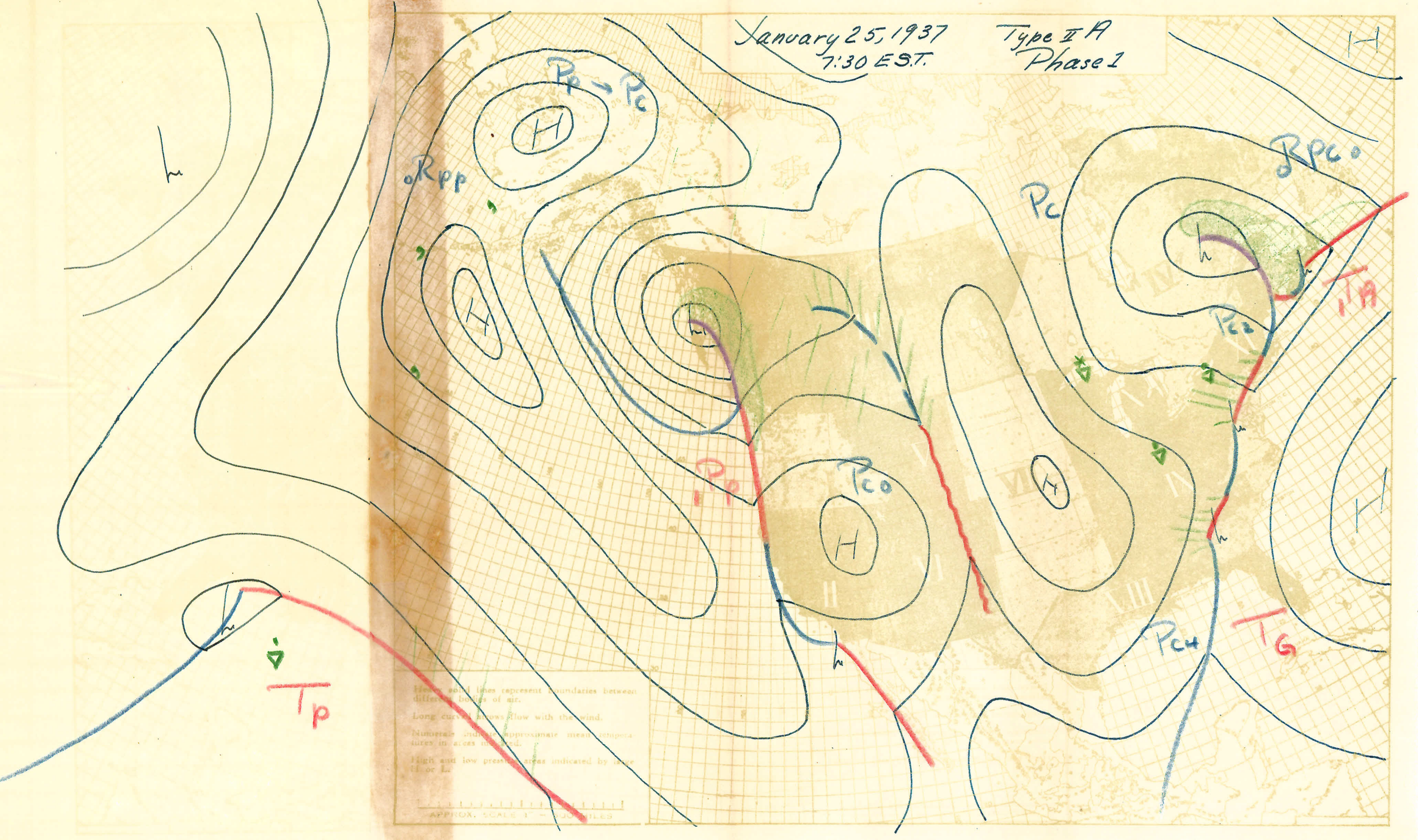
11. Canadian and Alaskan Situations

from maps.

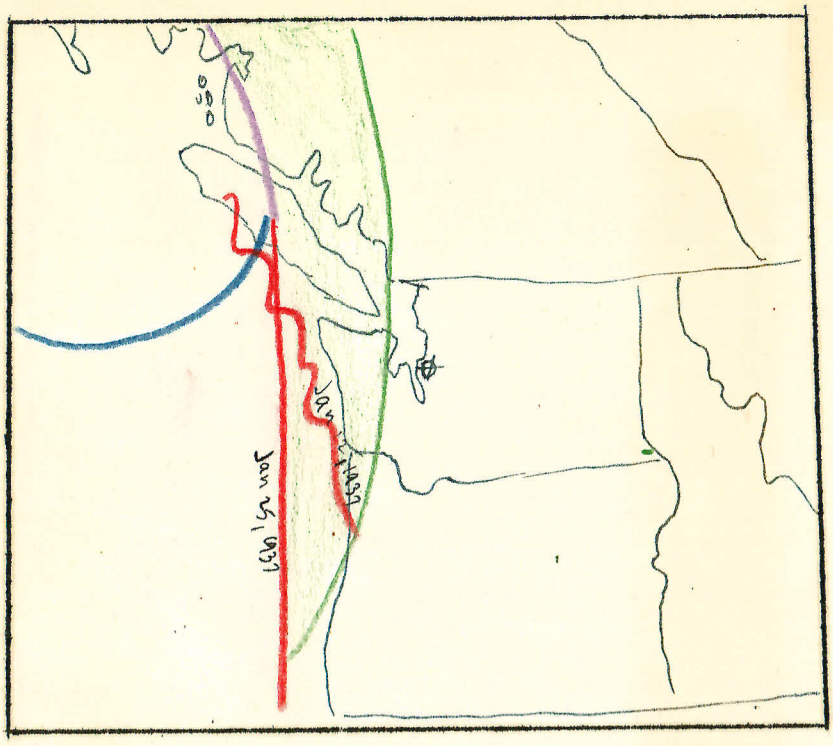
PHASE I


Type II A Phase 1
Pc
Pc
Pc
Pc
Pp
Rpp
Tg
Heavy solid lines represent boundaries between different bodies of air.
Numerals indicate approximate mean temperatures in areas indicated.
High and low pressure areas indicated by large H or L.
APPROX. SCALE 1" = 500 MILES


January 12, 1937
7:30 E.S.T.
Type II A
Phase 1
Pc
Pc1
Pc2
Pc0
3Pp
2Tp
4Rpp
4Pp
5Pp0
5Pc2
3Pc2
TA
TG
0Pp
4Pp2
0Tp
Tp
H
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.
APPROX. SCALE 1" = 500 MILES


January 25, 1937
7:30 E.S.T.
Type II A
Phase 1
Pp → Pc
Rpp
Pp
Pco
Pc
Rpco
Pc2
Pc4
TA
TG
Tp
H
L

Jan. 25
1937



Jan. 12
1937

SA

Type A
Phase 1

12 14 16 18 20 22 24 2 4 6 8 10 12 14 16 18 20 22 24 2 4 6 8 10 12 E.S.T.

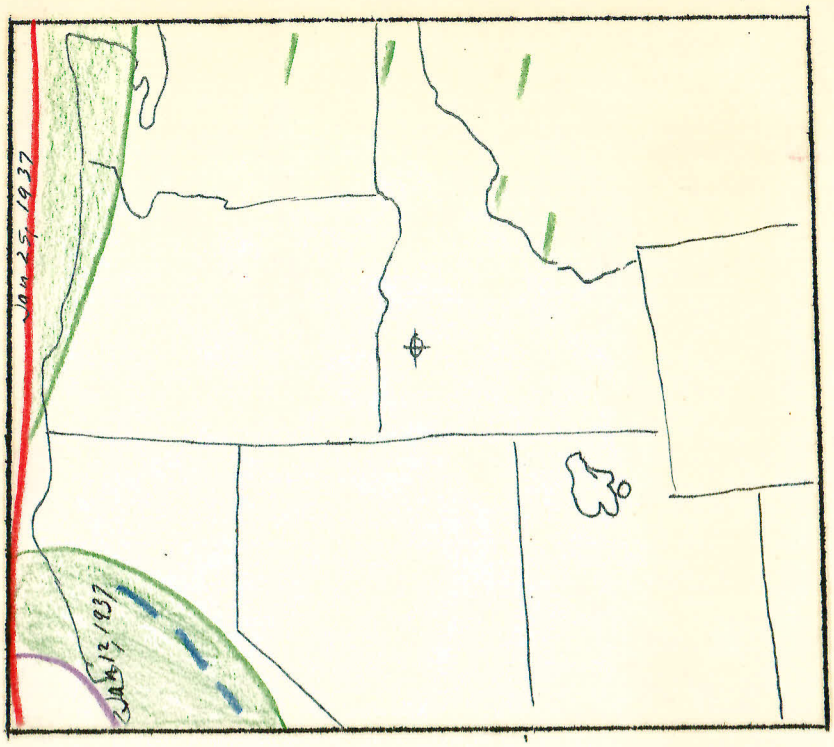
Ceiling (100ft):
100 60 20 10 6 2 0

Visibility (Mi):
12 10 8 6 4 2 0

Temperature °F
+60 +50 +40 +30 +20 +10

Phase 1

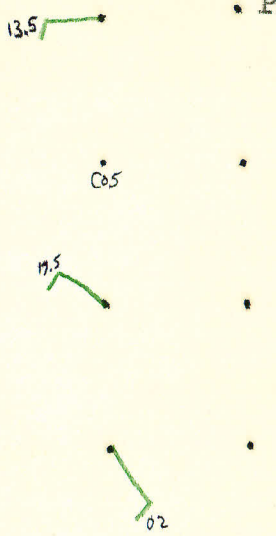
Jan. 25
1937

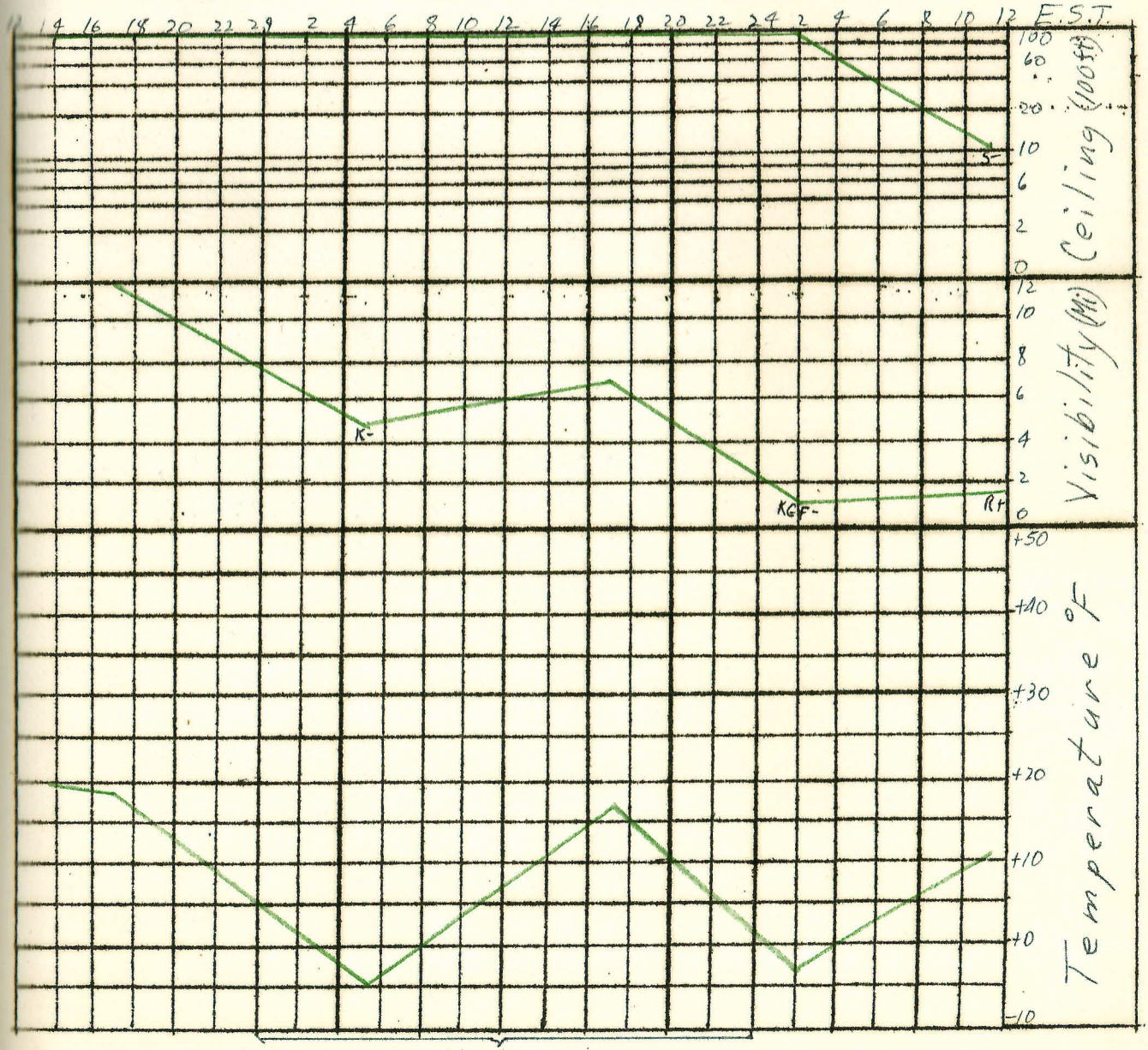


Jan. 12
1937

BE

Type A
Phase 1



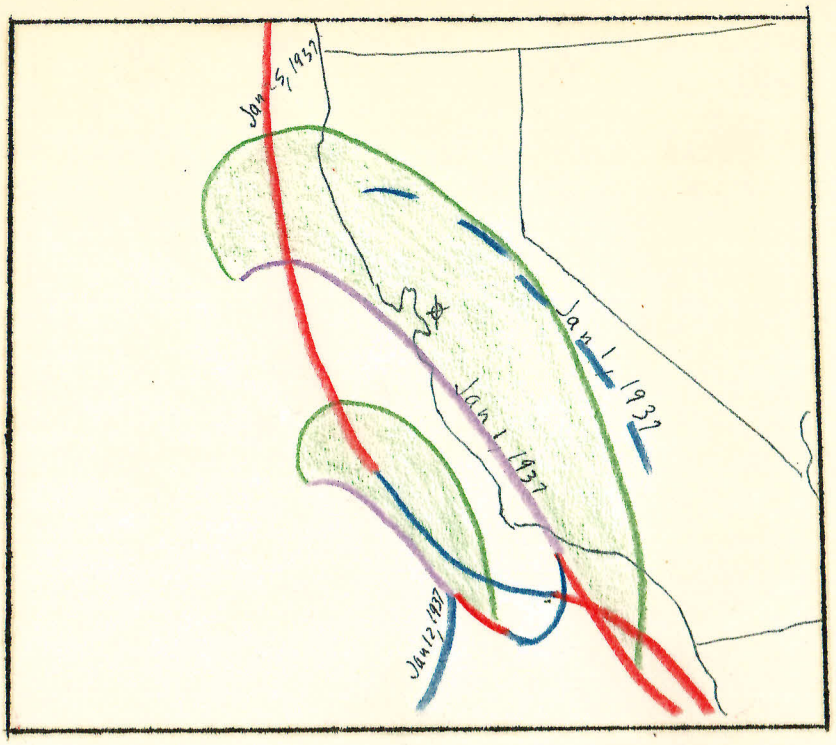


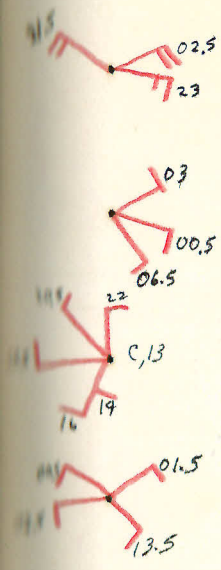
Jan. 25
1937

Jan. 12
1937

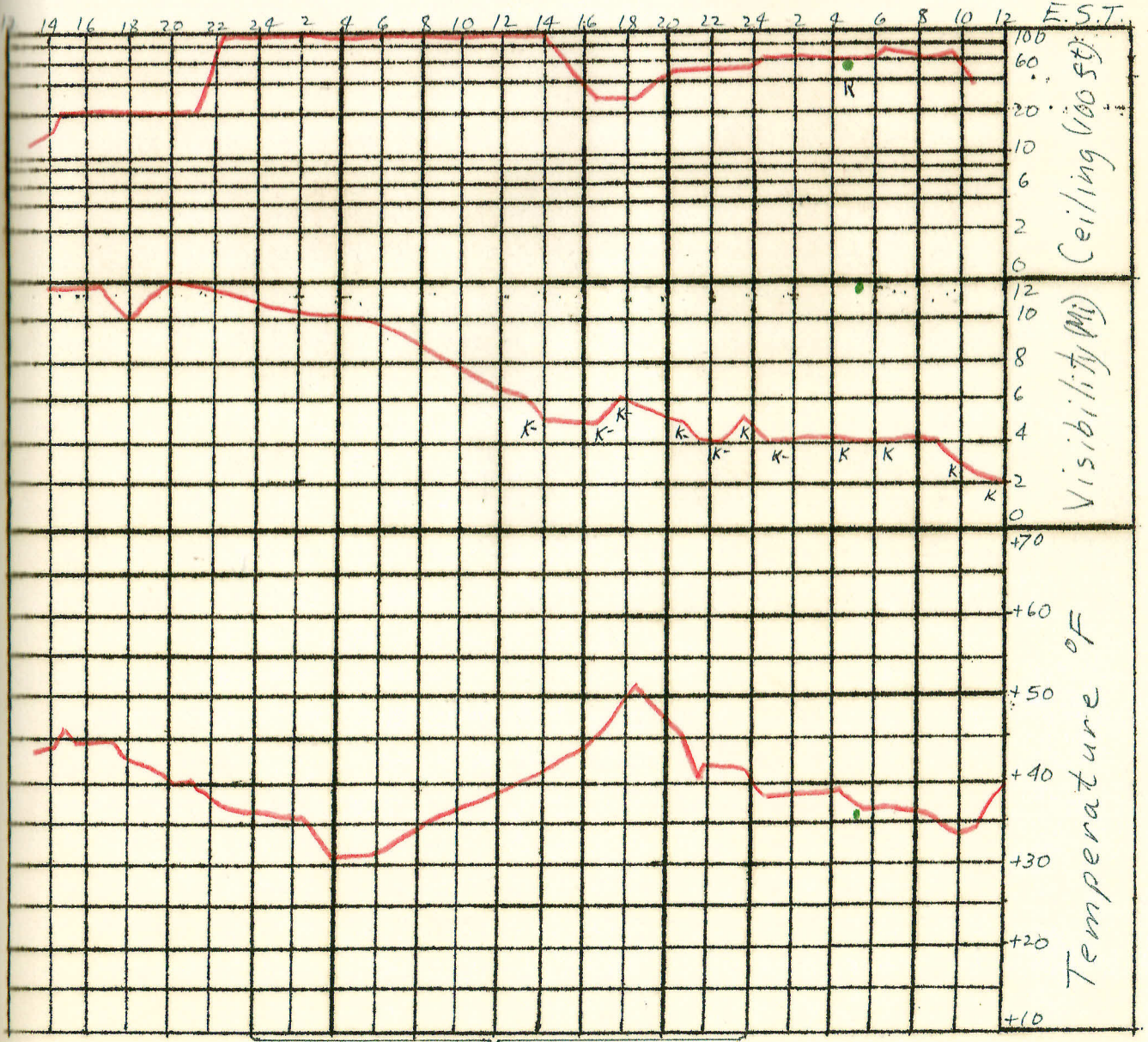
OA

Type A
Phase 1

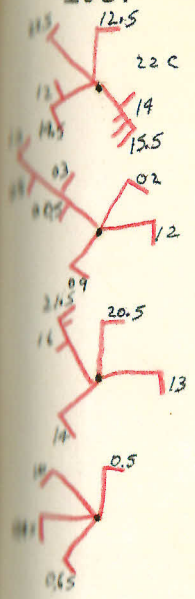


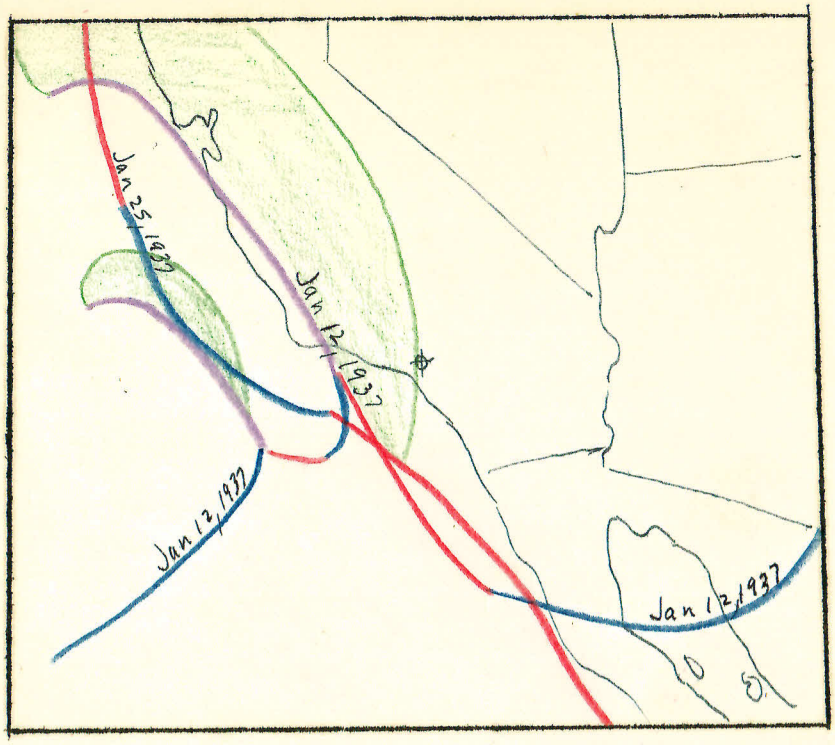






Jan. 25
1937

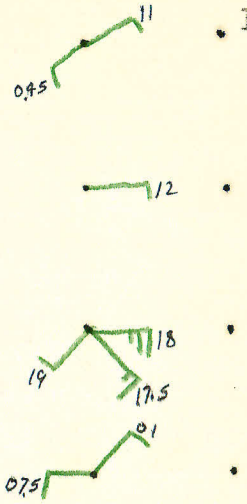


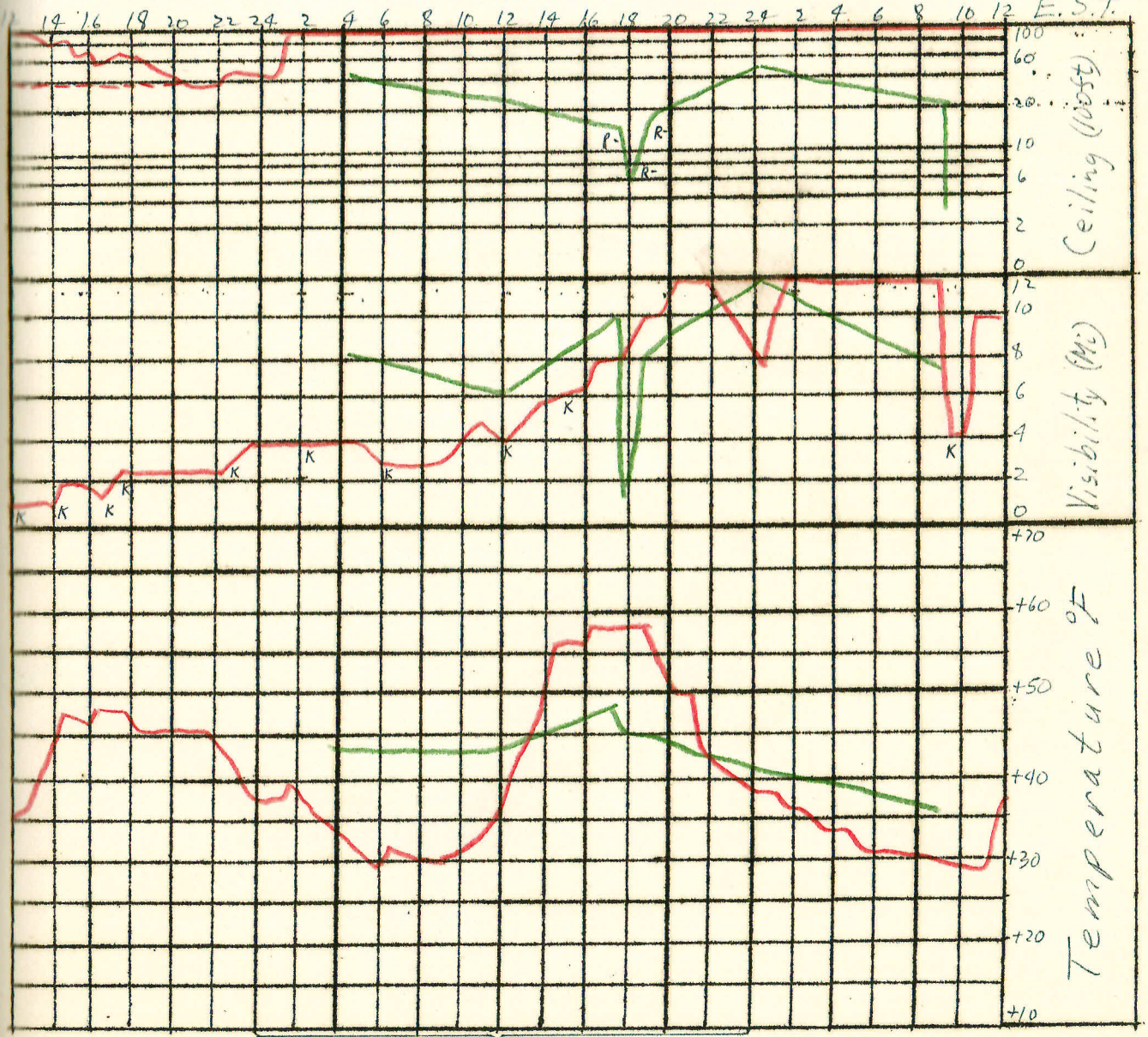


Jan. 12
1937

BU

Type A
Phase 1



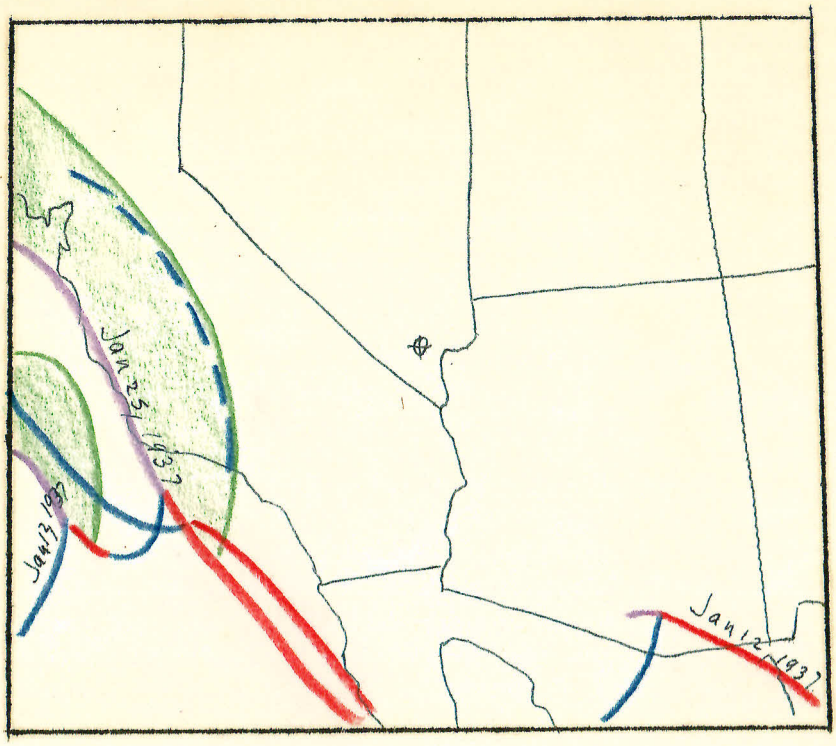


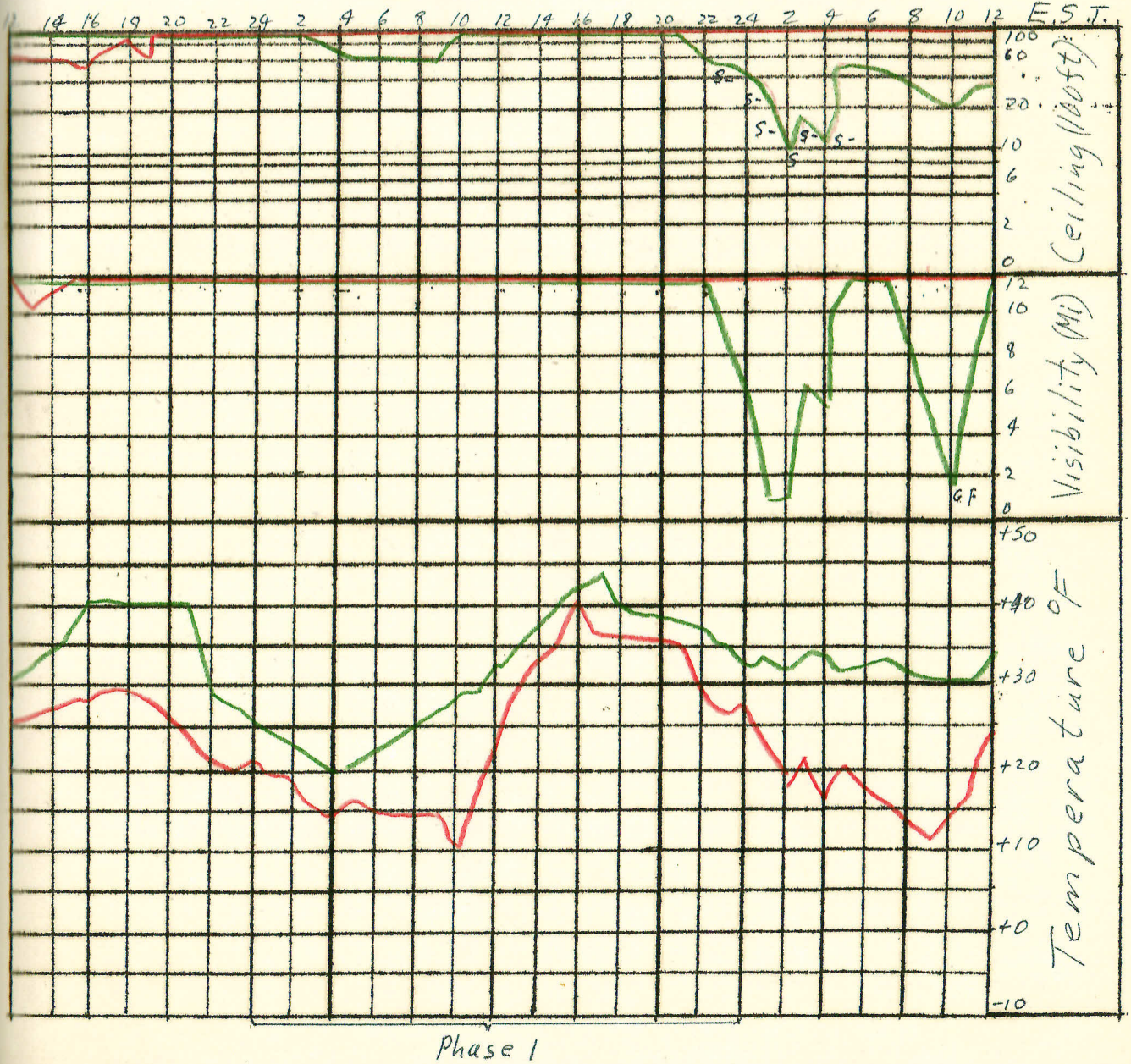
Jan. 25
1937

Jan. 12
1937

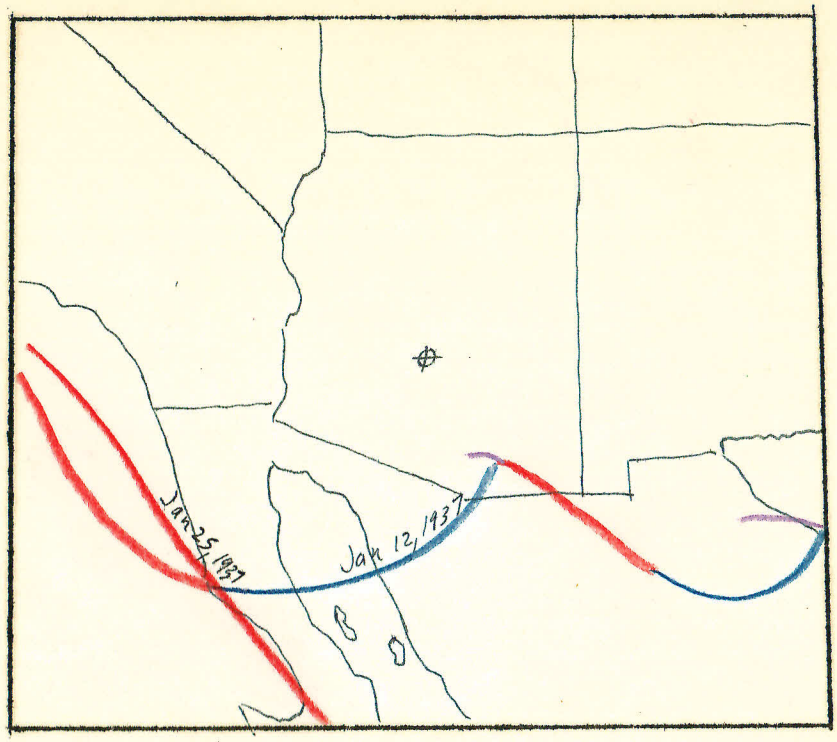
LQ

Type A
Phase 1





Jan. 25
1937



Jan. 12
1937

PH

Type A
Phase 1

E.S.T.

Ceiling (100 ft)

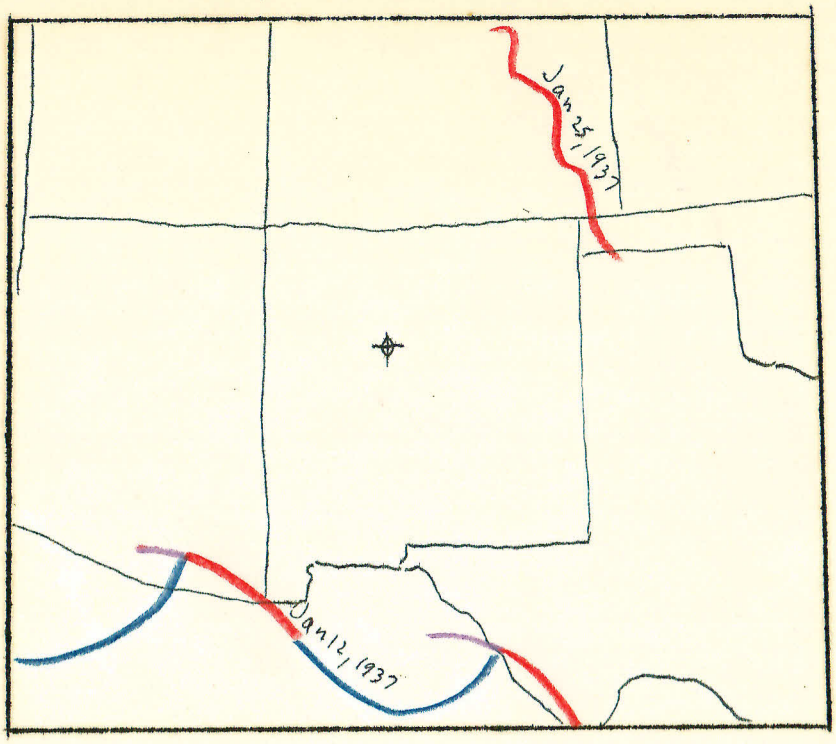
Visibility (Mi)

Temperature °F

Phase I

Jan. 25
1937



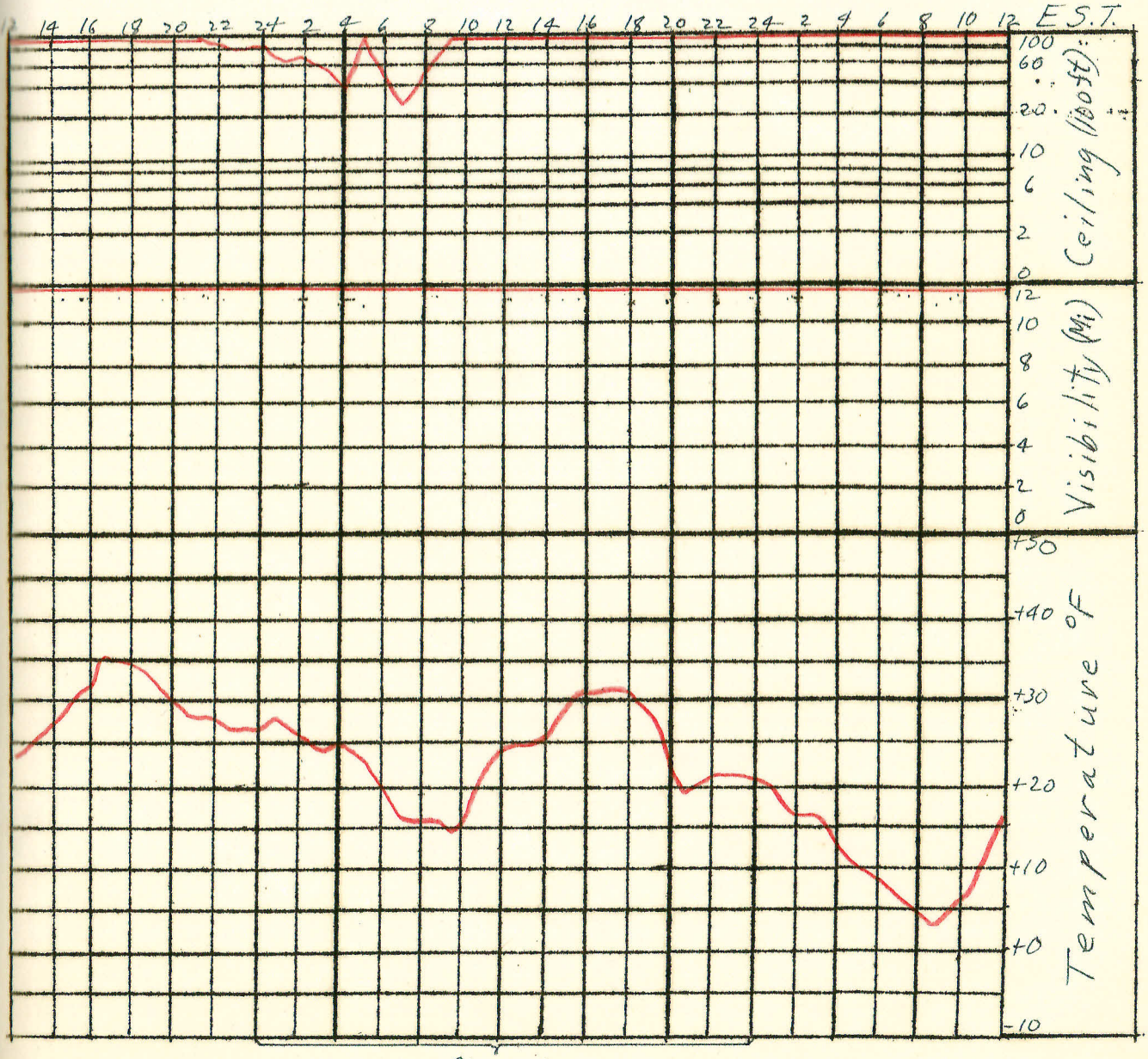


Jan. 12
1937

AB

Type A
Phase 1

09

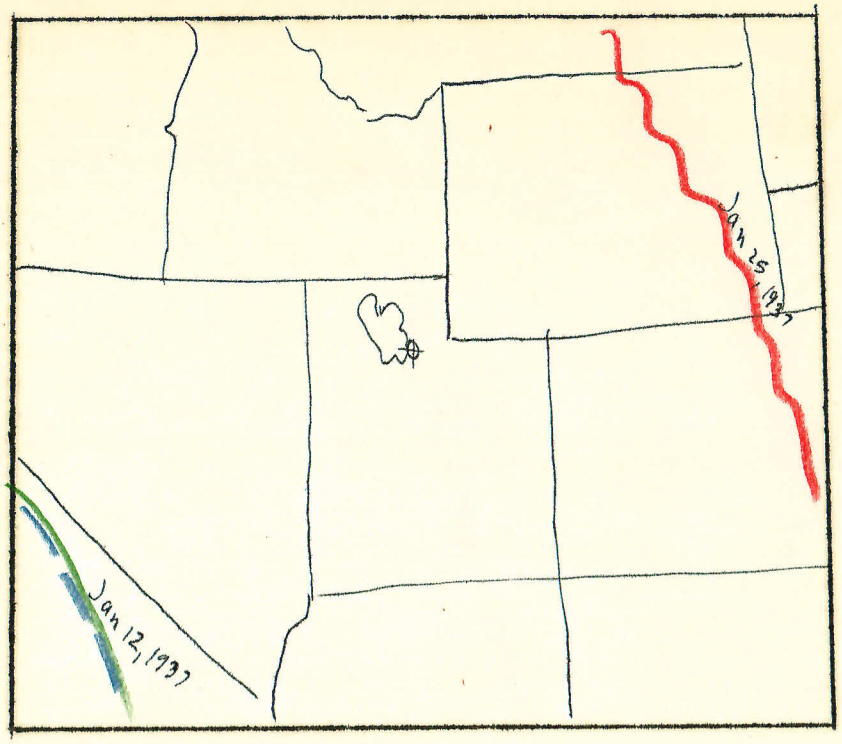


Phase 1

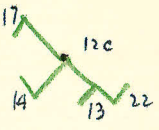
Jan. 25
1937

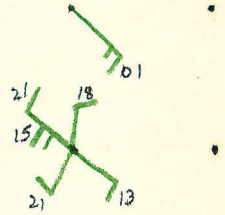


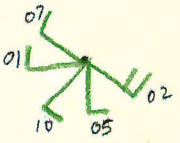




Jan. 12
1937

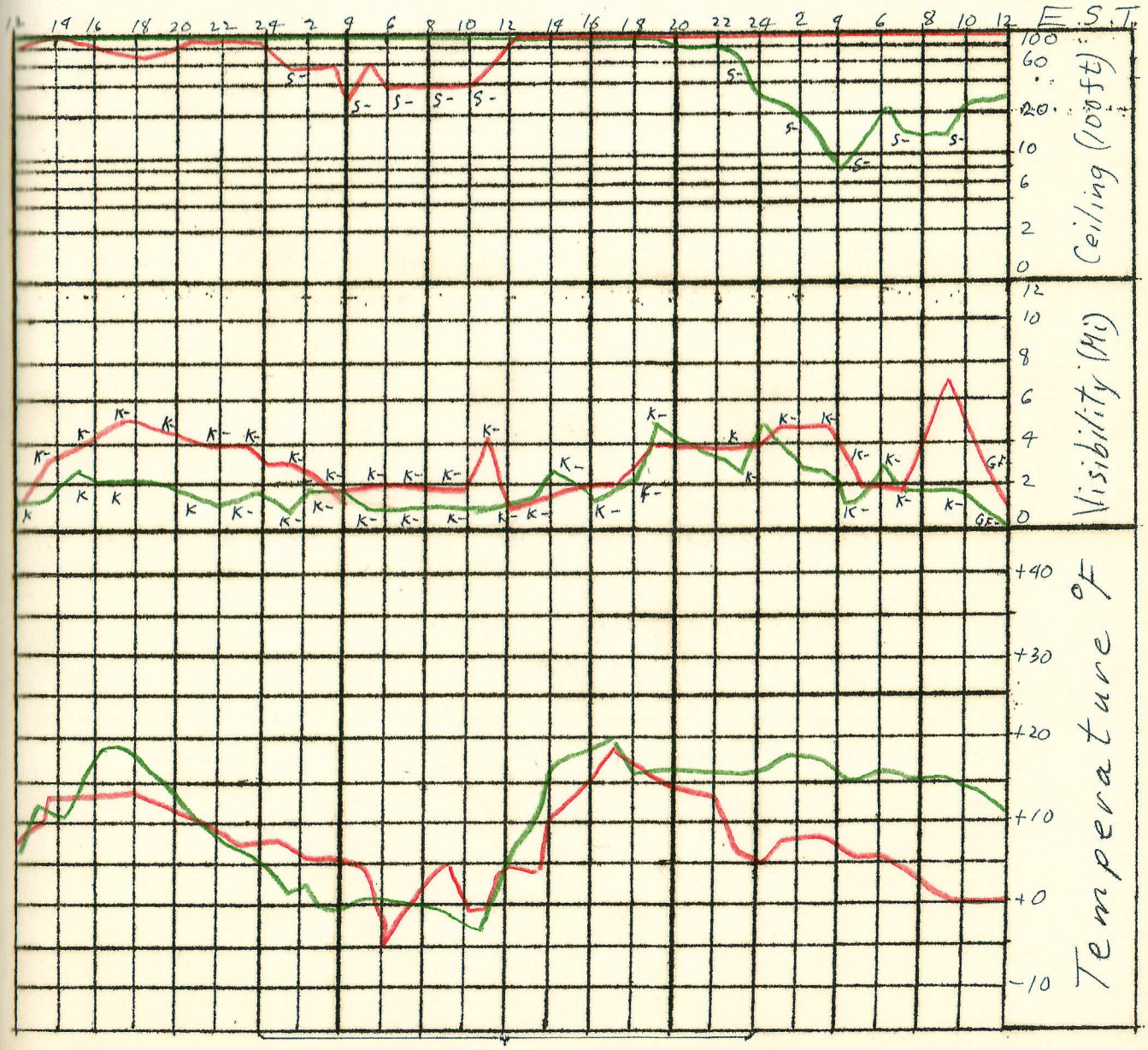






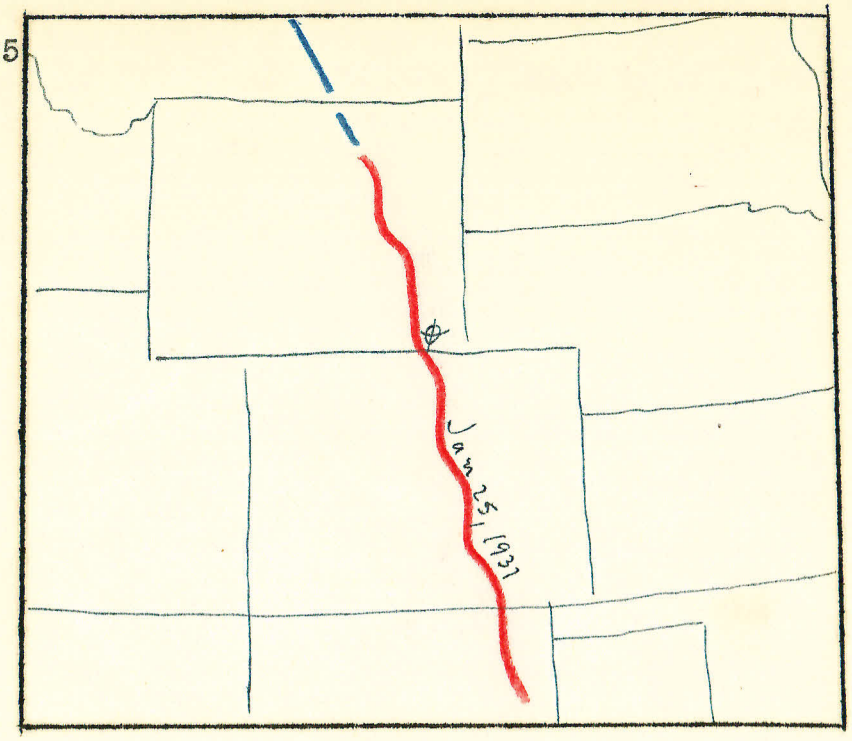
SL

Type A
Phase 1



Phase I

Jan. 25
1937



Jan. 12
1937

CX

Type A
Phase I

12 14 16 18 20 22 24 2 4 6 8 10 12 14 16 18 20 22 24 2 4 6 8 10 12 E.S.T.

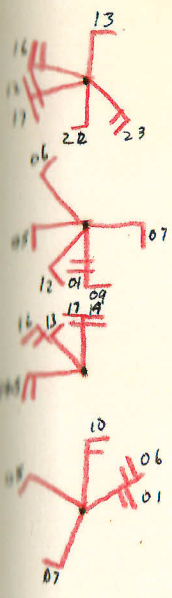
Ceiling (100 ft).
100
60
30
10
6
2
0

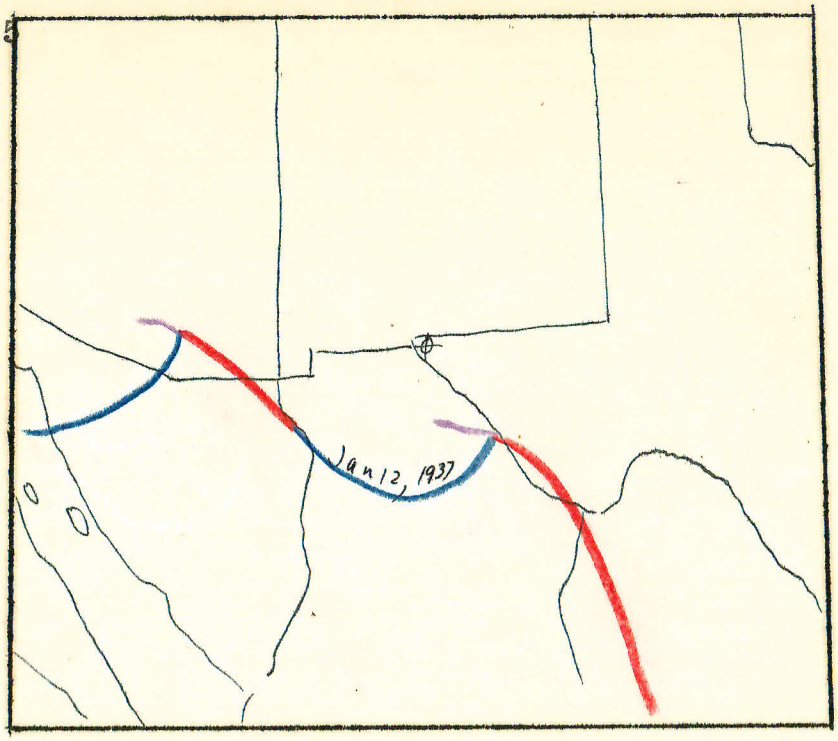
Visibility (Mi)
12
10
8
6
4
2
0

Temperature °F
+40
+30
+20
+10
0
-10
-20

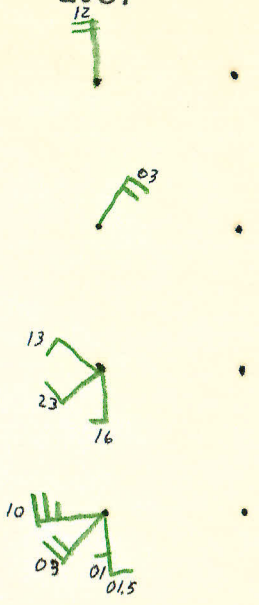
Phase I

Jan. 25
1937



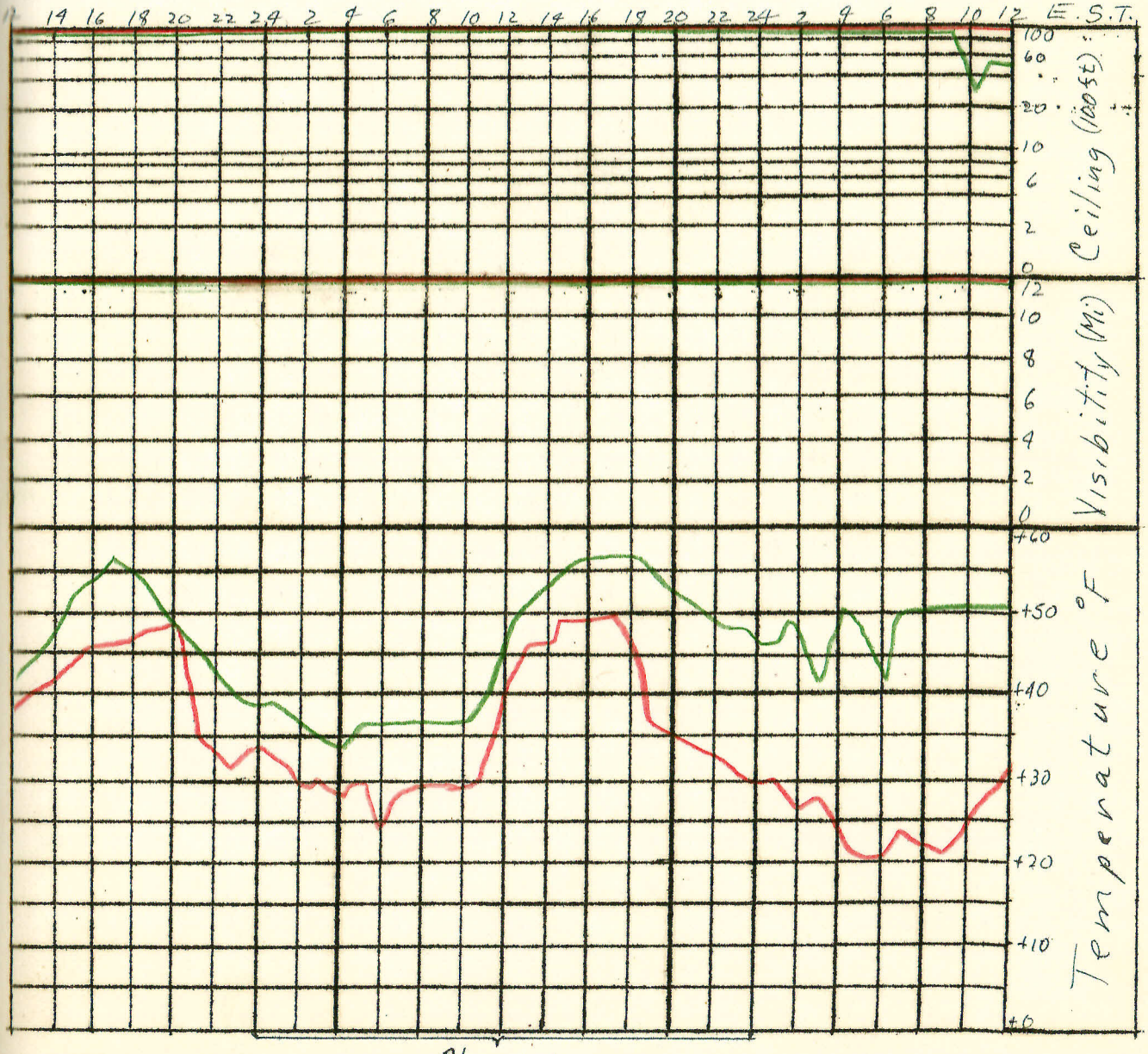


Jan. 12
1937



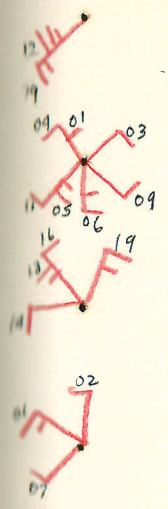
EO

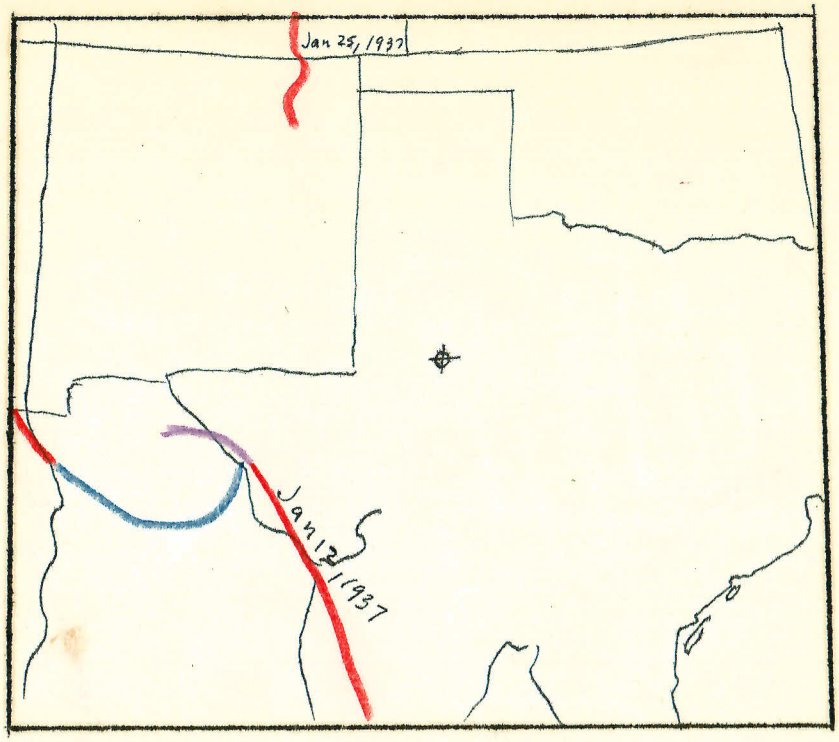
Type A
Phase



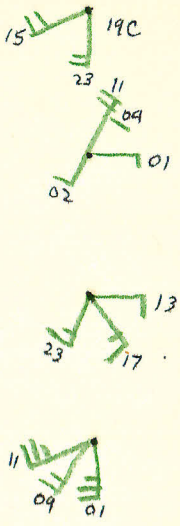
Phase I

Jan. 25
1937



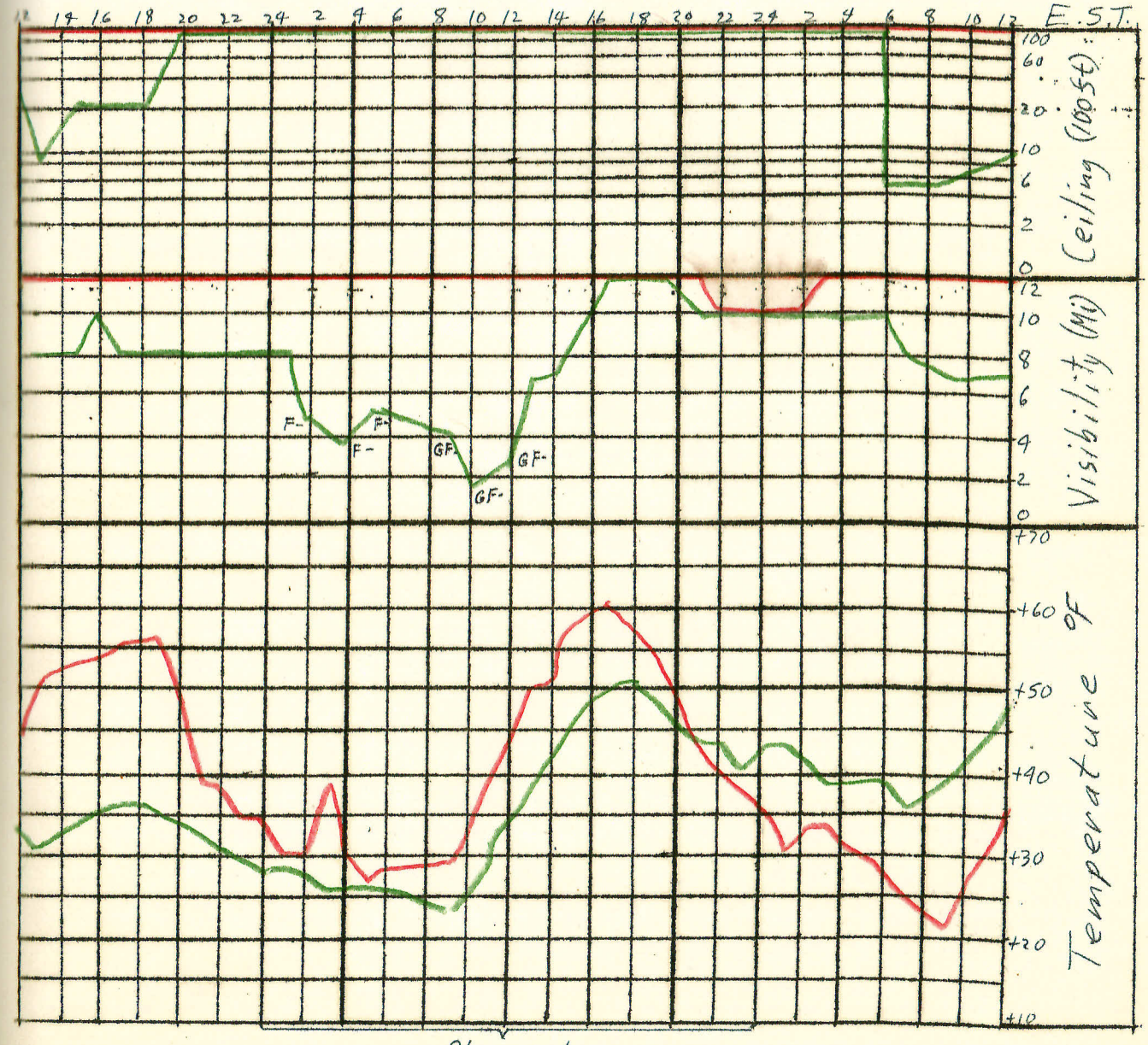


Jan. 12
1937



BZ

Type A
Phase 1

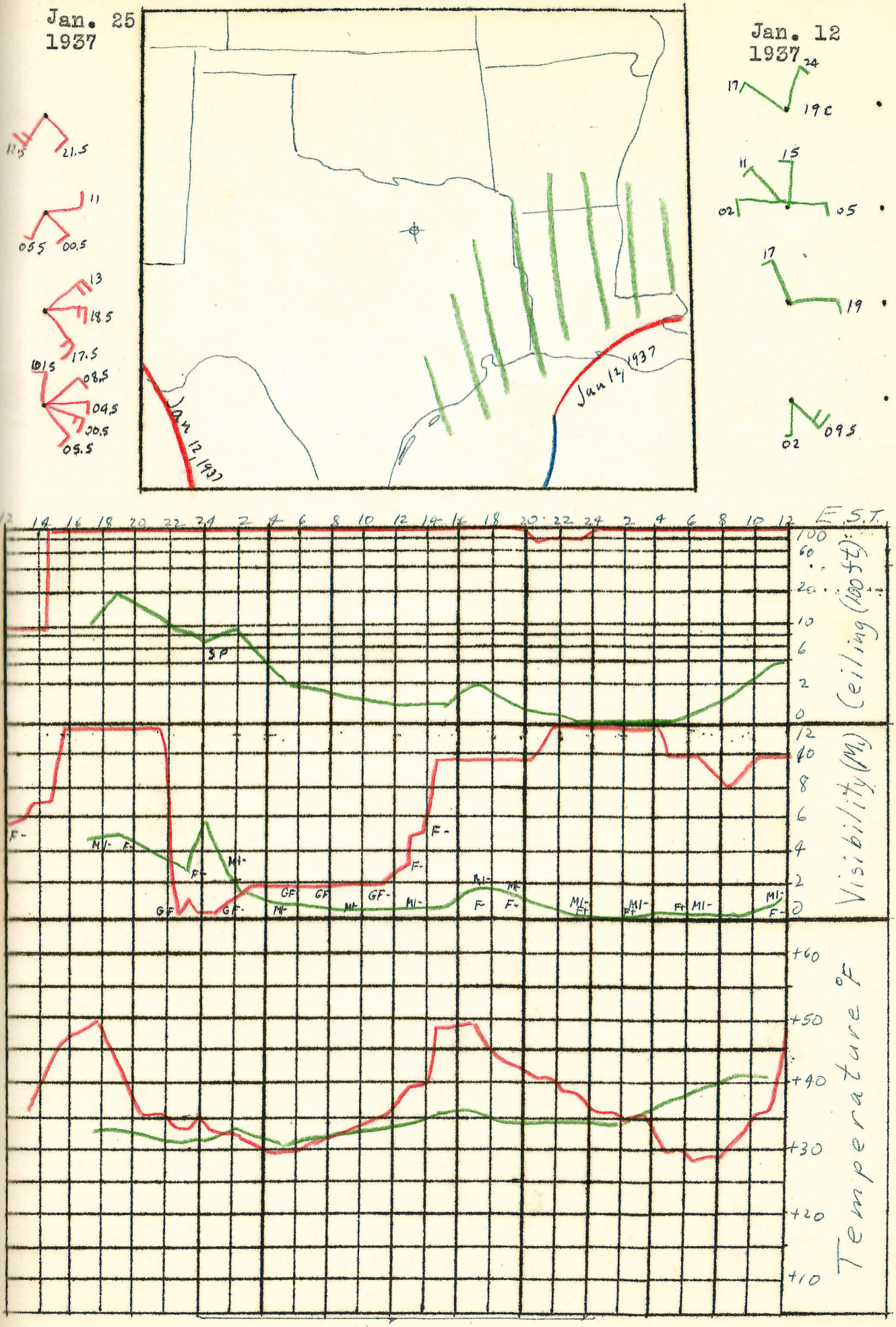


Jan. 25
1937

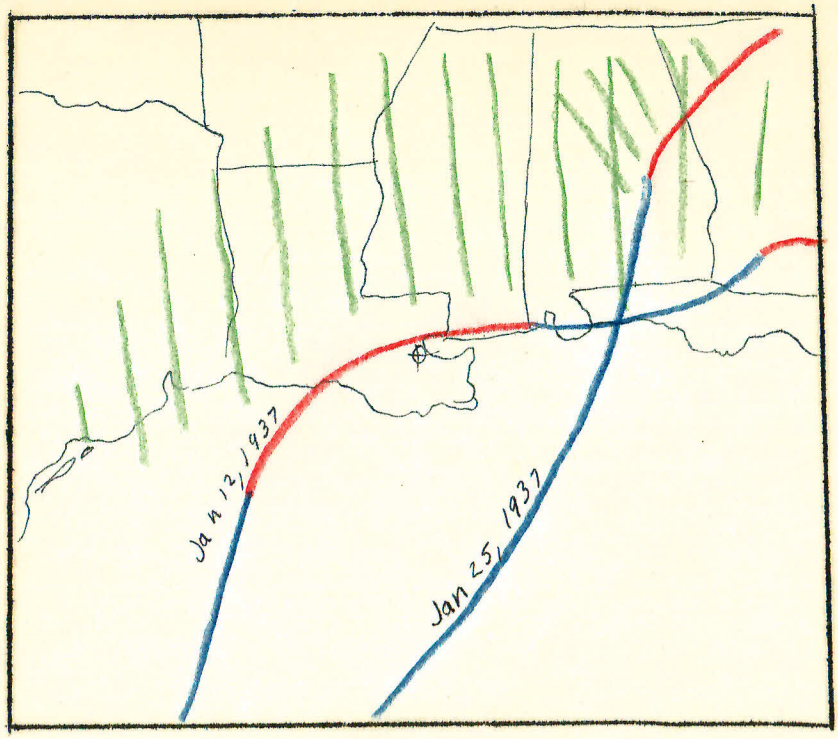
Jan. 12
1937

DL

Type A
Phase I



Jan. 25
1937



Jan. 12
1937

NO

Type A
Phase 1

12 14 16 18 20 22 24 2 4 6 8 10 12 14 16 18 20 22 24 2 4 6 8 10 12 E.S.T.

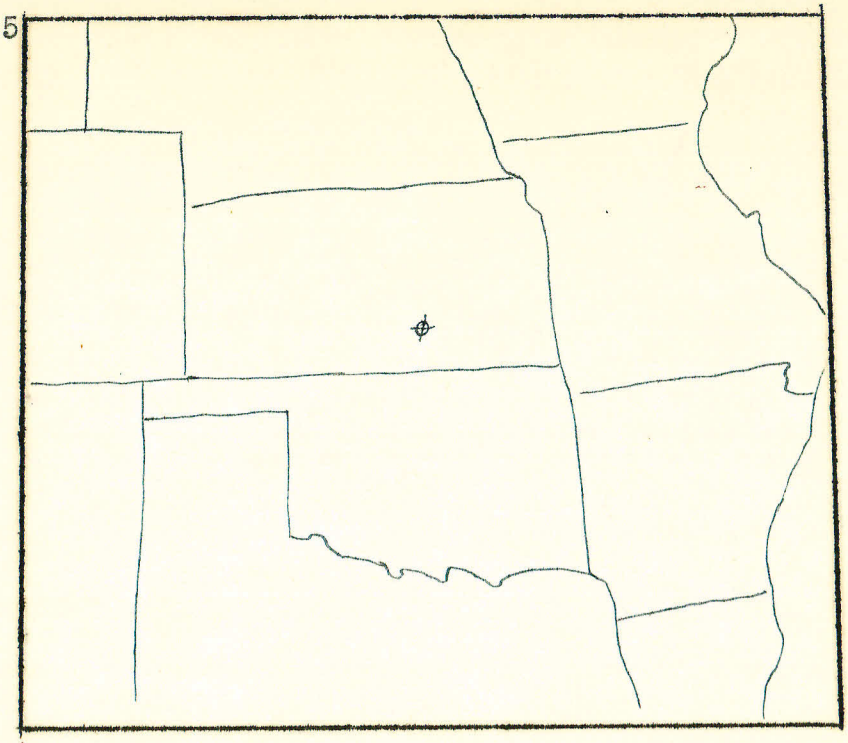
Ceiling (100ft): 100 60 20 10 6 2 0

Visibility (Mi): 12 10 8 6 4 2 0

Temperature °F: 180 170 160 150 140 130 120

Phase I

Jan. 25
1937



Jan. 12
1937

WD

Type A
Phase 1

12 14 16 18 20 22 24 2 4 6 8 10 12 14 16 18 20 22 24 2 4 6 8 10 12 E.S.T.

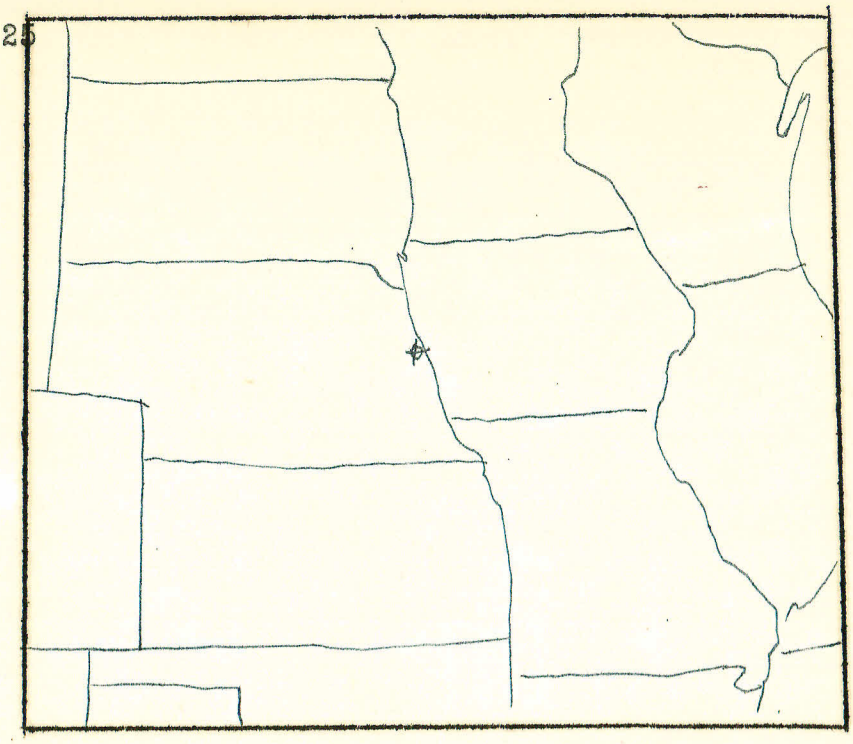
Ceiling (100 ft)
100
60
20
10
6
2
0

Visibility (Mi)
12
10
8
6
4
2
0

Temperature °F
+40
+30
+20
+10
+0
-10

phase1

Jan. 25
1937



Jan. 12
1937

OH

Type A
Phase 1

14 16 18 20 22 24 2 4 6 8 10 12 14 16 18 20 22 24 2 4 6 8 10 12 E.S.T.

Ceiling (100 ft): 100 60 20 10 6 2 0

Visibility (Mi): 12 10 8 6 4 2 0

Temperature °F: +40 +30 +20 +10 +0 -10 -20

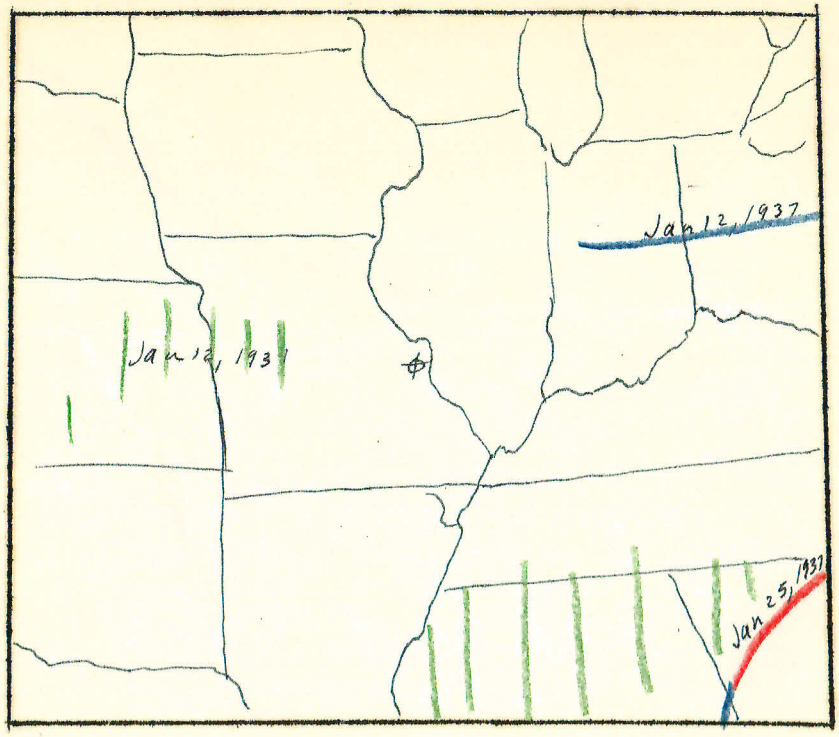
Phase 1

Jan. 25
1937

Jan. 12
1937

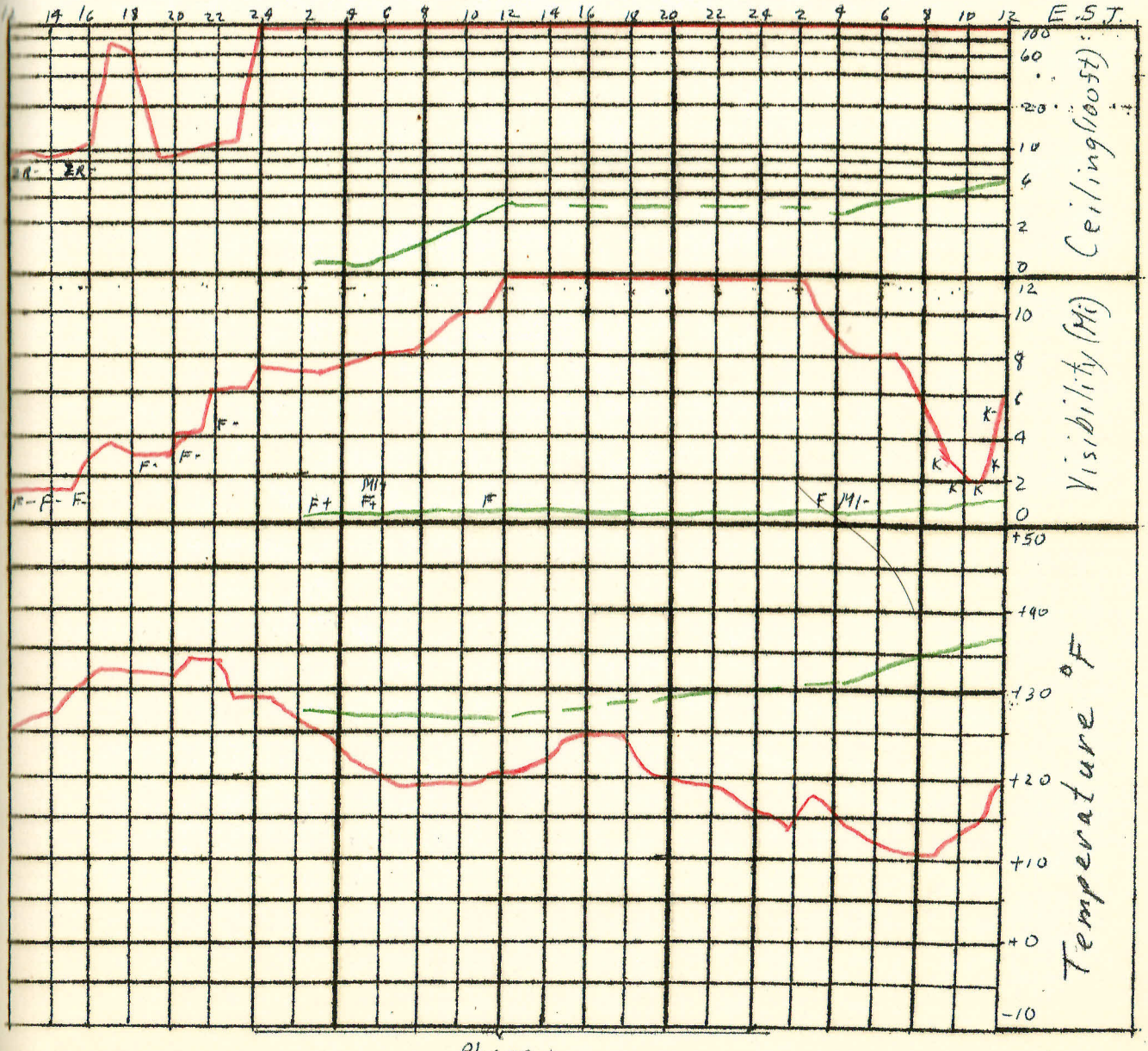
LS

Type A
Phase 1



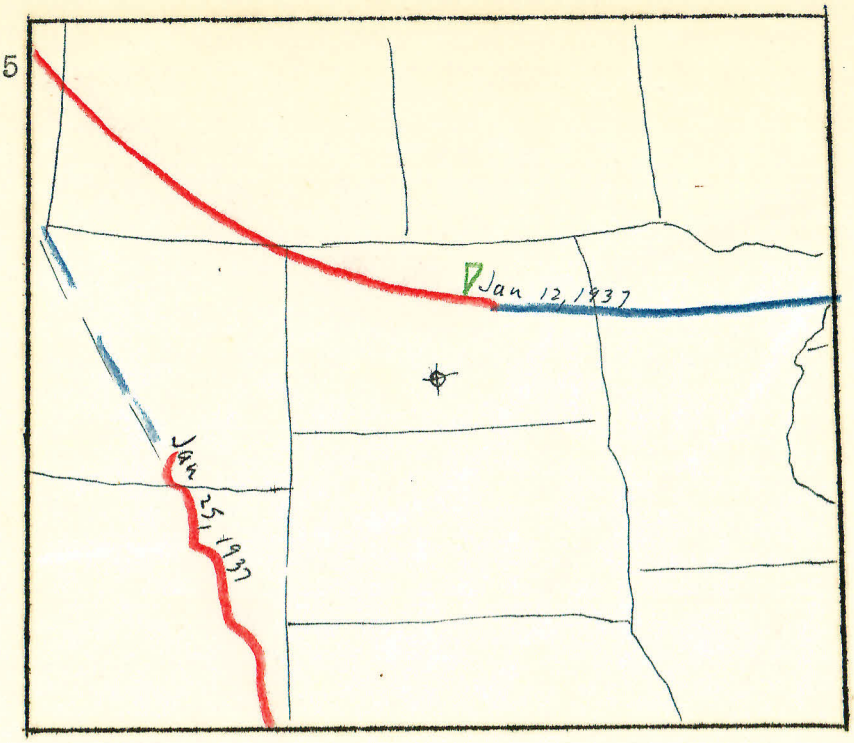






Phase 1

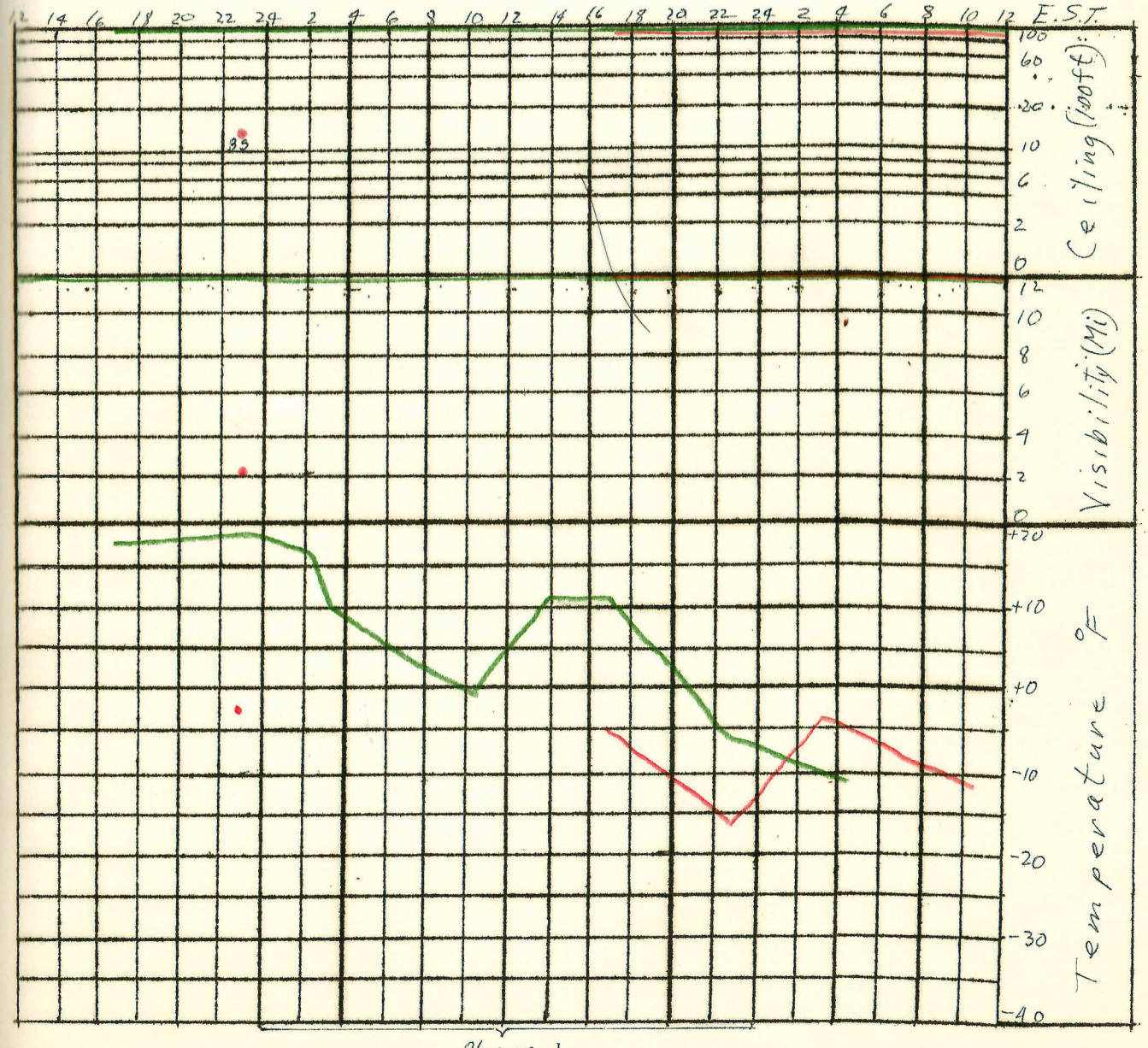
Jan. 25
1937



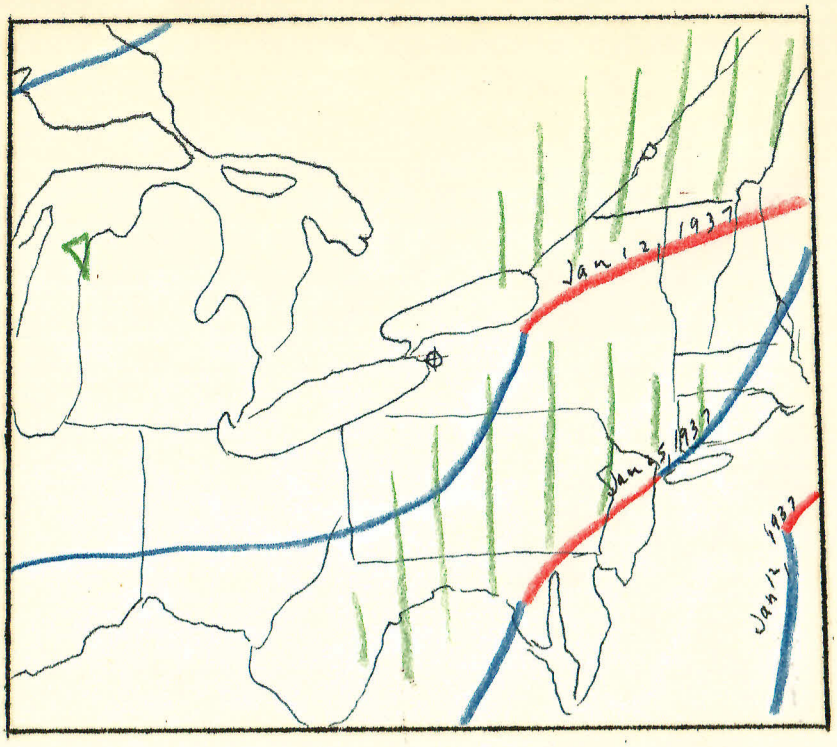
Jan. 12
1937

RK

Type A
Phase 1



Jan. 25
1937

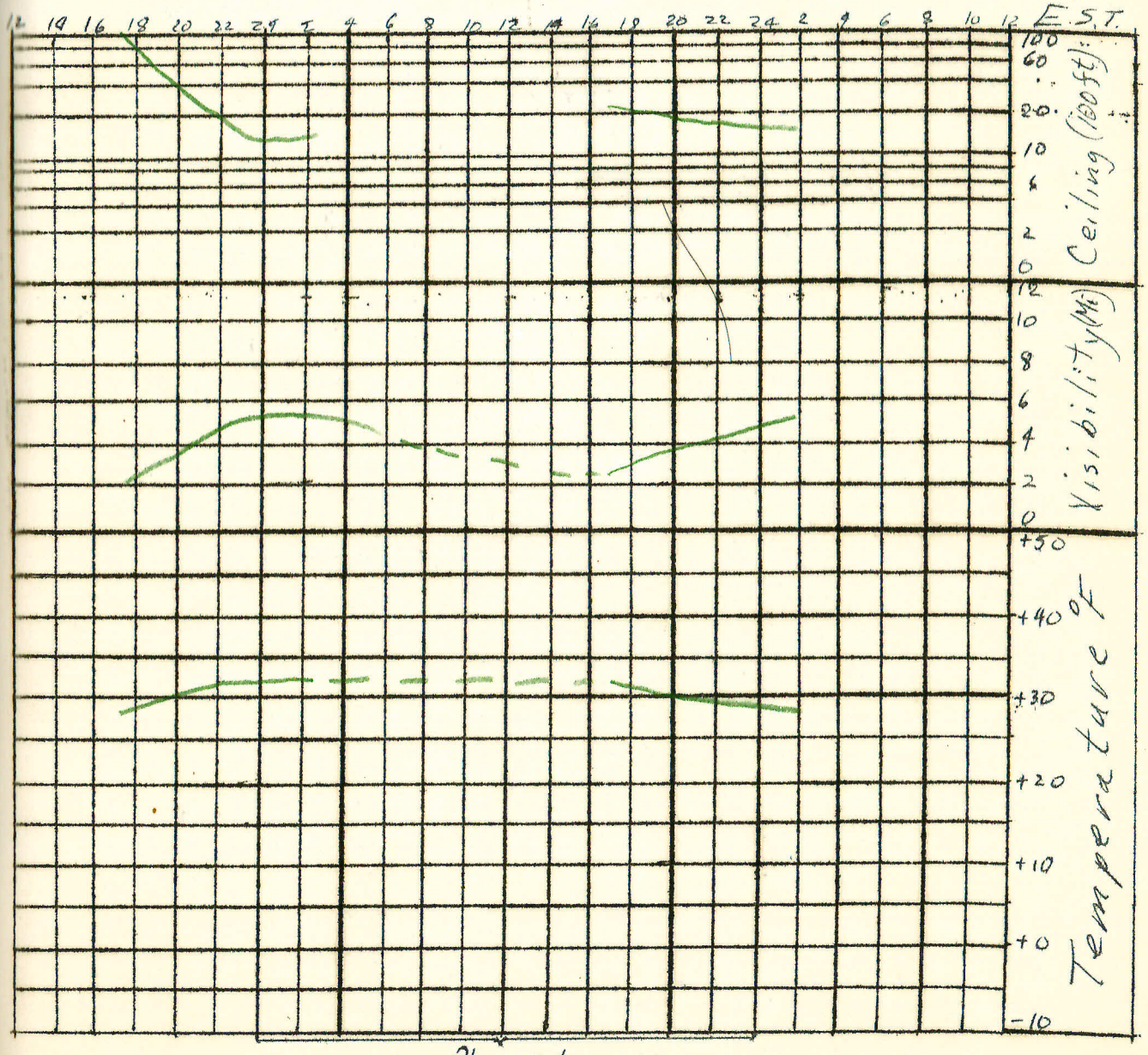


Jan. 12
1937



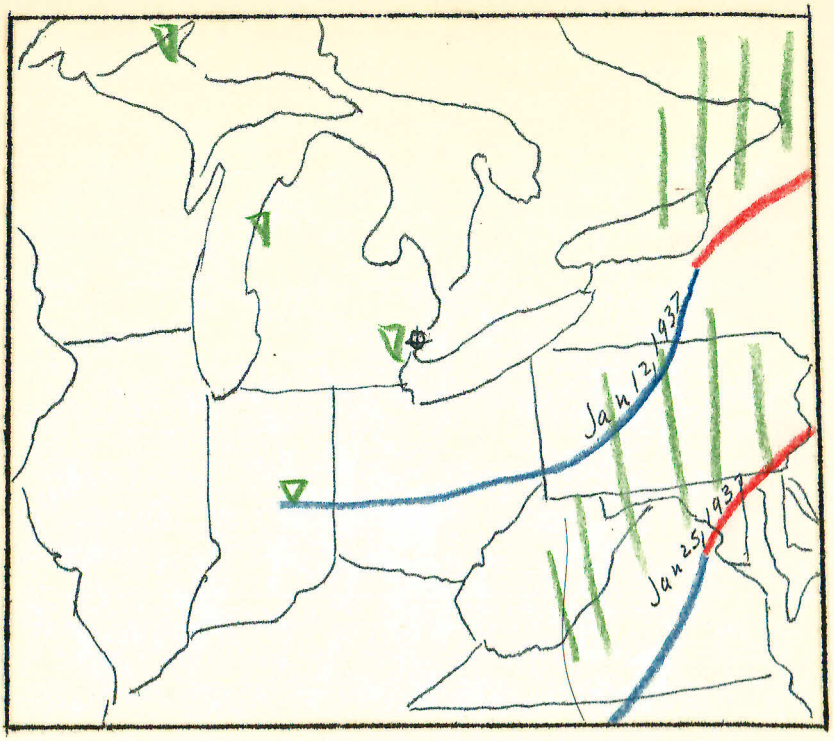
BJ

Type A
Phase 1



Phase 1

Jan. 25
1937



Jan. 12
1937

DO

Type A
Phase 1

E.S.T.

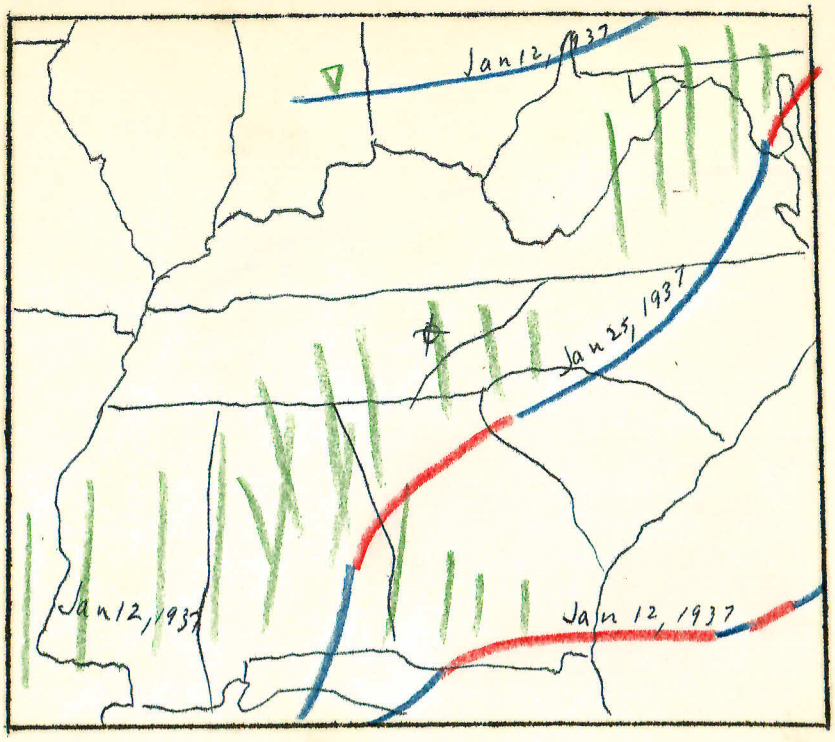
Ceiling (100 ft)

Visibility (Mi)

Temperature °F

Phase I

Jan. 25
1937

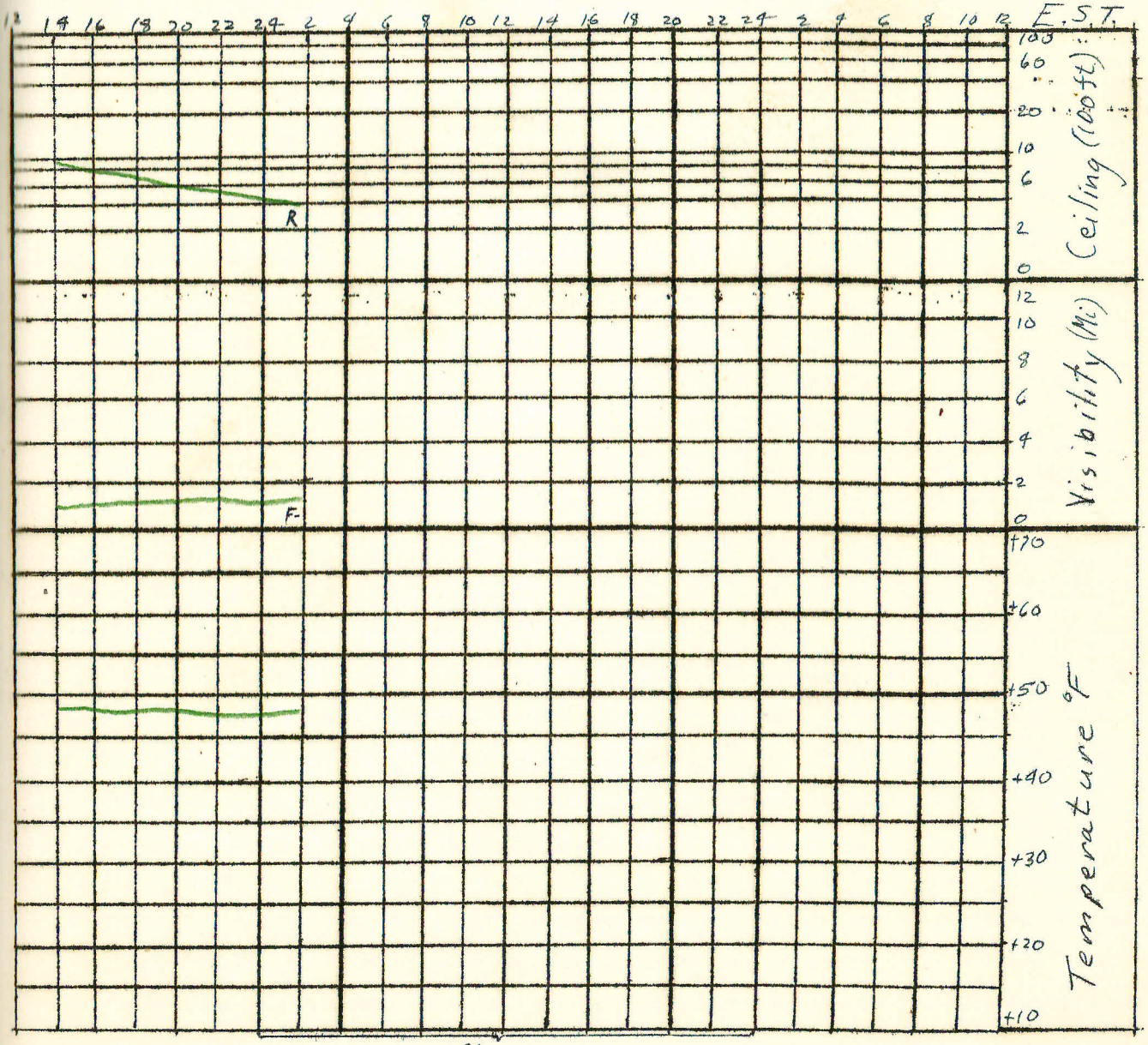


Jan. 12
1937

KX

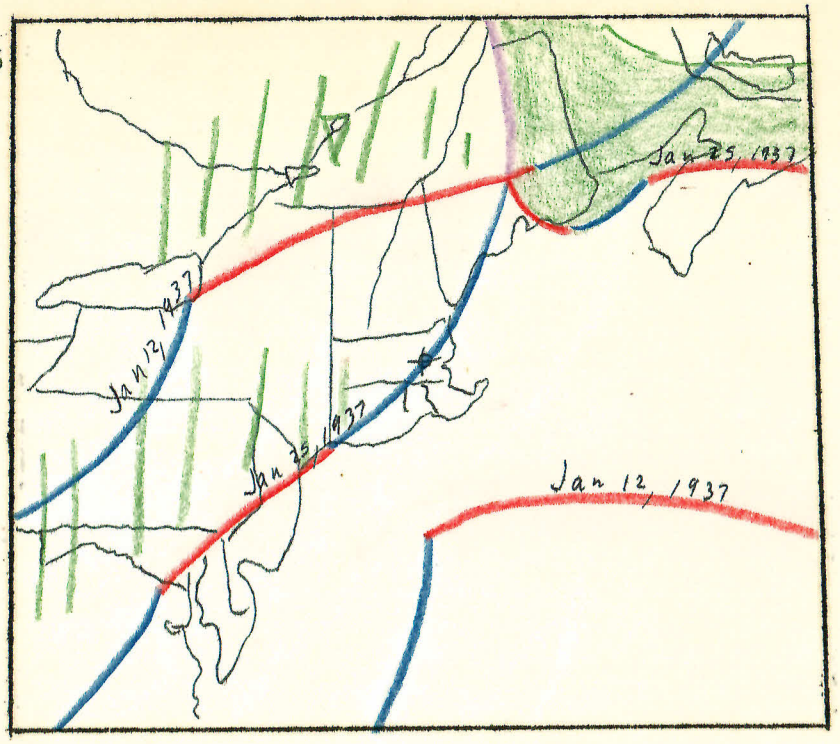
Type A
Phase1





Phase 1

Jan. 25
1937

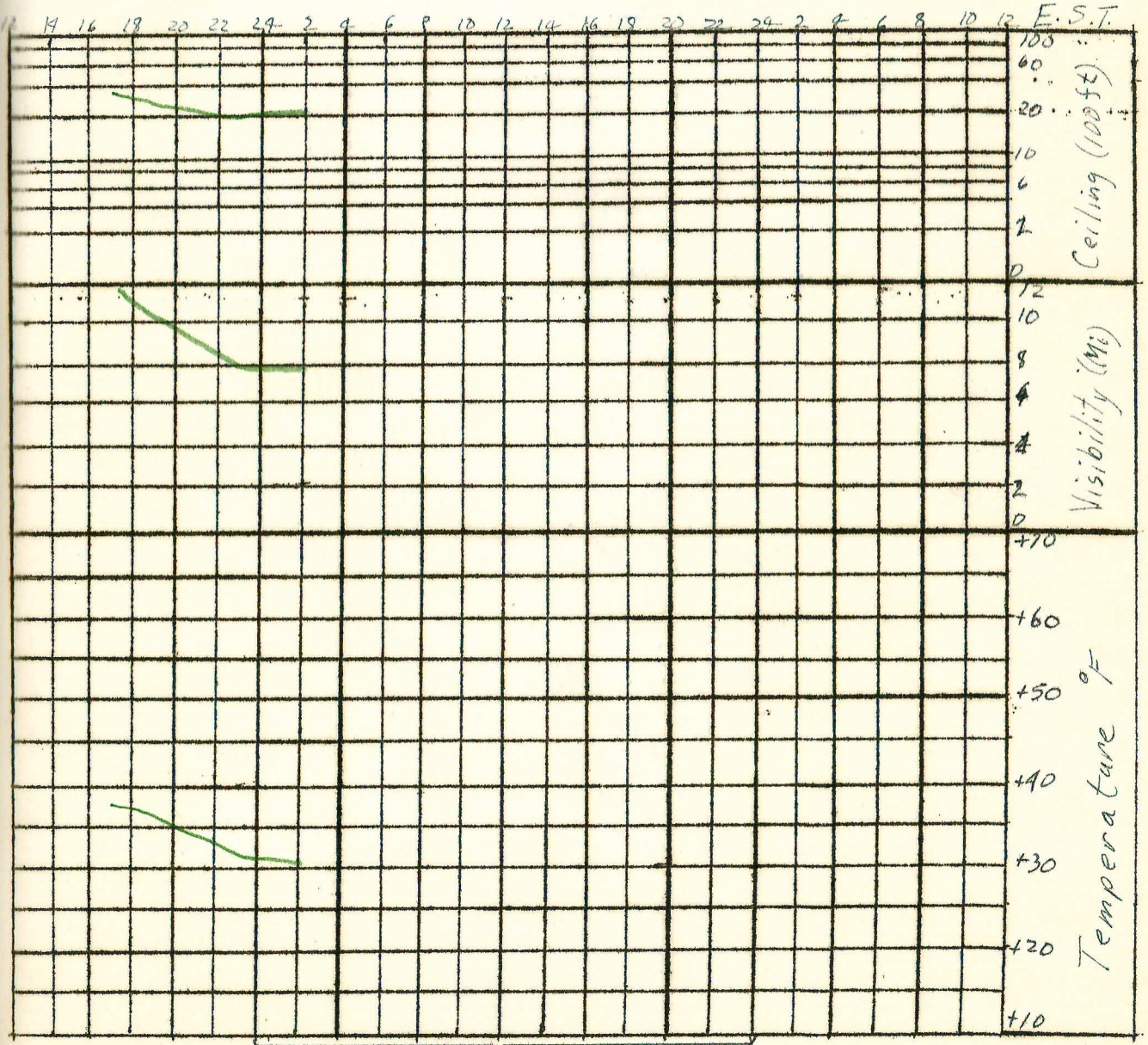


Jan. 12
1937

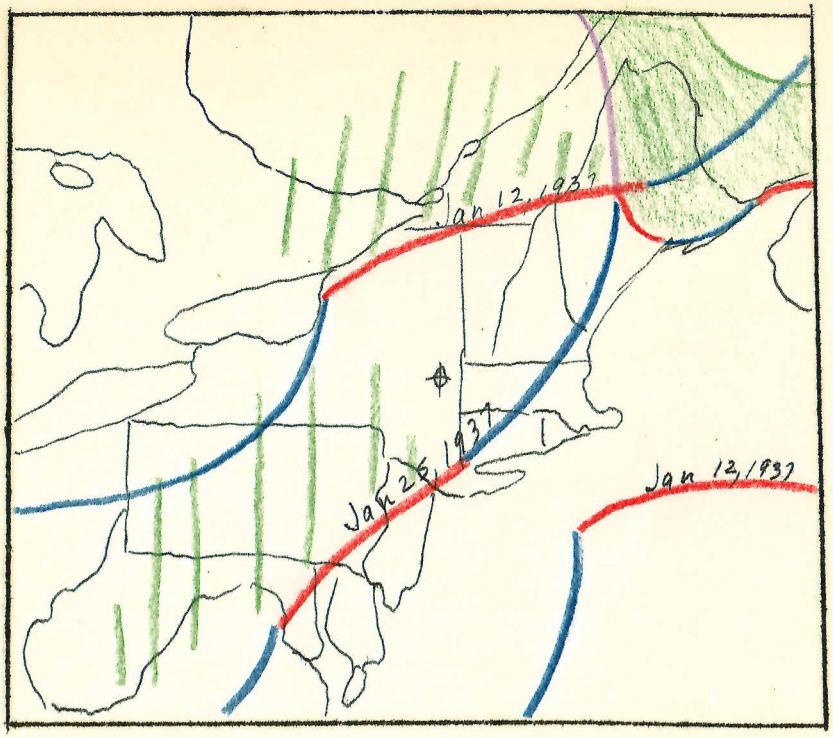


BW

Type A
Phase 1



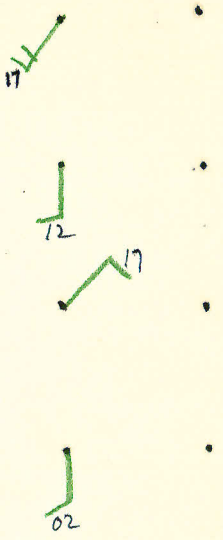
Jan. 25
1937

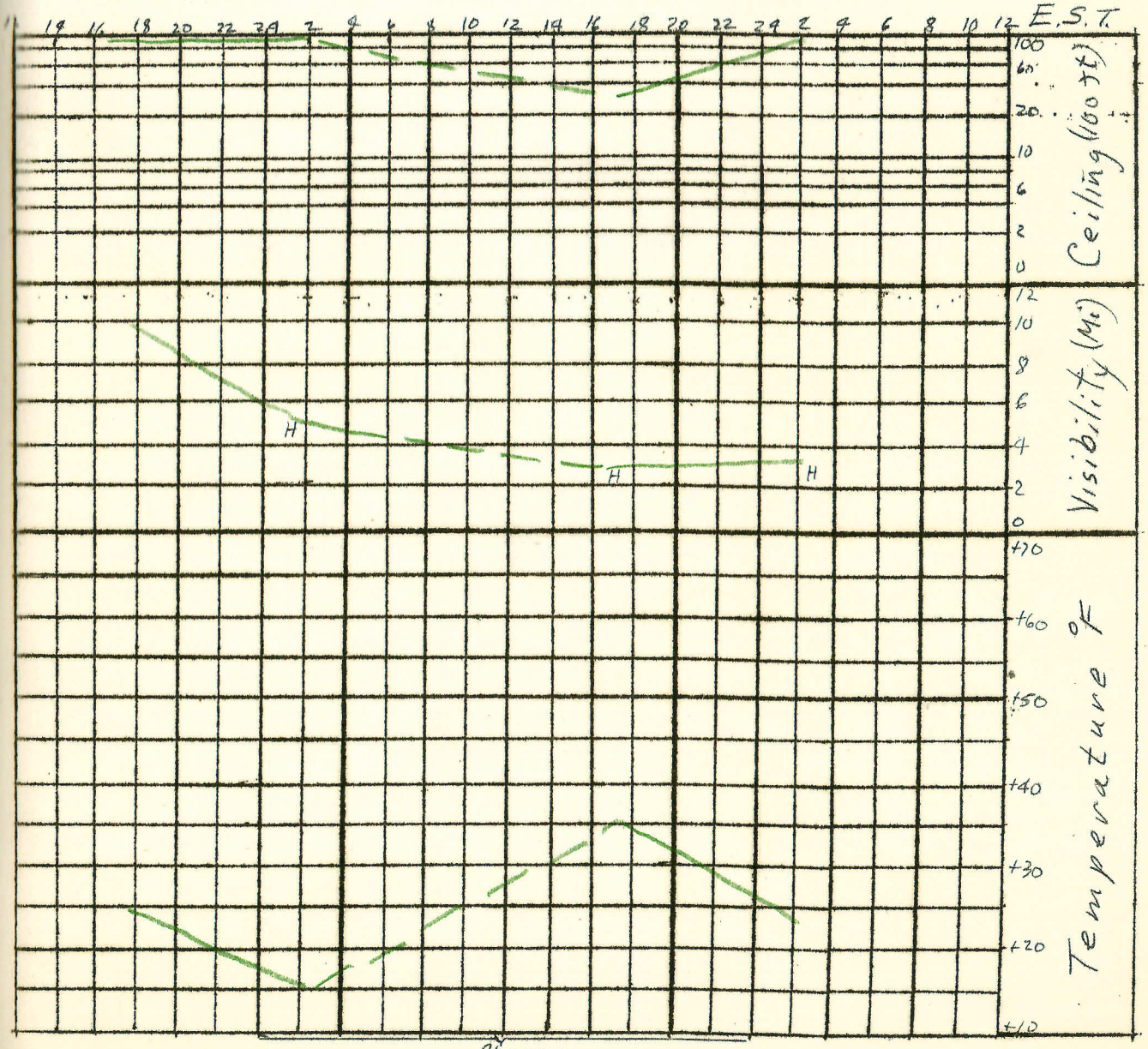


Jan. 12
1937

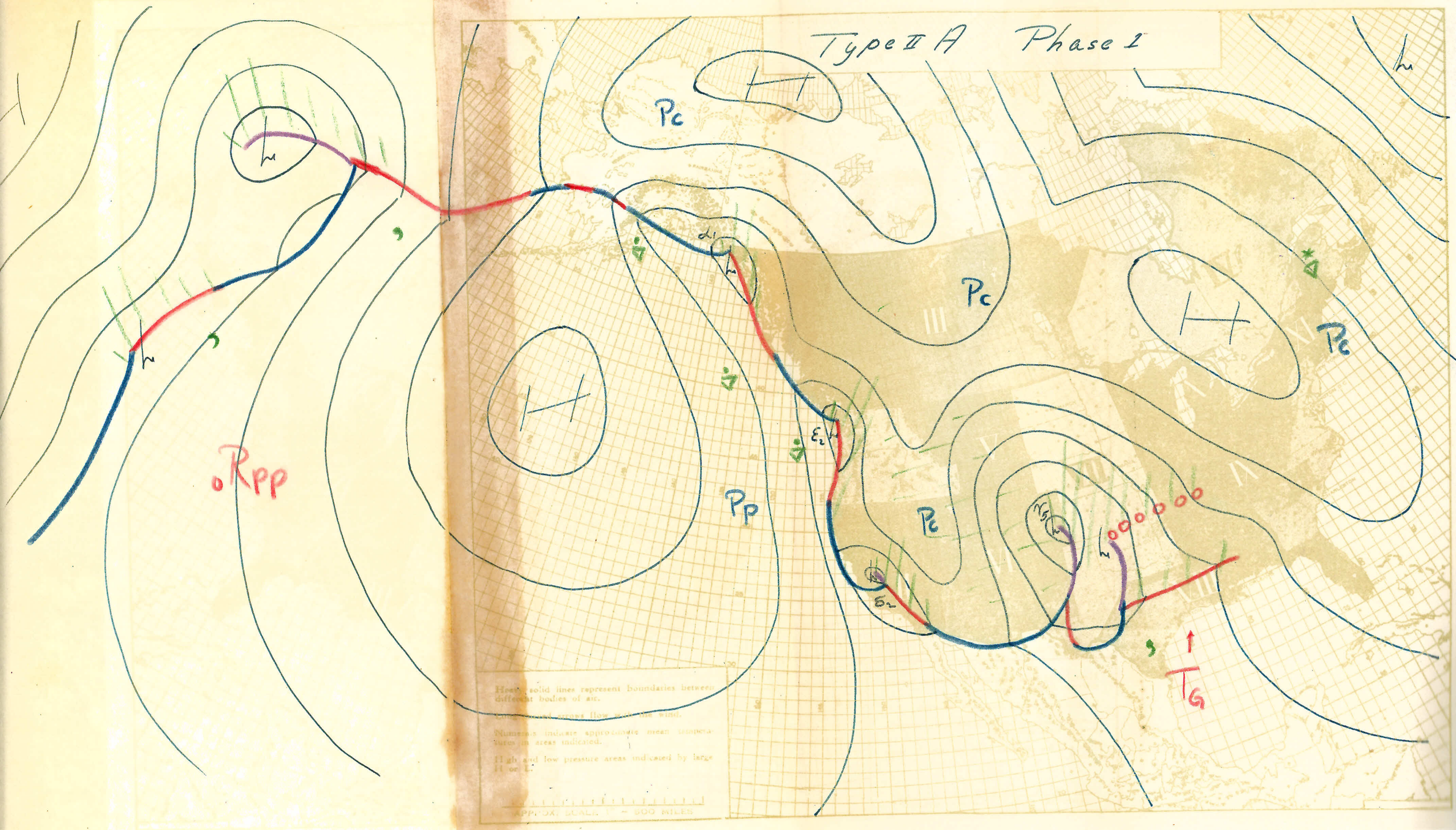
AZ

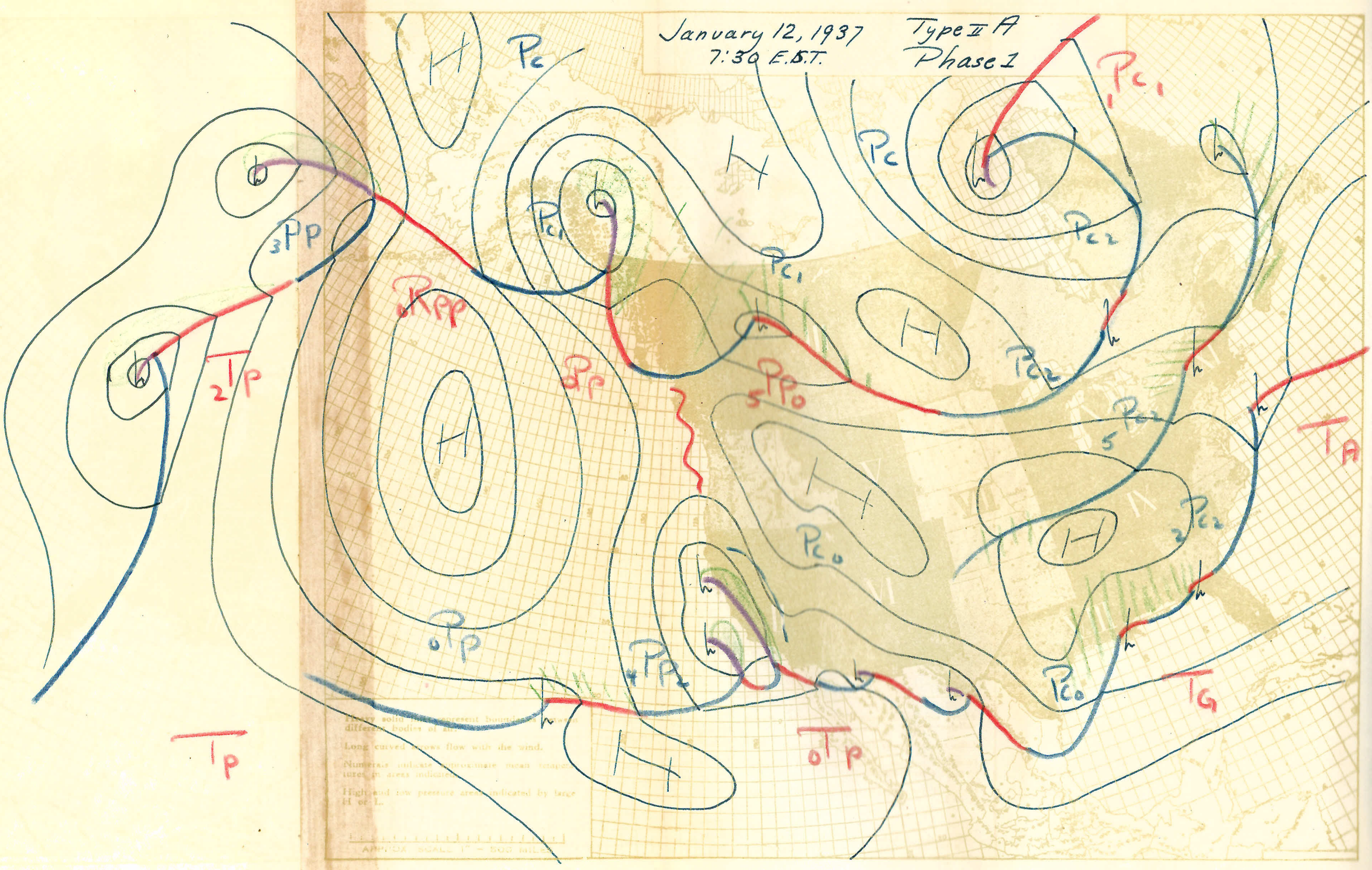
Type A
Phase 1

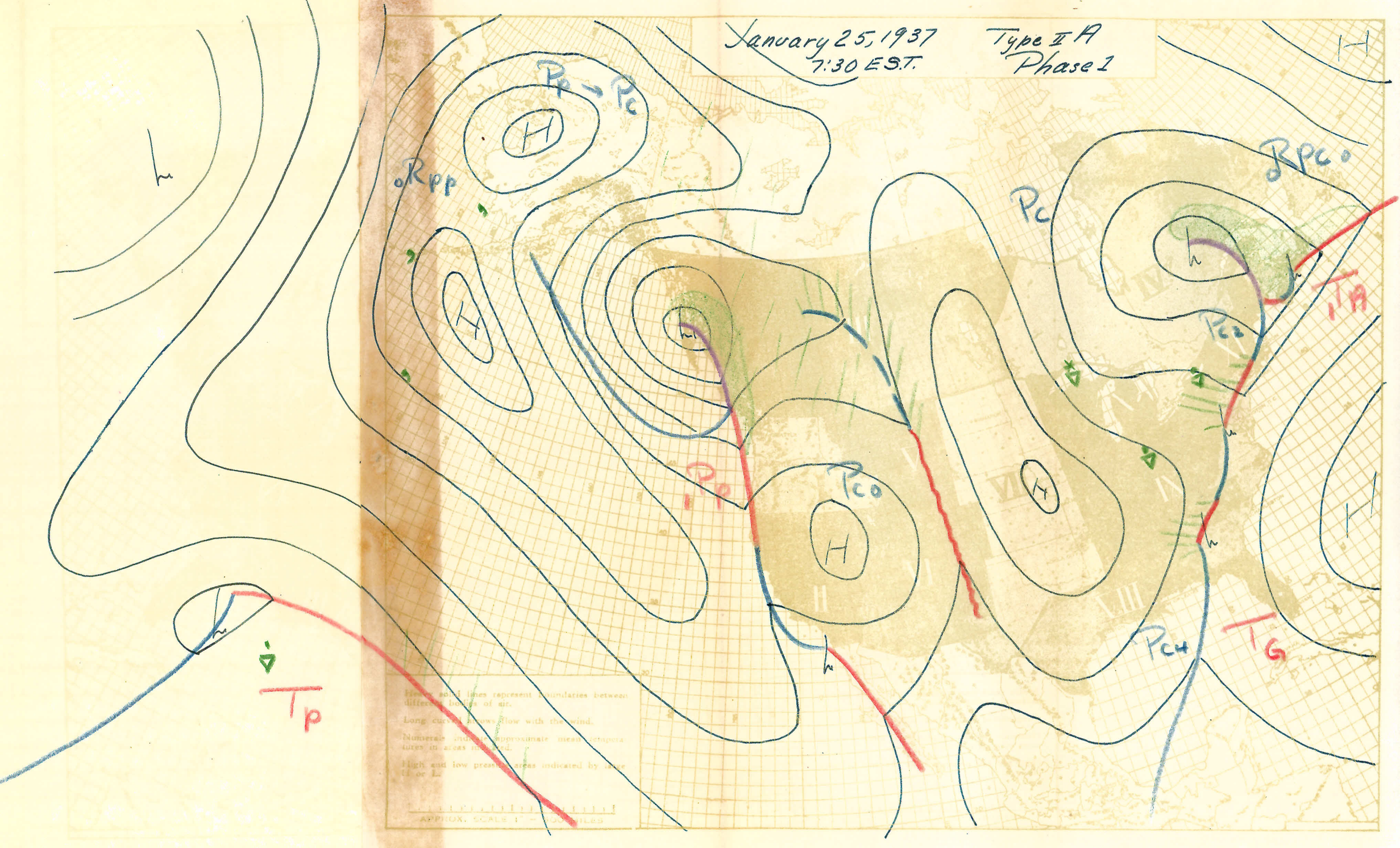




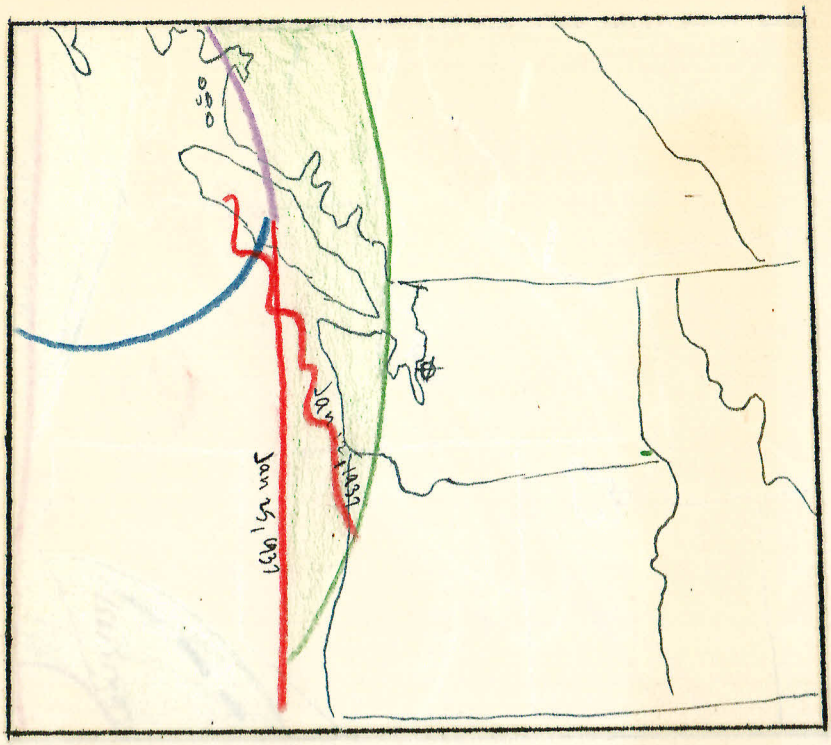
PHASE II


Type II A Phase 1
Pc
Pc
Pc
Pc
Pp
Rpp
Tg
Hea[illegible] solid lines represent boundaries between different bodies of air.
Numerals indicate approximate mean temperatures in areas indicated.
High and low pressure areas indicated by large H or L.
APPROX. SCALE, 1" = 500 MILES


January 12, 1937
7:30 E.S.T.
Type II A
Phase 1
H
Pc
Pc1
Pc2
Pc0
3Pp
2Tp
1Rpp
Rp
Pp
0Pp
4Pp2
5Pp0
Tp
0Tp
TA
TG


January 25, 1937
7:30 E.S.T.
Type II A
Phase 1
H
L
P_p
P_c
R_{pp}
P_{co}
R_{pc}
P_{c2}
T_{IA}
P_{c4}
T_G
T_P

Jan. 25
1937



Jan. 12
1937

SA

Type A
Phase 1

12 14 16 18 20 22 24 2 4 6 8 10 12 14 16 18 20 22 24 2 4 6 8 10 12 E.S.T.

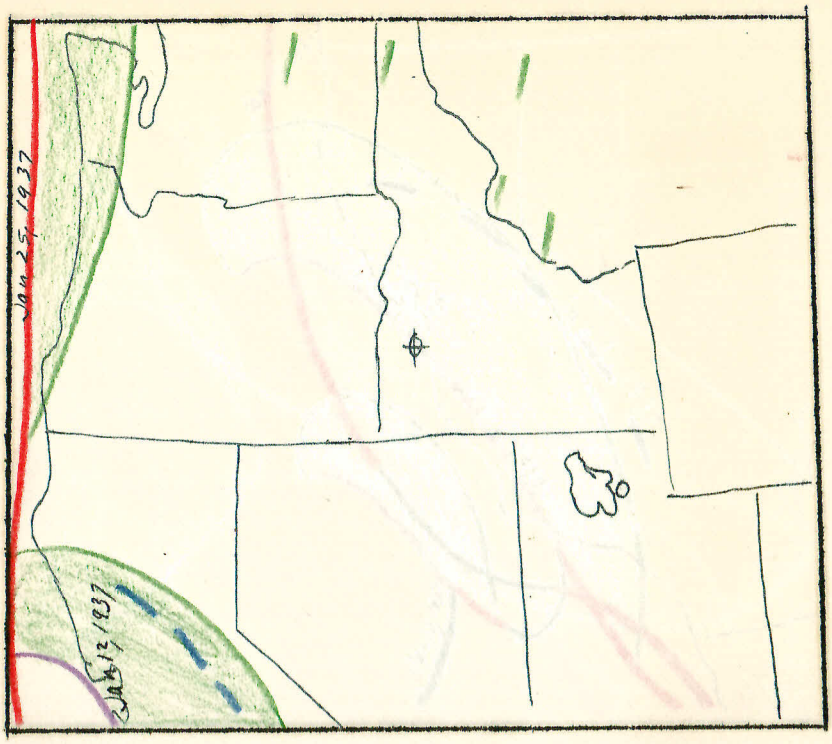
Ceiling (100 ft):
100
60
20
10
6
2
0

Visibility (Mi):
12
10
8
6
4
2
0

Temperature °F
+60
+50
+40
+30
+20
+10

Phase 1

Jan. 25
1937



Jan. 12
1937

BE

Type A
Phase 1

13.5

C05

11.5

02

12 14 16 18 20 22 24 2 4 6 8 10 12 14 16 18 20 22 24 2 4 6 8 10 12 E.S.T.

Ceiling (100 ft)
100 60 20 10 6 2 0

Visibility (Mi)
12 10 8 6 4 2 0

Temperature °F
+50 +40 +30 +20 +10 +0 -10

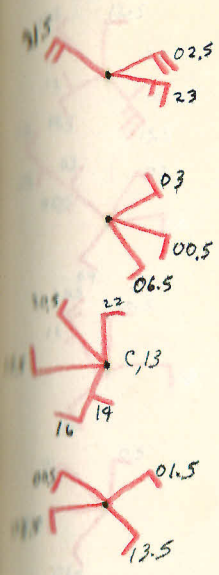
K-

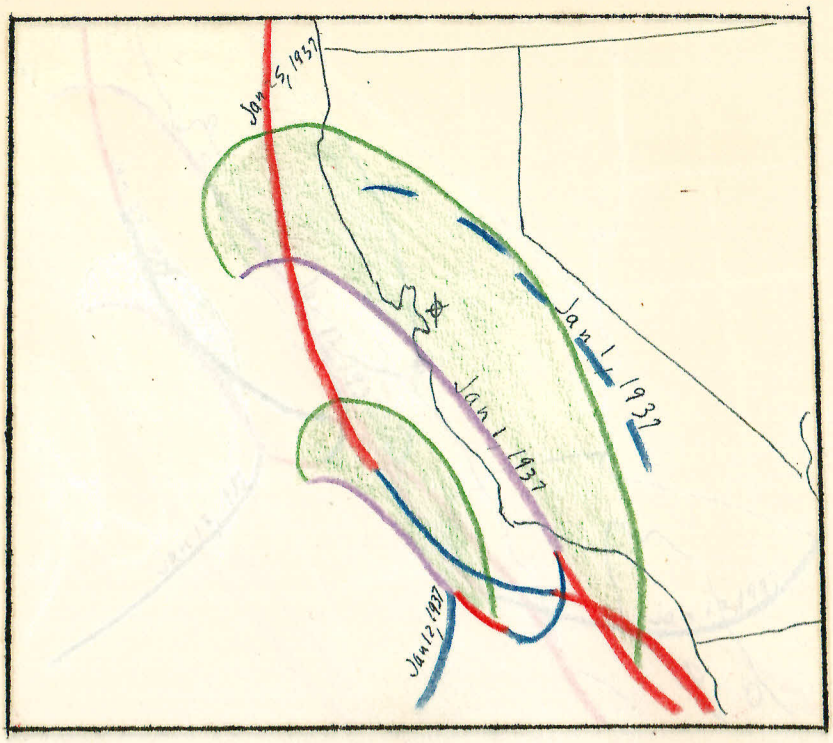
KGF-

RH

Phase 1

Jan. 25
1937

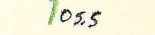


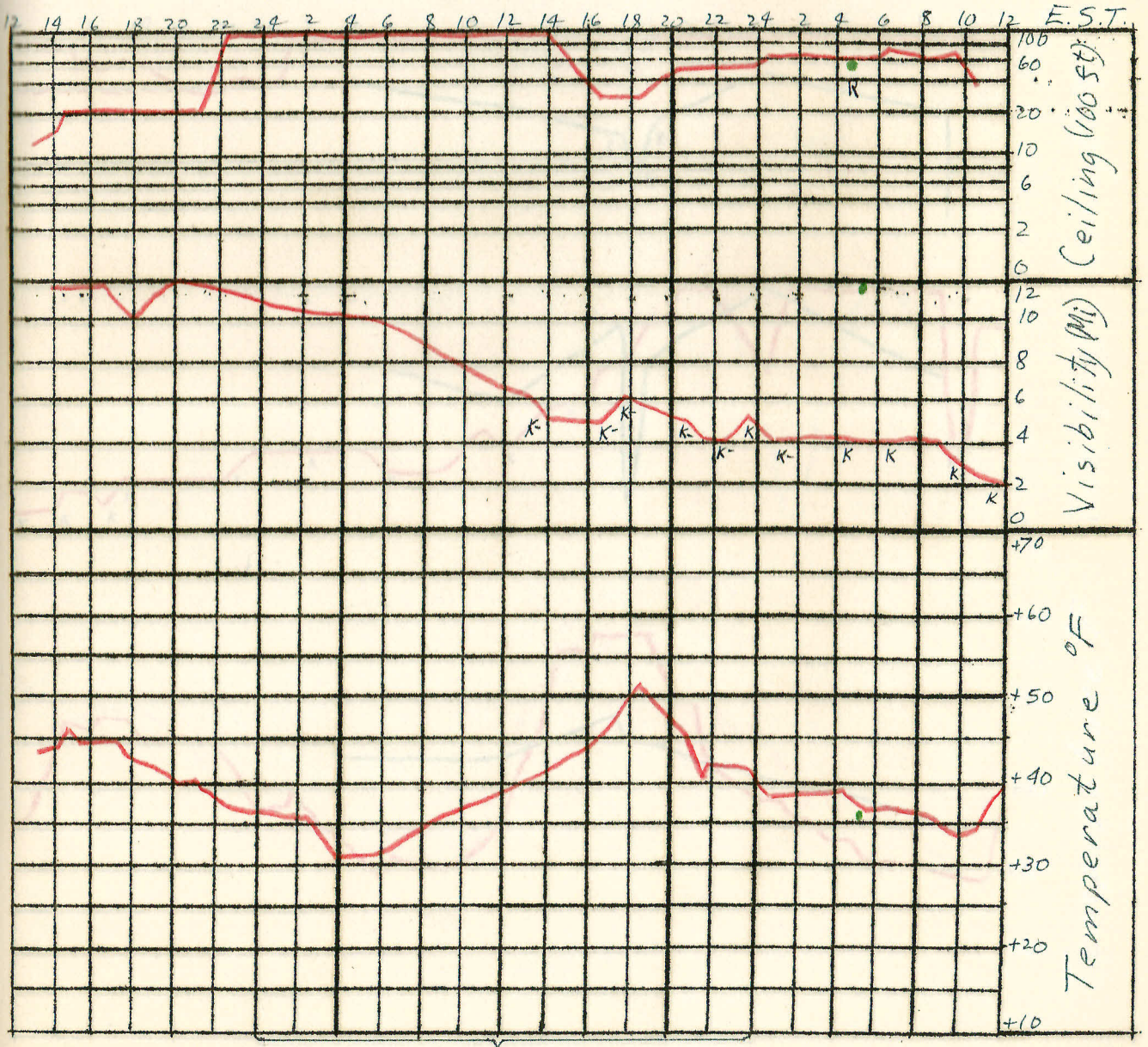


Jan. 12
1937

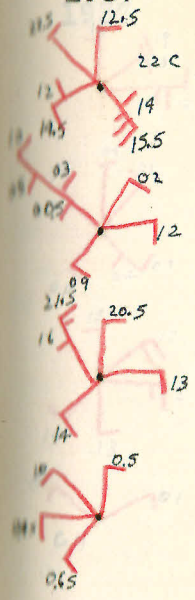
0A

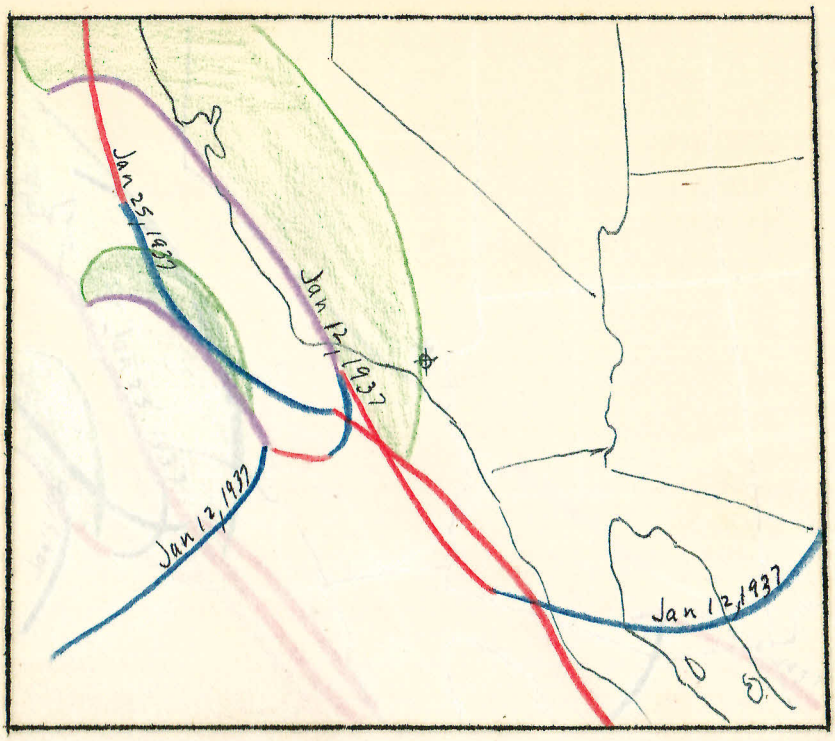
Type A
Phase 1





Jan. 25
1937

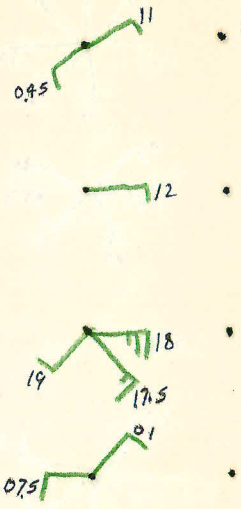


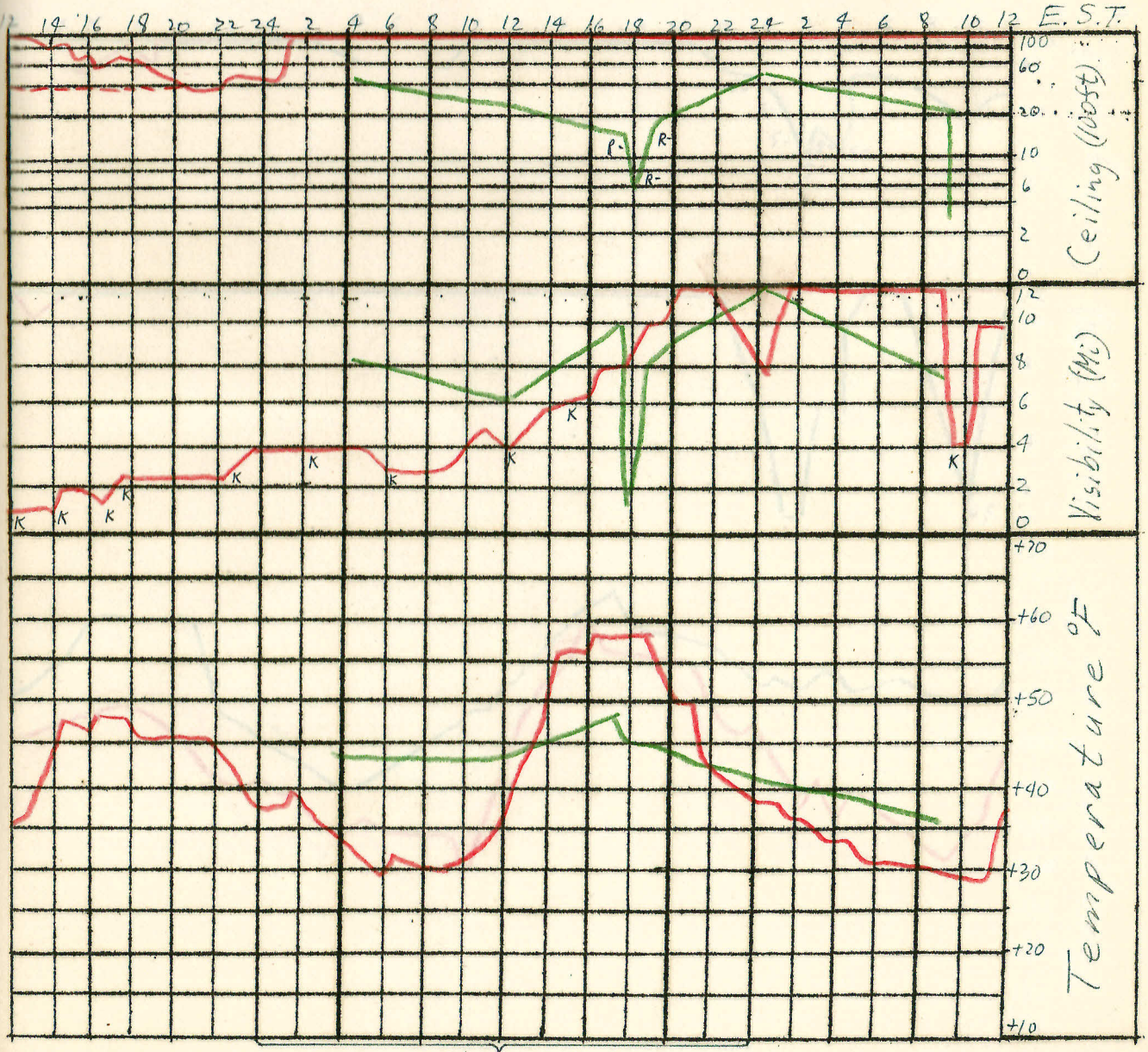


Jan. 12
1937

BU

Type A
Phase 1





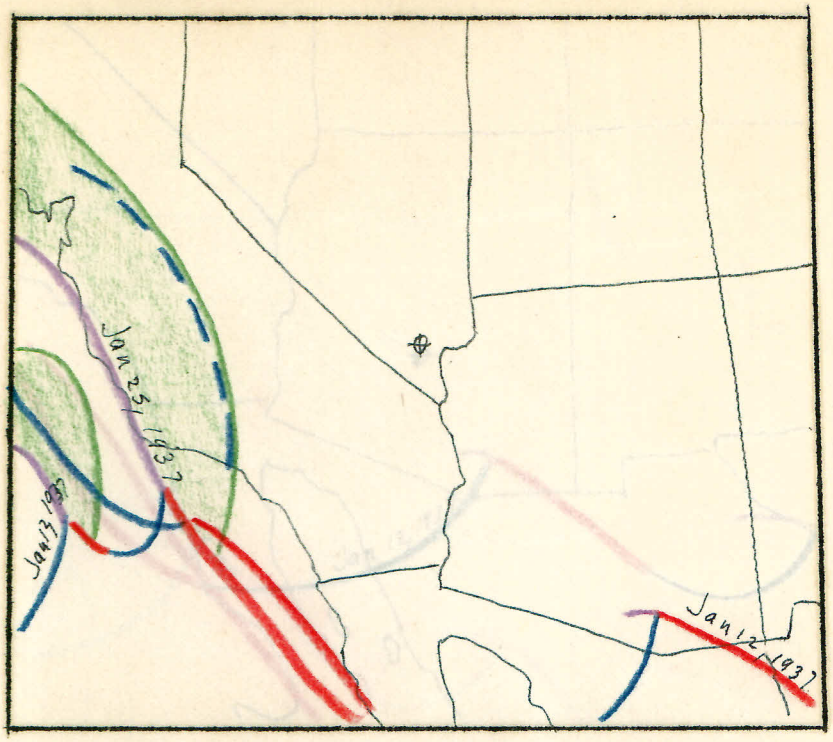
Phase 1

Jan. 25
1937

Jan. 12
1937

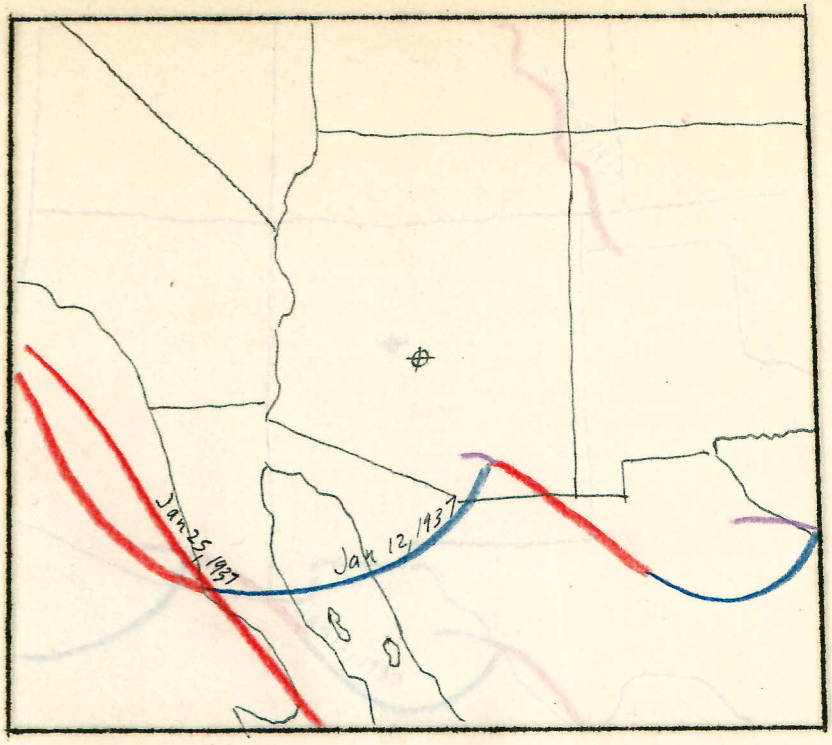
LQ

Type A
Phase 1



Jan. 25
1937

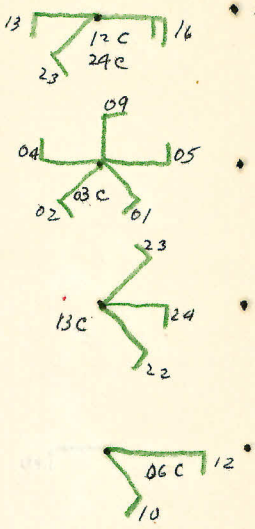


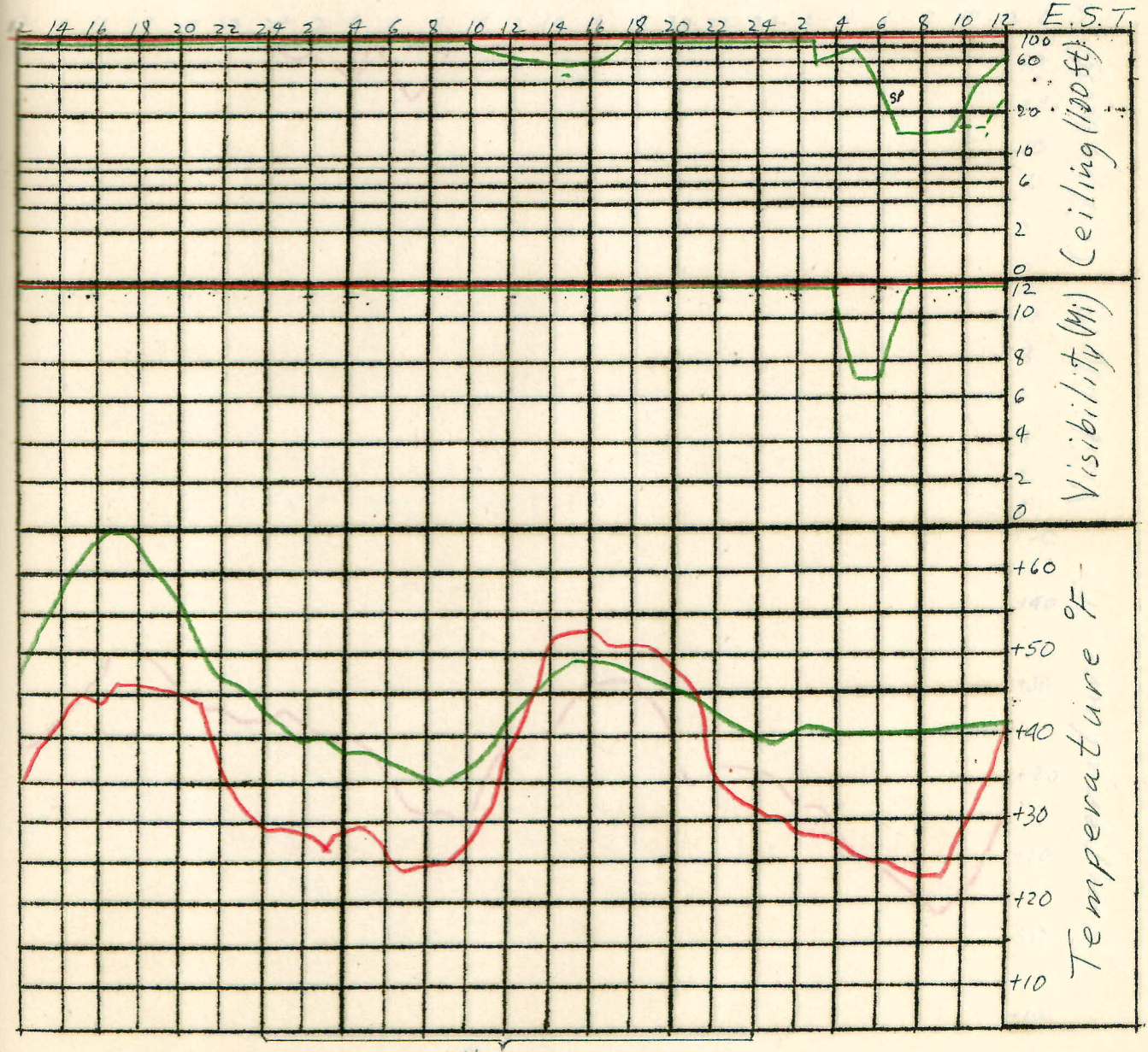


Jan. 12
1937

PH

Type A
Phase 1



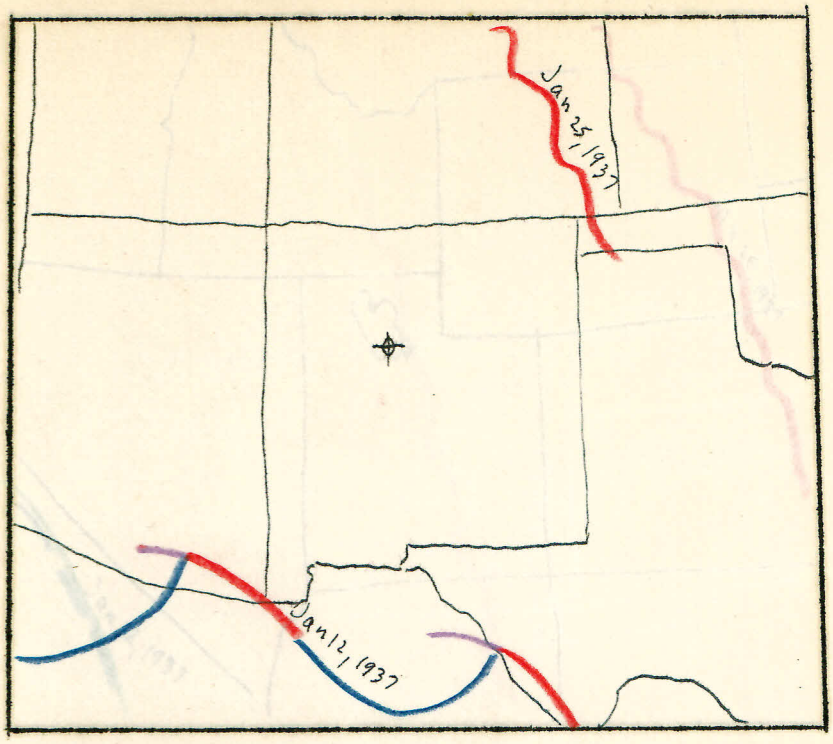


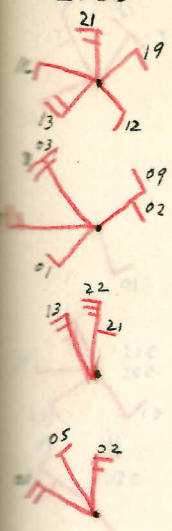
Jan. 25
1937

Jan. 12
1937

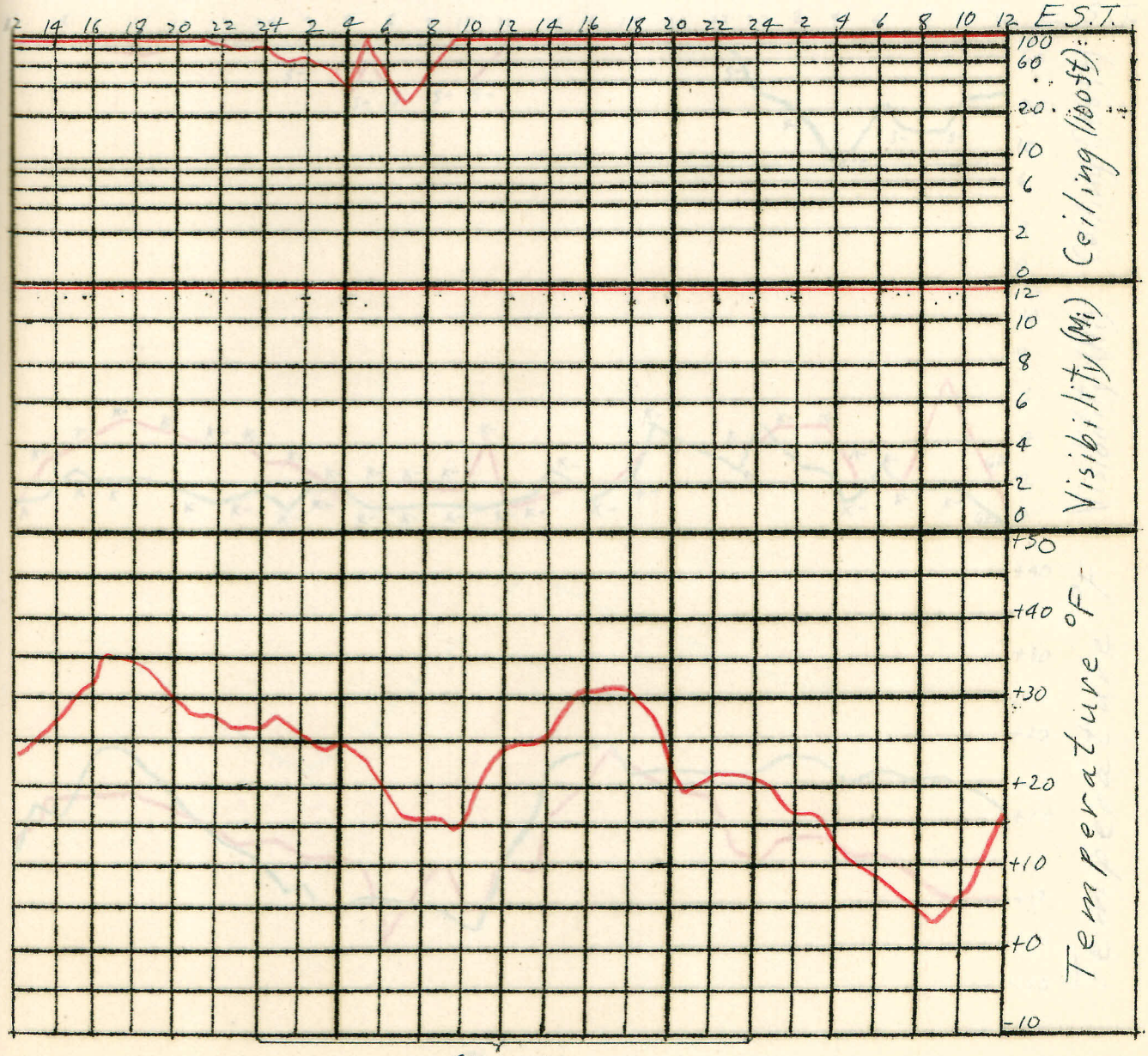
AB

Type A
Phase 1







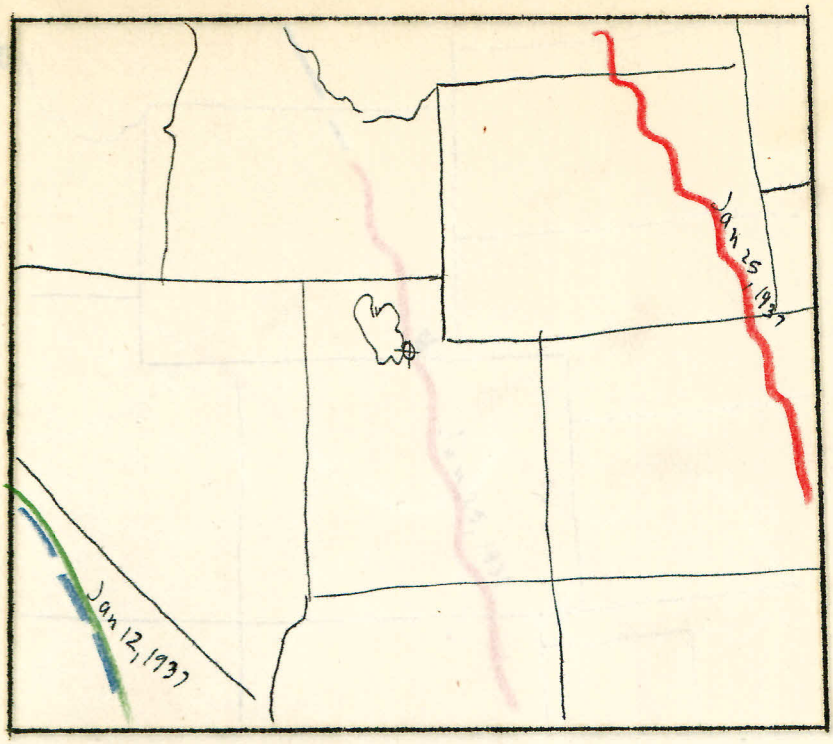


Jan. 25
1937

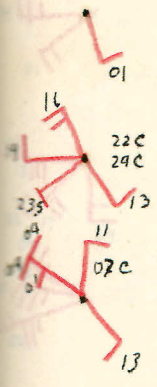
Jan. 12
1937

SL

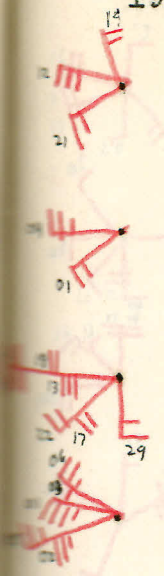
Type A
Phase 1

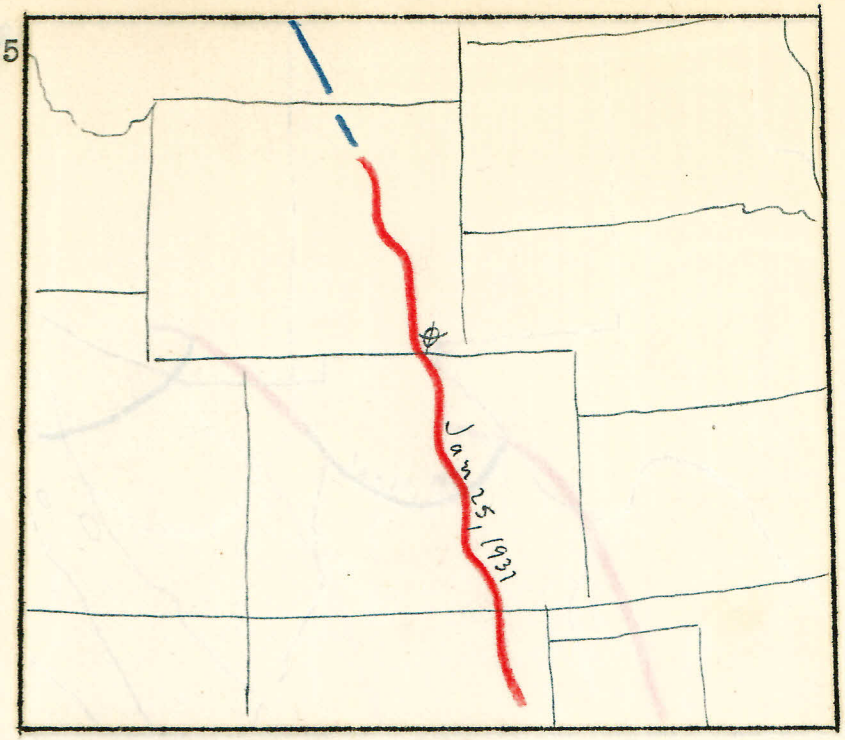




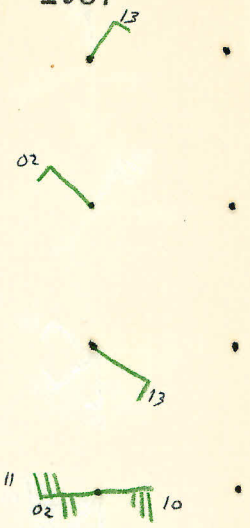


Jan. 25
1937



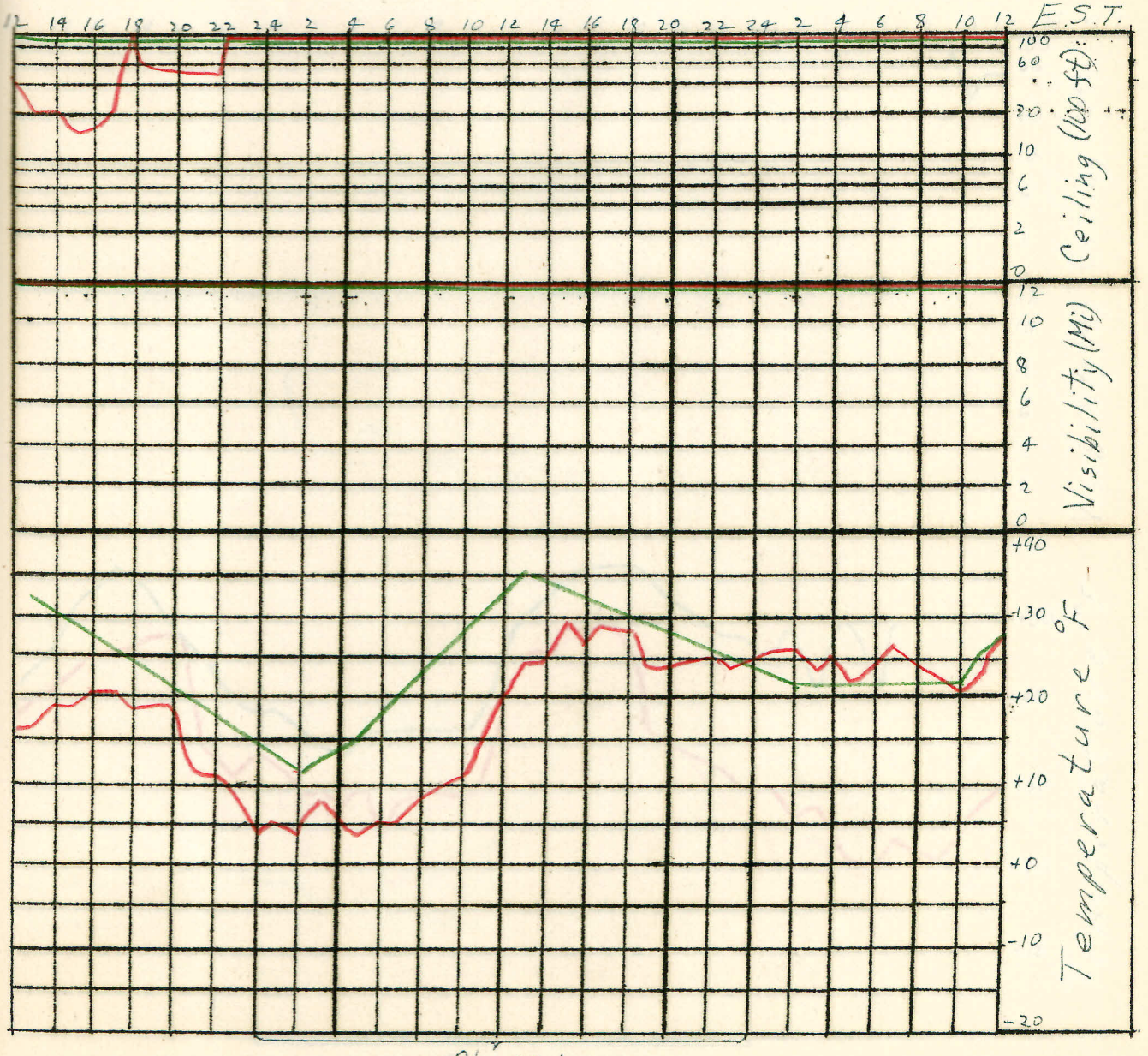


Jan. 12
1937

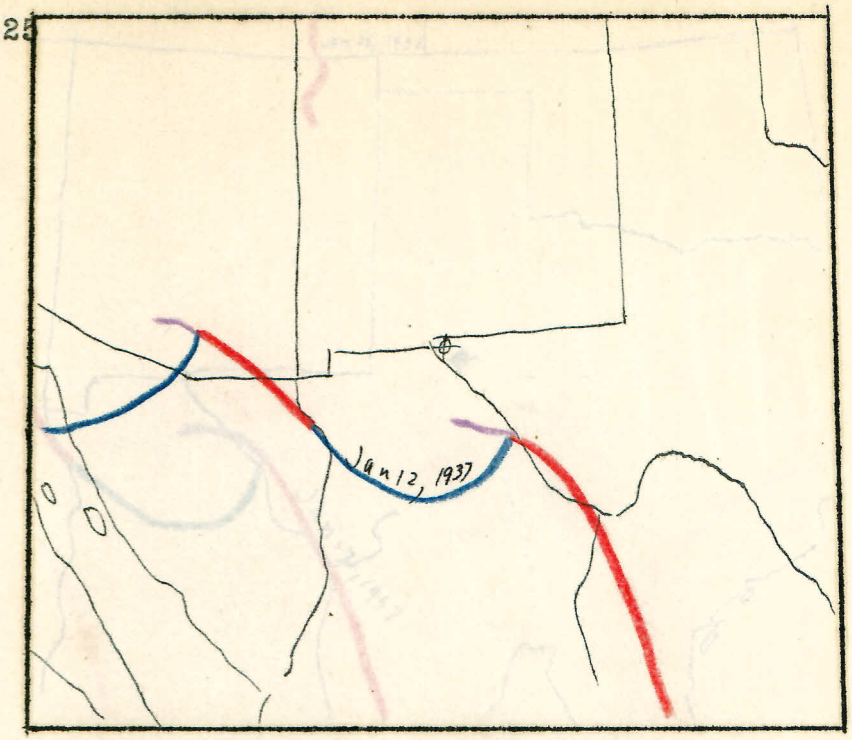


CX

Type A
Phase 1



Jan. 25
1937



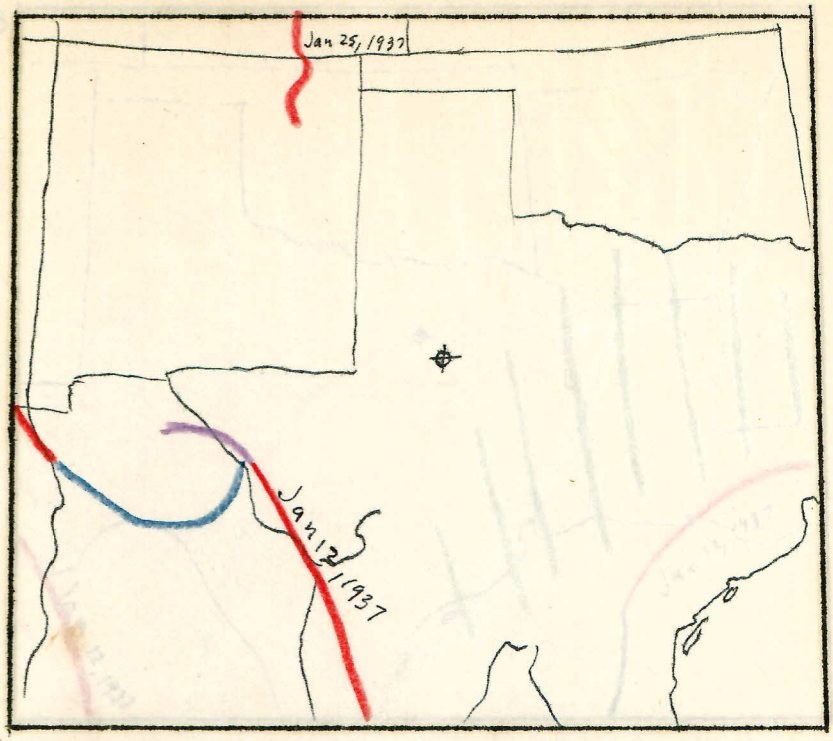
Jan. 12
1937

EO

Type A
Phase 1

Phase 1

Jan. 25
1937

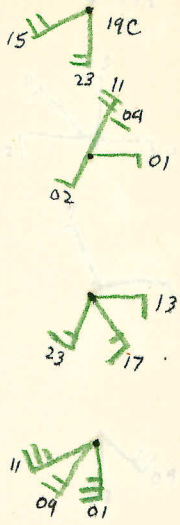


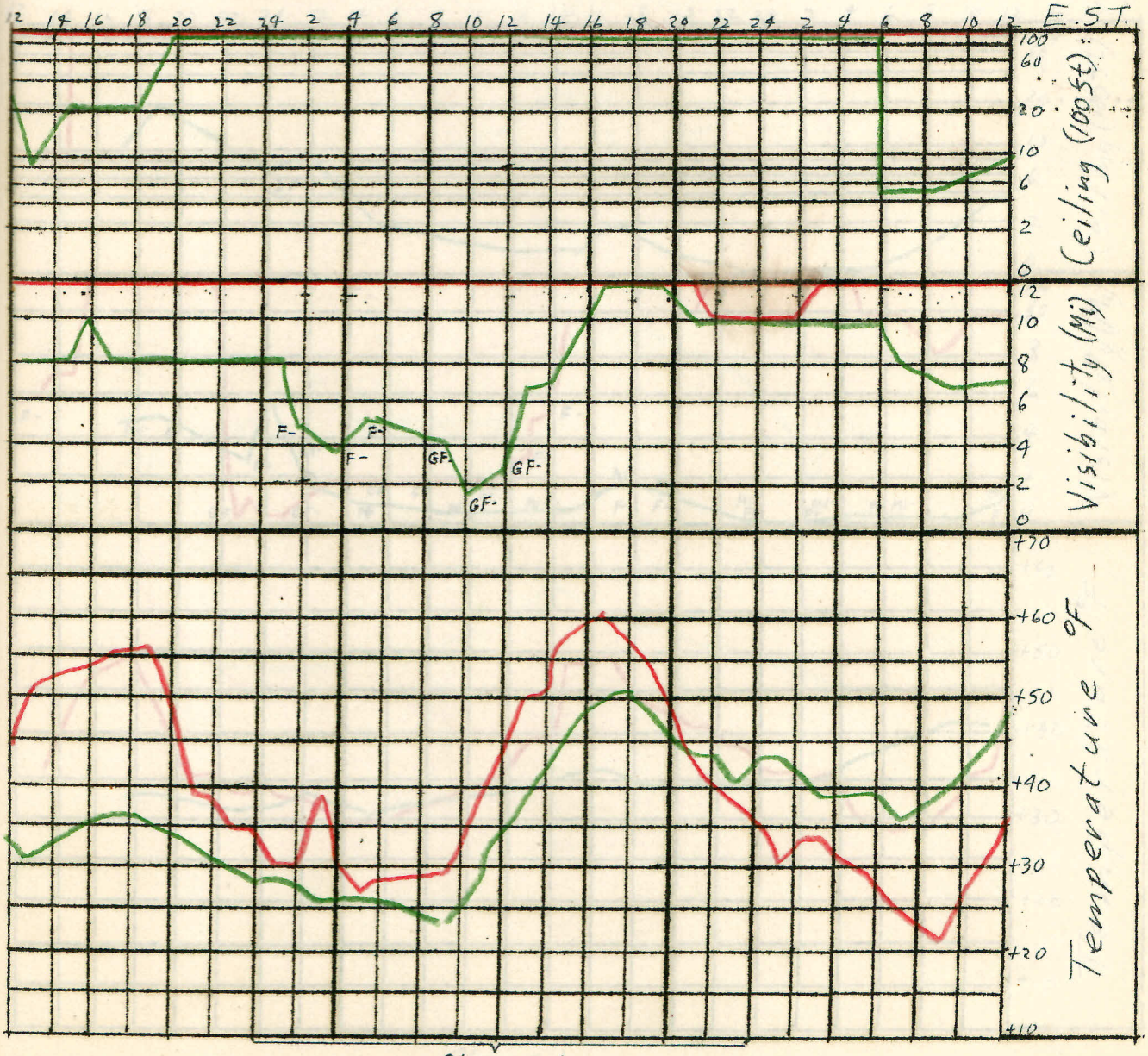
Jan. 12
1937

BZ

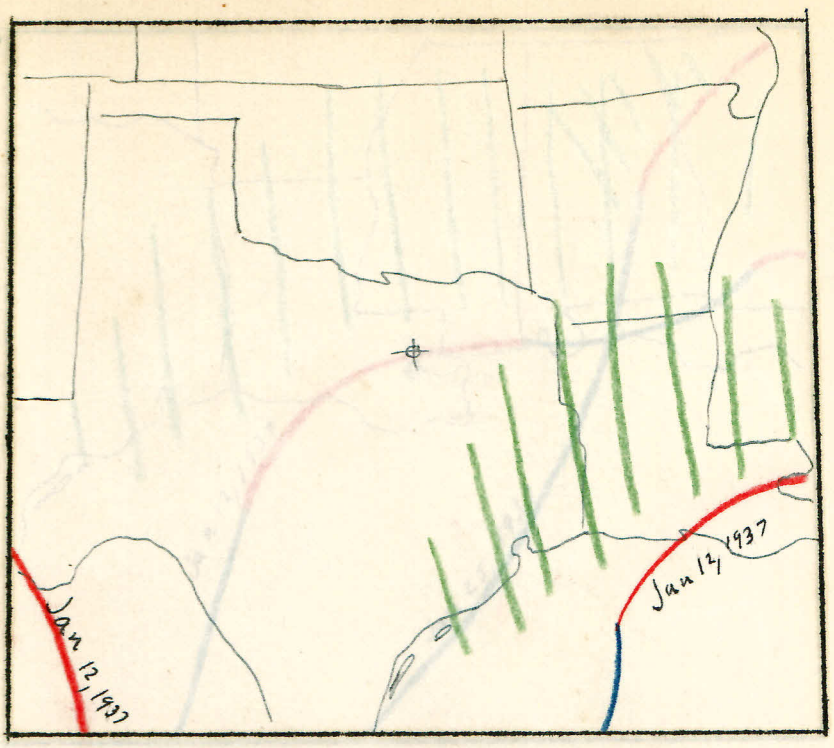
Type A
Phase 1







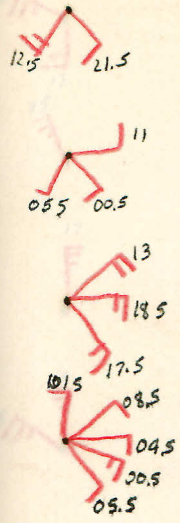
Jan. 25
1937

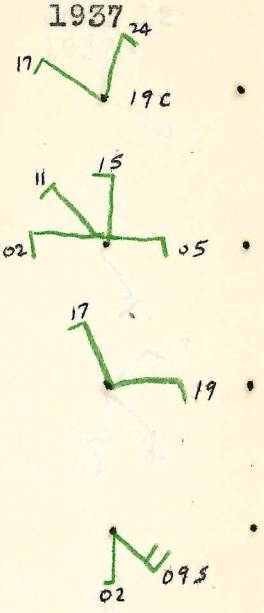


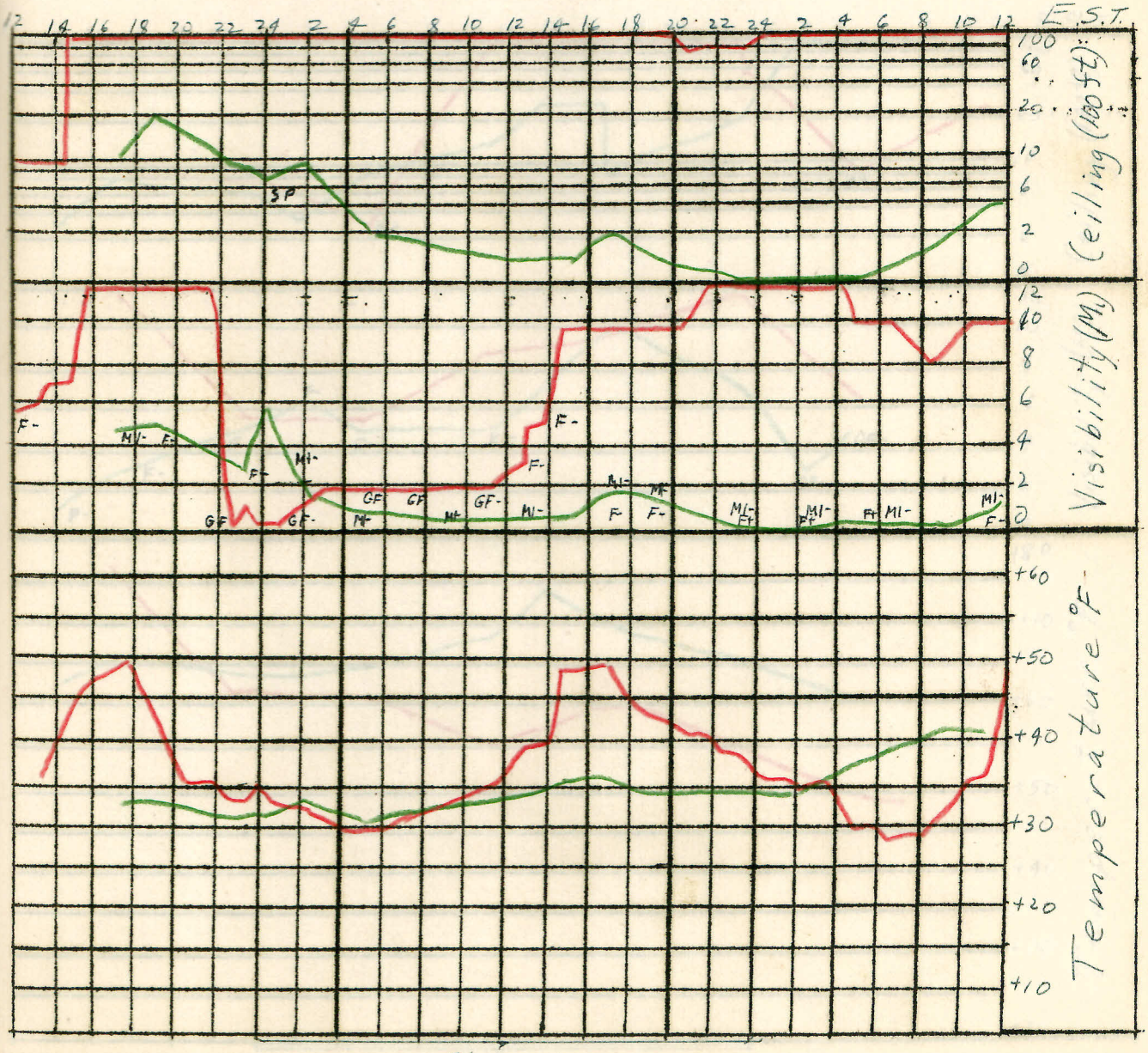
Jan. 12
1937

DL

Type A
Phase 1

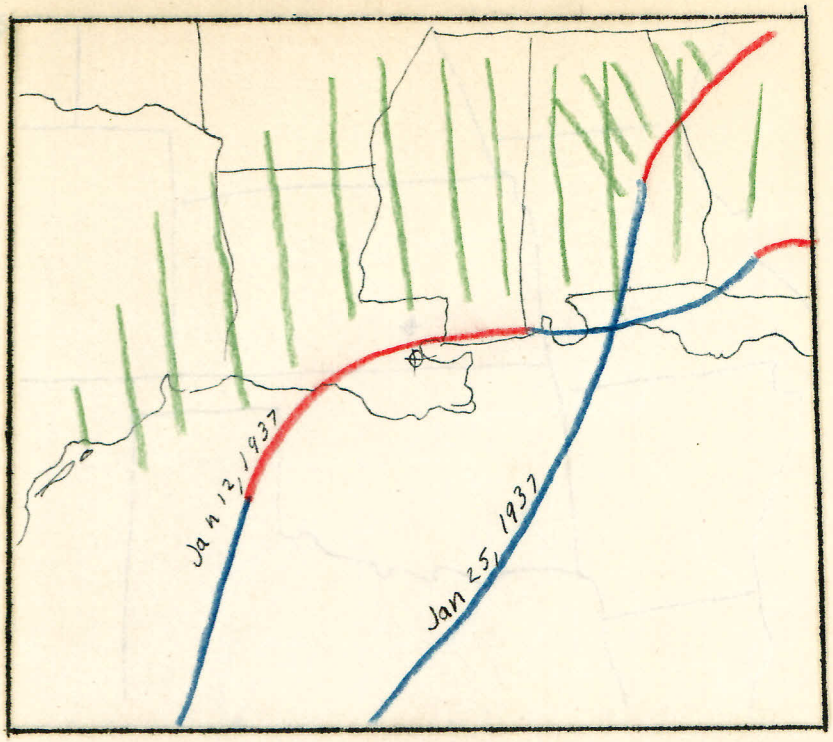






Phase 1

Jan. 25
1937



Jan. 12
1937

NO

Type A
Phase 1

12 14 16 18 20 22 24 2 4 6 8 10 12 14 16 18 20 22 24 2 4 6 8 10 12 E.S.T.

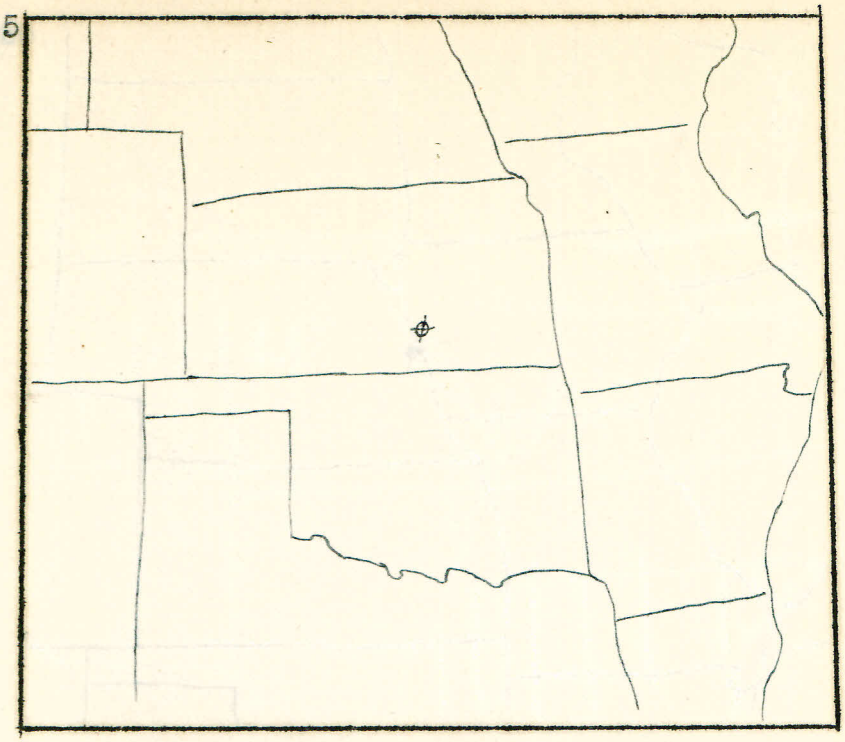
Ceiling (100ft): 100, 60, 20, 10, 6, 2, 0

Visibility (Mi): 12, 10, 8, 6, 4, 2, 0

Temperature °F: 180, 170, 160, 150, 140, 130, 120

Phase I

Jan. 25
1937



Jan. 12
1937

WD

Type A
Phase 1

12 14 16 18 20 22 24 2 4 6 8 10 12 14 16 18 20 22 24 2 4 6 8 10 12 E.S.T.

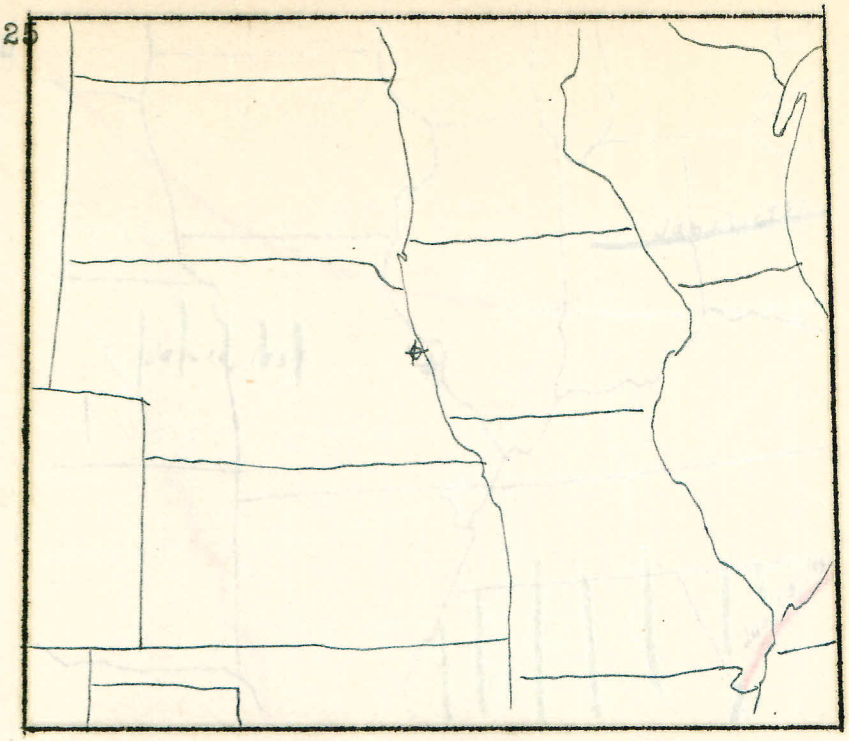
Ceiling (100 ft)
100
60
20
10
4
2
0

Visibility (Mi)
12
10
8
6
4
2
0

Temperature °F
+40
+30
+20
+10
+0
-10

phase1

Jan. 25
1937



Jan. 12
1937

OH

Type A
Phase 1

12 14 16 18 20 22 24 2 4 6 8 10 12 14 16 18 20 22 24 2 4 6 8 10 12 E.S.T.

Ceiling (100 ft)
100
60
30
10
6
2
0

Visibility (Mi)
12
10
8
6
4
2
0

Temperature °F.
+40
+30
+20
+10
+0
-10
-20

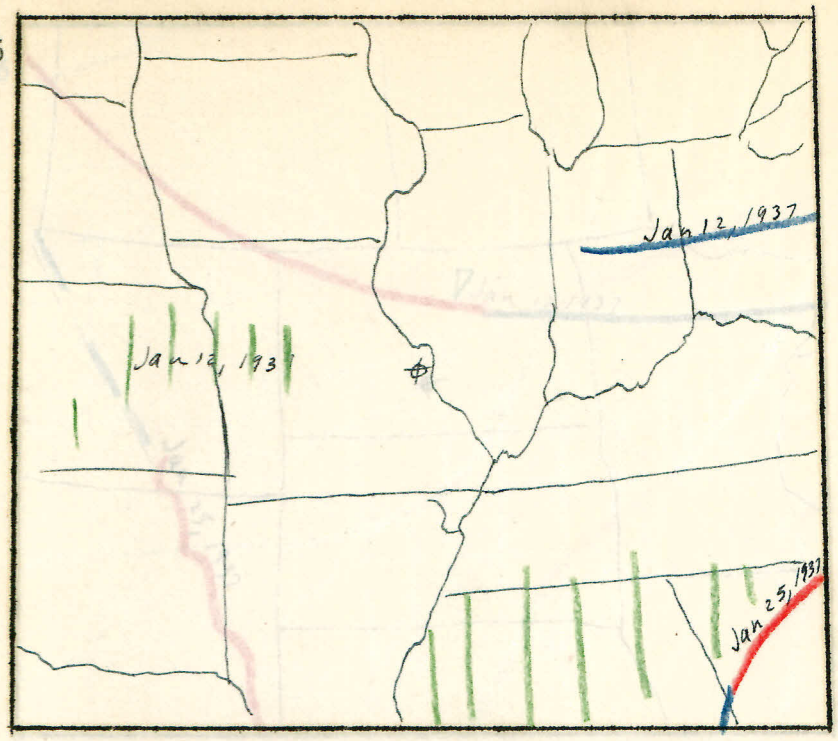
Phase 1

Jan. 25
1937

Jan. 12
1937

LS

Type A
Phase 1

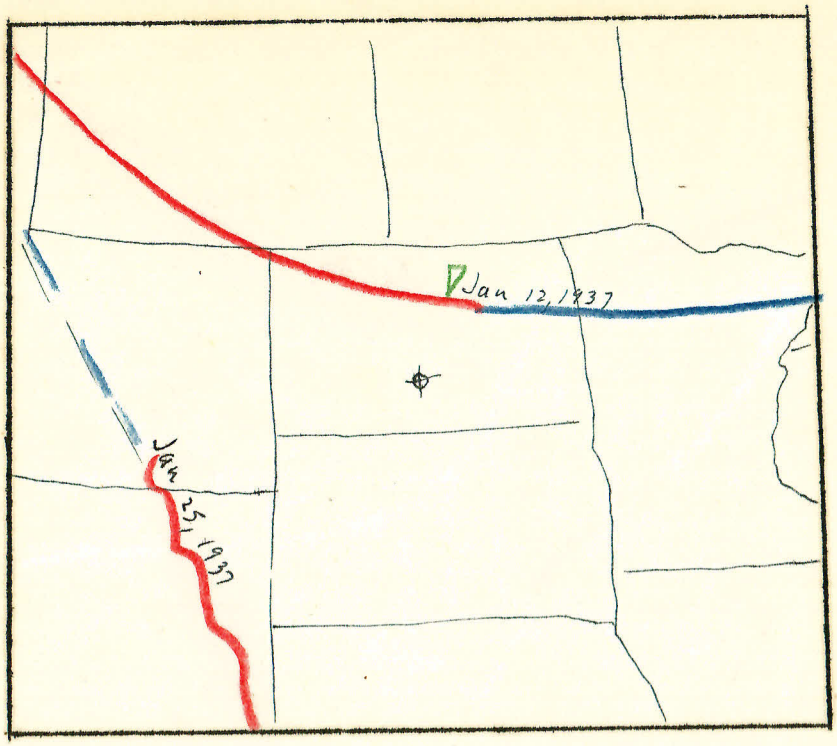


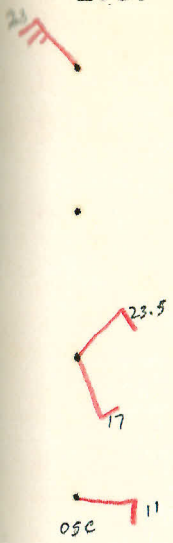
Jan. 25
1937

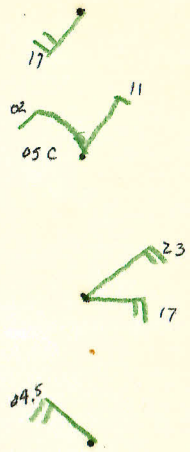
Jan. 12
1937

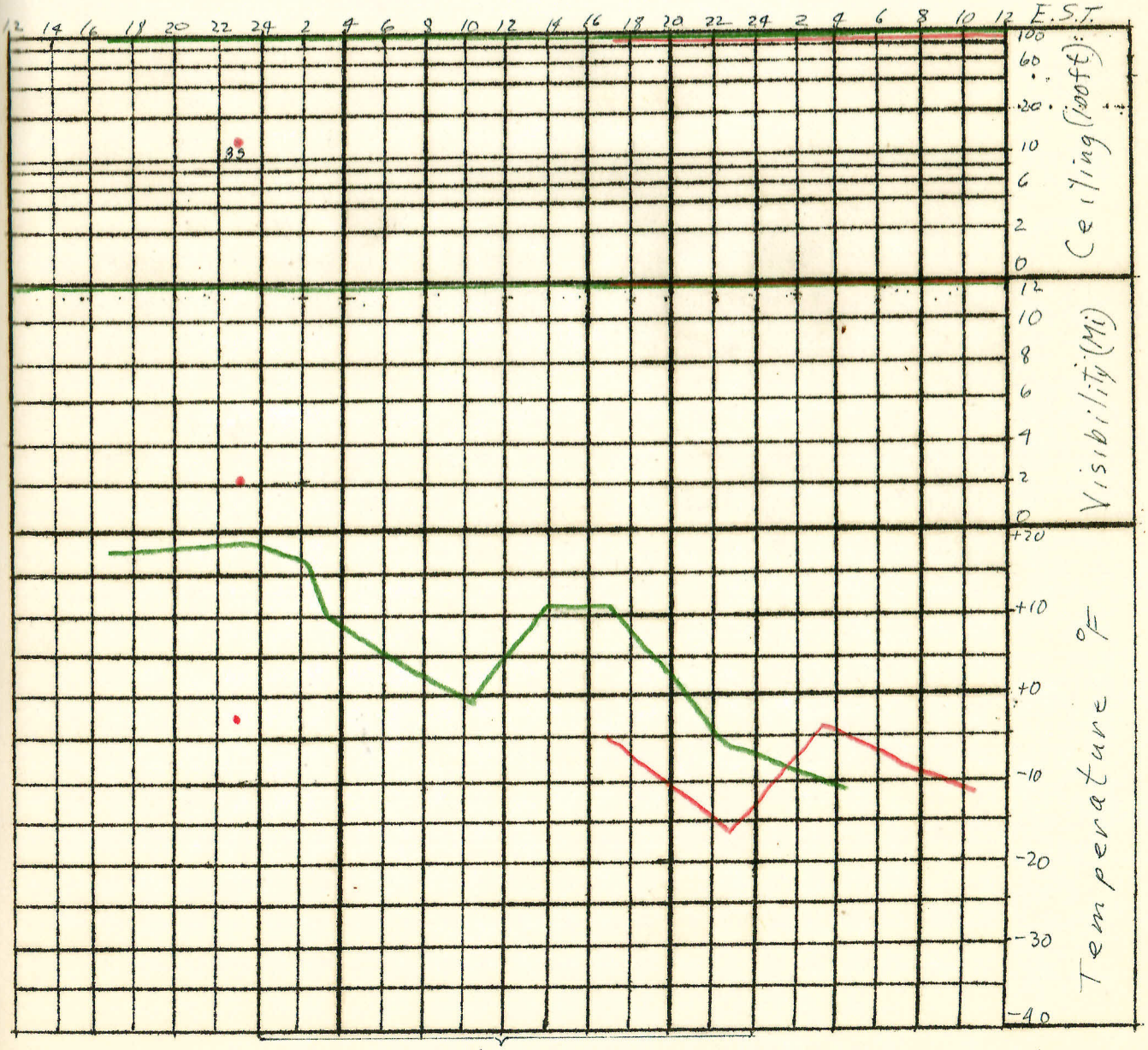
RK

Type A
Phase 1

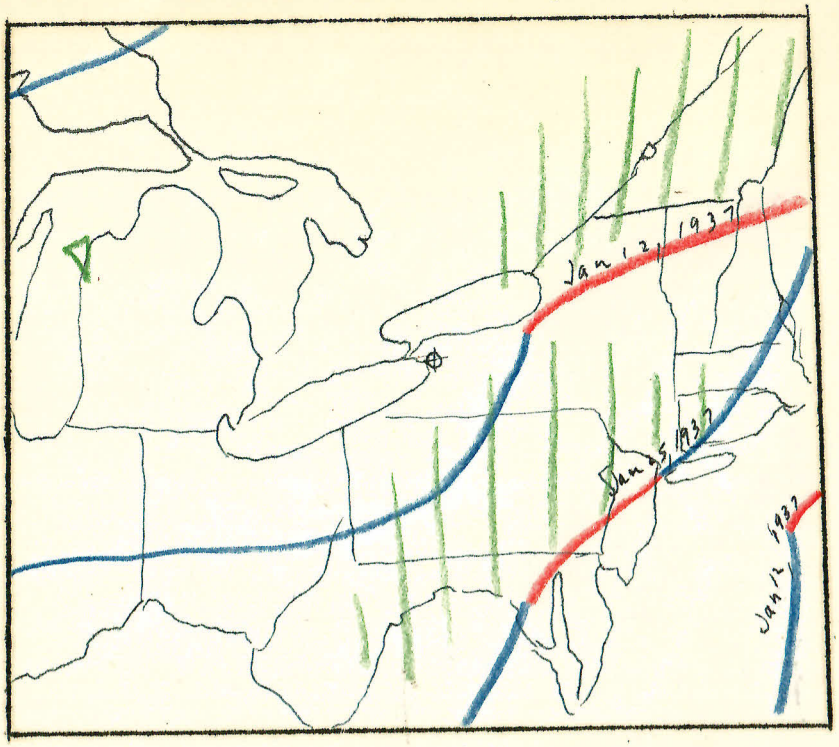








Jan. 25
1937

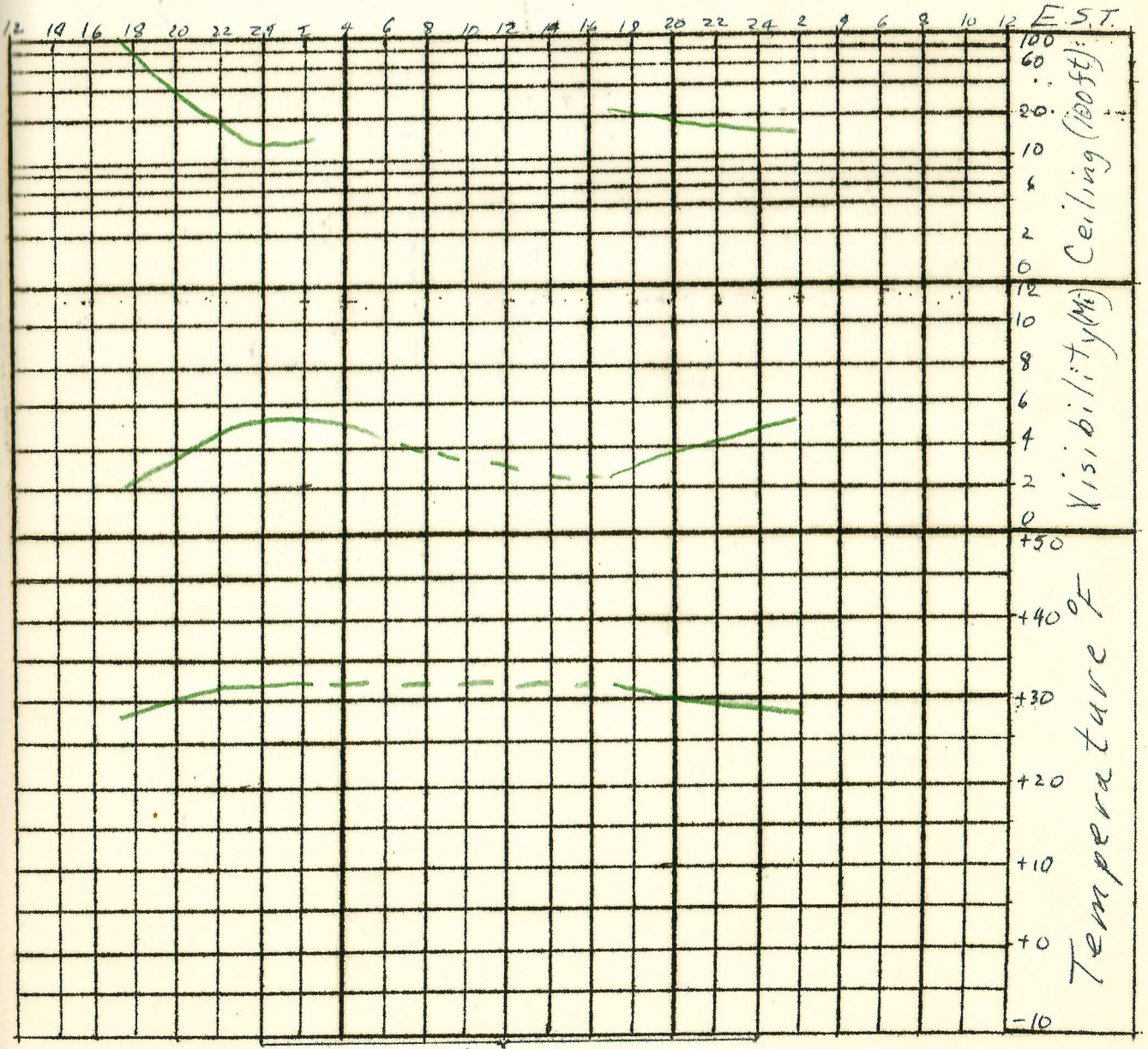


Jan. 12
1937

BJ

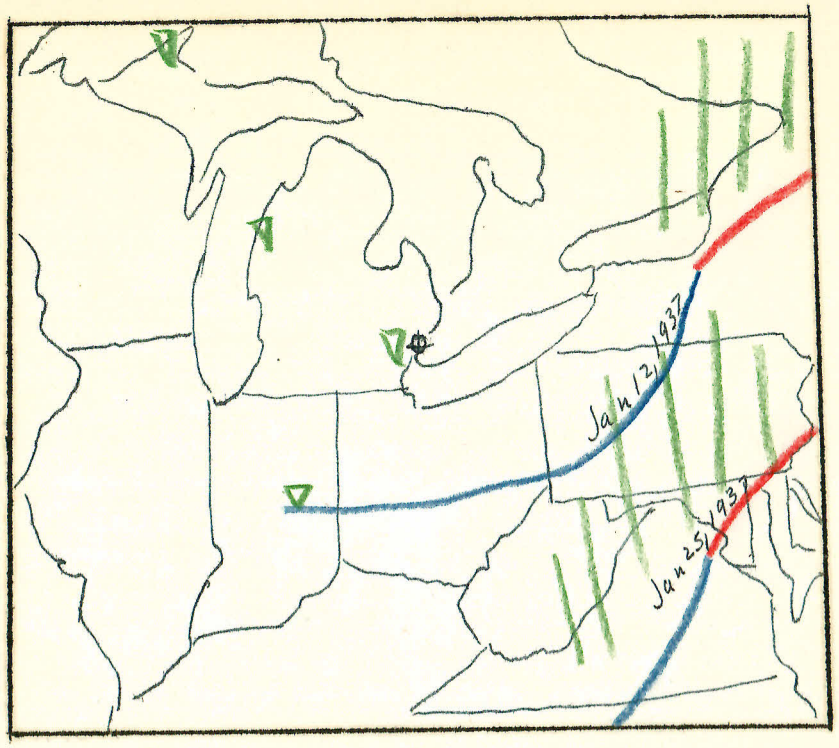
Type A
Phase 1





Phase 1

Jan. 25
1937



Jan. 12
1937

DO

Type A
Phase 1

E.S.T.

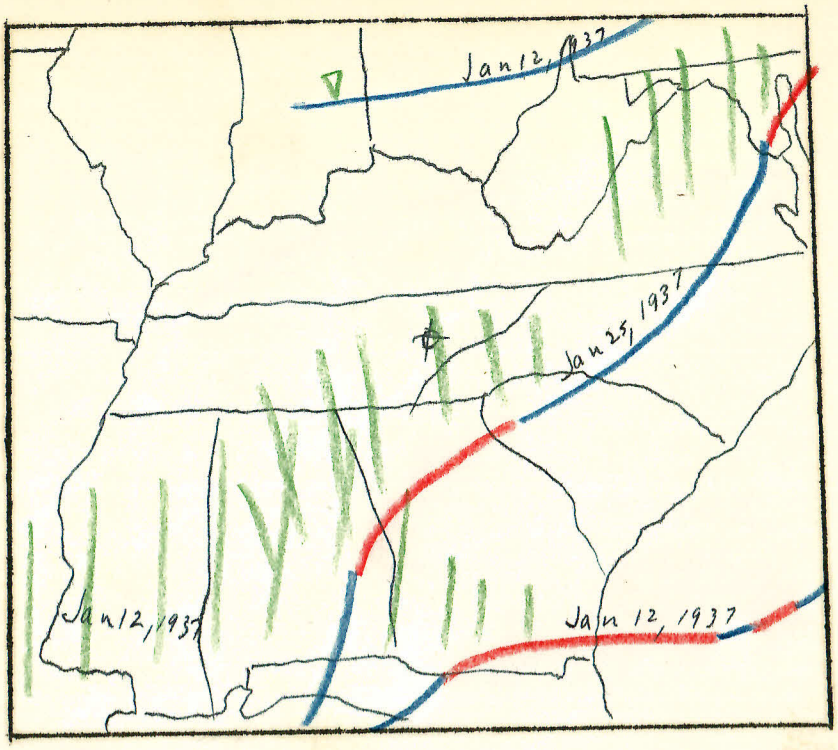
Ceiling (100 ft)

Visibility (Mi)

Temperature °F

Phase I

Jan. 25
1937



Jan. 12
1937

KX

Type A
Phase1

14

02

12 14 16 18 20 22 24 2 4 6 8 10 12 14 16 18 20 22 24 2 4 6 8 10 12 E.S.T.

Ceiling (100 ft.)
100
60
20
10
6
2
0

R

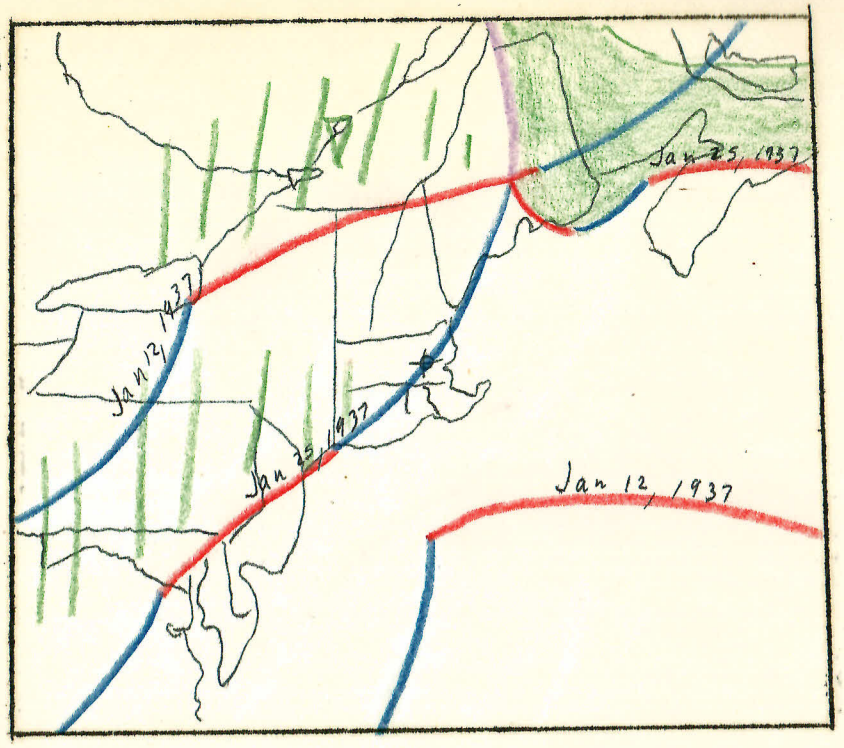
Visibility (Mi.)
12
10
8
6
4
2
0

F.

Temperature °F
+70
+60
+50
+40
+30
+20
+10

Phase 1

Jan. 25
1937

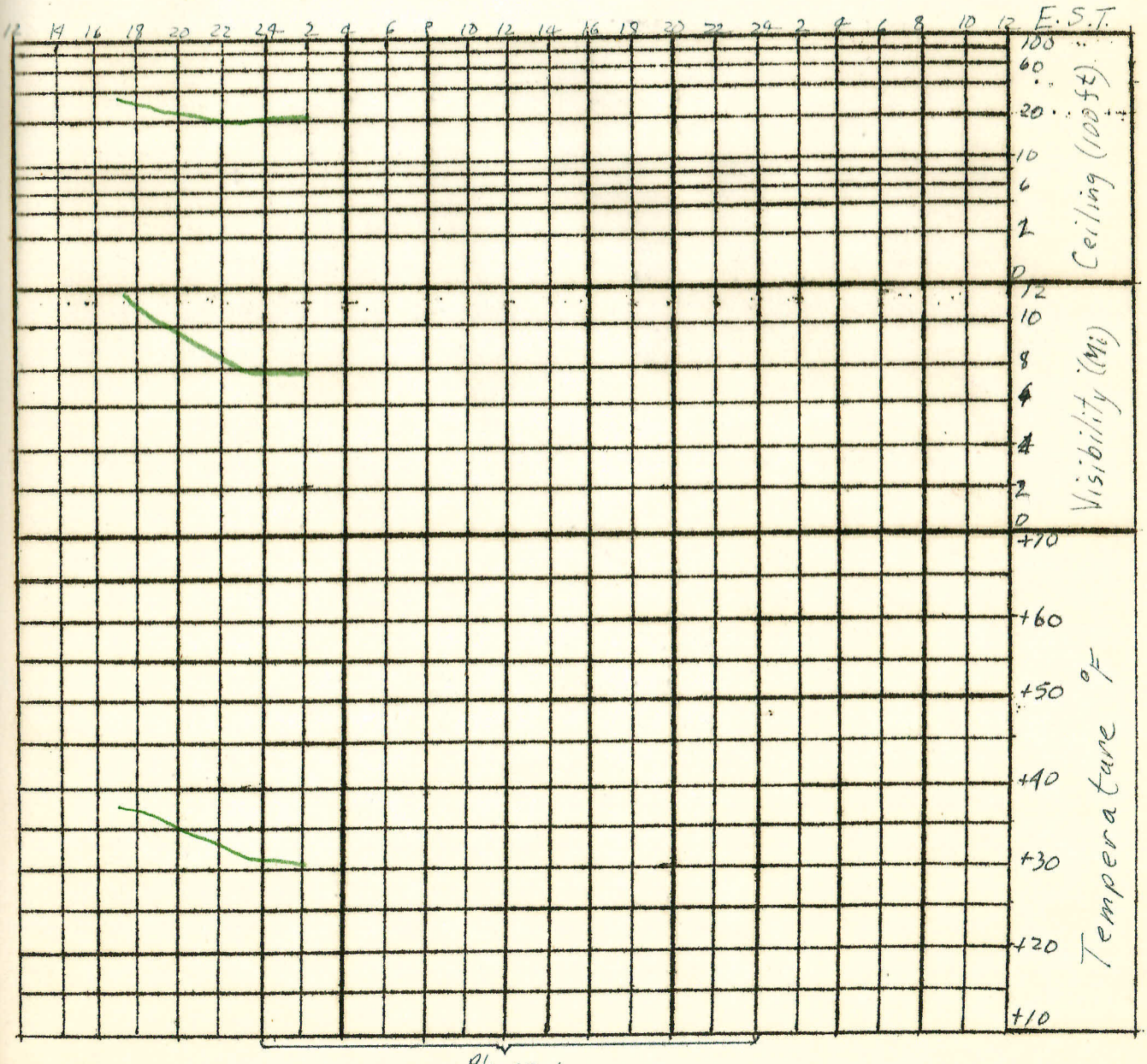


Jan. 12
1937

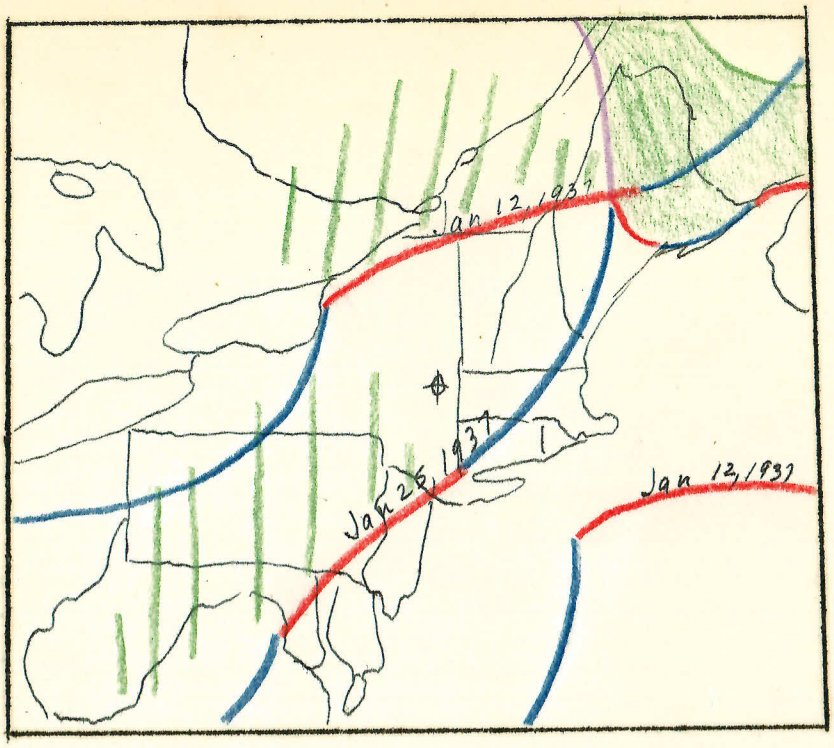
BW

Type A
Phase 1





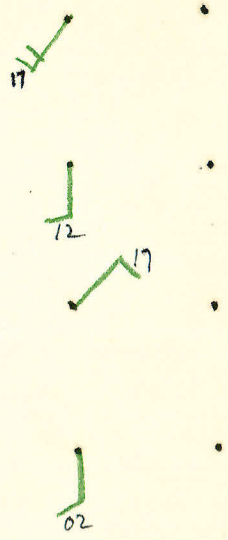
Jan. 25
1937

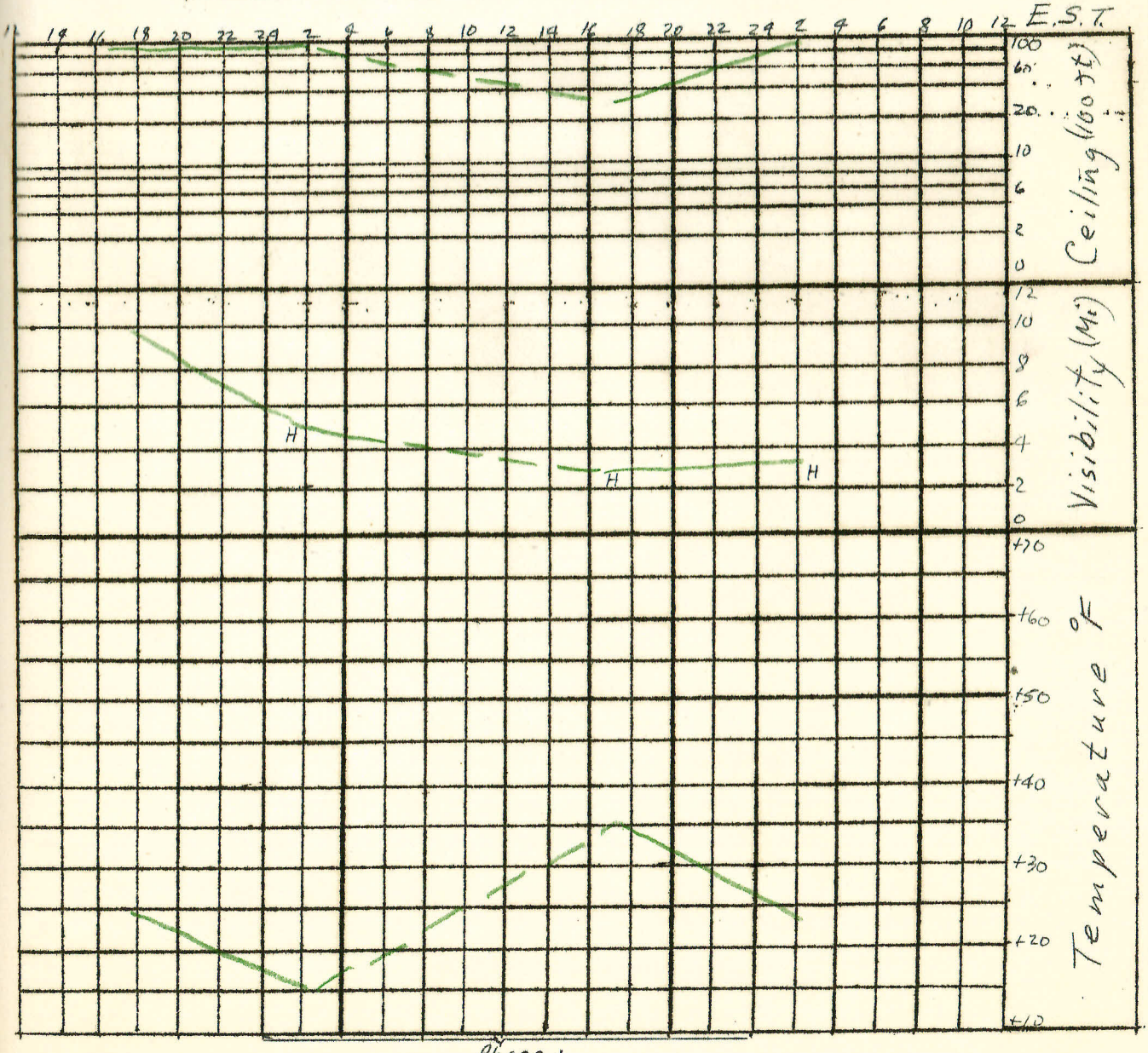


Jan. 12
1937

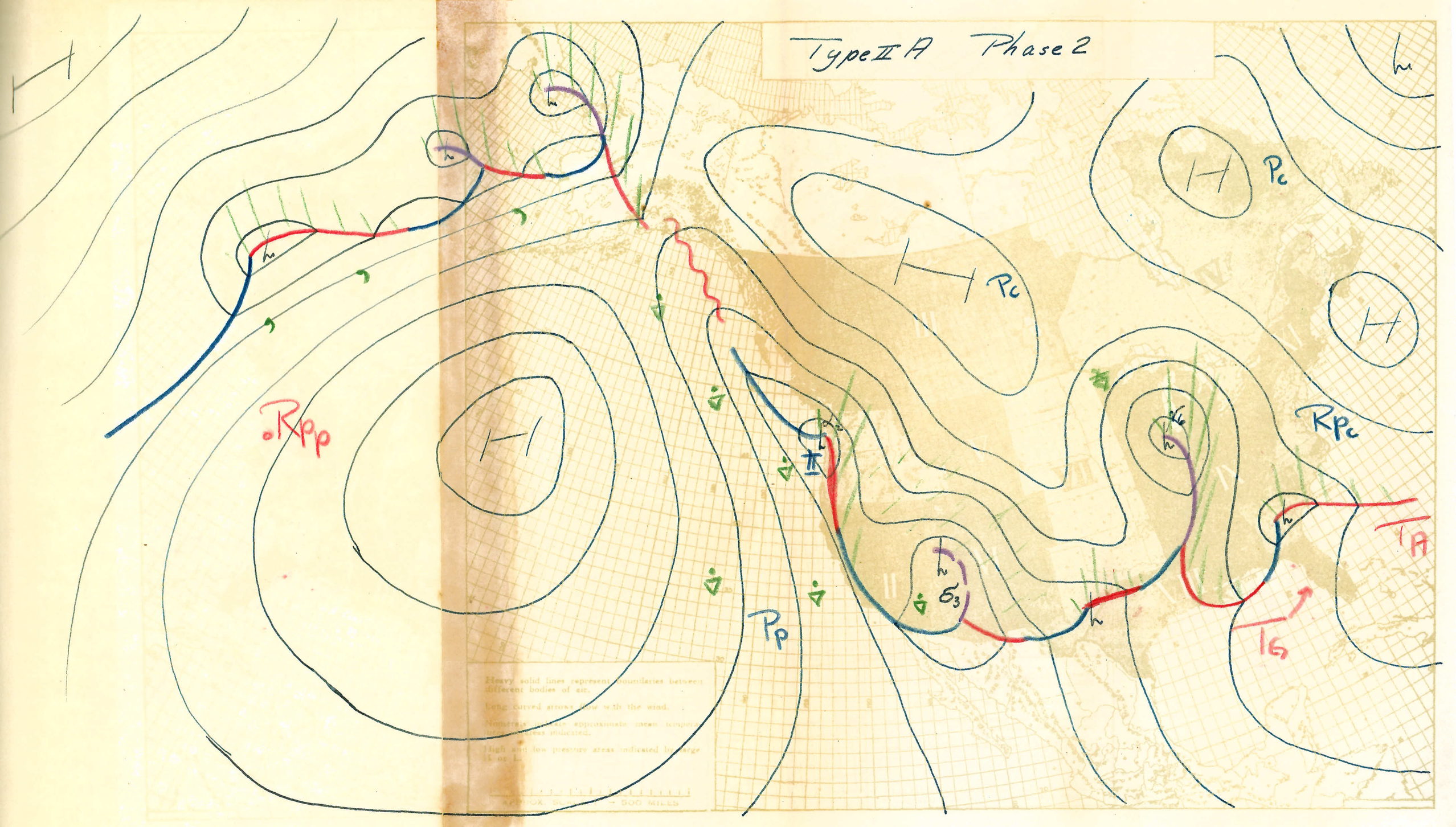
AZ

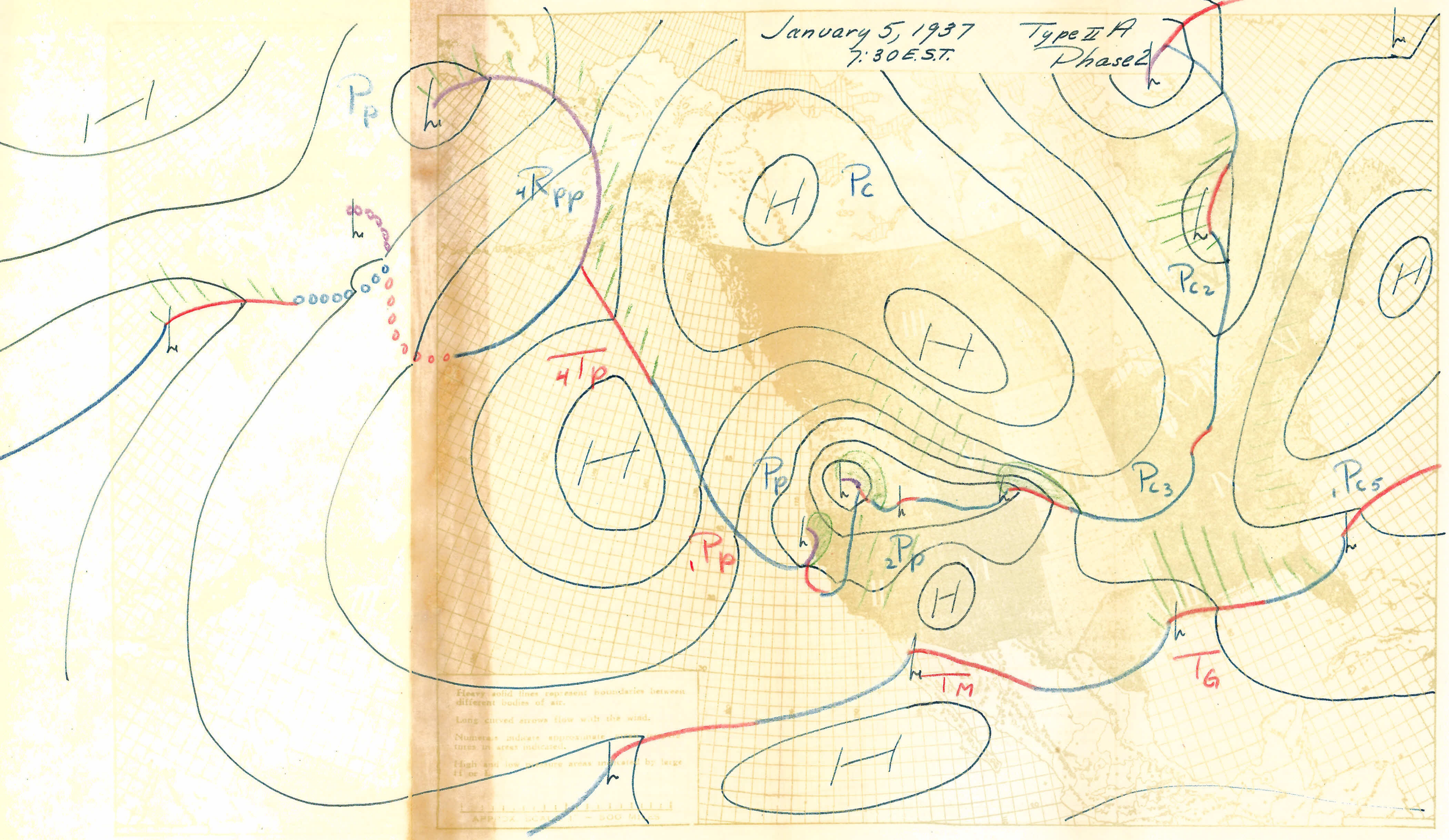
Type A
Phase 1

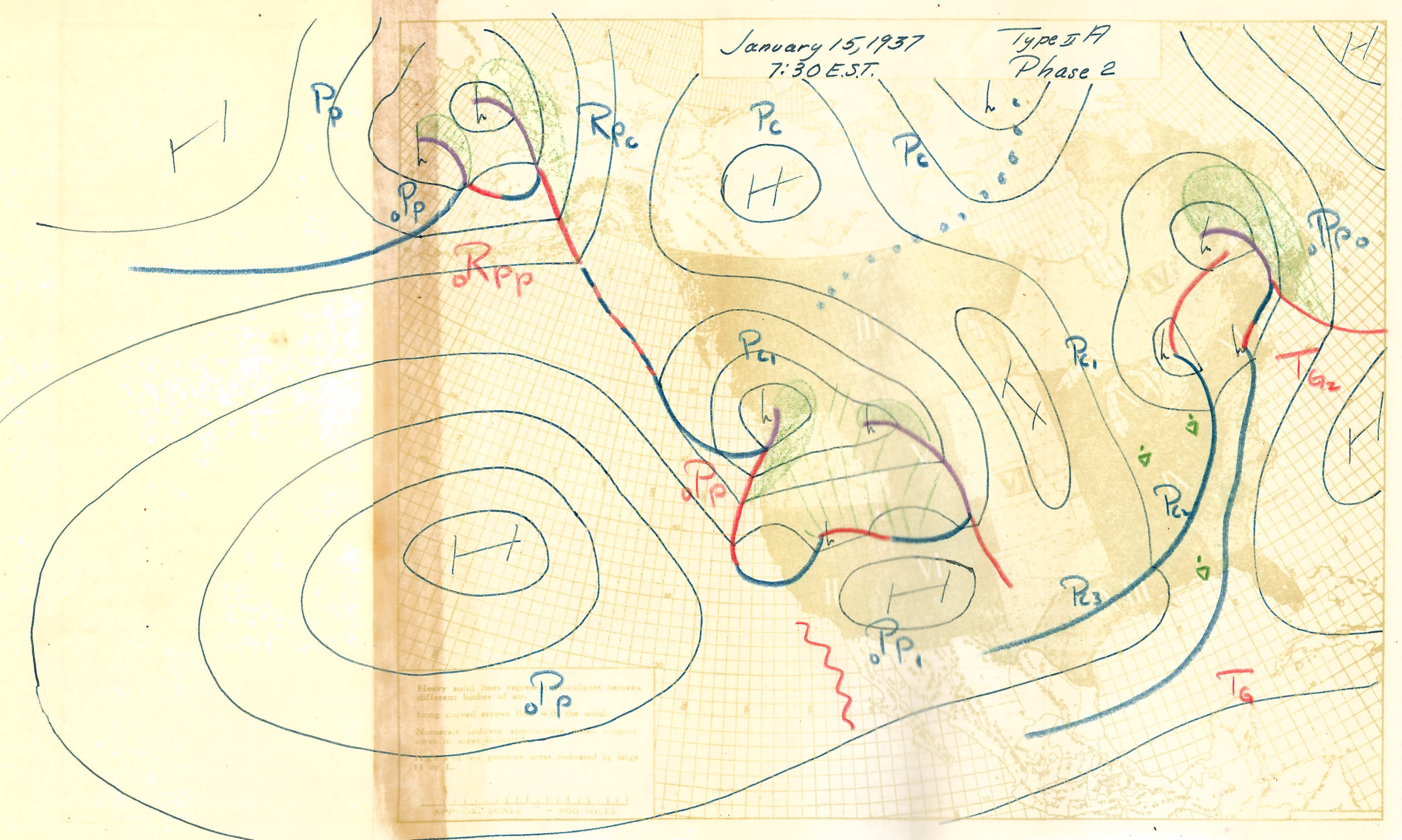




PHASE II


Type II A Phase 2
H
Pc
H
Pc
H
Rpp
Pp
Rpc
TA
IG
S3


January 5, 1937
7:30 E.S.T.
Type II A
Phase 2
Pp
4Rpp
Pc
Pc2
4Tp
Pc3
Pc5
1Pp
Pp
2Pp
TM
TG
Heavy solid lines represent boundaries between different bodies of air.
Long curved arrows flow with the wind.
Numerals indicate approximate temperatures in areas indicated.
High and low pressure areas indicated by large H or L.

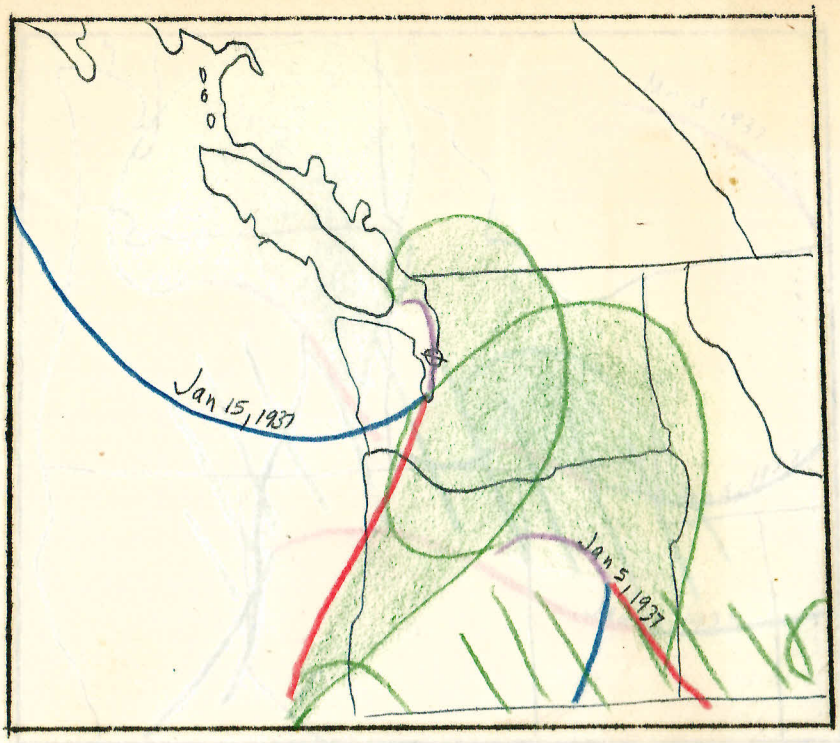

January 15, 1937
7:30 E.S.T.
Type II A
Phase 2
H
Pp
Rpc
Pc
H
Pc
h
h
h
Pp
Rpp
Pc1
h
h
Pc1
K
Pc2
h
h
h
Tg2
Pc3
Pp
Pp1
Tg
H
H
Heavy solid lines repre... boundaries between different bodies of air
Long curved arrows ... with the wind
Numerals indicate approximate ... heights in ... areas
... low pressure areas indicated by large H or L.
APPROX. SCALE ... = 500 MILES

Jan. 5
1937

Jan. 15
1937

SA

Type A
Phase 2



E.S.T.

Ceiling (100 ft)

Visibility (Mi)

Temperature °F

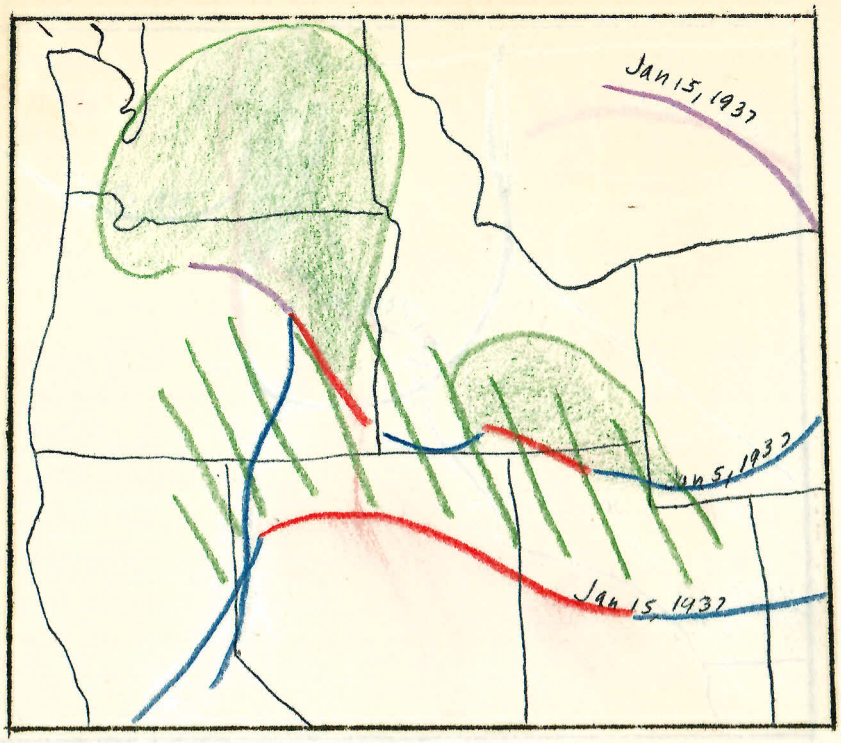
Phase 2

Jan. 5
1937

Jan. 15
1937

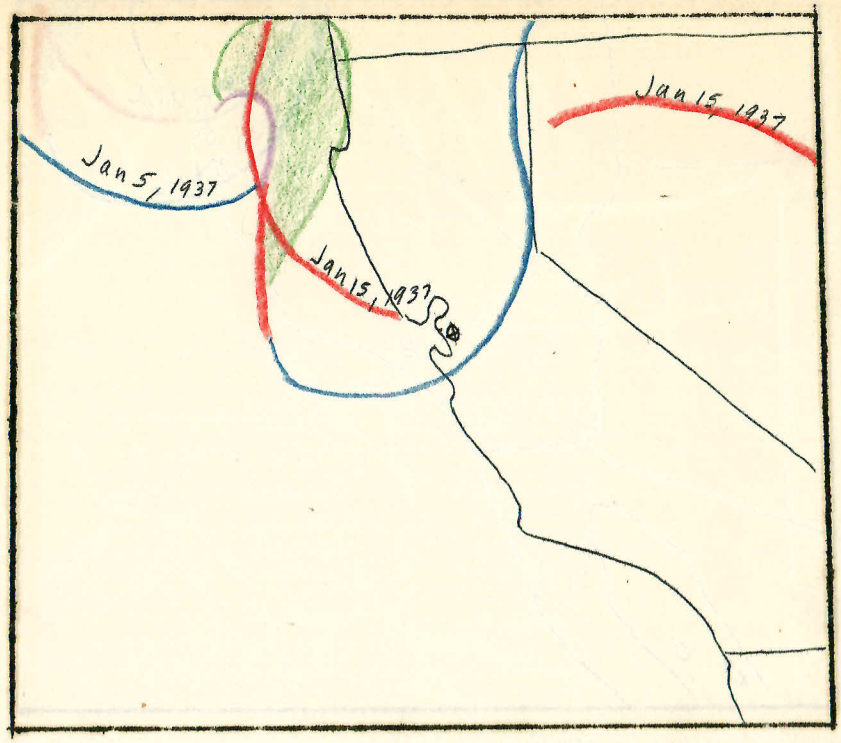
BE

Type A
Phase2



Phase 2

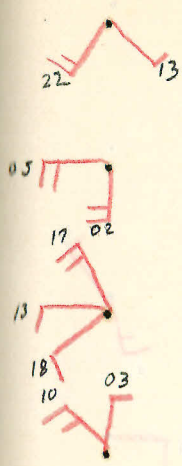
Jan. 5
1937



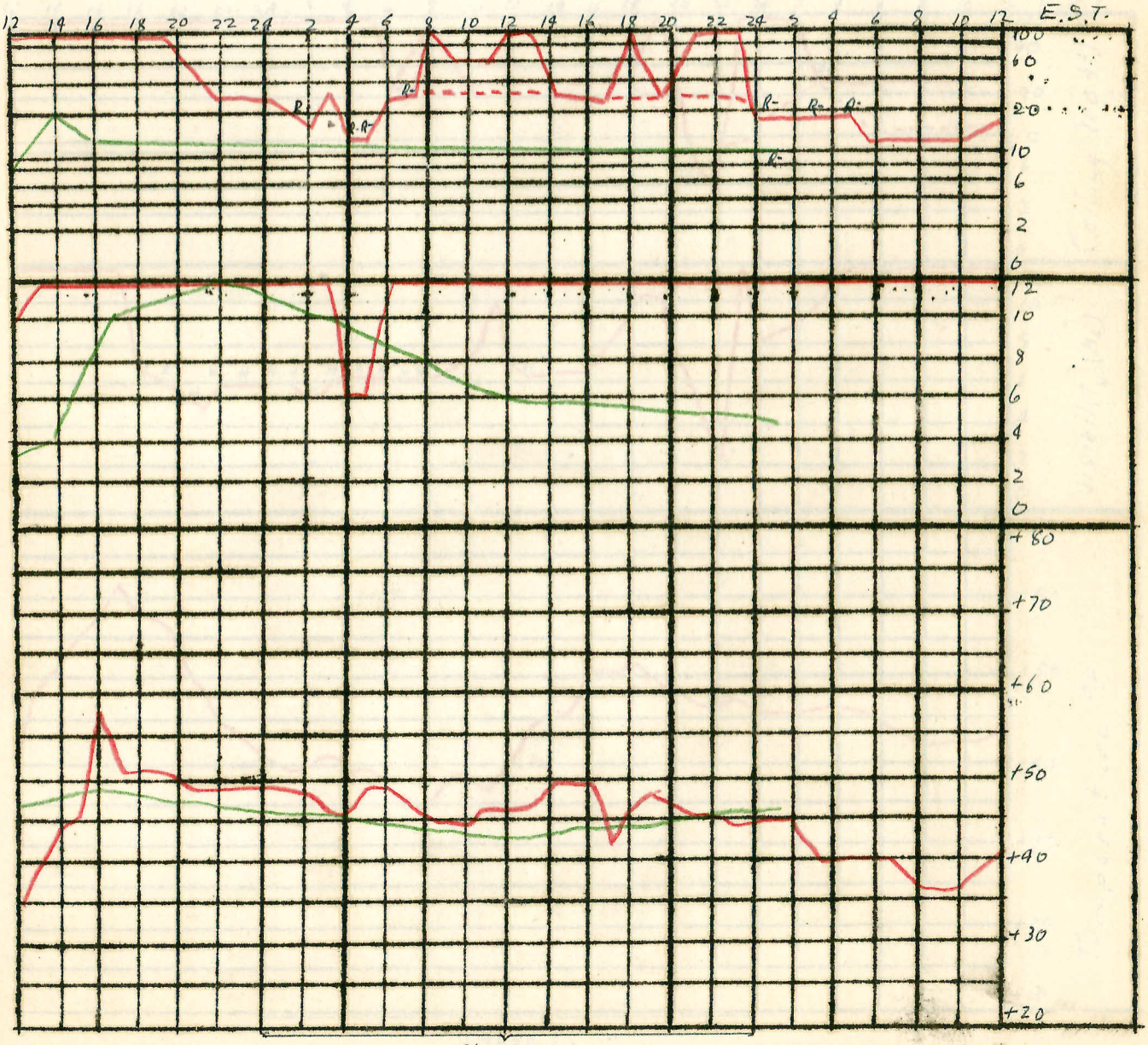
Jan. 15
1937

OA

Type A
Phase 2





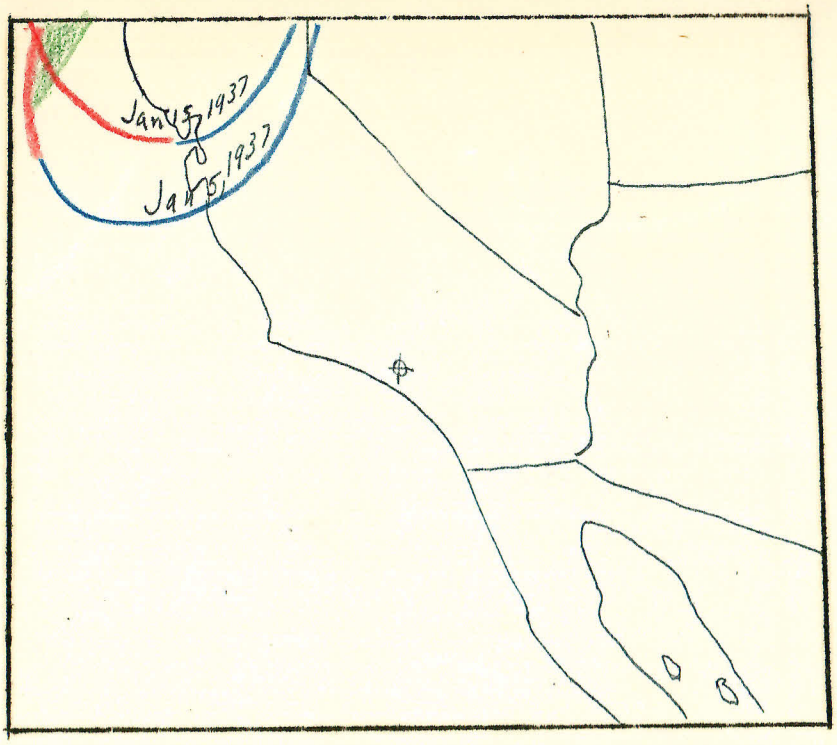


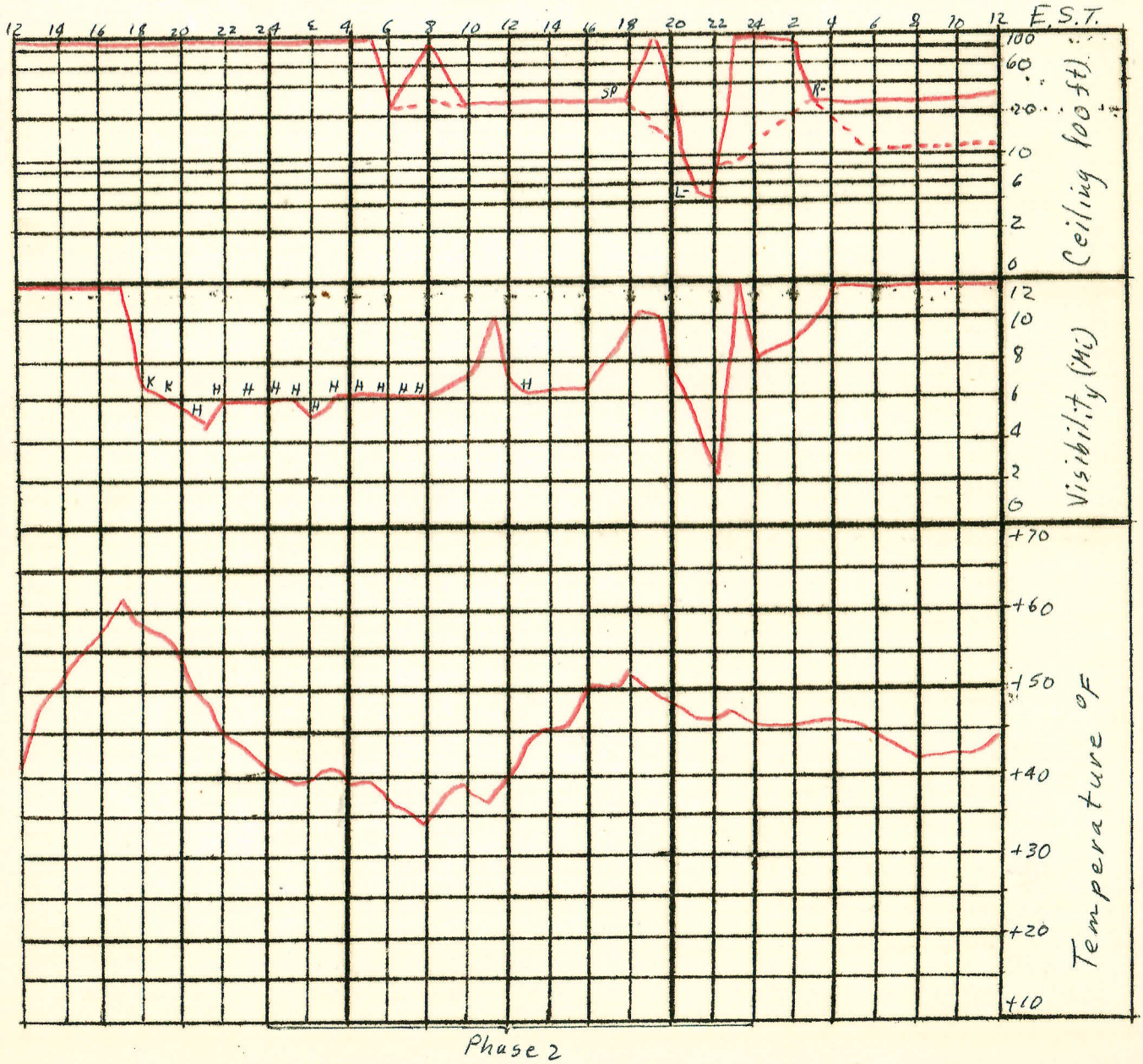
Phase 2

Jan. 5
1937

Jan. 15 BU
1937

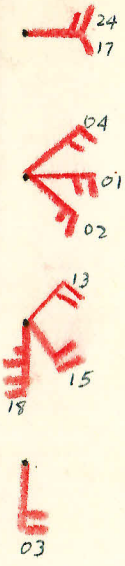
Type A
Phase 2

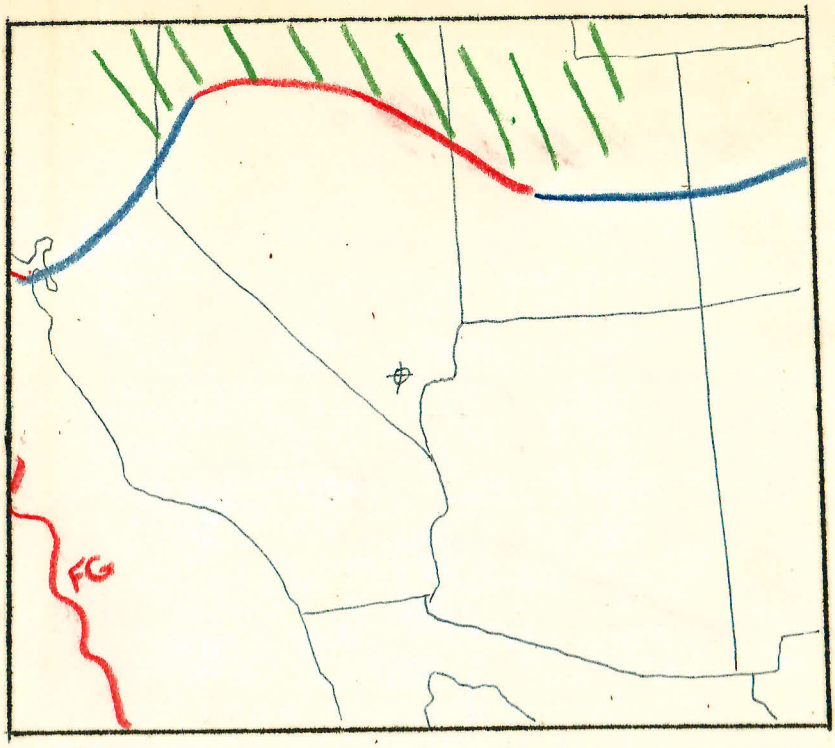




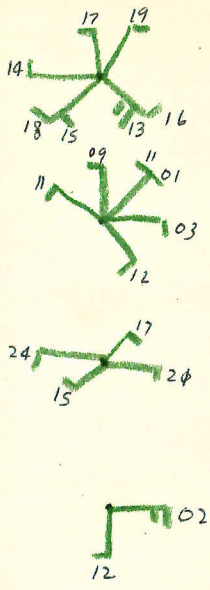
Phase 2

Jan. 5
1937



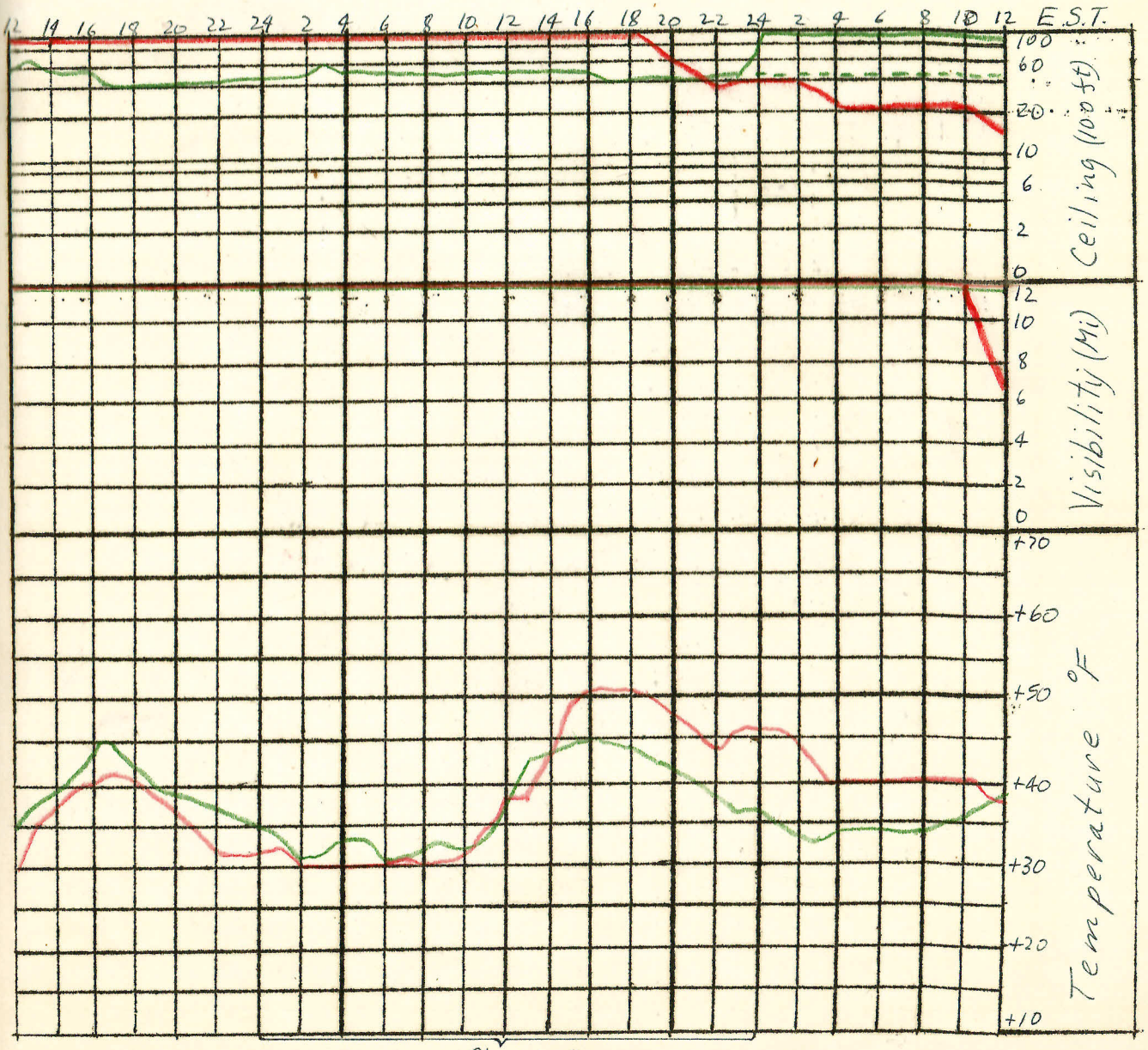


Jan. 15
1937



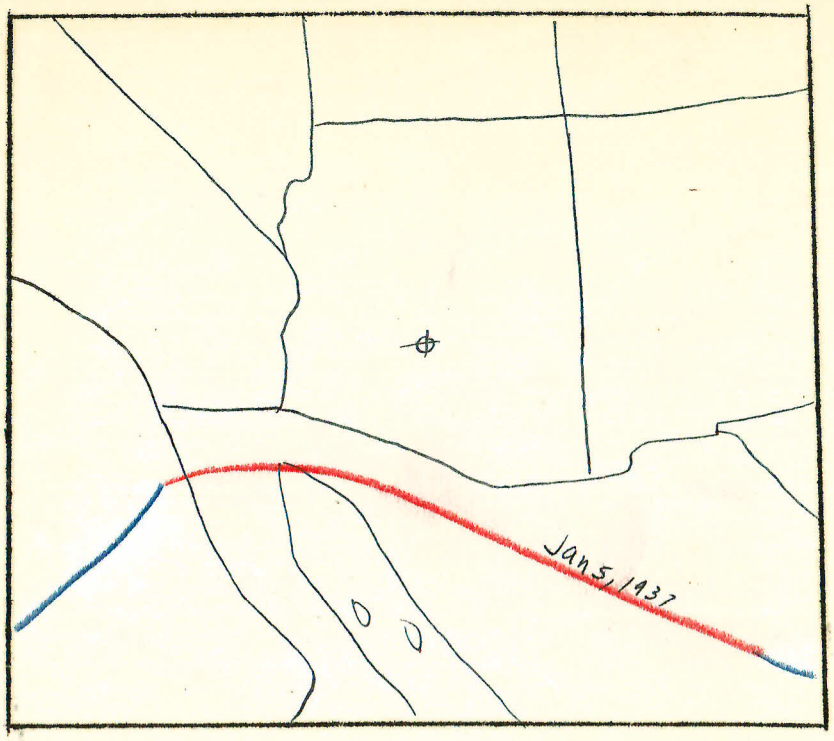
LQ

Type A
Phase 2



Phase 2

Jan. 5
1937



Jan. 15
1937

PH

Type A
Phase 2

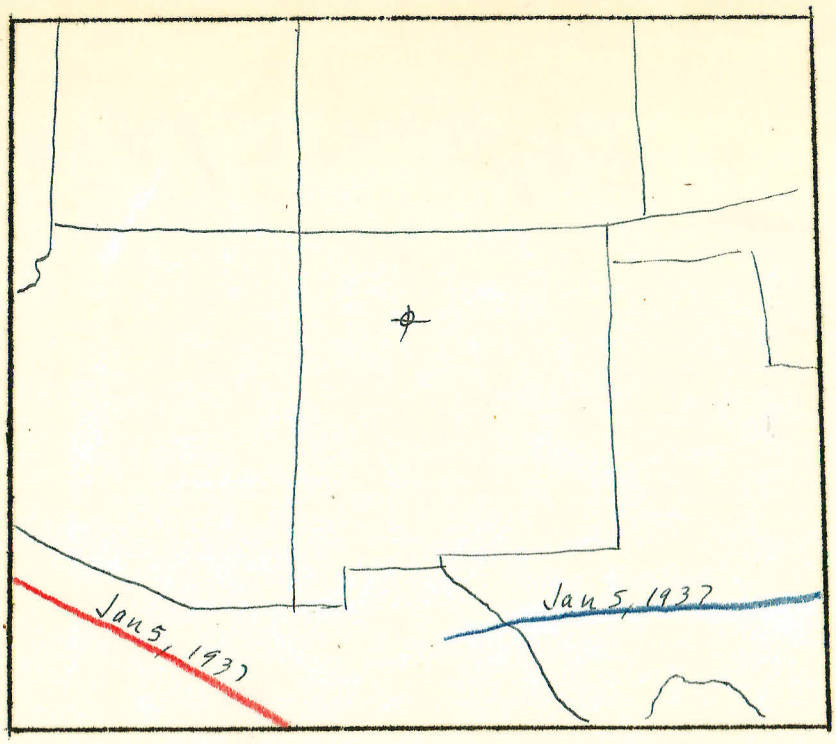
Jan. 5
1937

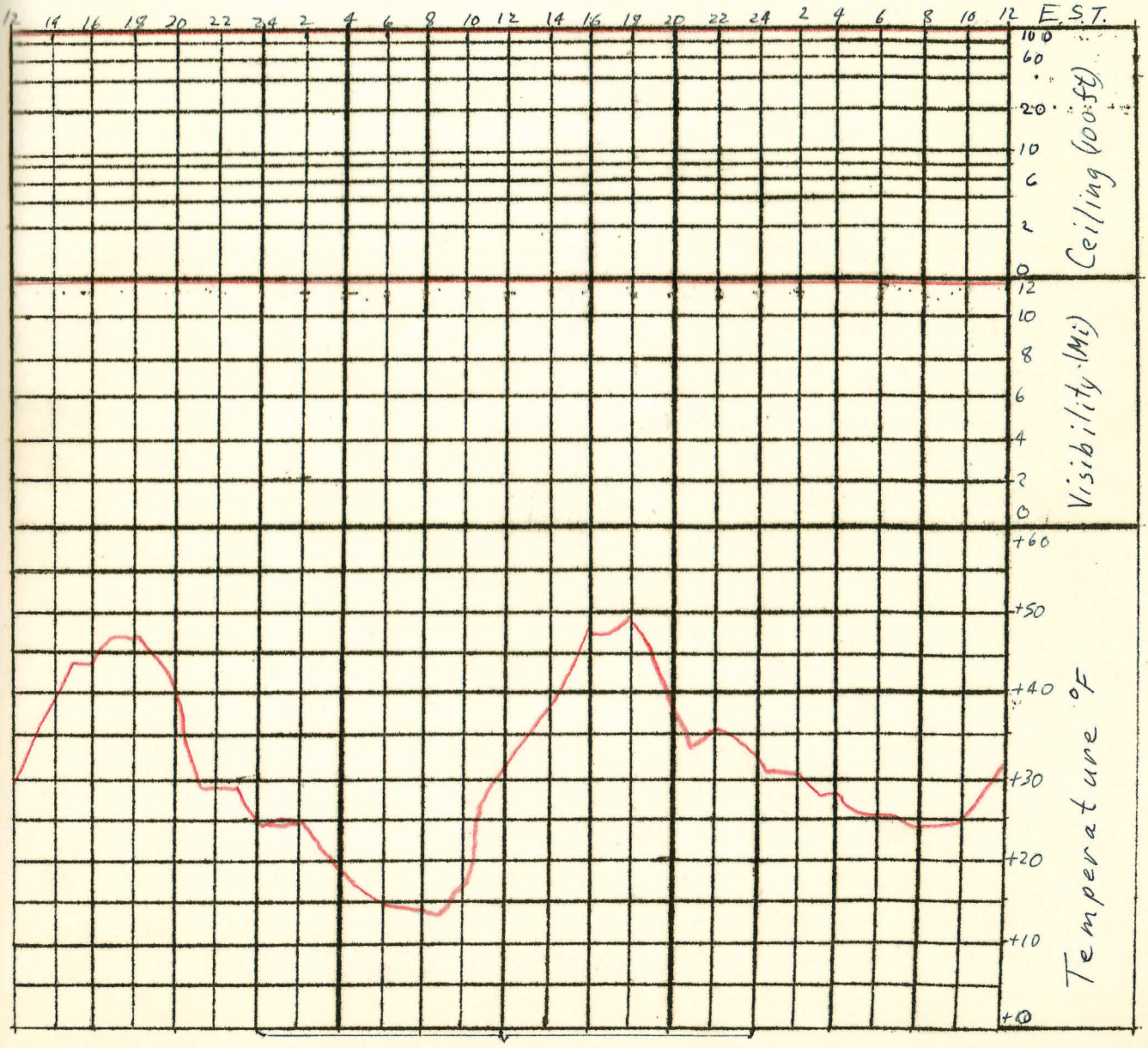
Jan. 15
1937

AB

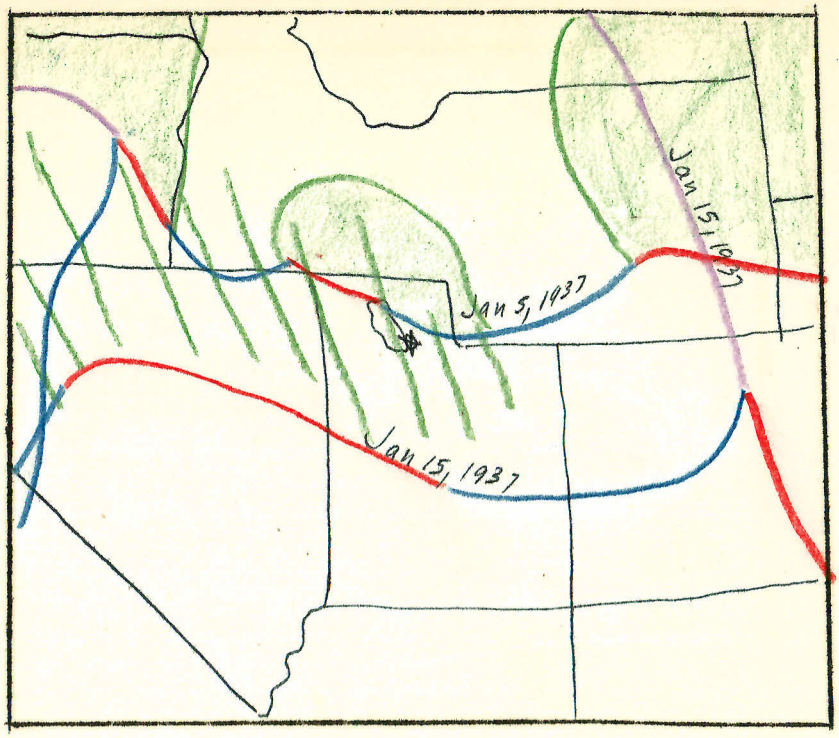
Type A
Phase 2







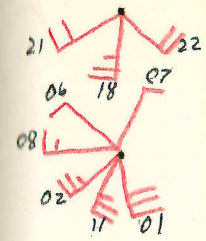
Jan. 5
1937

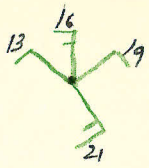


Jan. 15
1937

SL

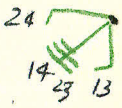
Type A
Phase 2





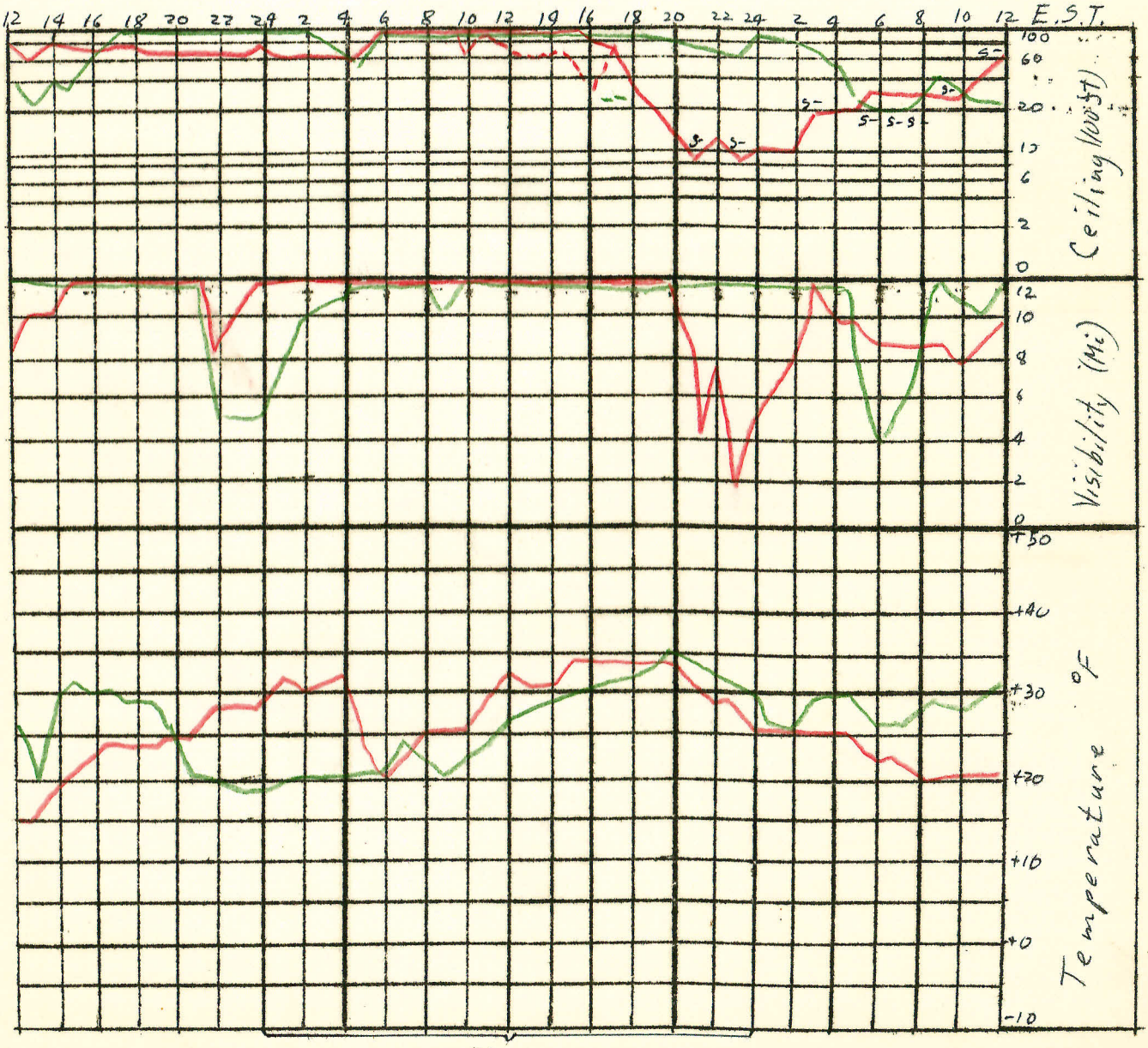






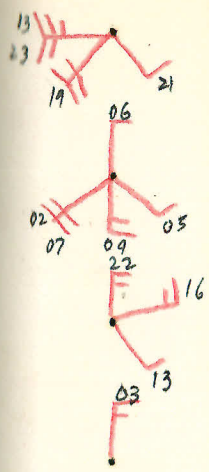


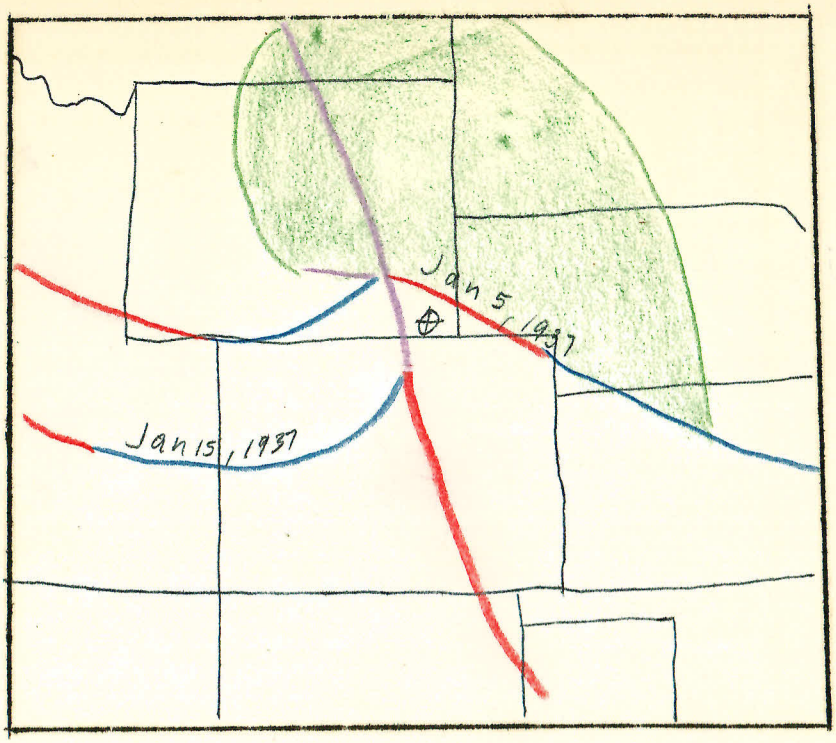




Phase 2

Jan. 5
1937





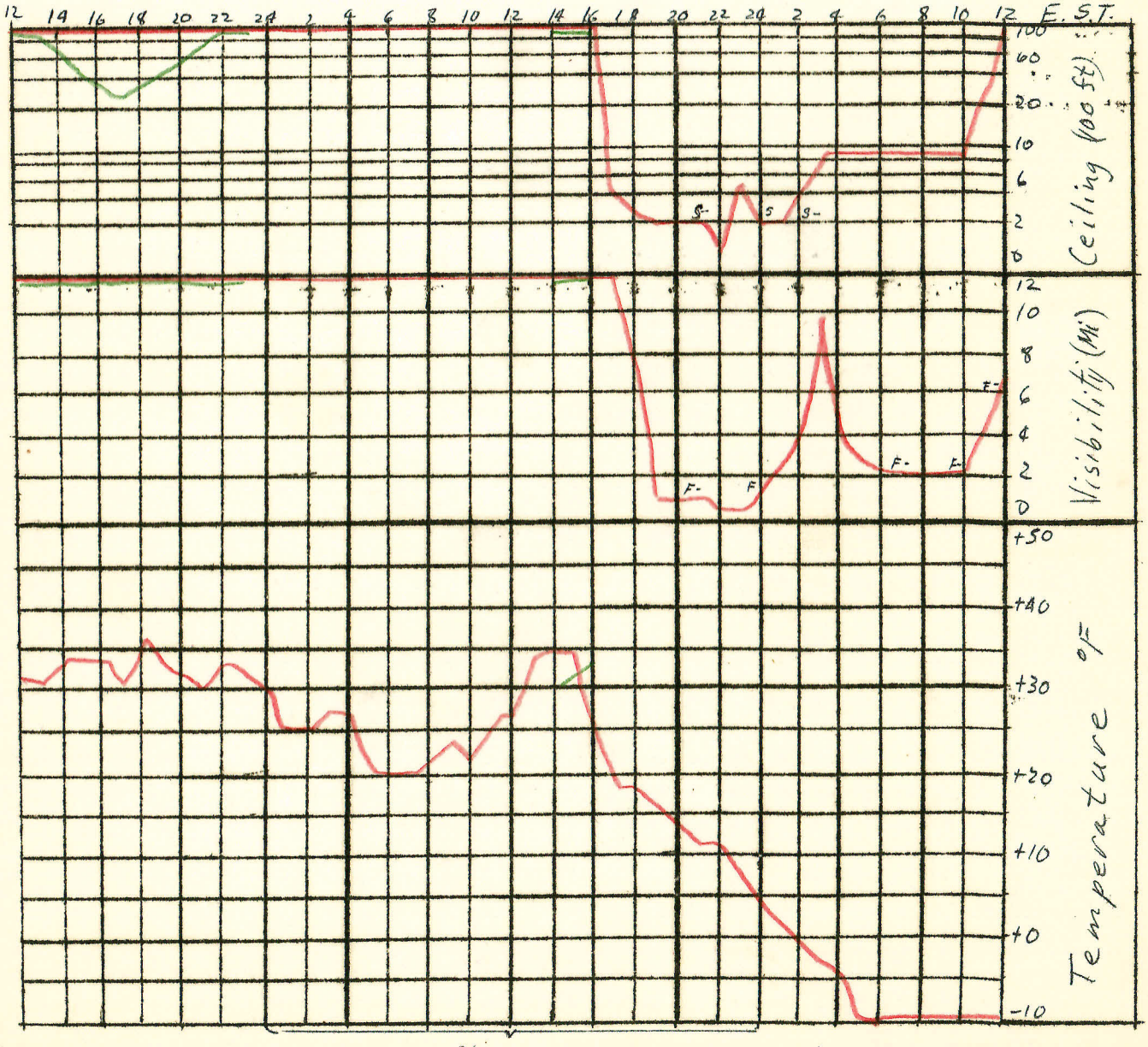
Jan. 15
1937



CX

Type A
Phase 2





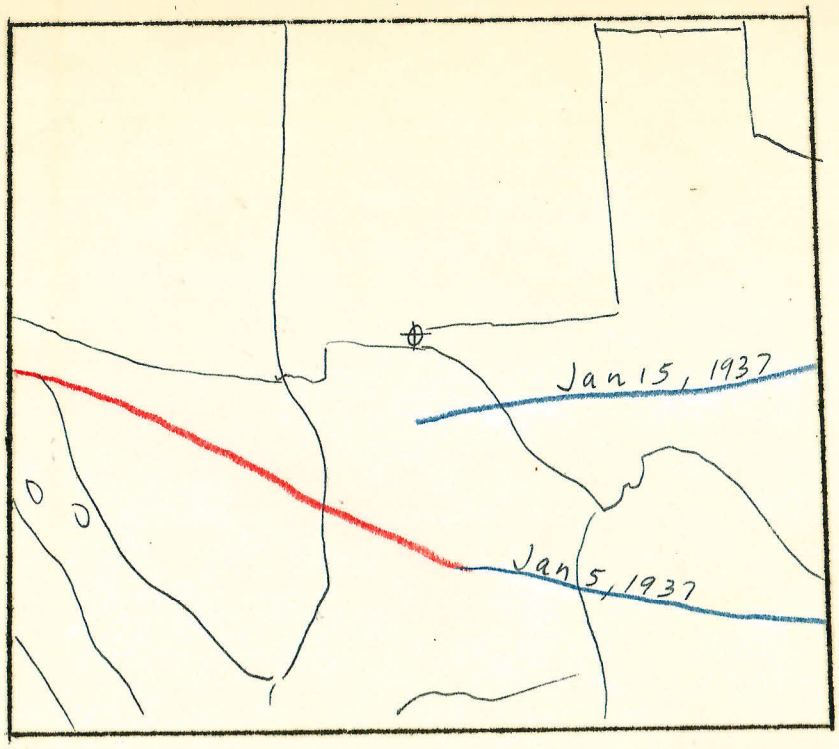
Phase 2

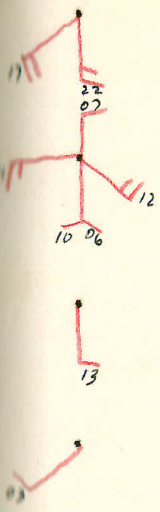
Jan. 5
1937

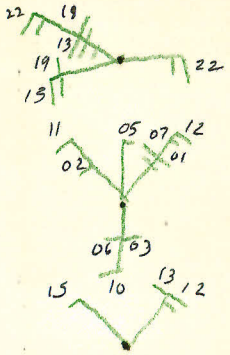
Jan. 15
1937

EO

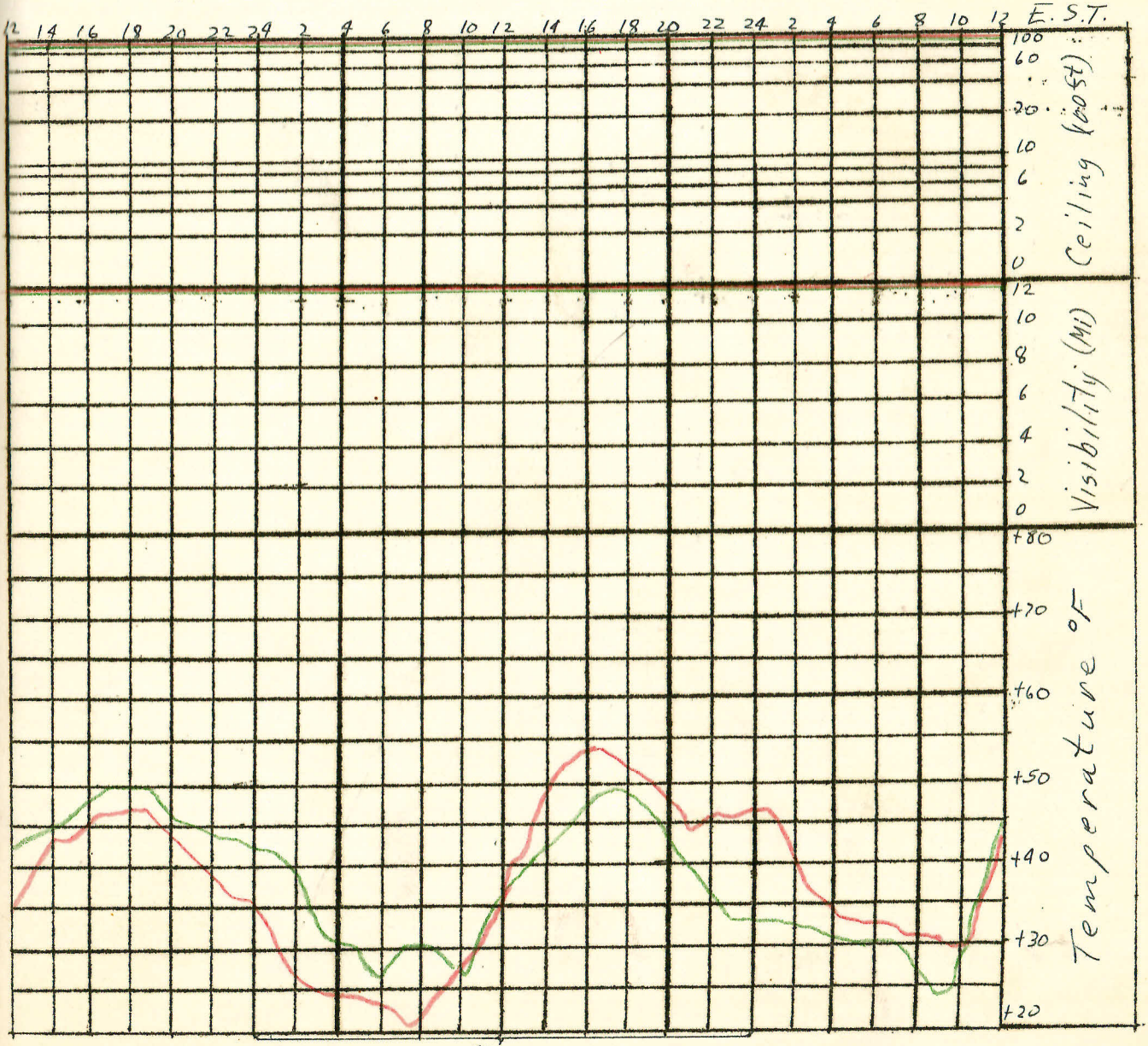
Type A
Phase 2











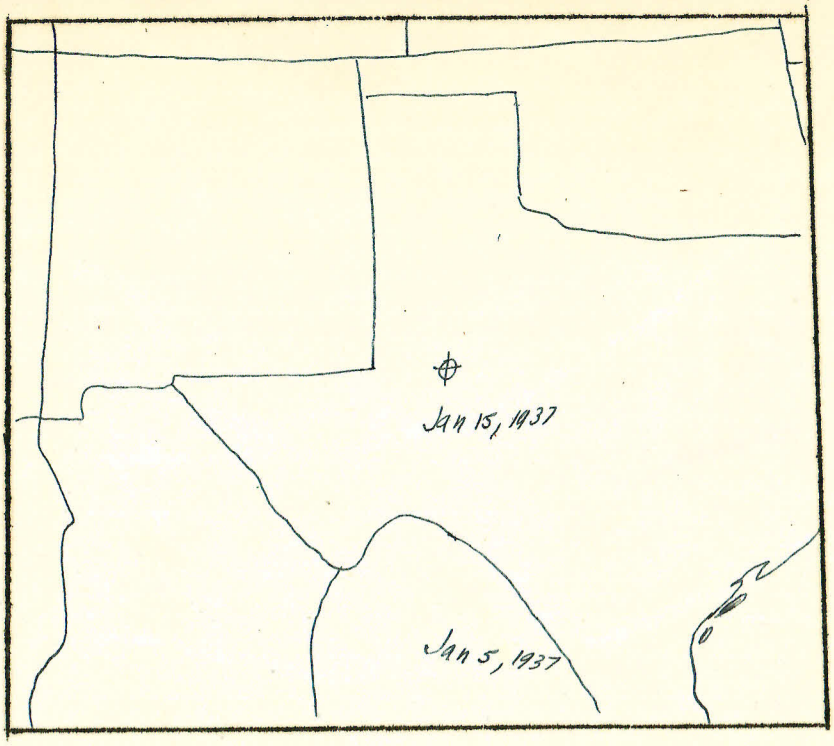
Phase 2

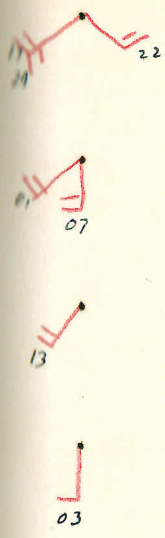
Jan. 5
1937

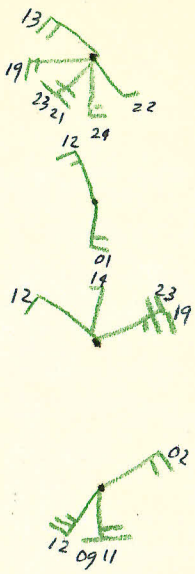
Jan. 15
1937

BZ

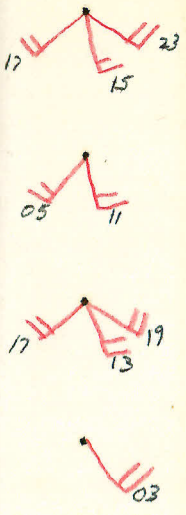
Type A
Phase 2

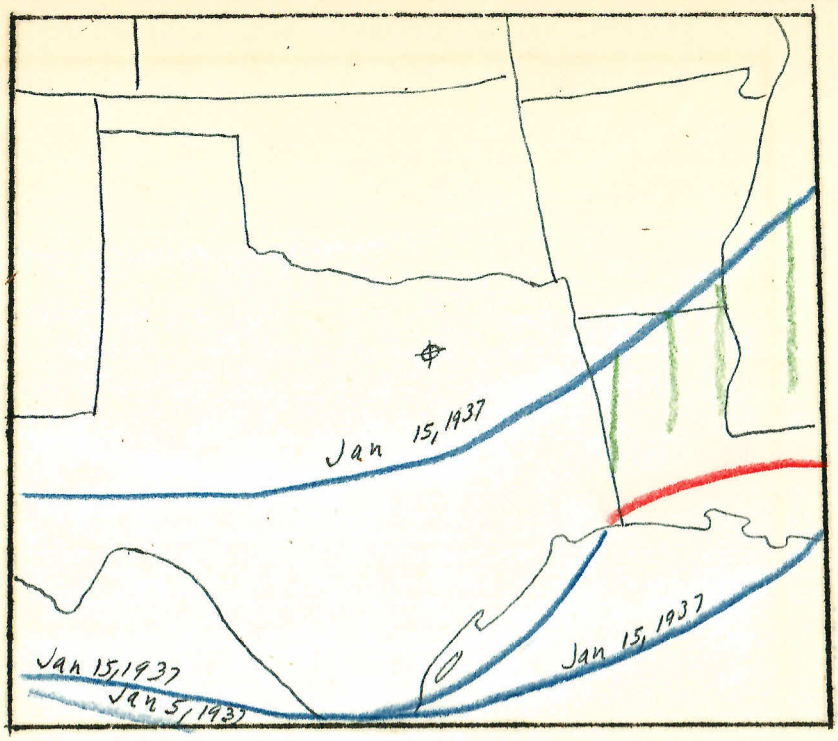






Jan. 5
1937



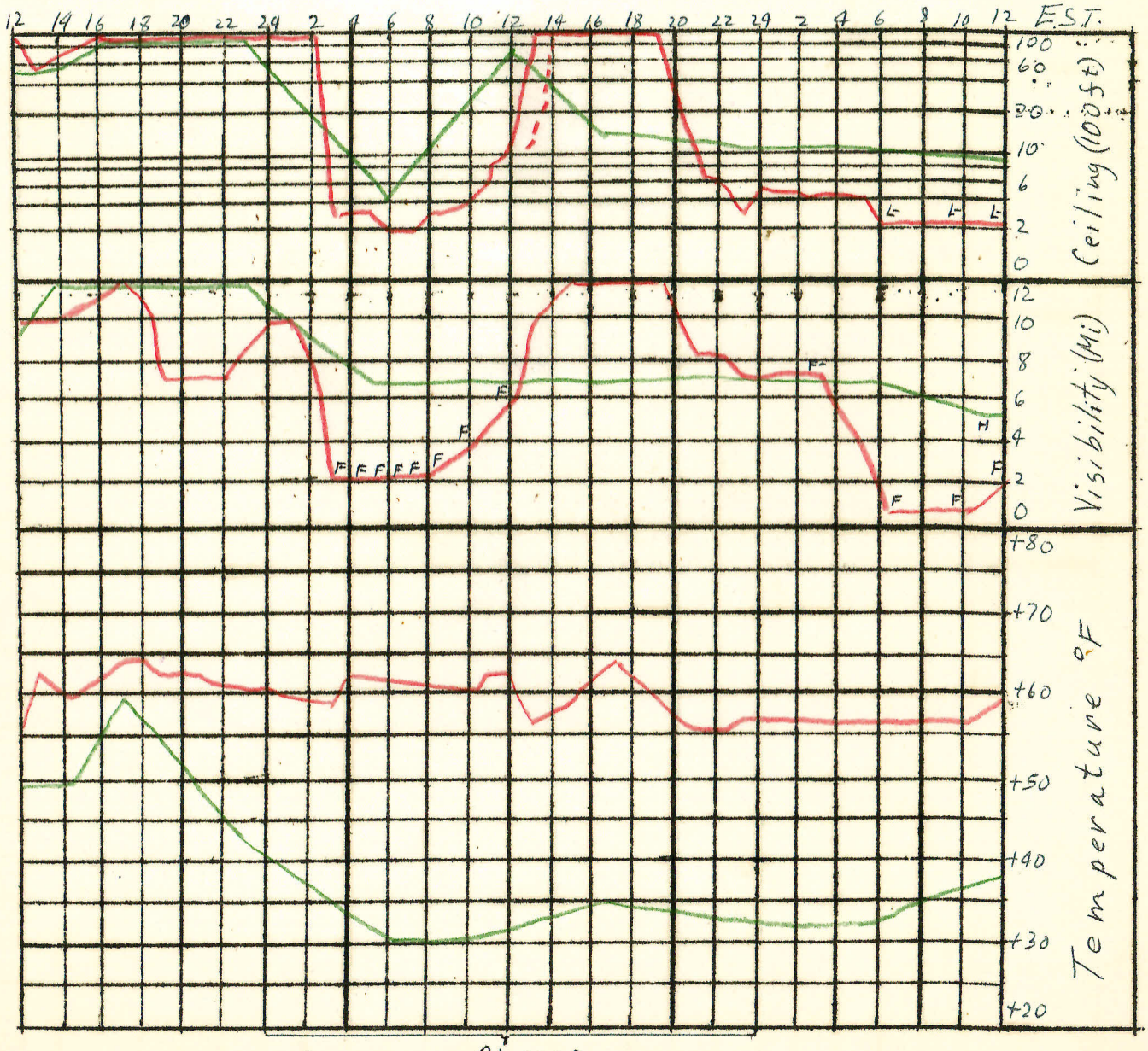


Jan. 15
1937

DL

Type A
Phase 2



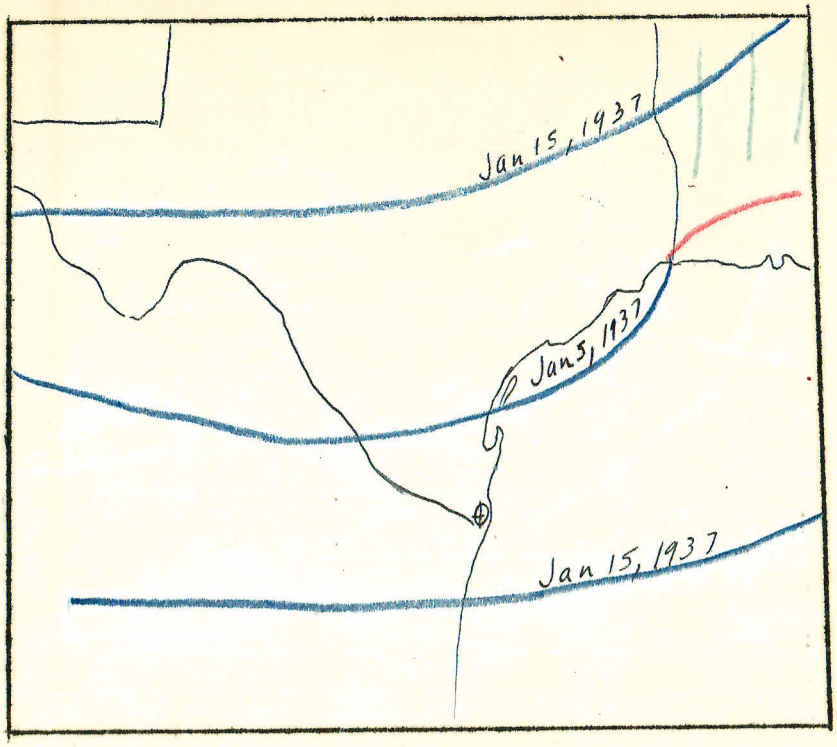


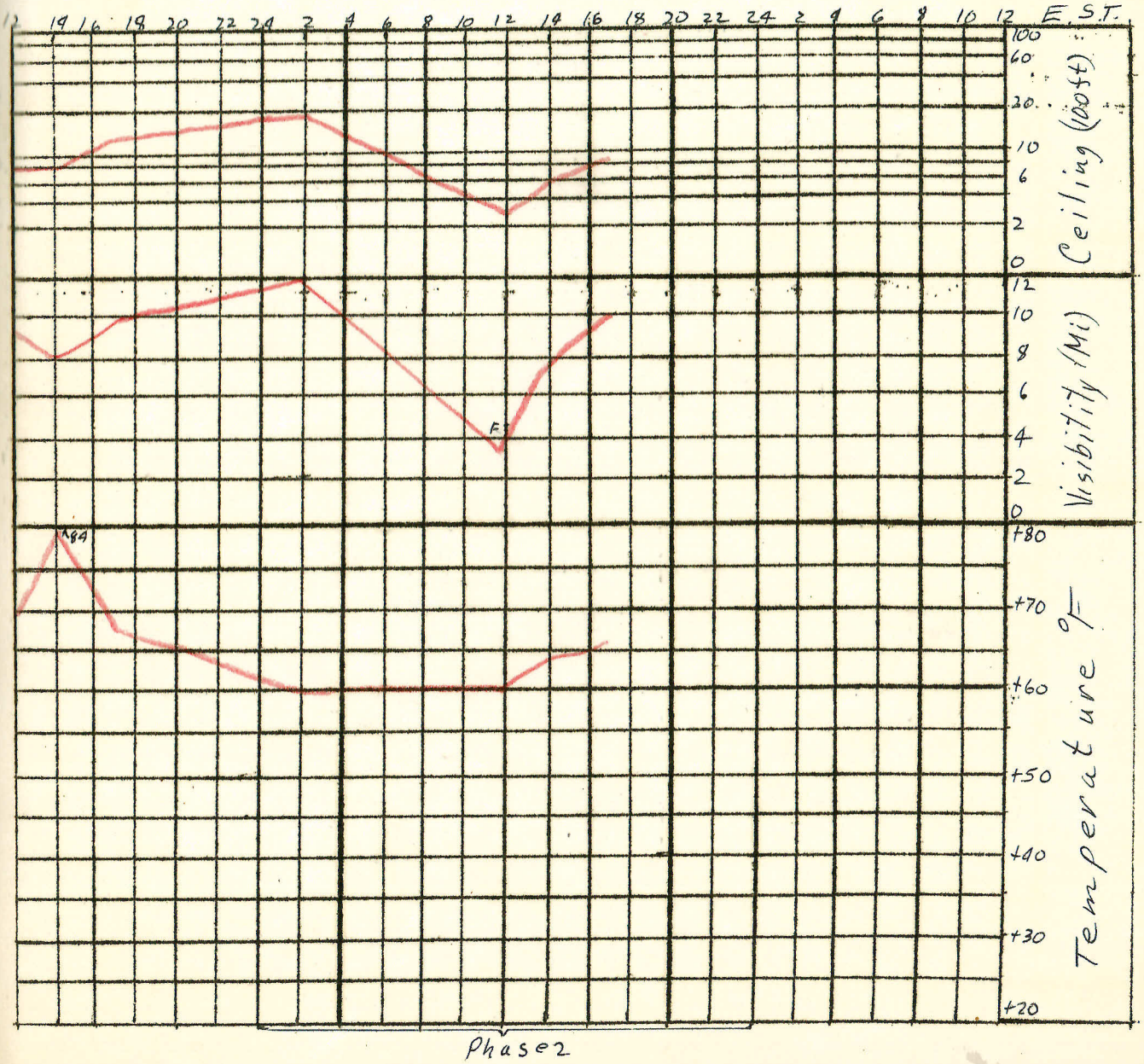
Jan. 5
1937

Jan. 15
1937

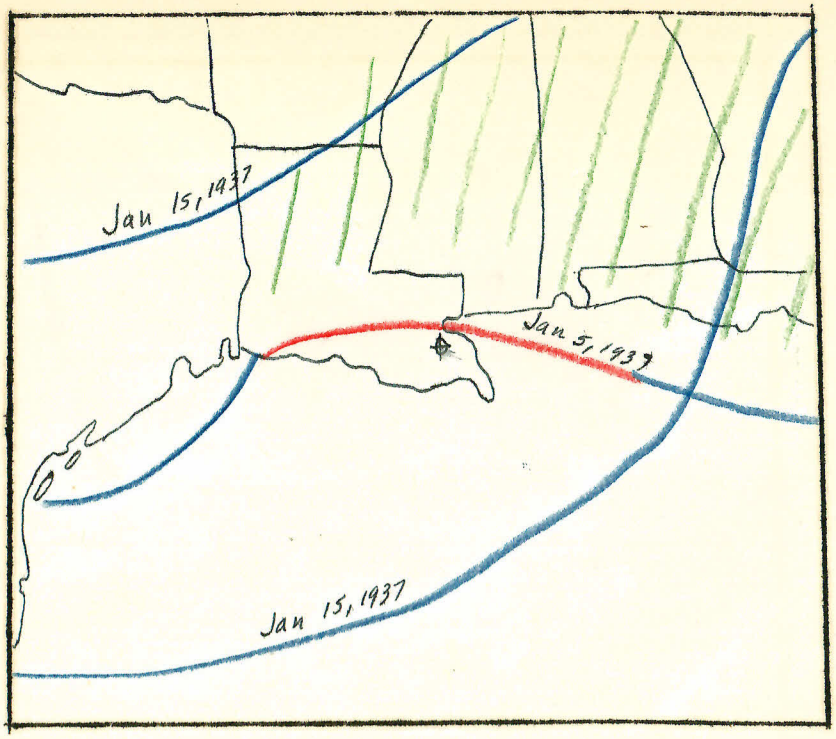
JI

Type A
Phase 2





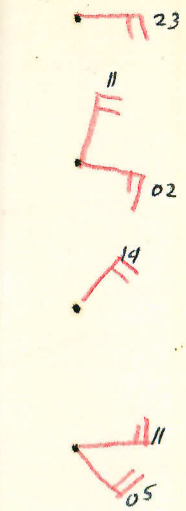
Jan. 5
1937



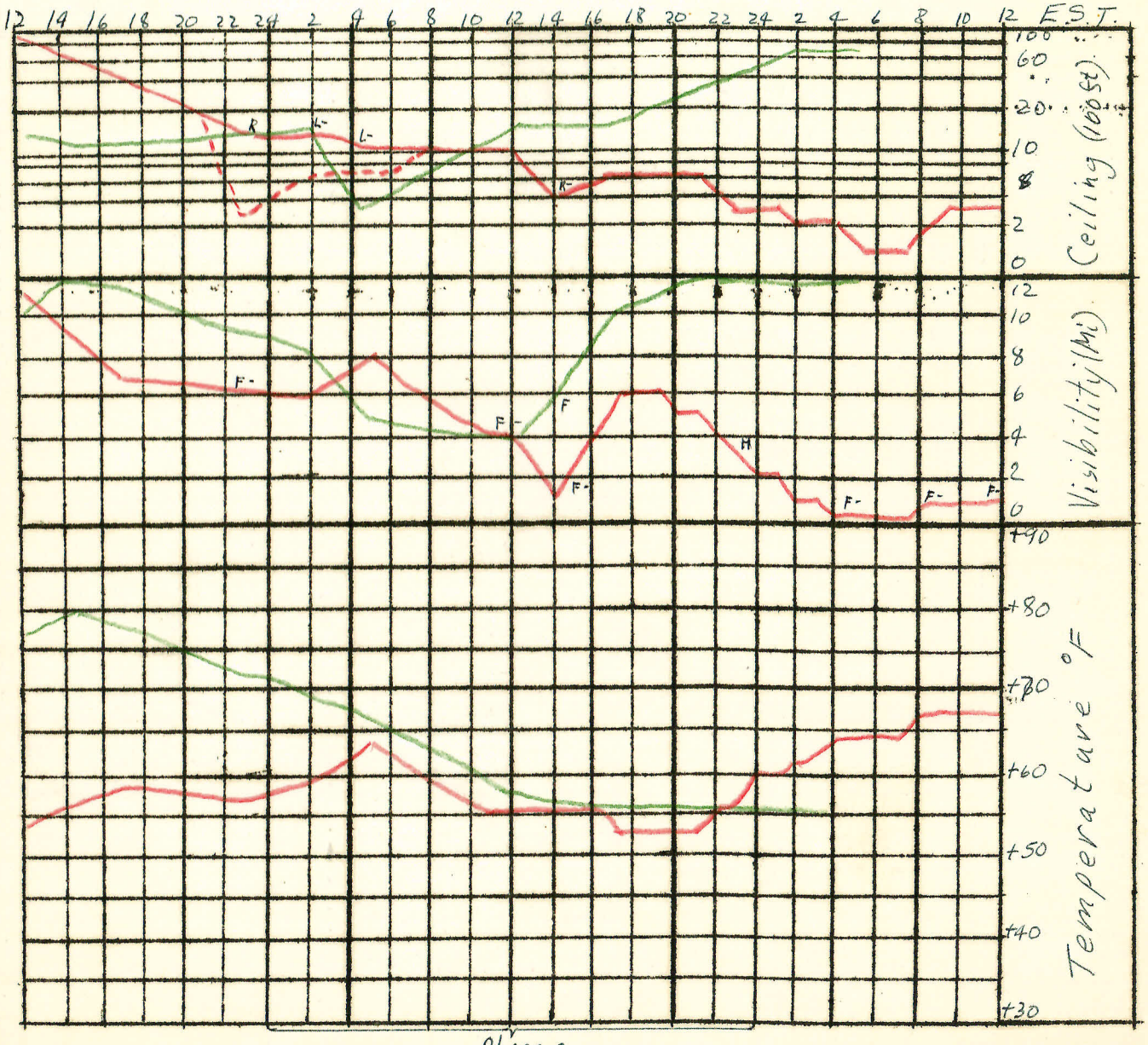
Jan. 15
1937

NO

Type A
Phase 2







Phase 2

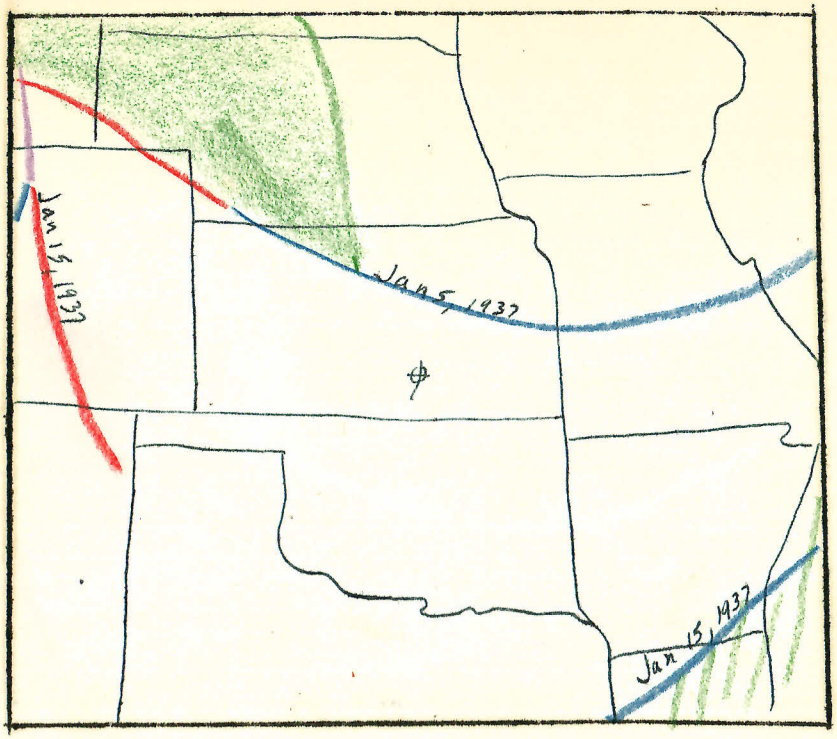
Jan. 5
1937

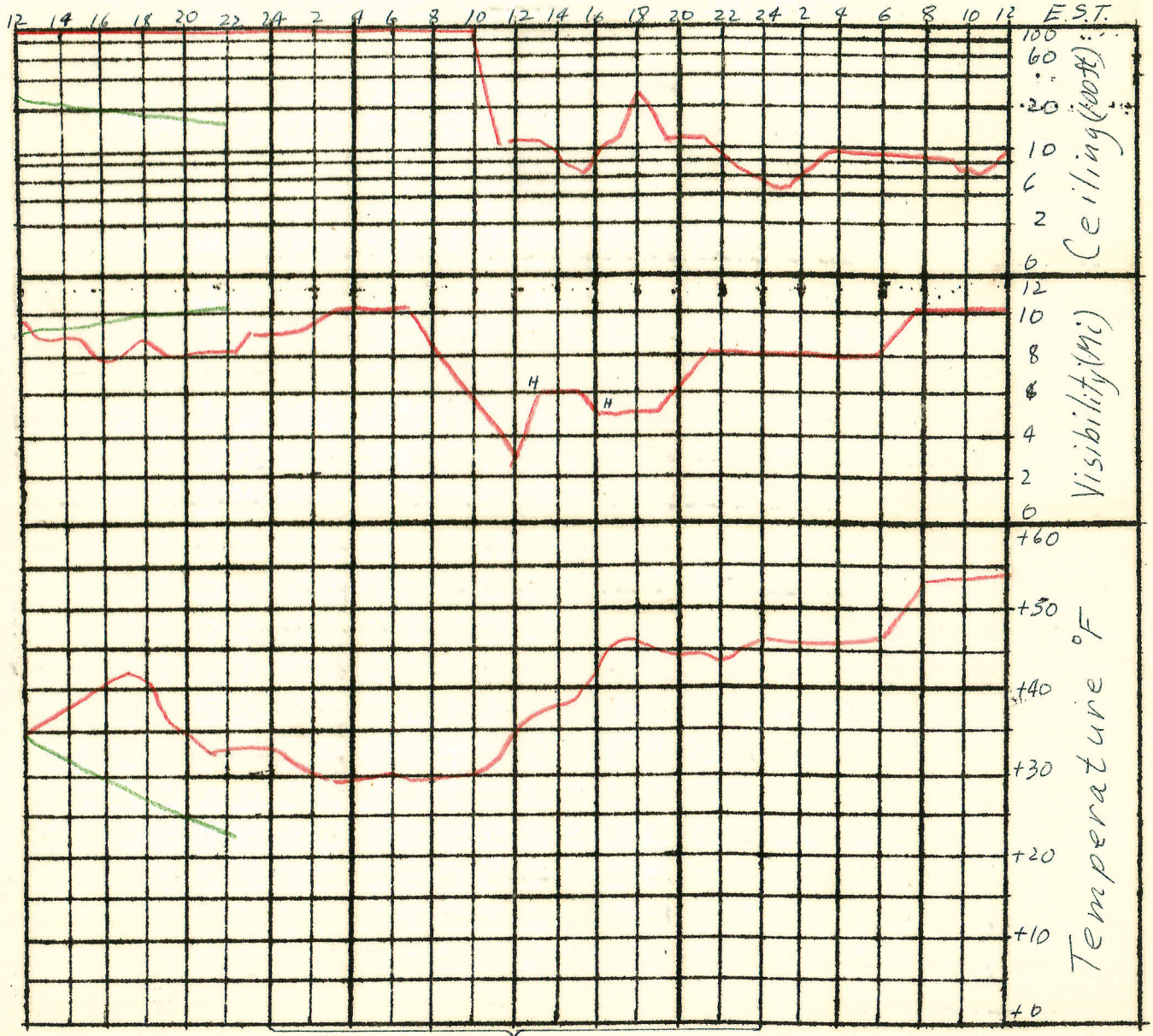
Jan. 15
1937

MD

Type A
Phase 2







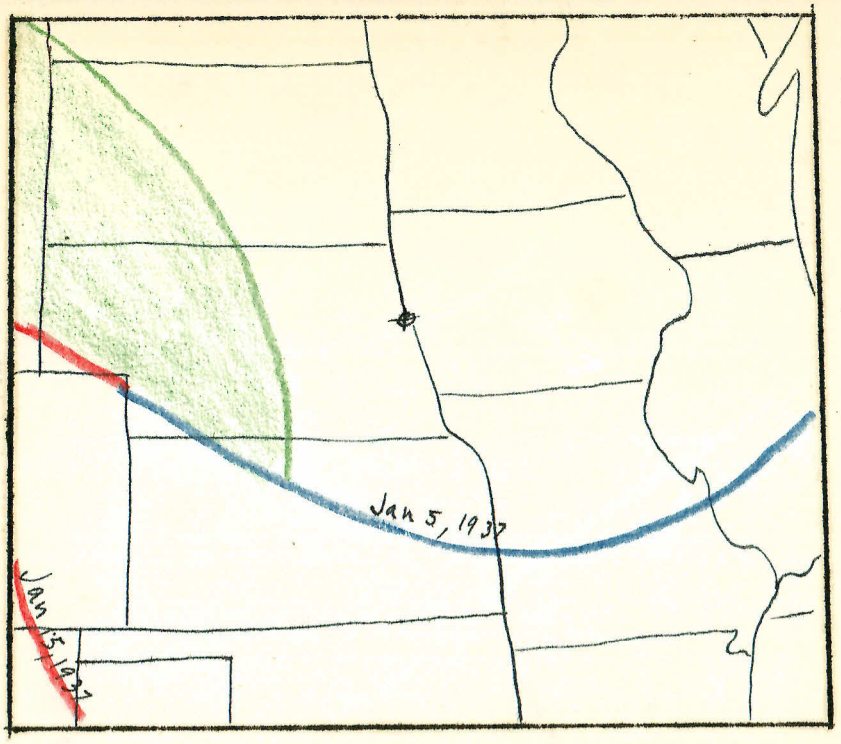
Phase 2

Jan. 5
1937

Jan. 15
1937

OH

Type A
Phase 2



12 14 16 18 20 22 24 2 4 6 8 10 12 14 16 18 20 22 24 2 4 6 8 10 12 E.S.T.

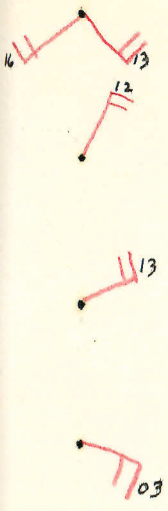
Ceiling (hundreds of ft): 100 60 20 10 6 2 0

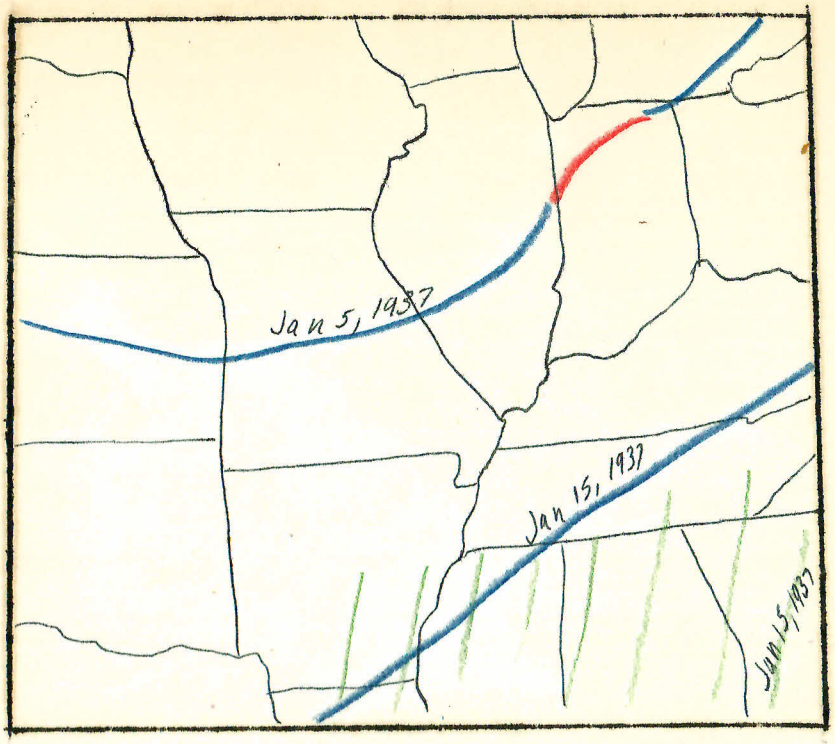
Visibility (Mi) 12 10 8 6 4 2 0

Temperature °F +40 +30 +20 +10 +0 -10 -20

Phase 2

Jan. 5
1937

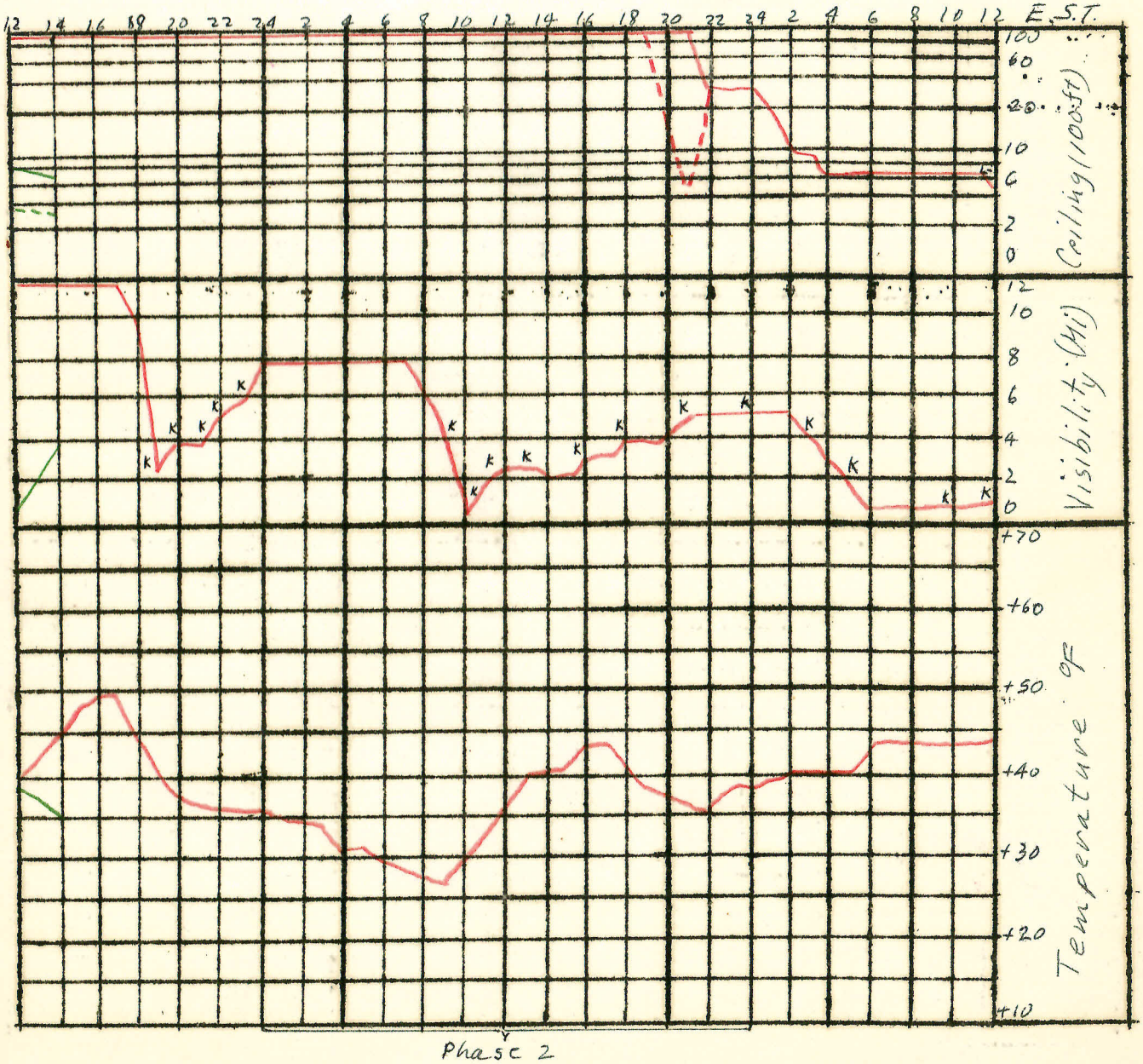




Jan. 15
1937

LS

Type A
Phase 2



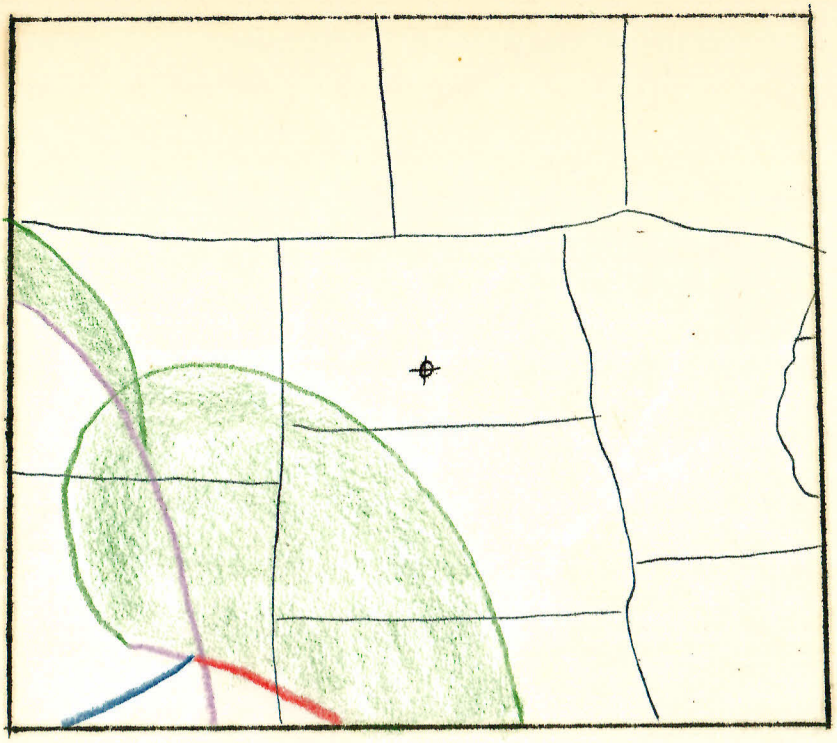
Phase 2

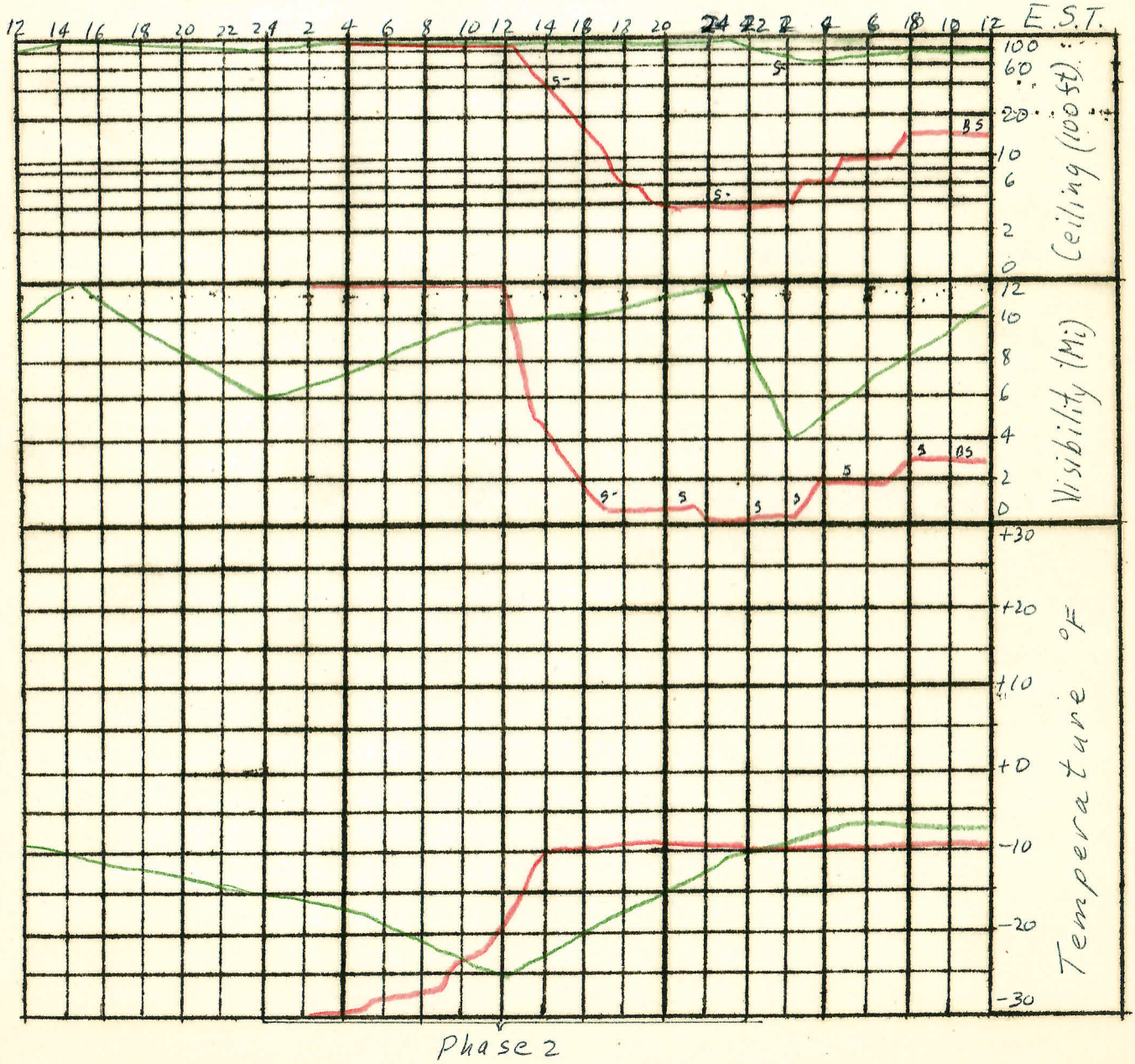
Jan. 5
1937

Jan. 15
1937

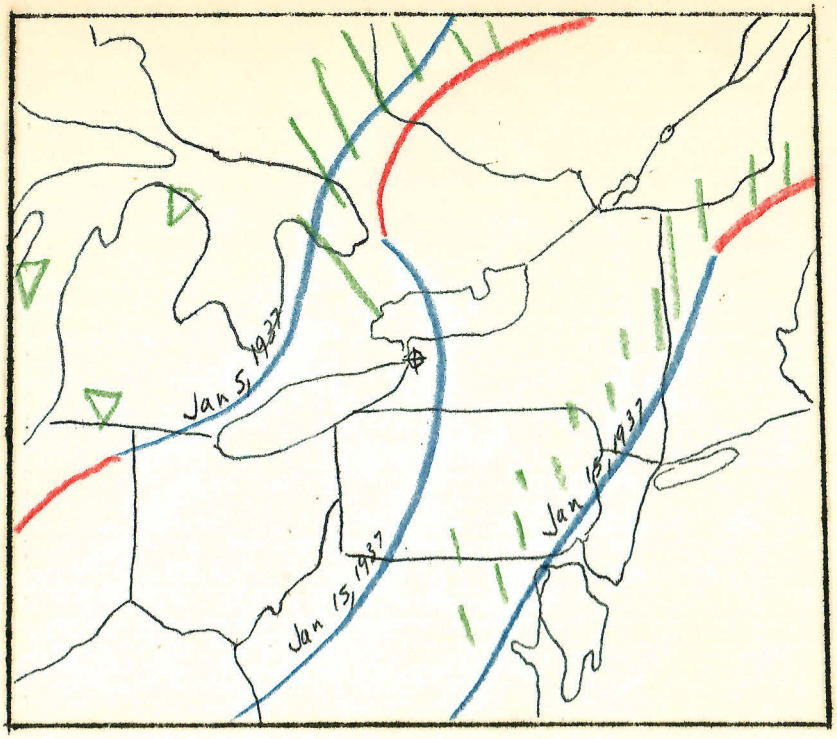
RK

Type A
Phase 2





Jan. 5
1937



Jan. 15
1937

BJ

Type A
Phase 2

12 14 16 18 20 22 24 2 4 6 8 10 12 14 16 18 20 22 24 2 4 6 8 10 12 E.S.T.

Ceiling (100 ft): 100 60 20 10 6 2 0

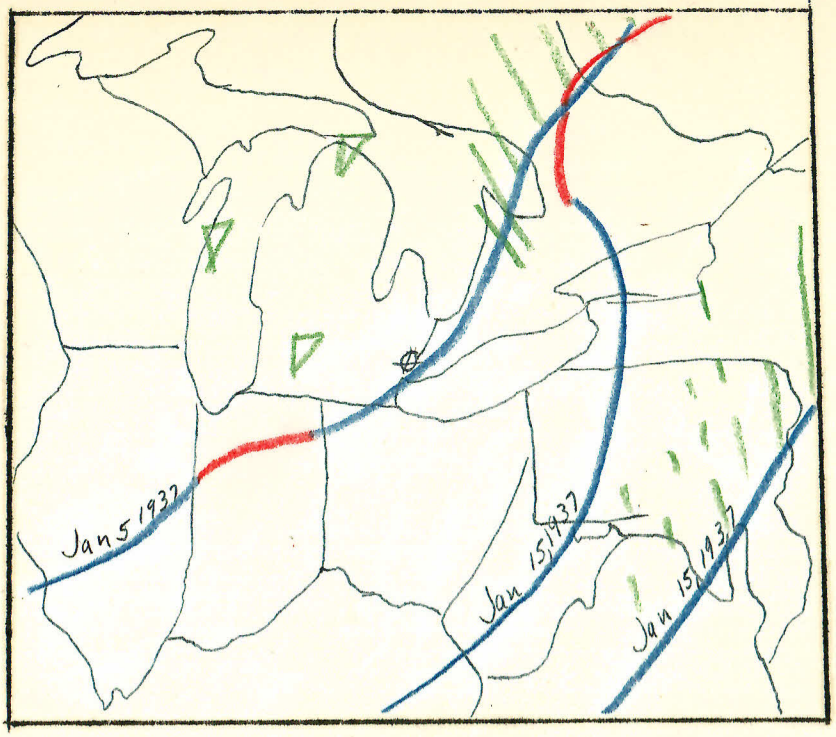
Visibility (Mi): 12 10 8 6 4 2 0

Temperature °F: +60 +50 +40 +30 +20 +10 +0

Phase 2

Jan. 5
1937



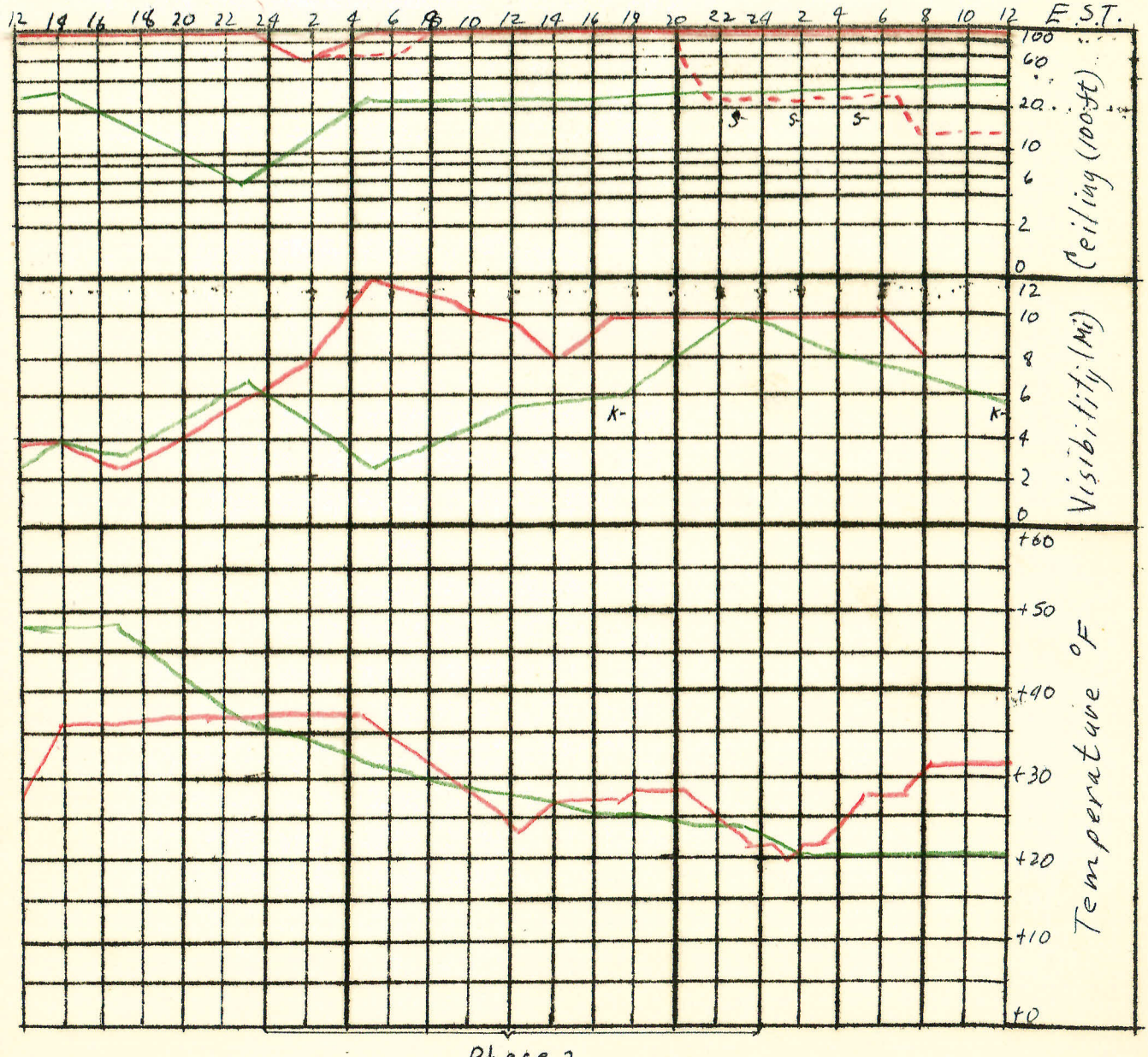


Jan. 15
1937



DO

Type A
Phase 2



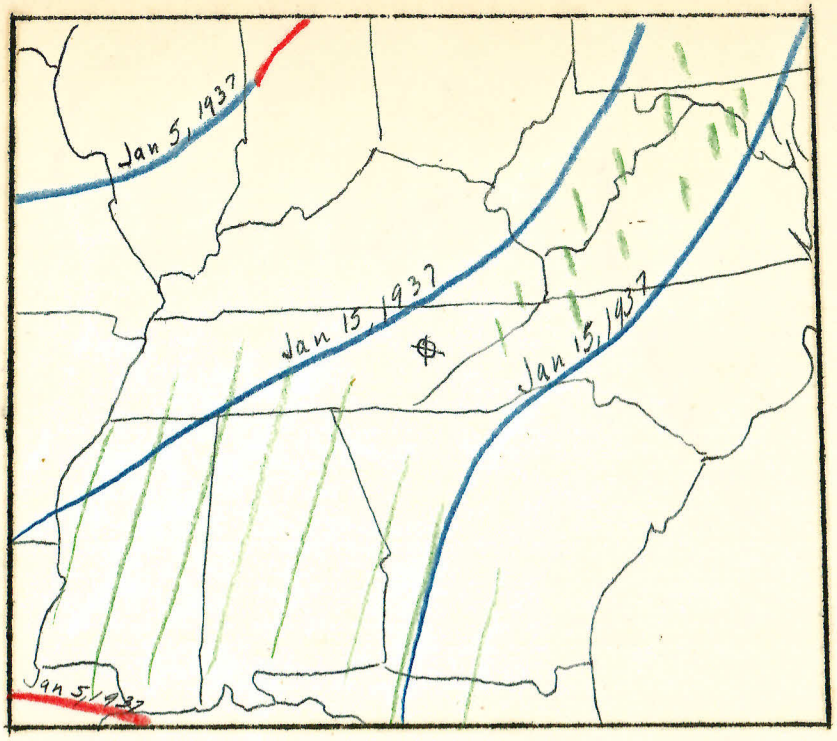
Phase 2

Jan. 5
1937

Jan. 15
1937

KX

Type A
Phase 2



12 14 16 18 20 22 24 2 4 6 8 10 12 14 16 18 20 22 24 2 4 6 8 10 12 E.S.T.

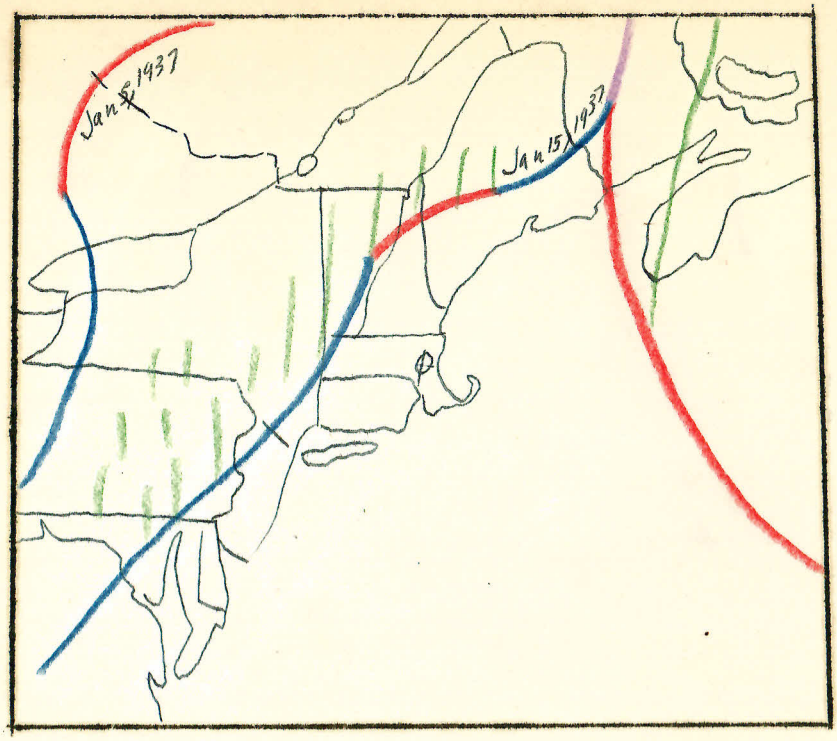
Ceiling (100 ft):
100
60
20
10
6
2
0

Visibility (Mi)
12
10
8
6
4
2
0

Temperature °F
+70
+60
+50
+40
+30
+20
+10

Phase 2

Jan. 5
1937



Jan. 15
1937

BW

Type A
Phase 2

17

05

15

23

12 14 16 18 20 22 24 2 4 6 8 10 12 14 16 18 20 22 24 2 4 6 8 10 12 E.S.T.

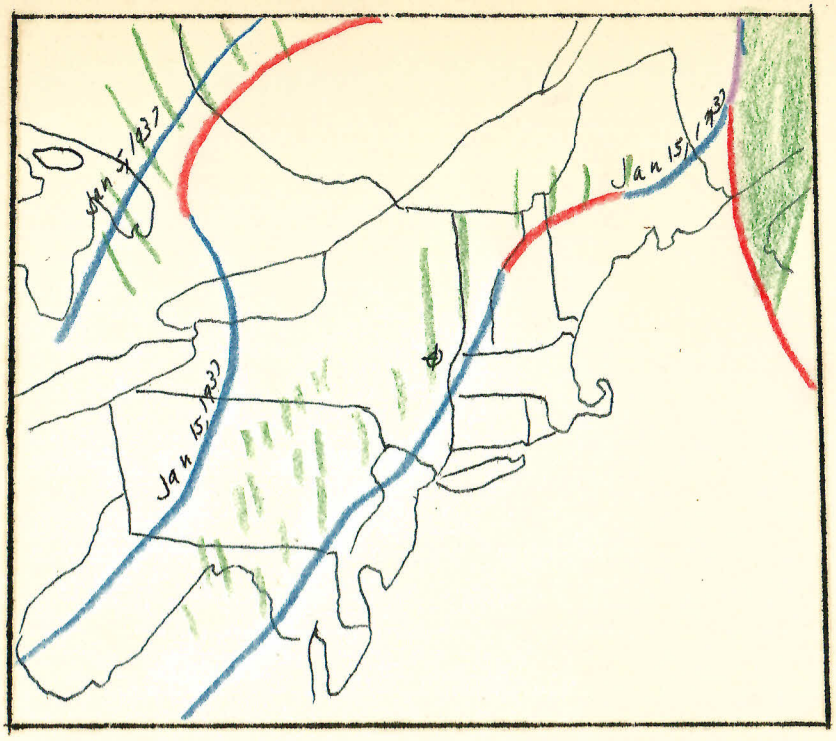
100
60
20
10
6
2
0
Ceiling (100 ft)

12
10
8
6
4
2
0
Visibility (Mi)

+80
+70
+60
+50
+40
+30
+20
Temperature °F

Phase 2

Jan. 5
1937



Jan. 15
1937

AZ

Type A
Phase 2

12 14 16 18 20 22 24 2 4 6 8 10 12 14 16 18 20 22 24 2 4 6 8 10 12 E.S.T.

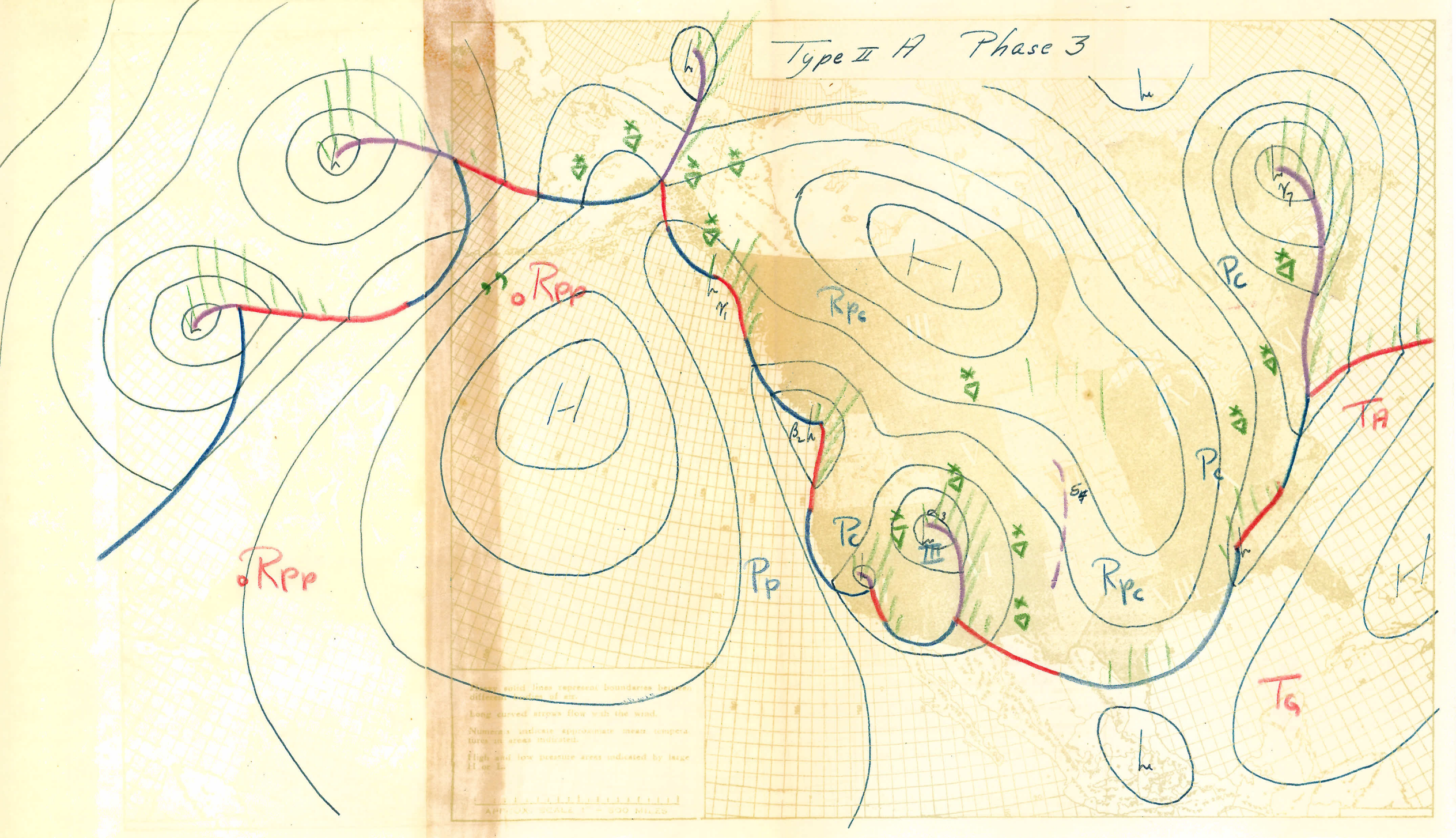
Ceiling (100 ft):
100 60 20 10 6 2 0

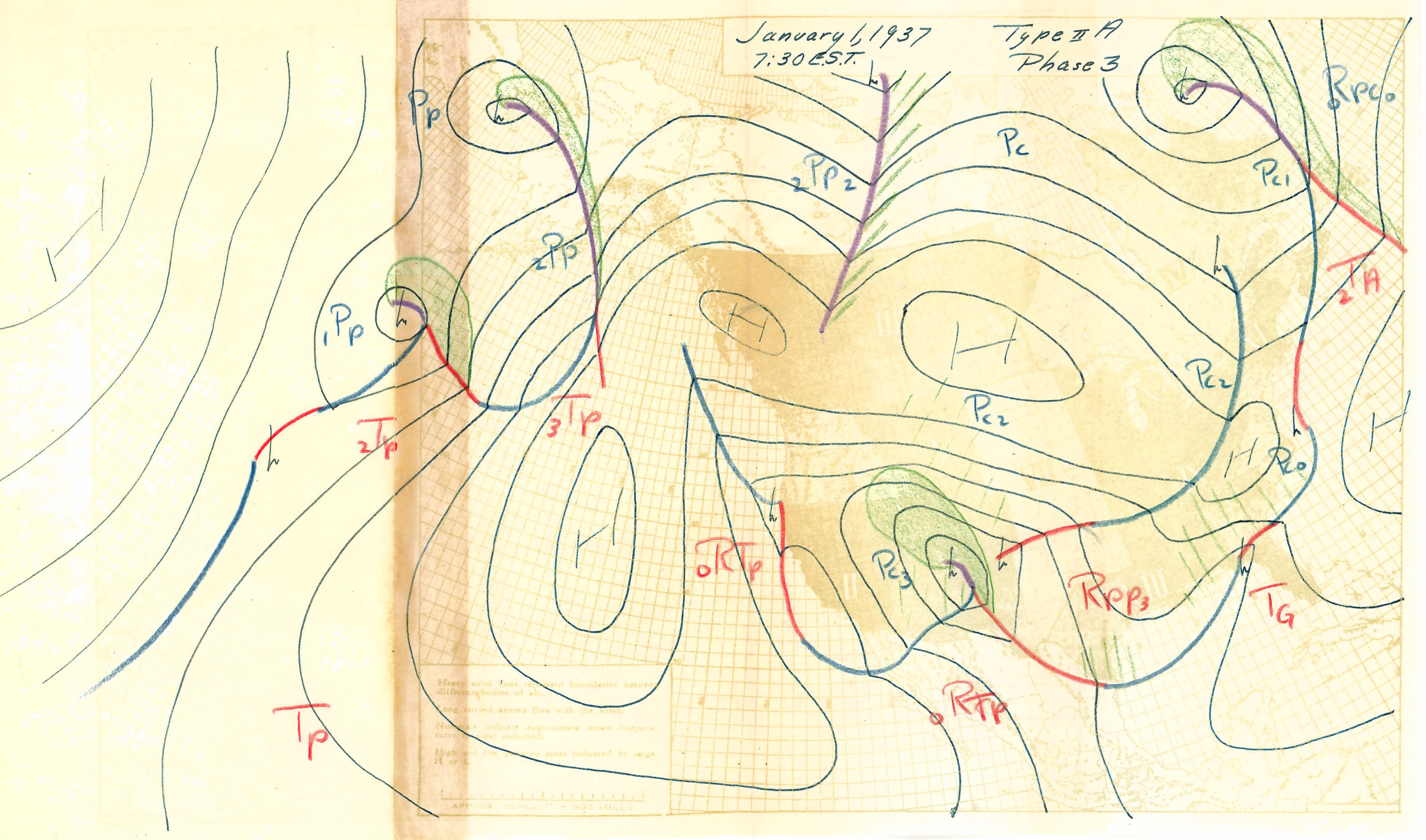
Visibility (Mi)
12 10 8 6 4 2 0

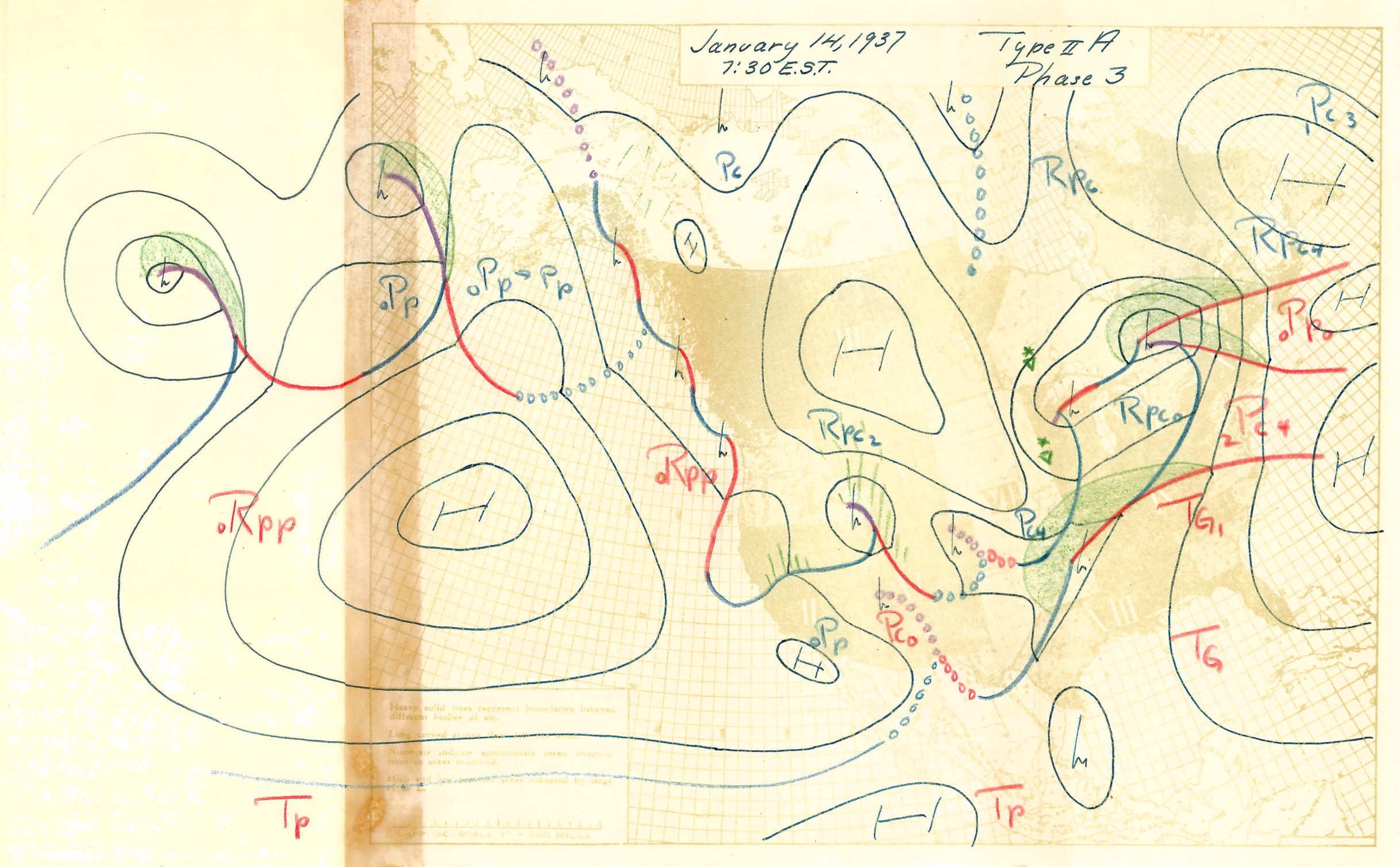
Temperature °F
+60 +50 +40 +30 +20 +10 +0

Phase 2

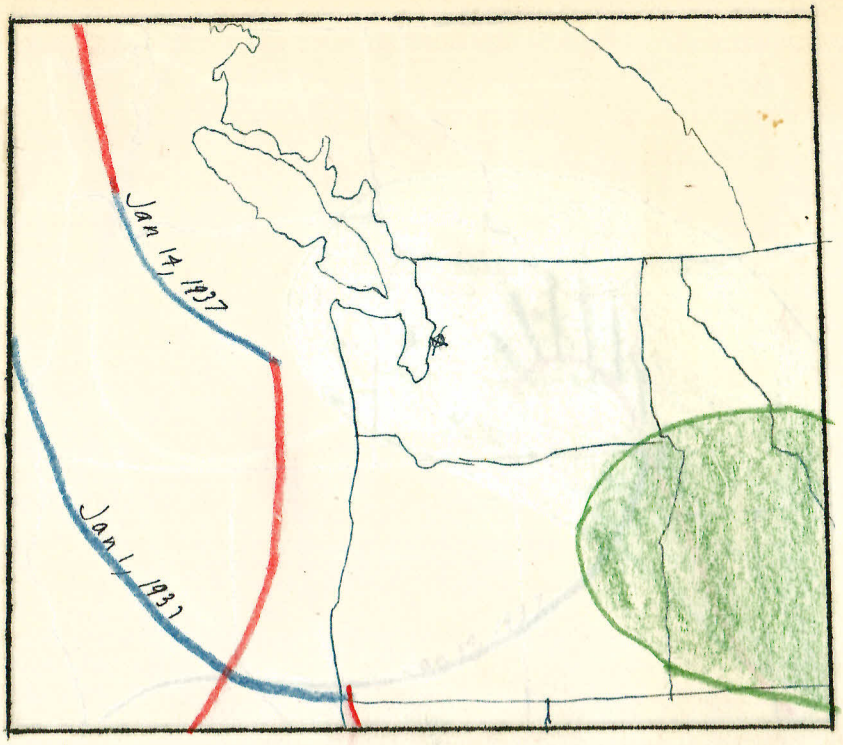
PHASE III


Type II A Phase 3
Rpp
Rpp
Rpc
Rpc
Pc
Pc
Pc
Pp
TA
TG
Long curved arrows flow with the wind.
Numerous isotherms approximate mean temperatures in areas indicated.
High and low pressure areas indicated by large H or L.


January 1, 1937
7:30 E.S.T.
Type II A
Phase 3
Pp
2Pp2
Pc
Pc1
Rpc0
2Pp
1Pp
2TA
2Tp
3Tp
Pc2
Pc2
R0
0RTp
Pc3
RcP3
TG
0RTp
Tp


January 14, 1937
7:30 E.S.T.
Type II A
Phase 3
Pc
RPc
Pc3
RPc4
oPp
oPp→Pp
oRpp
Rpc2
Pc4
Rpco
2Pc4
oPo
TG1
TG
Tp
Tp

Jan. 14
1937



Jan. 1
1937

SA

Type A
Phase 3

E.S.T.

Ceiling (hdrft):

Visibility (Mi)

Temperature °F

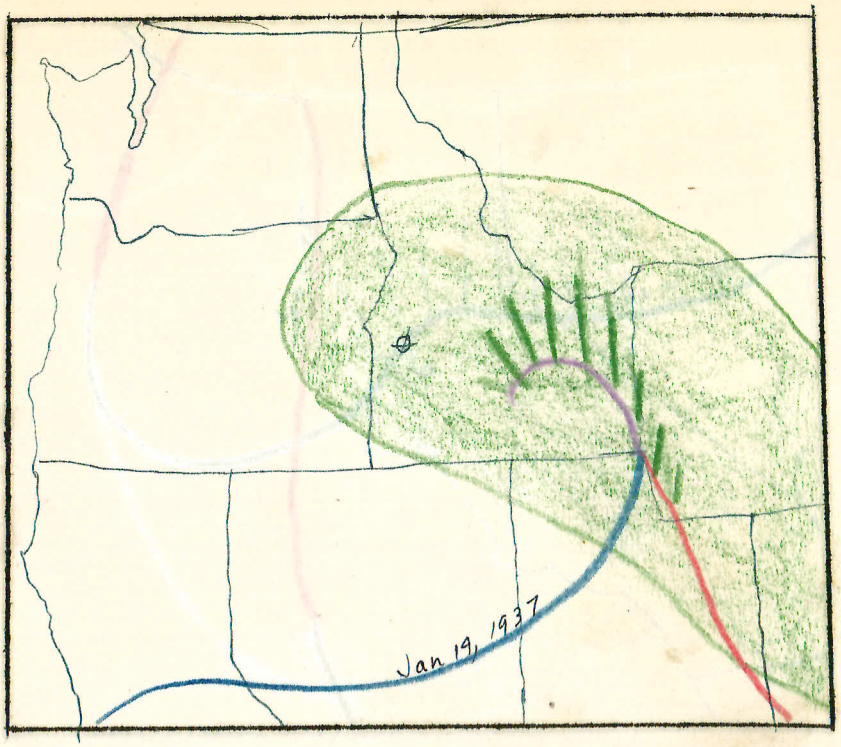
Phase 3

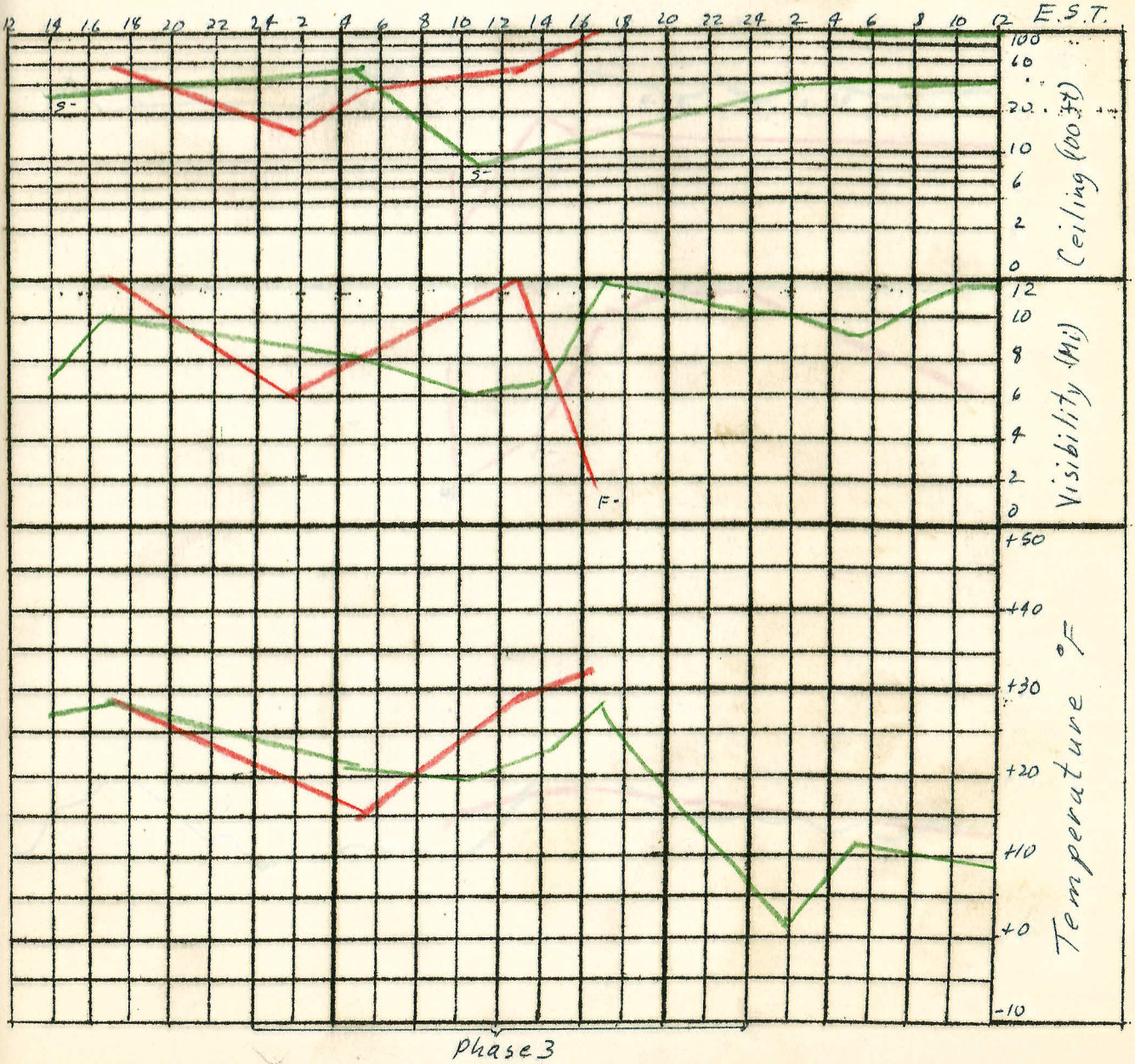
Jan. 14
1937

Jan. 1
1937

BE

Type A
Phase 3



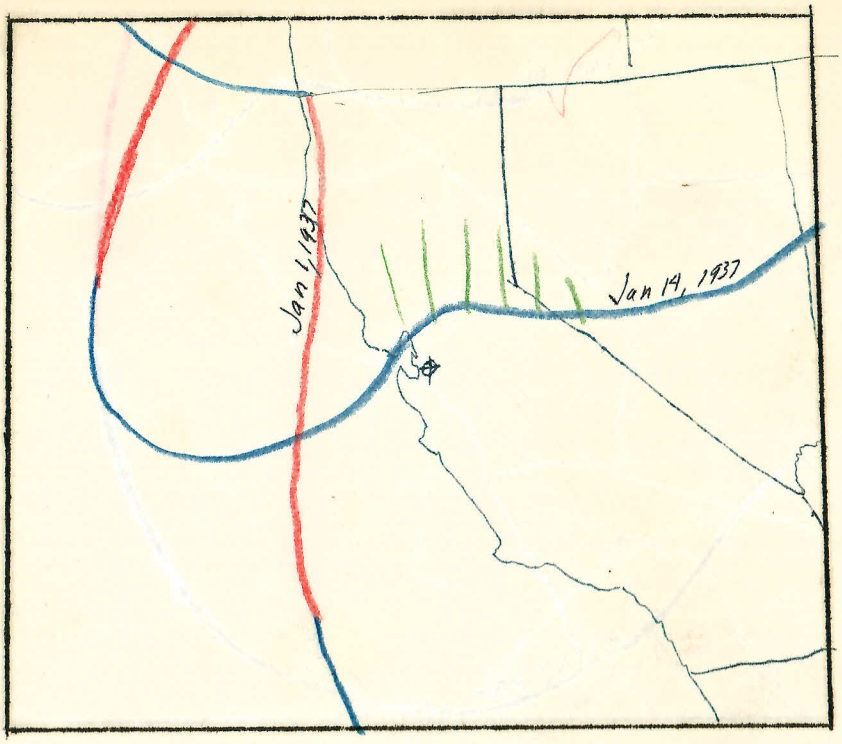


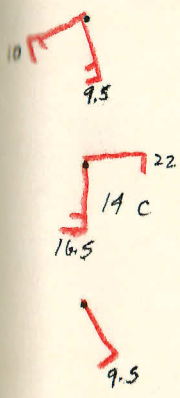
Jan. 14
1937

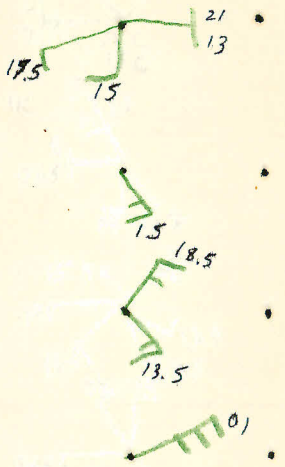
Jan. 1
1937

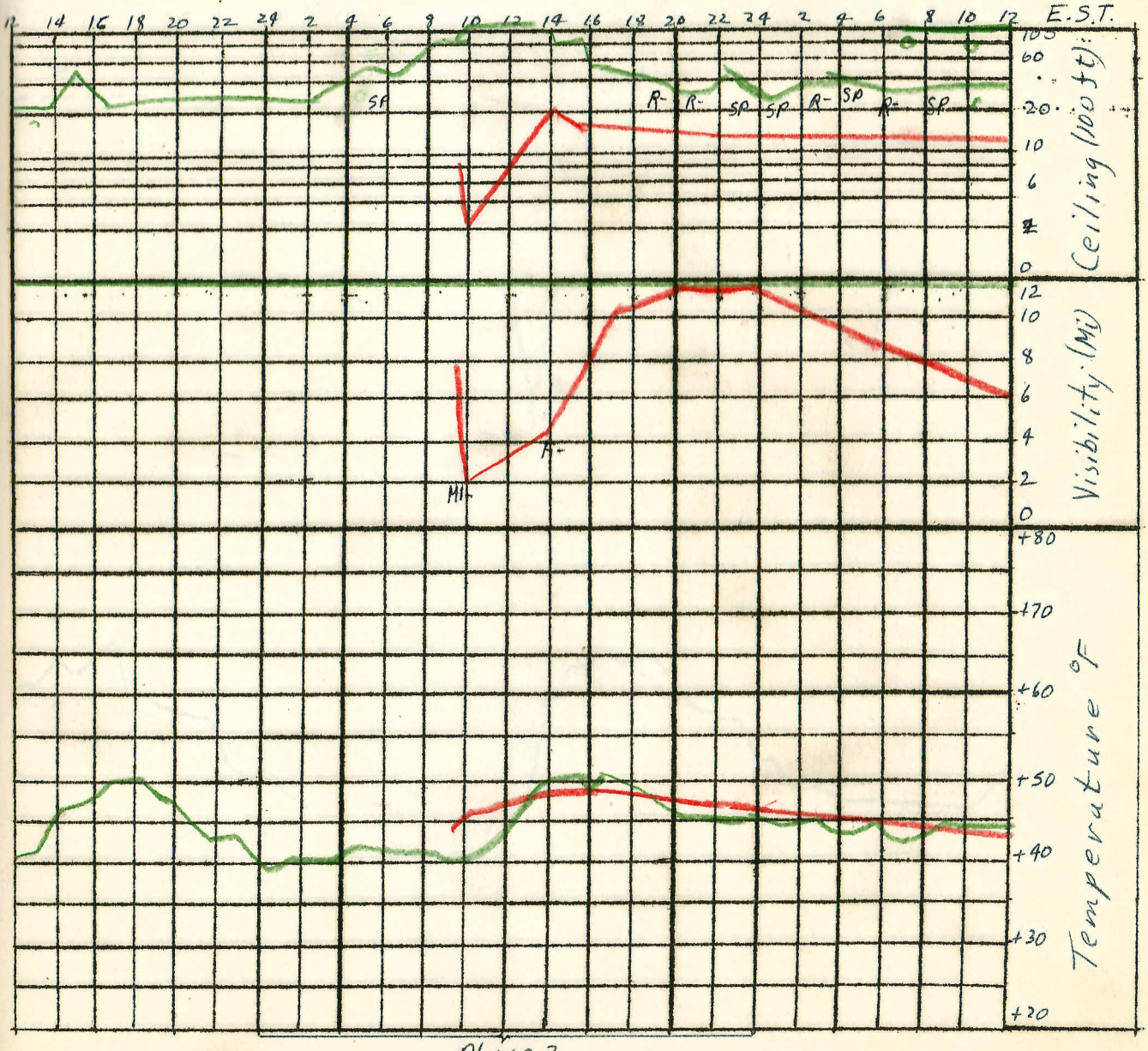
0A

Type A
Phase 3



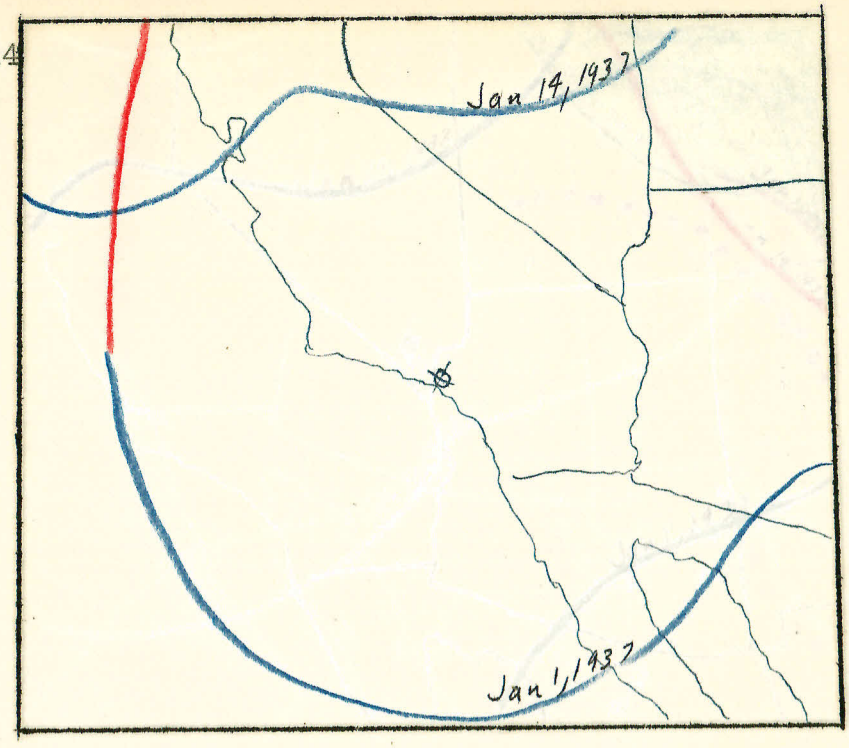




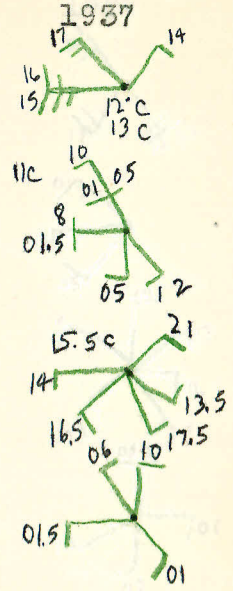


Phase 3

Jan. 14
1937

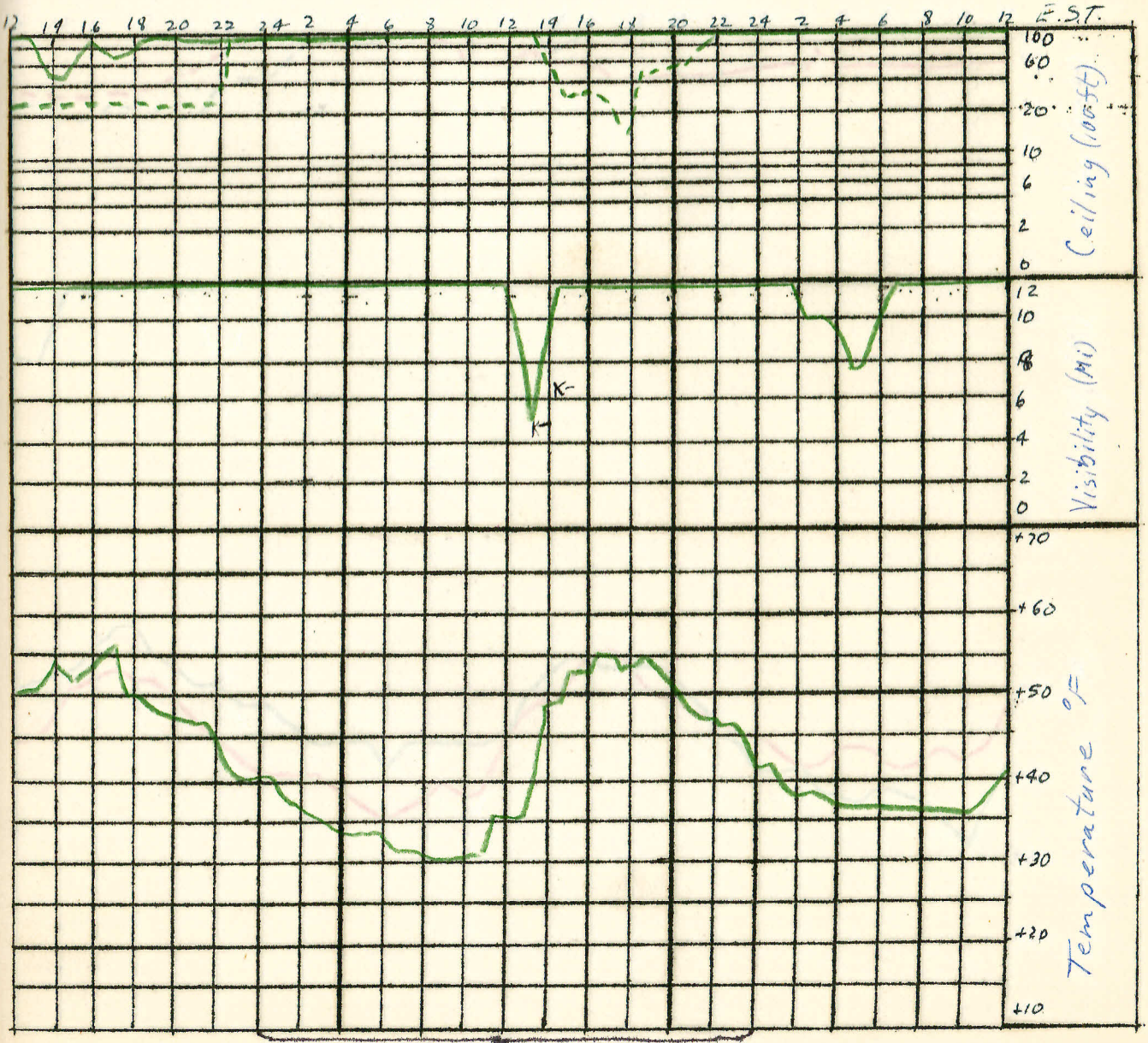


Jan. 1
1937



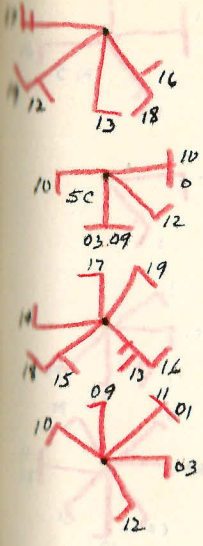
BU

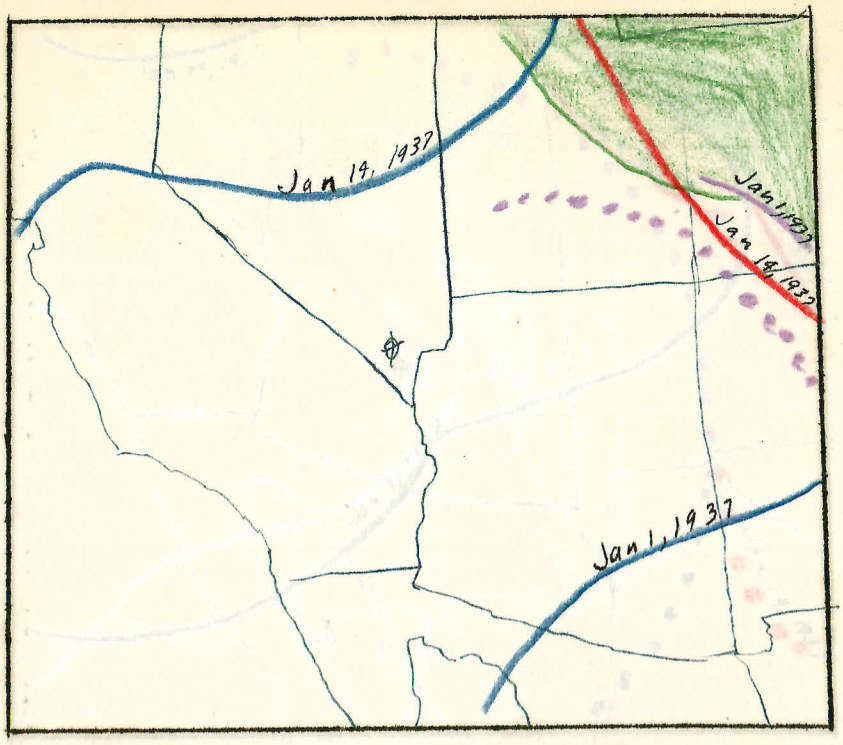
Type A
Phase 3



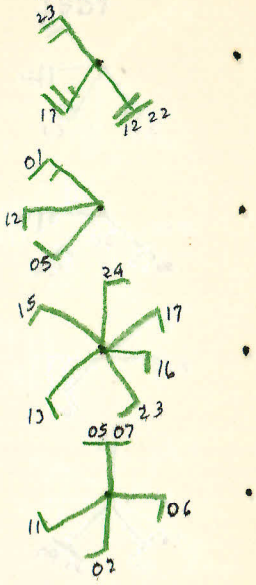
Phase 3

Jan. 14
1937



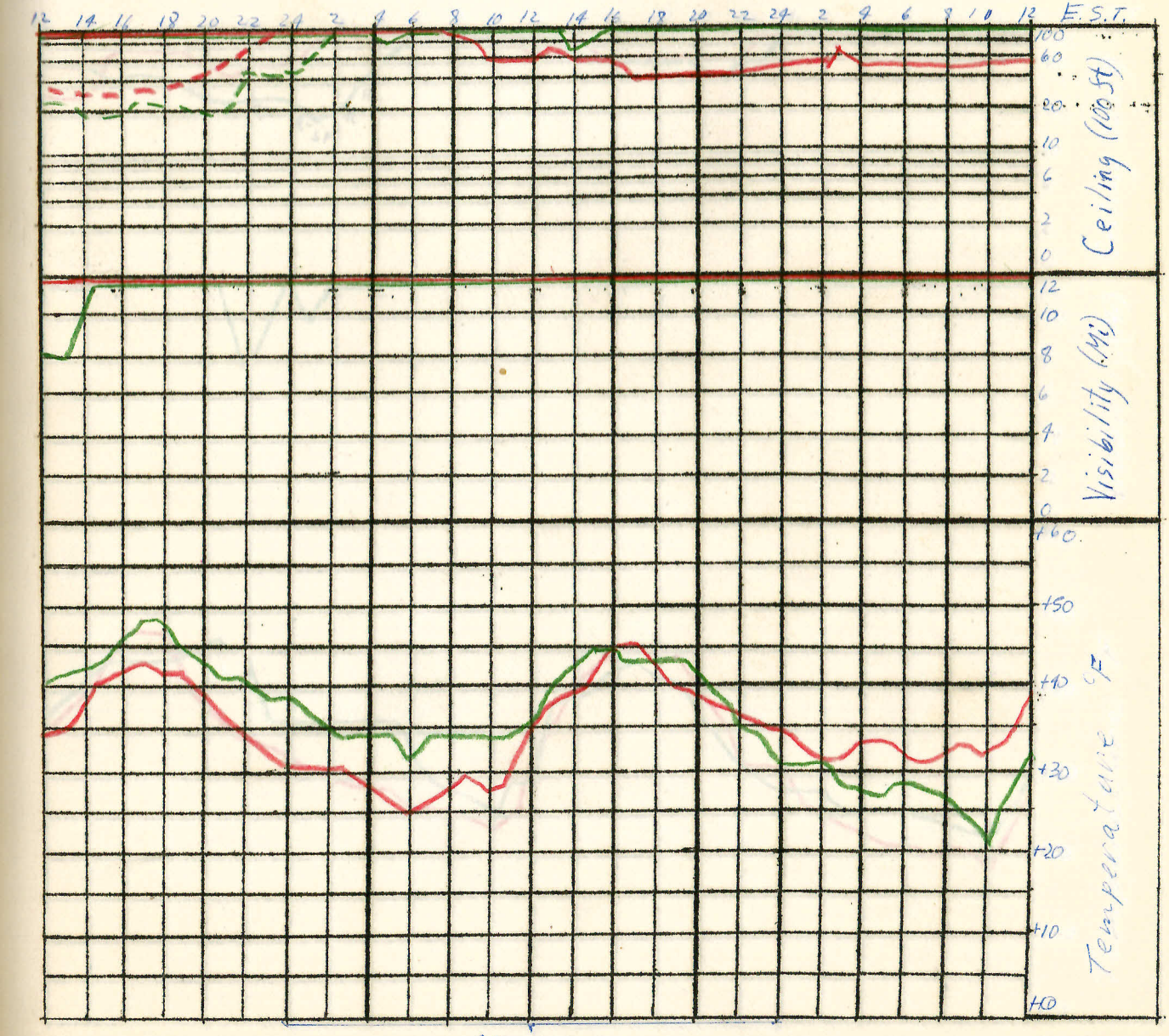


Jan. 1
1937

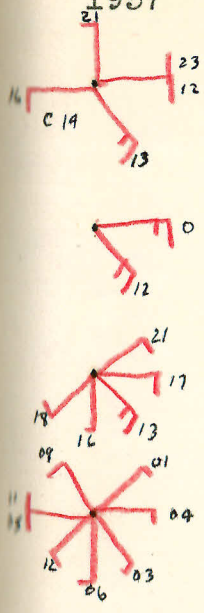


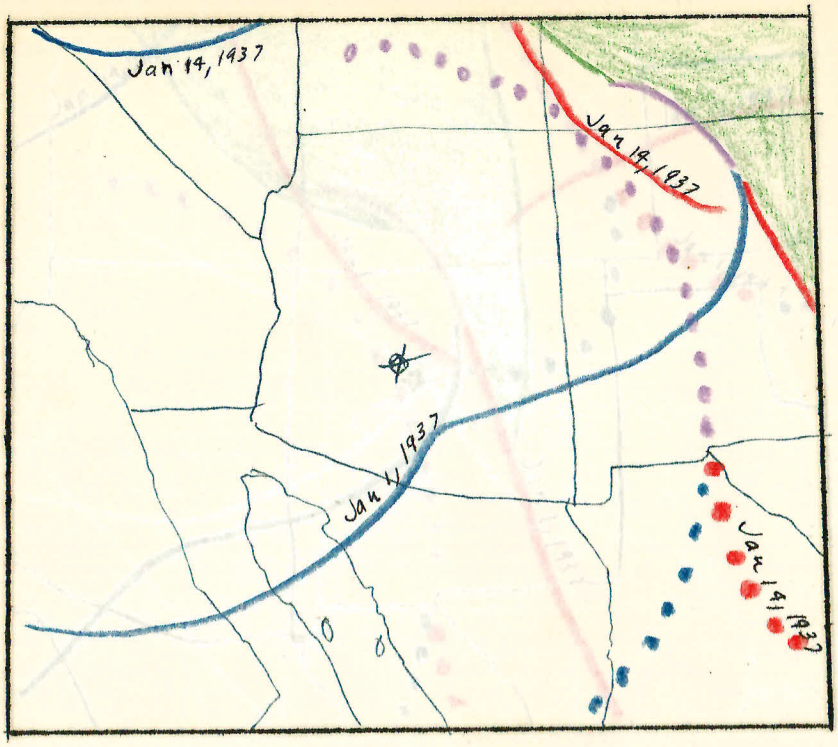
LQ

Type A
Phase3

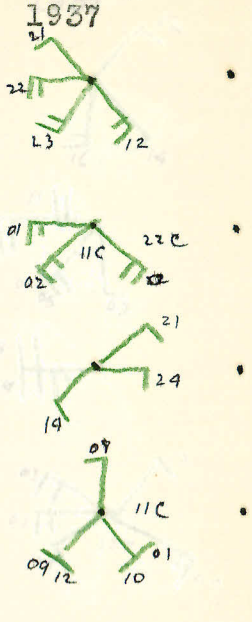


Jan. 14
1937



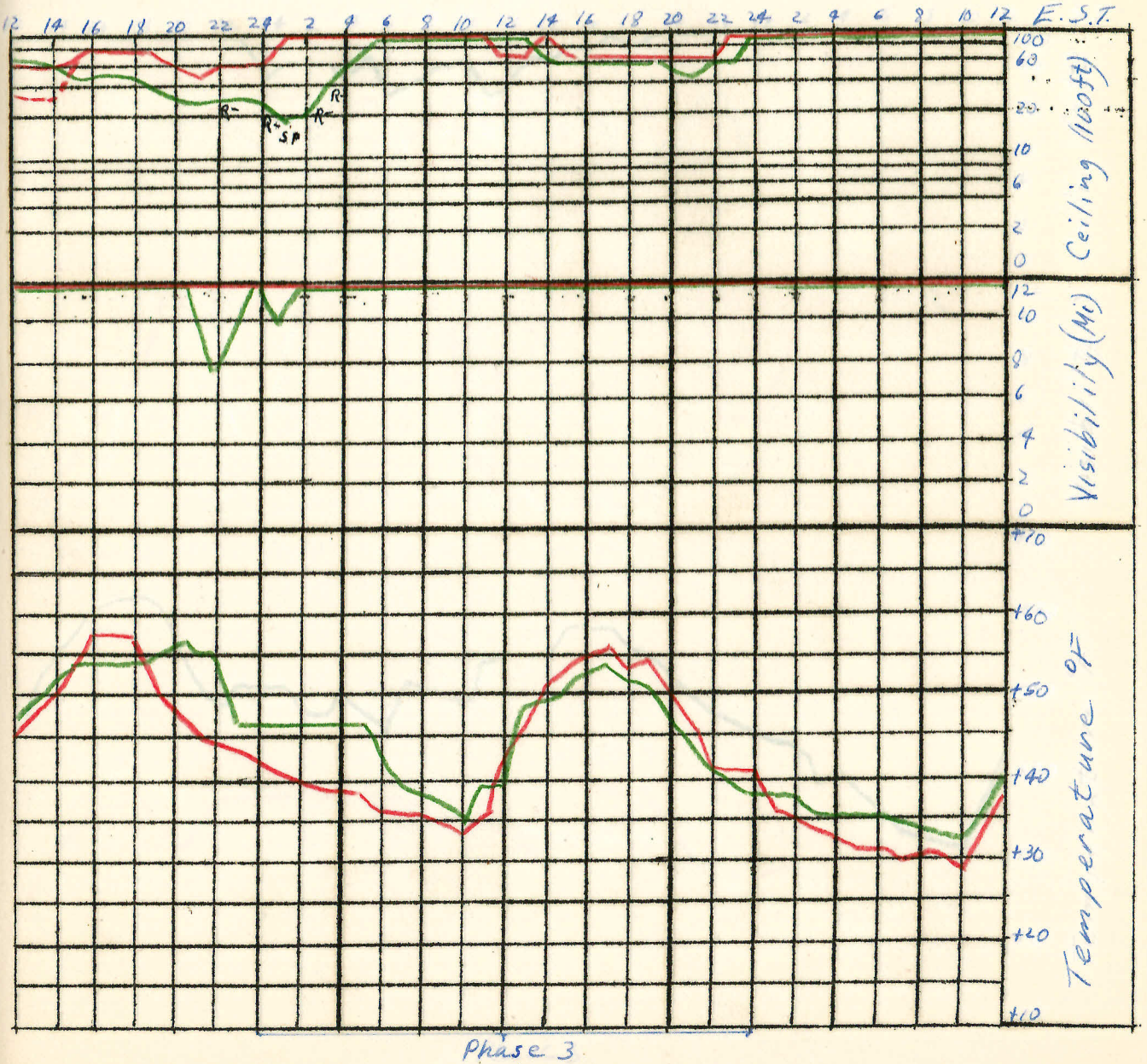


Jan. 1
1937

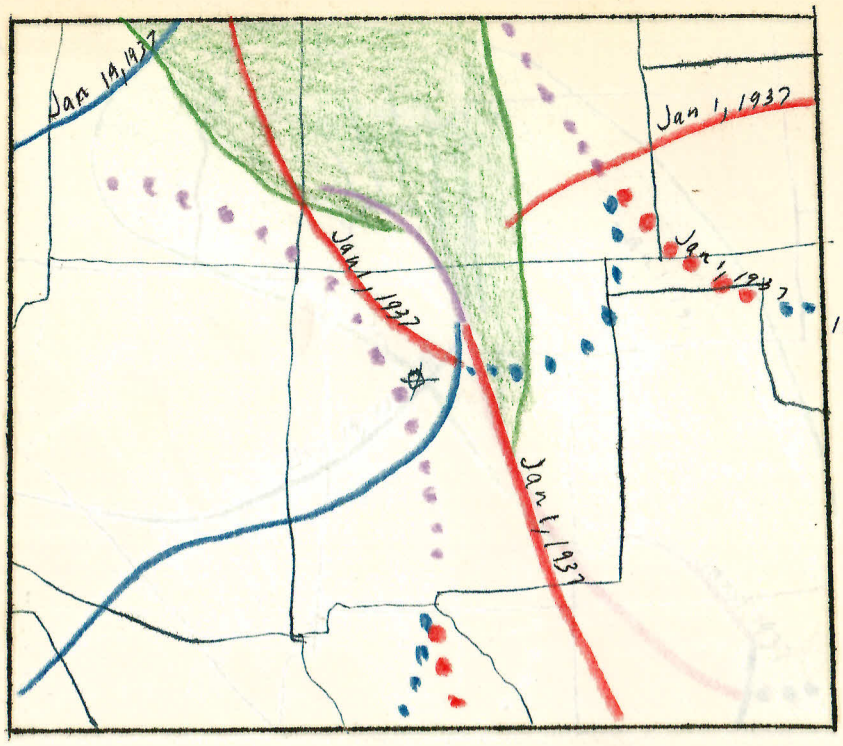


PH

Type A
Phase 3



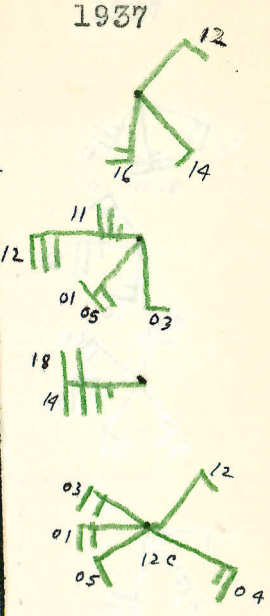
Jan. 14
1937

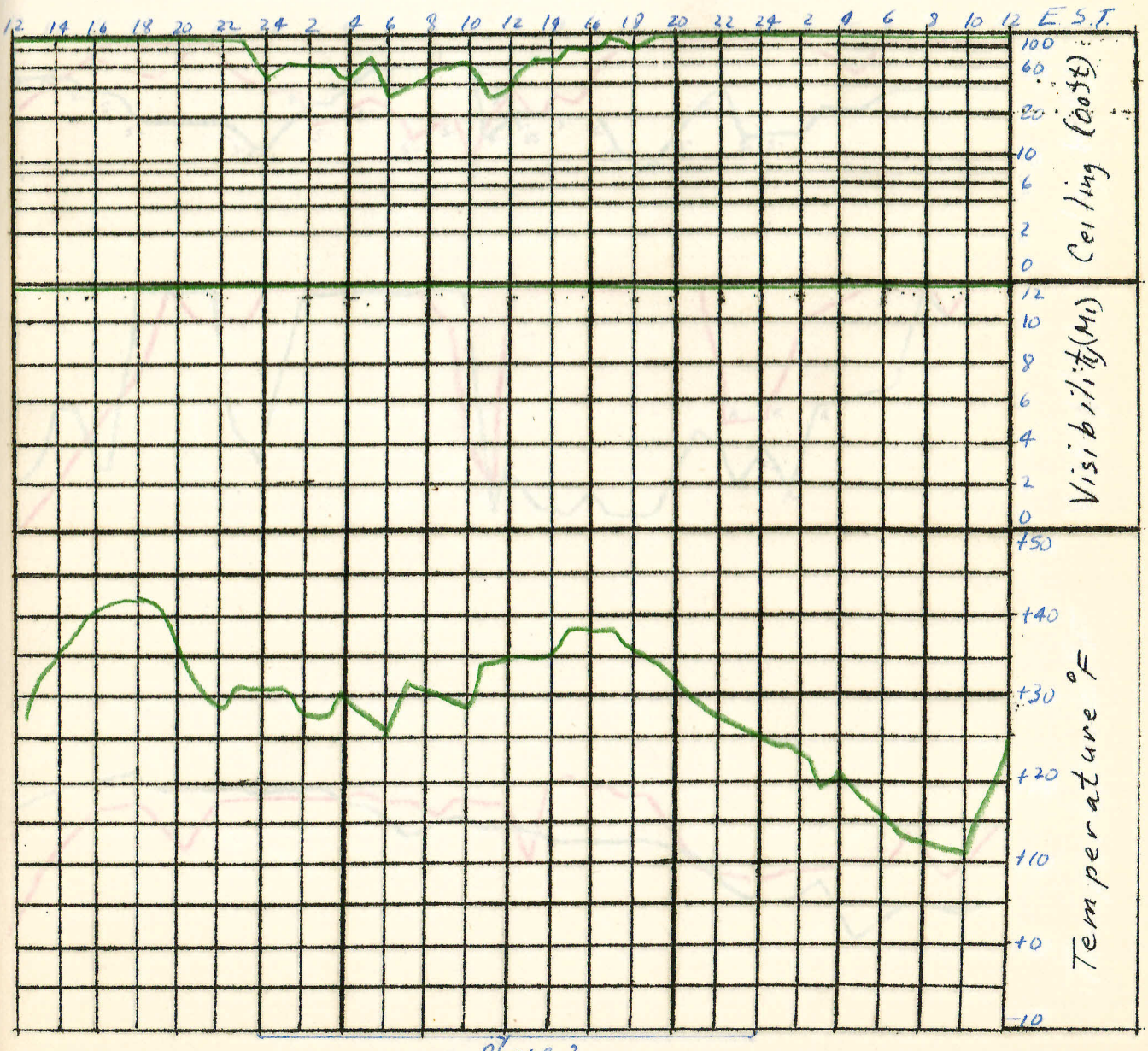


Jan. 1
1937

AB

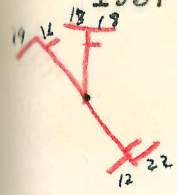
Type A
Phase 3



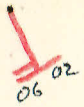


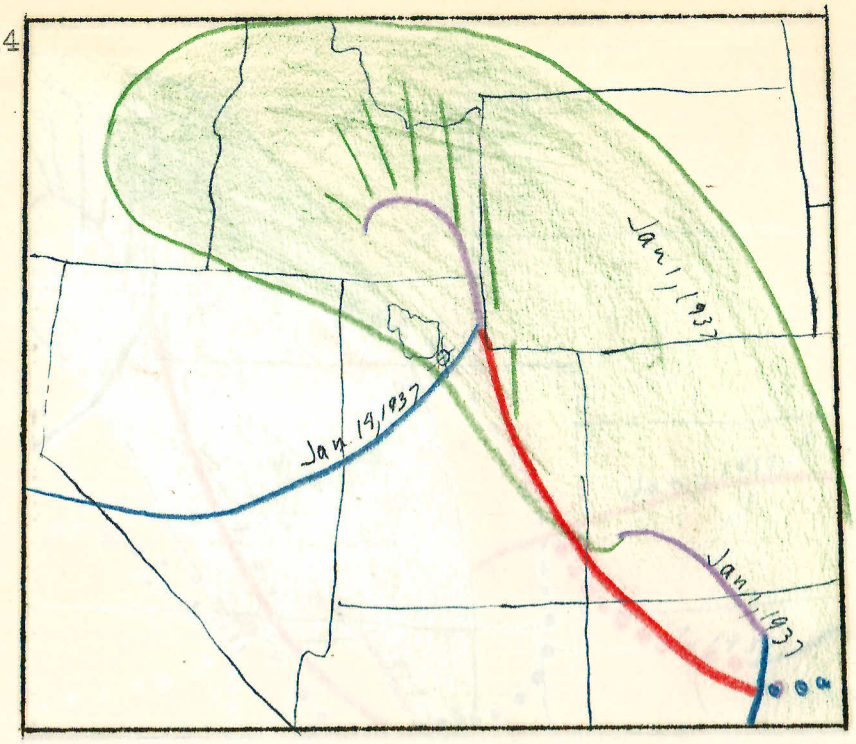
Phase 3

Jan. 14
1937

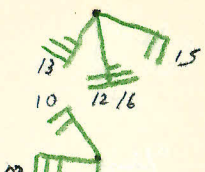


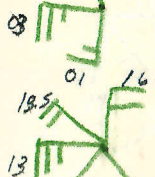


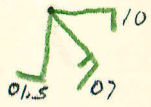




Jan. 1
1937

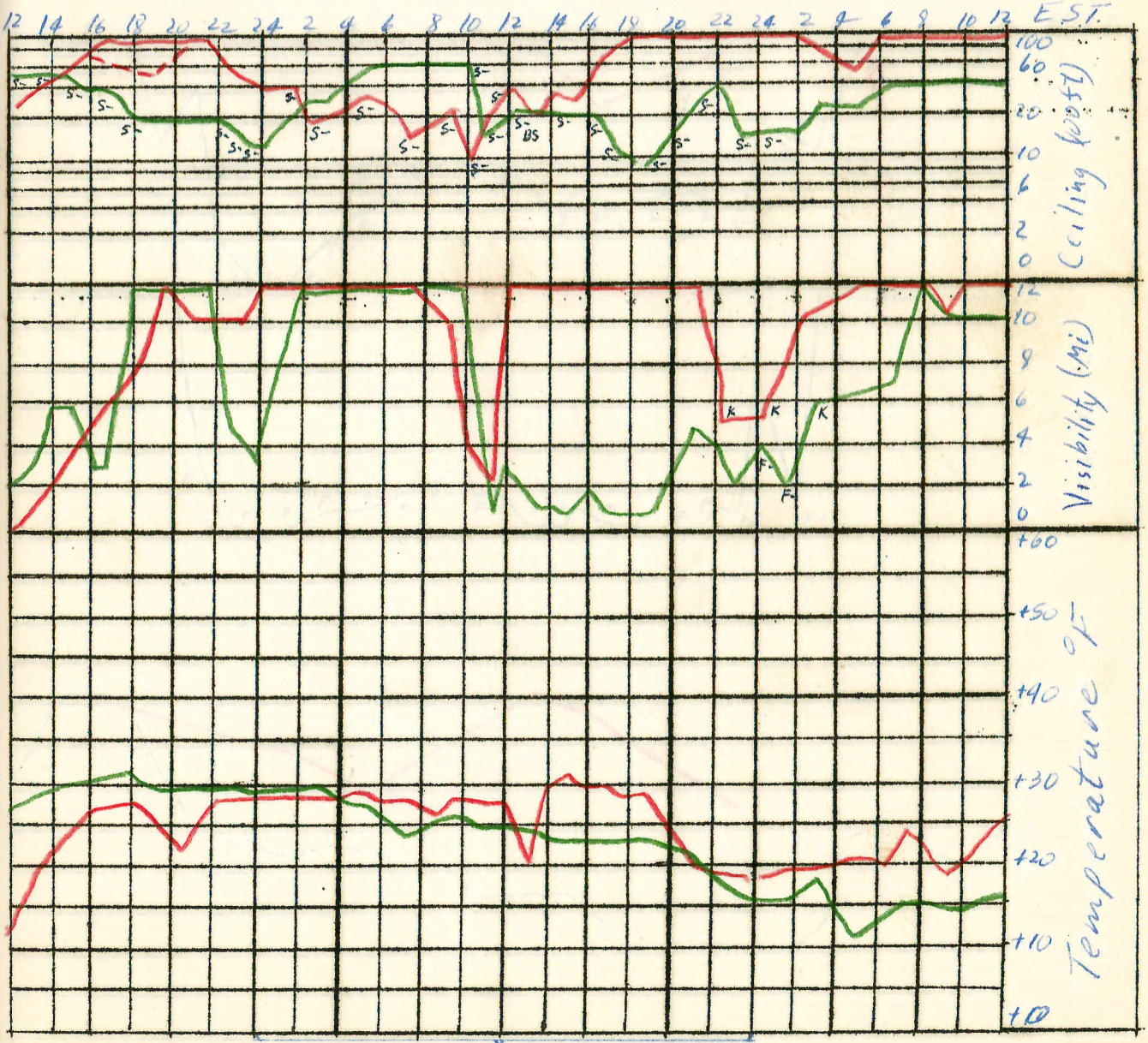




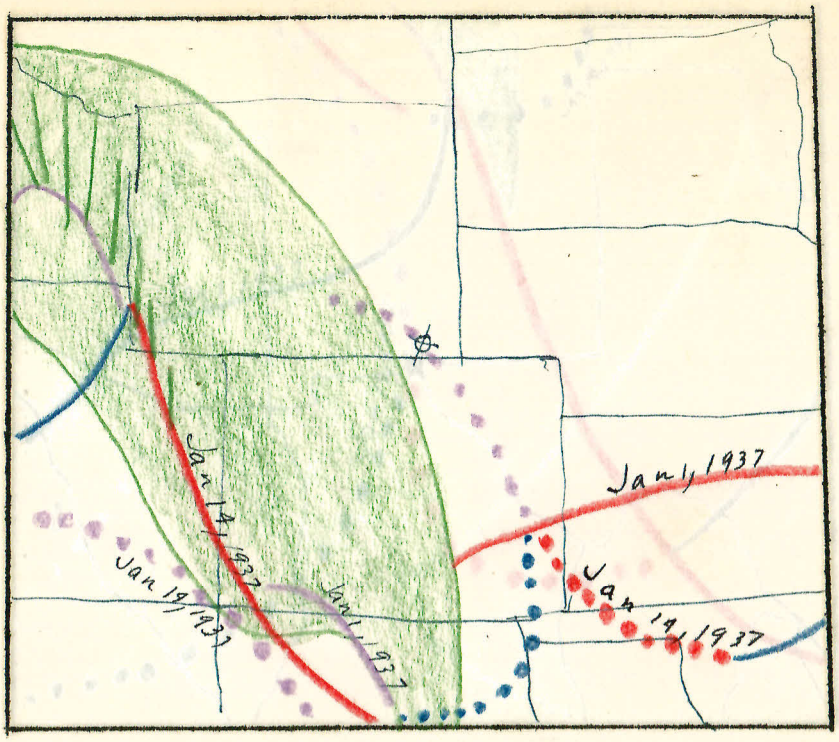


SL

Type A
Phase 3



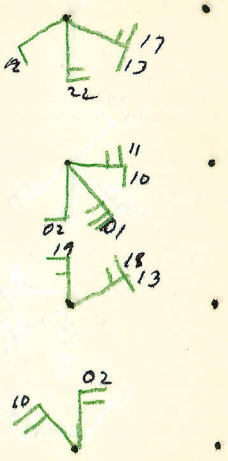
Jan. 14
1937



Jan. 1
1937

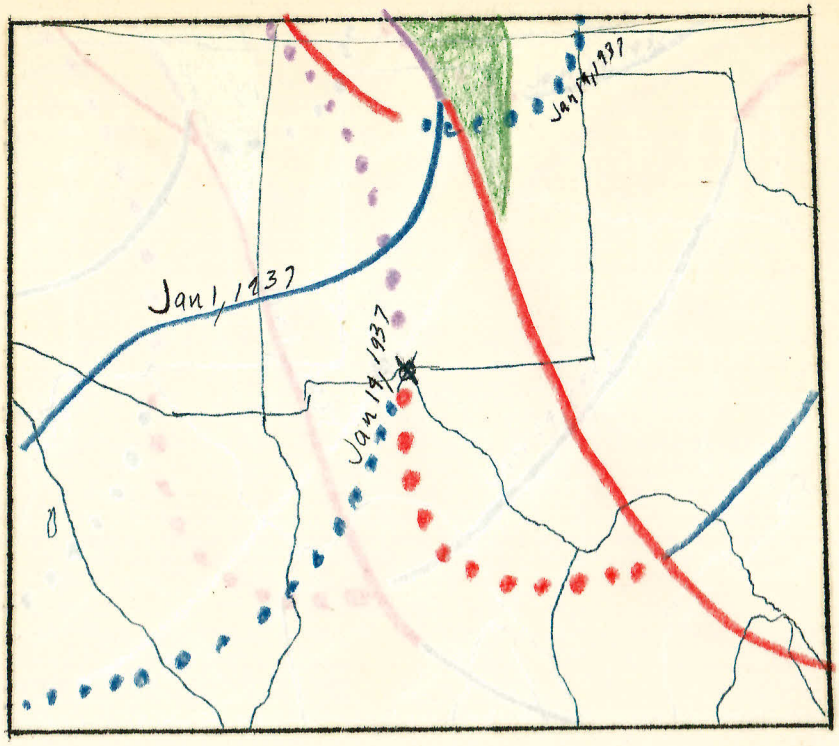
CX

Type A
Phase 3

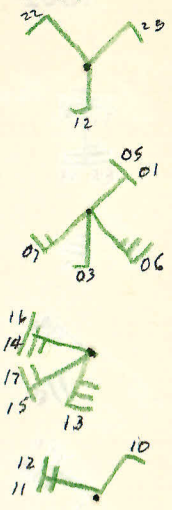


Jan. 14
1937



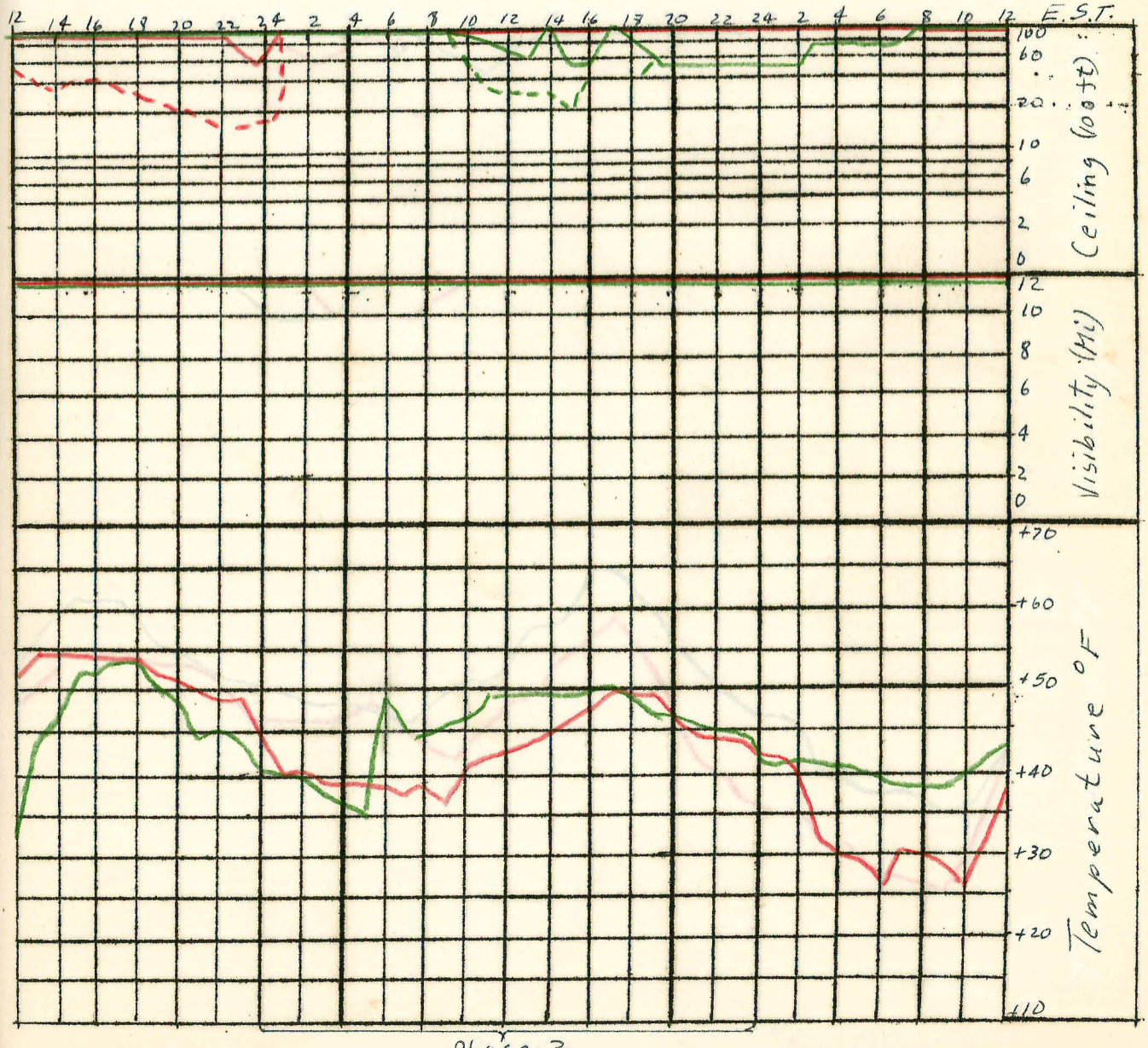


Jan. 1
1937

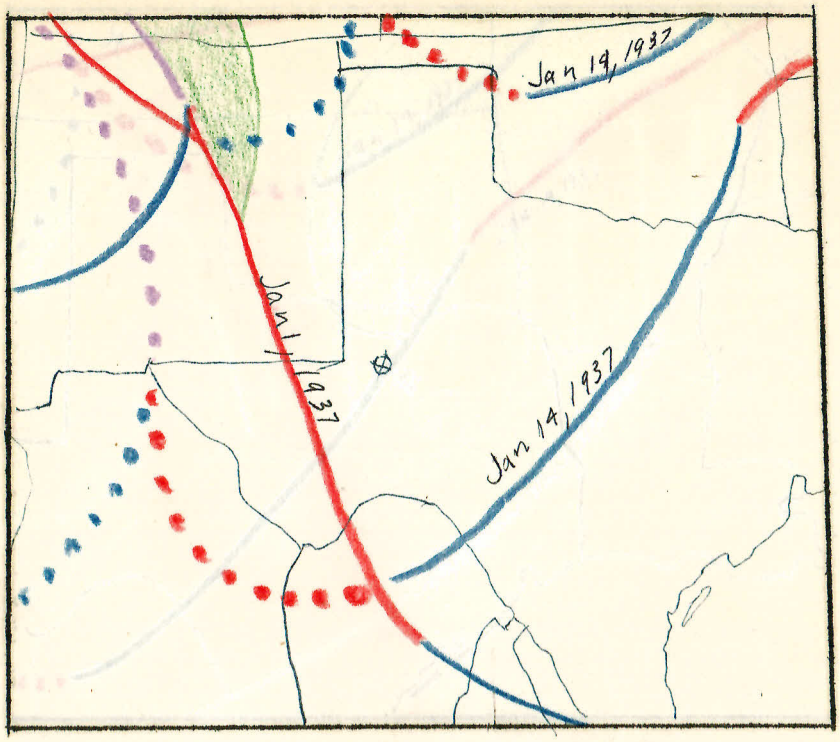


30

Type A
Phase 3



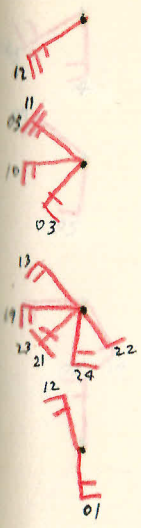
Jan. 14
1937



Jan. 1
1937

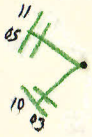
BZ

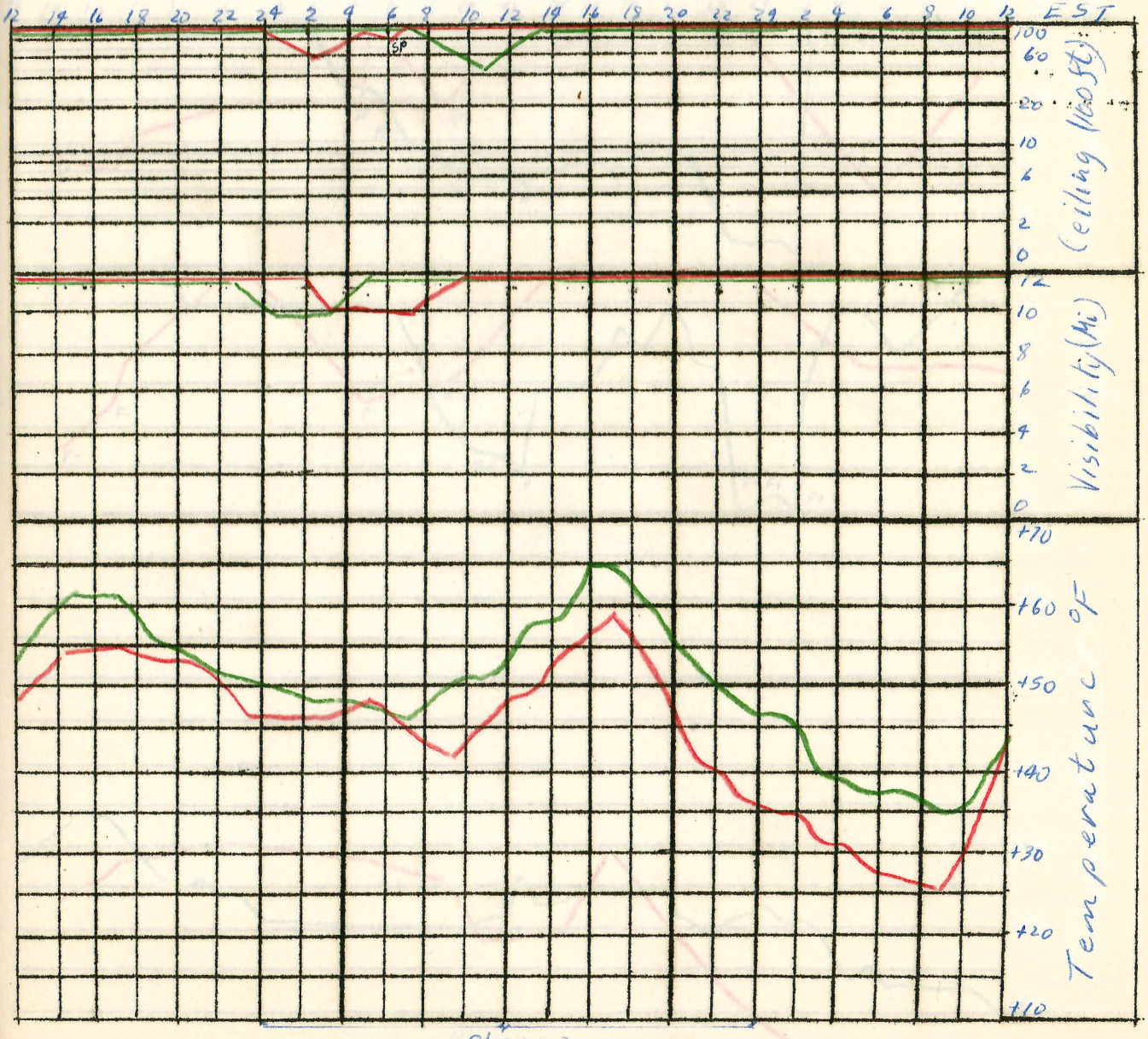
Type A
Phase 3





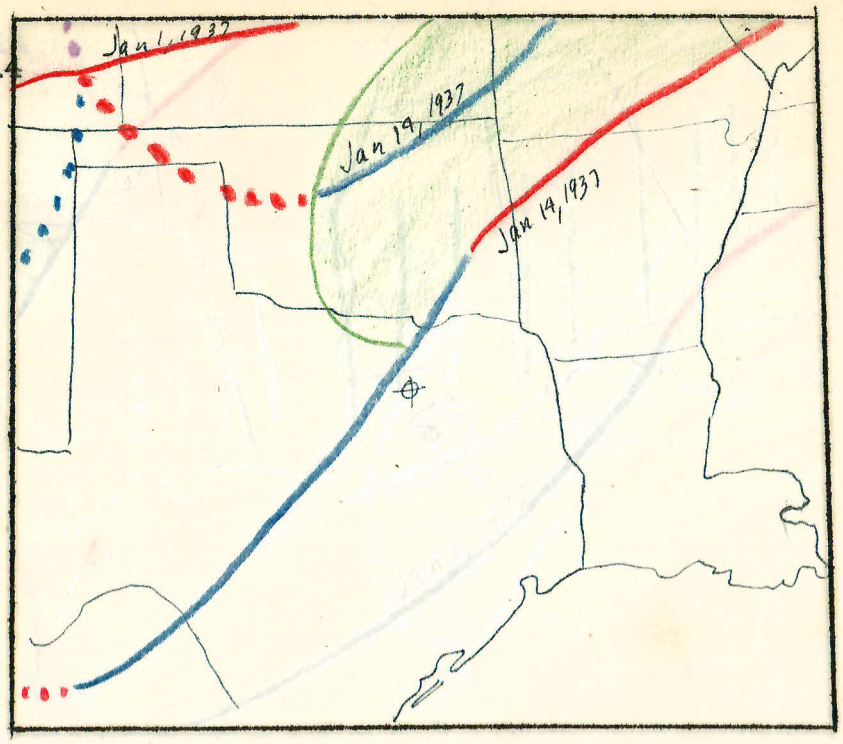






Phase 3

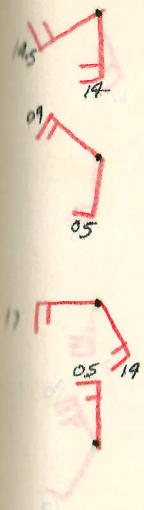
Jan. 14
.937

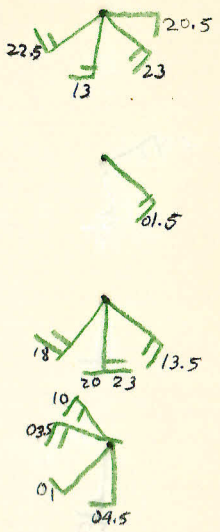


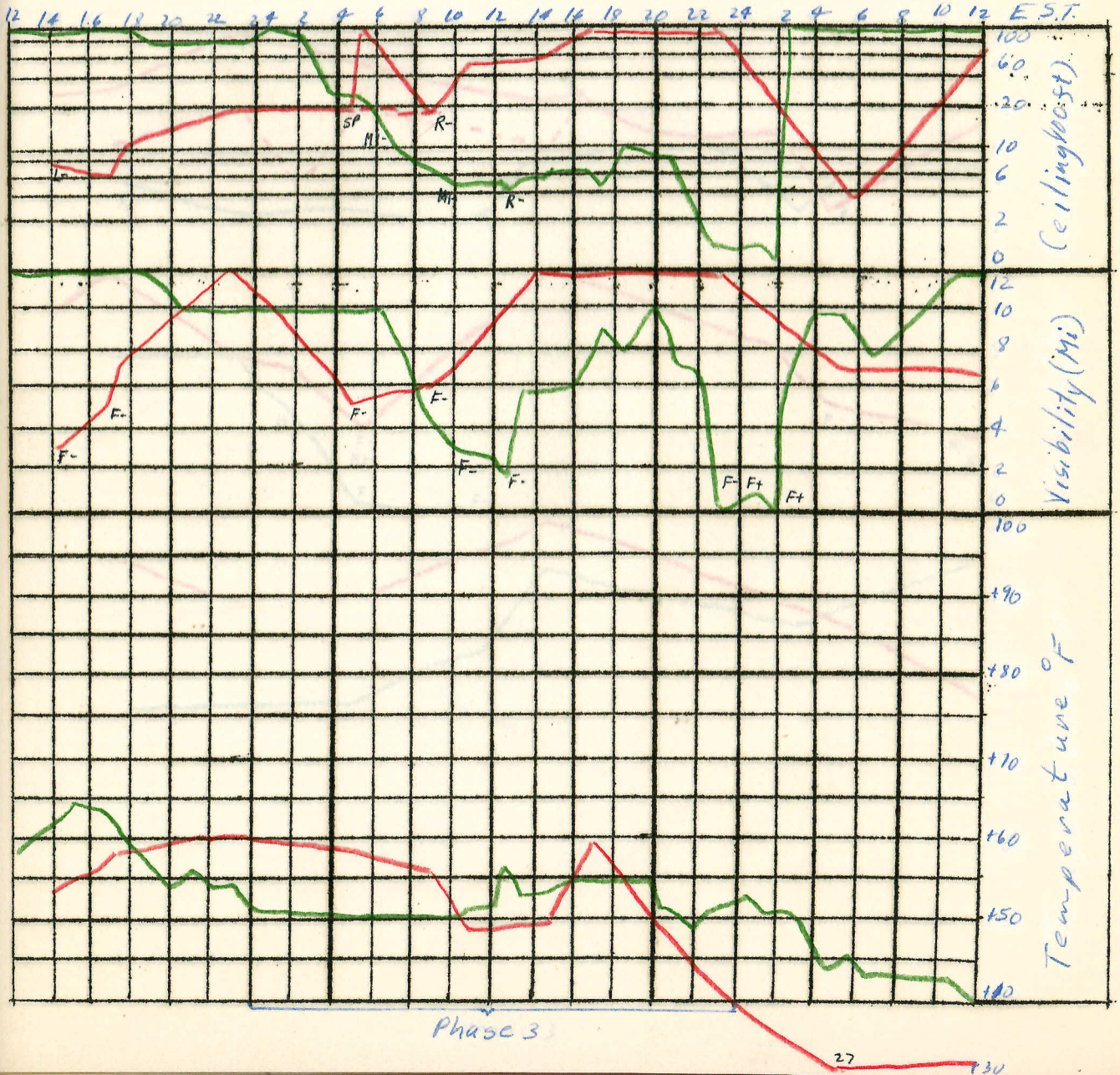
Jan. 1
1937

DL

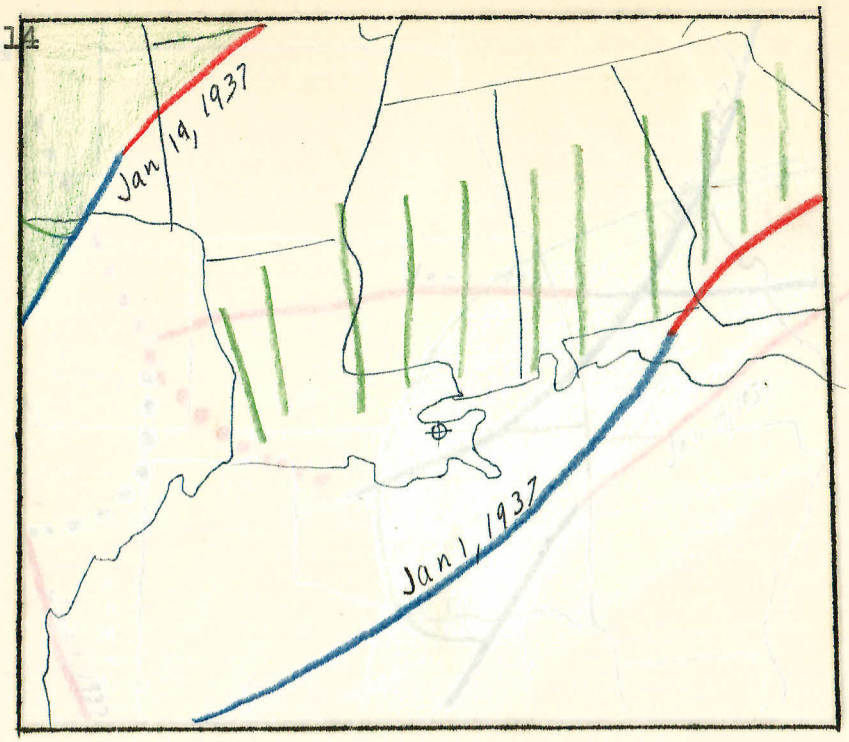
Type A
Phase 3







Jan. 14
1937



Jan. 1
1937

NO

Type A
Phase 3

12 14 16 18 20 22 24 2 4 6 8 10 12 14 16 18 20 22 24 2 4 6 8 10 12 EST

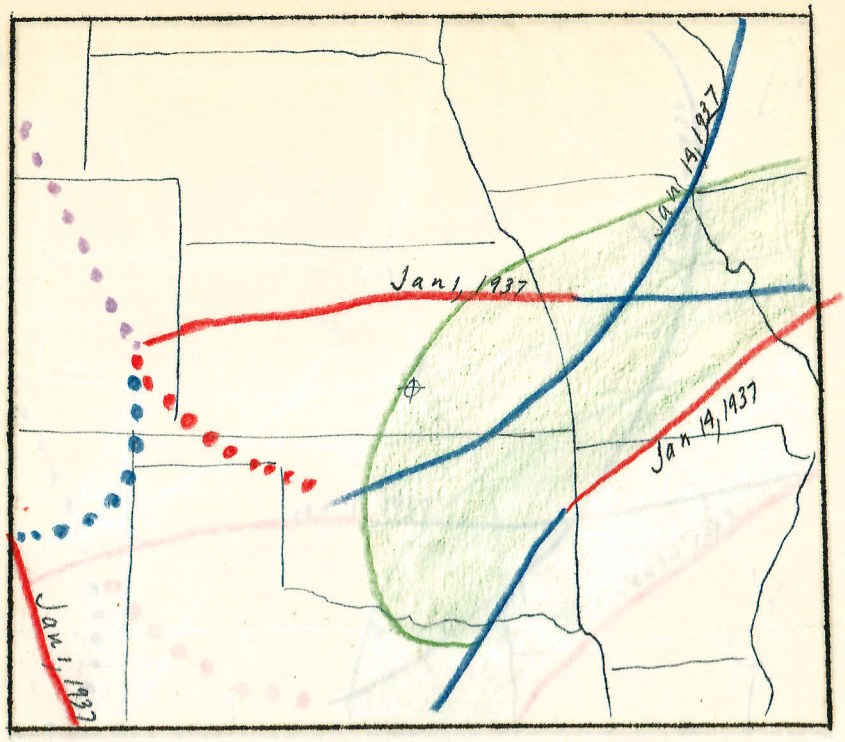
Ceiling (100 ft)

Visibility (Mi)

Temperature °F

Phase 3

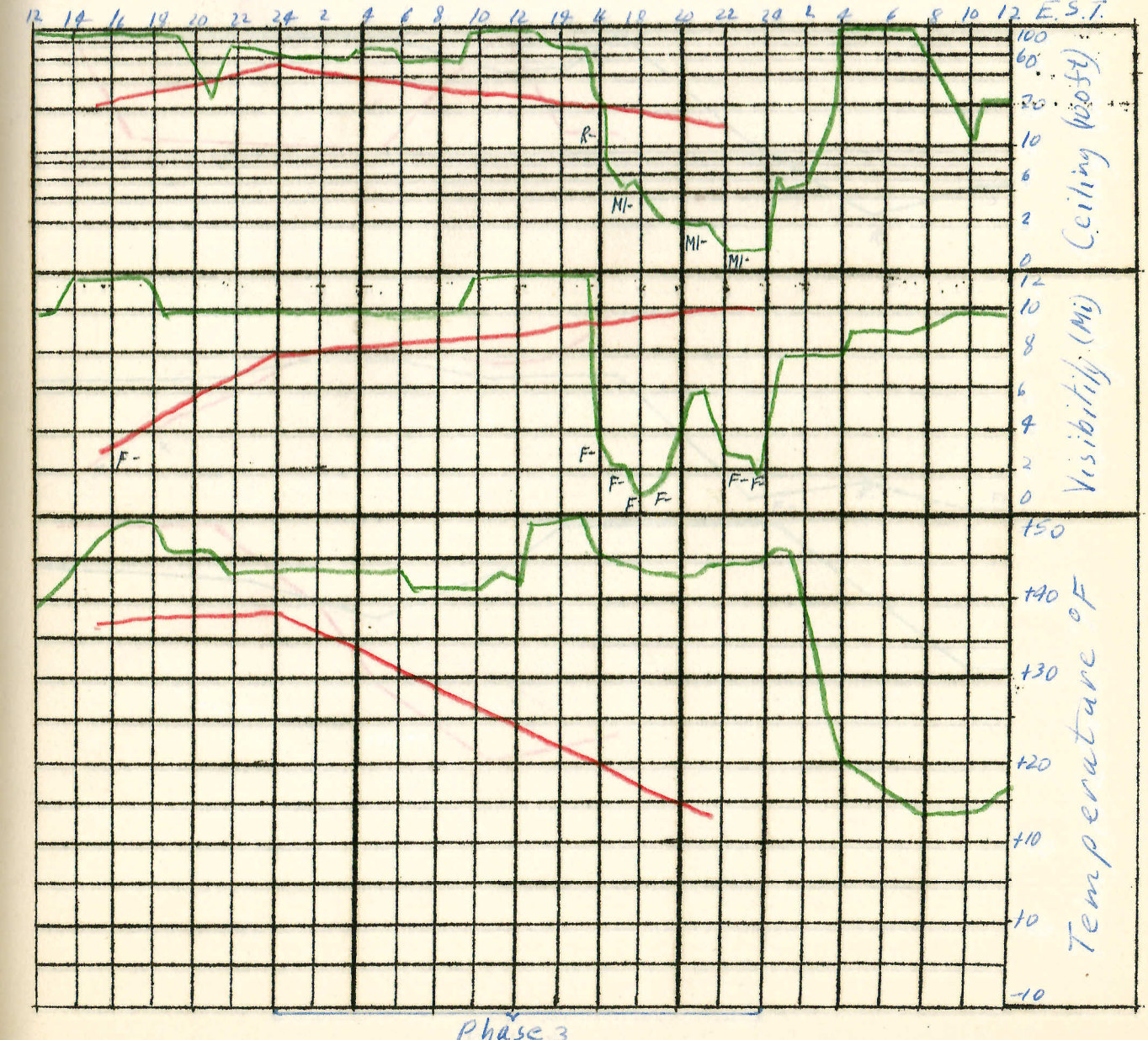
Jan. 14
1937



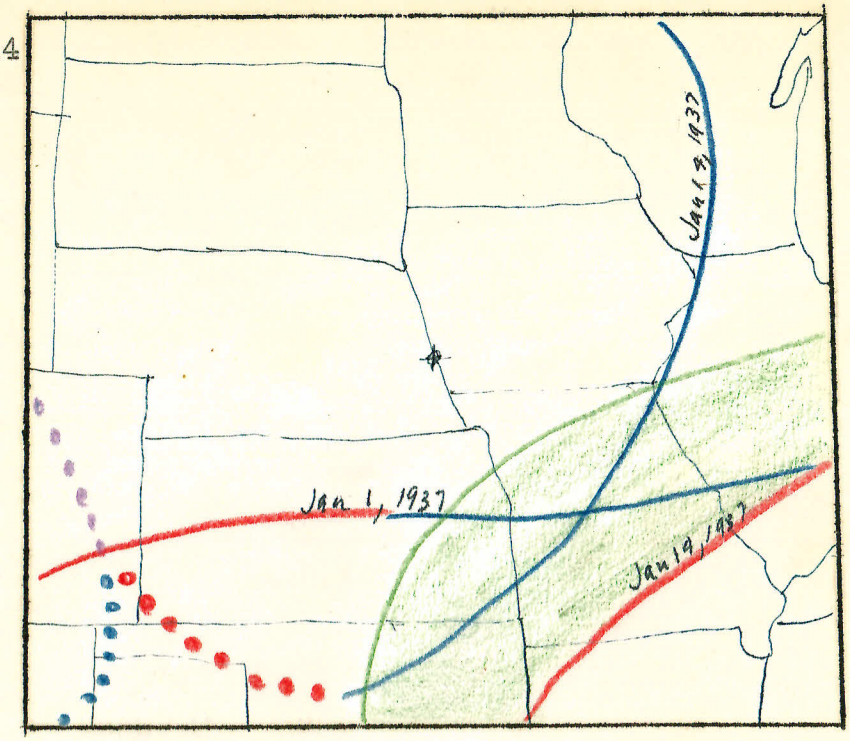
Jan. 1
1937

WD

Type A
Phase 3



Jan. 14
1937



Jan. 1
1937

OH

Type A
Phase 3

12 14 16 18 20 22 24 2 4 6 8 10 12 14 16 18 20 22 24 2 4 6 8 10 12 E.S.T.

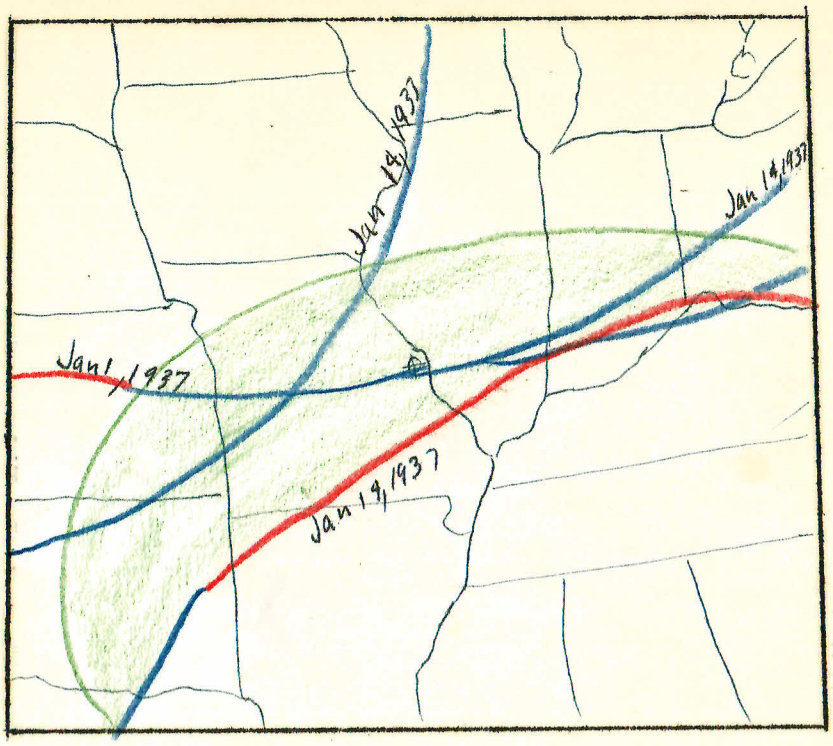
Ceiling (100 ft)
100
60
20
16
8
4
2
0

Visibility (mi)
12
10
8
6
4
2
0

Temperature °F
+30
+20
+10
+0
-10
-20
-30

Phase 3

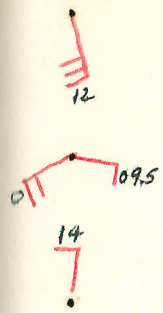
Jan. 14
1937

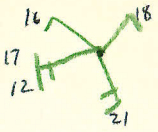


Jan. 1
1937

LS

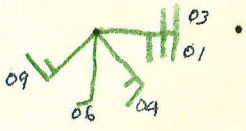
Type A
Phase 3

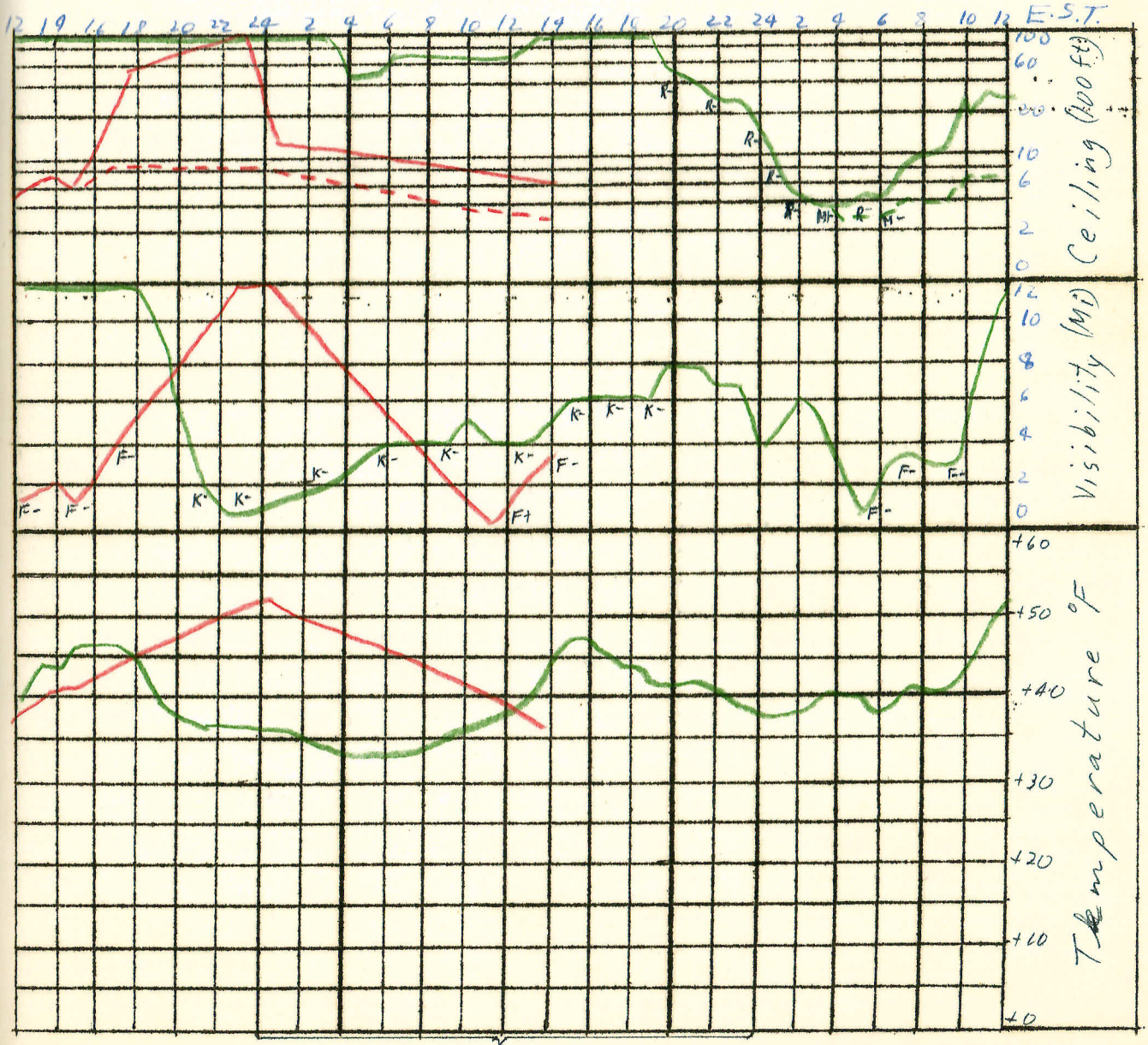






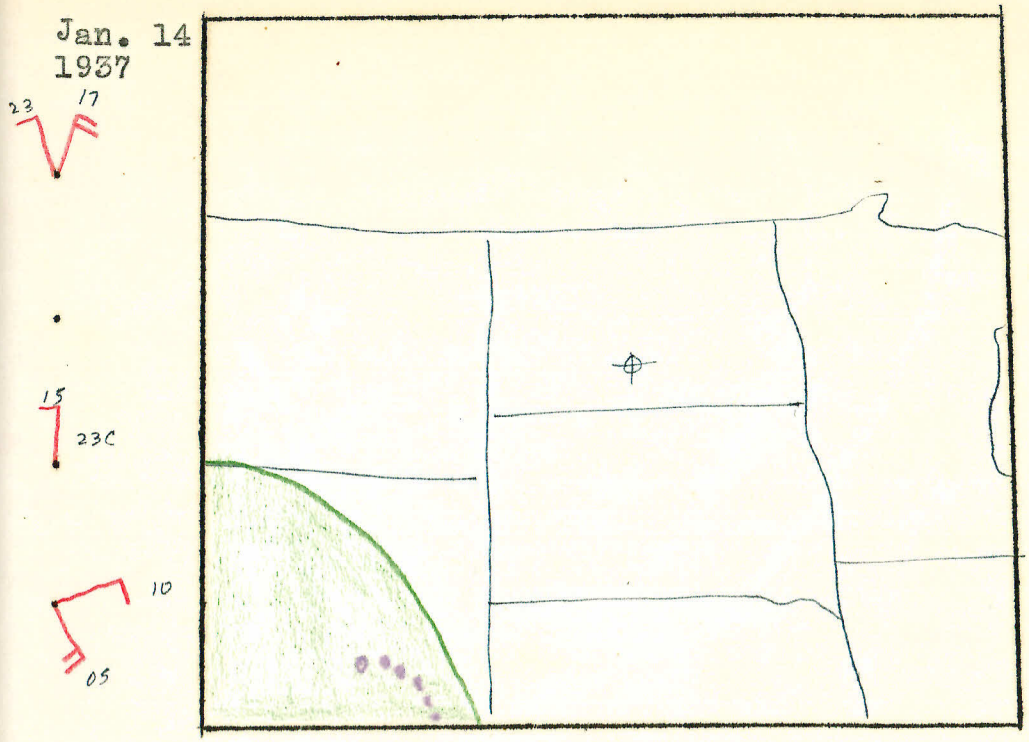




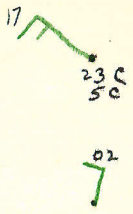


Phase 3

Jan. 14
1937

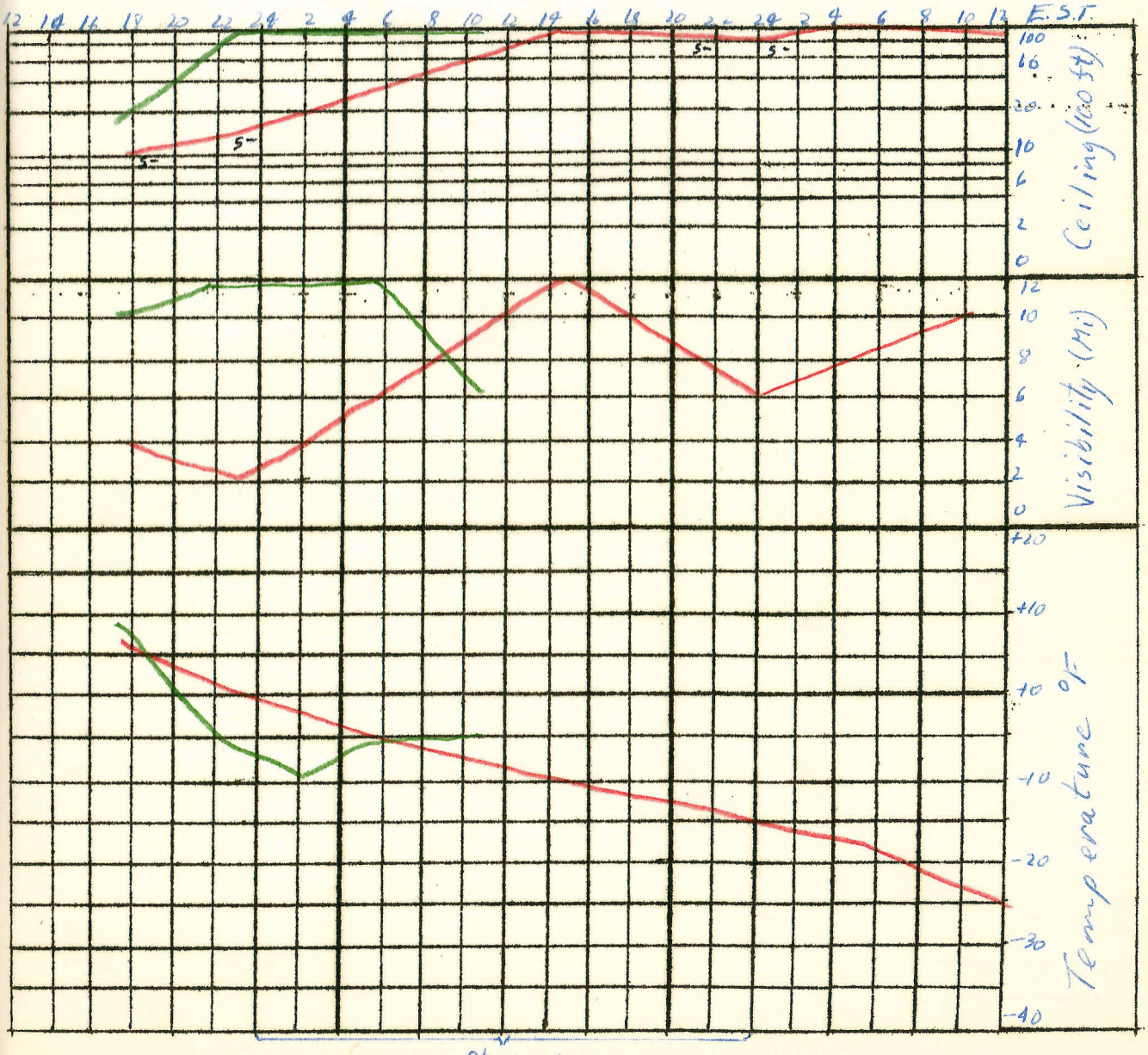


Jan. 1
1937

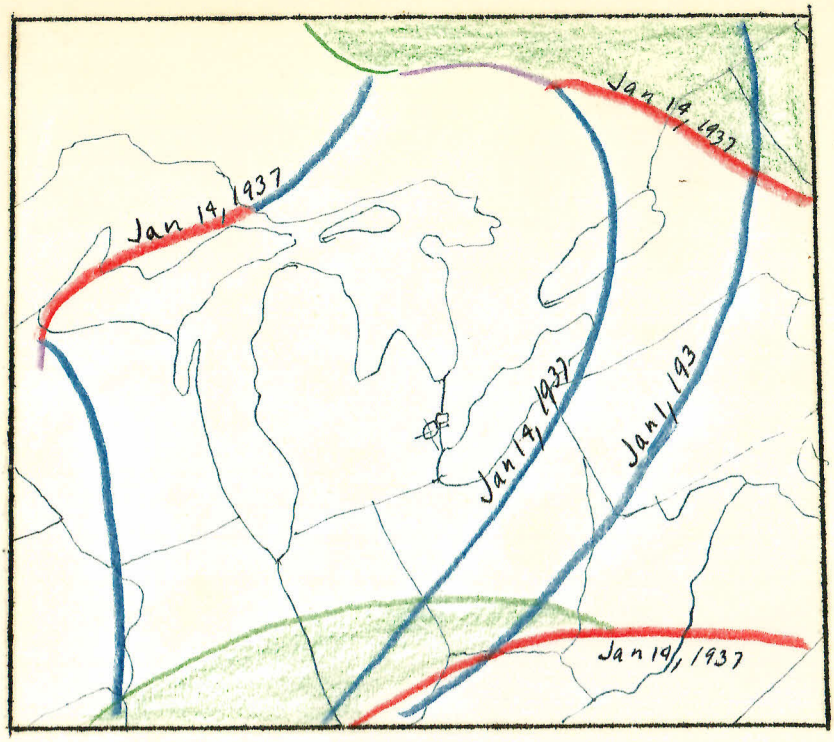


RK

Type A
Phase 3



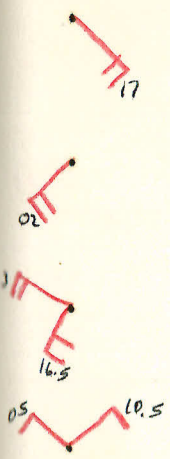
Jan. 14
1937

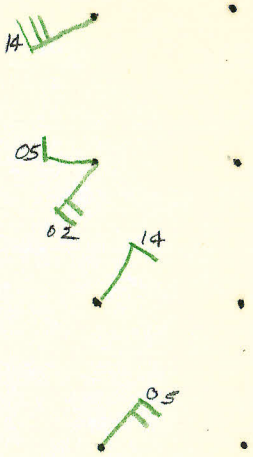


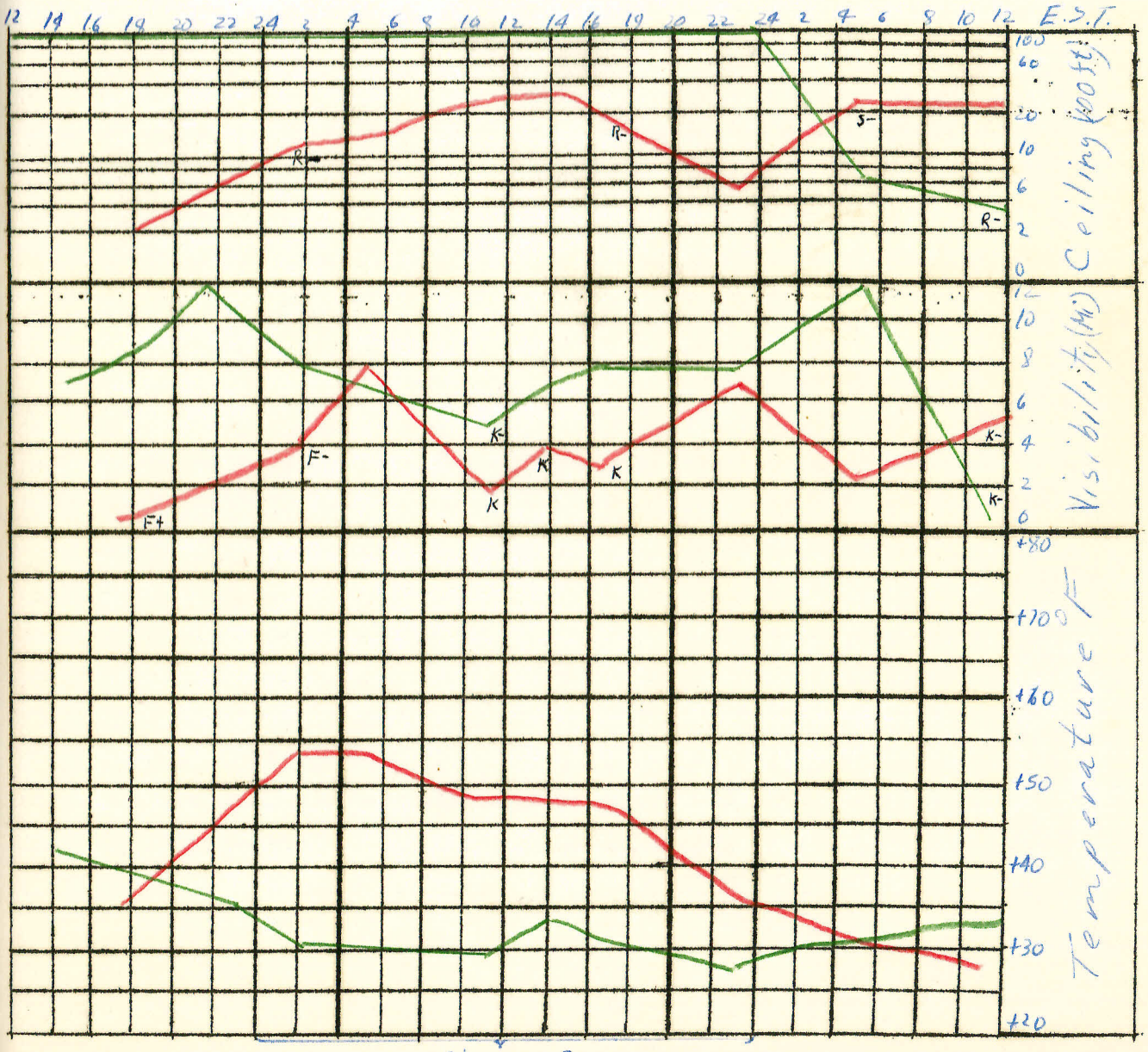
Jan. 1
1937

DO

Type A
Phase 3

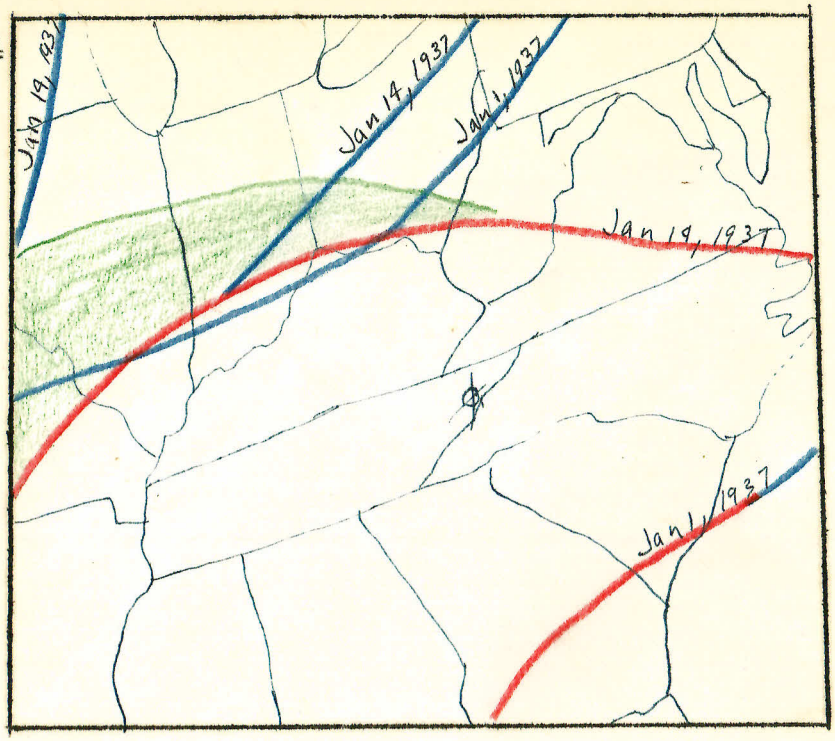






Phase 3

Jan. 14
1937



Jan. 1
1937

KK
Type A
Phase 3

12 14 16 18 20 22 24 2 4 6 8 10 12 14 16 18 20 22 24 2 4 6 8 10 12 E.S.T

Visibility (Feet)
100
60
30
10
6
3
0

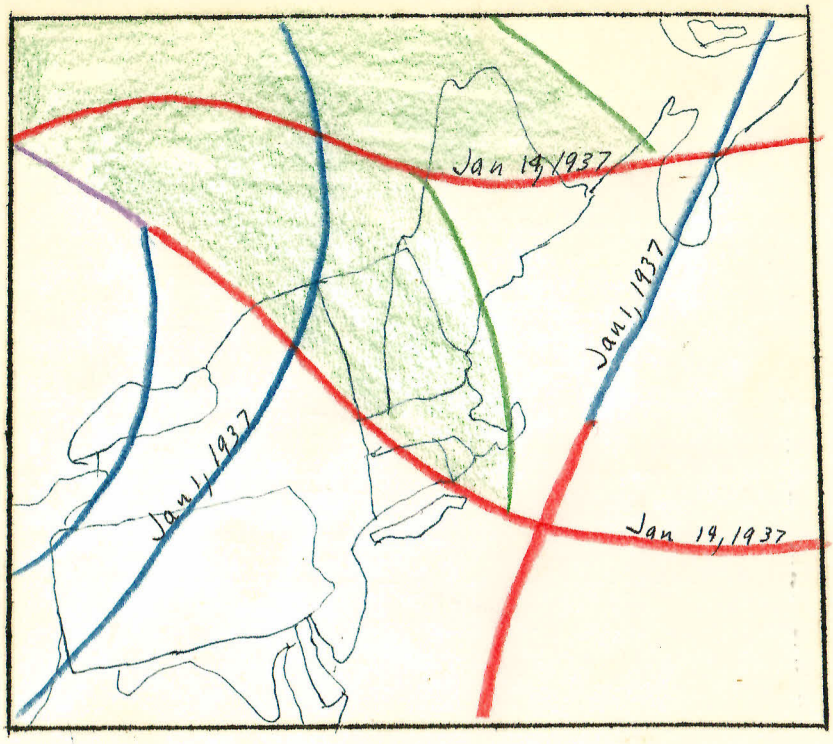
Visibility (Mi)
12
10
8
6
4
2
1

Temperature °F
+100
+90
+80
+70
+60
+50
+40

K

Phase 3

Jan. 14
1937



Jan. 1
1937

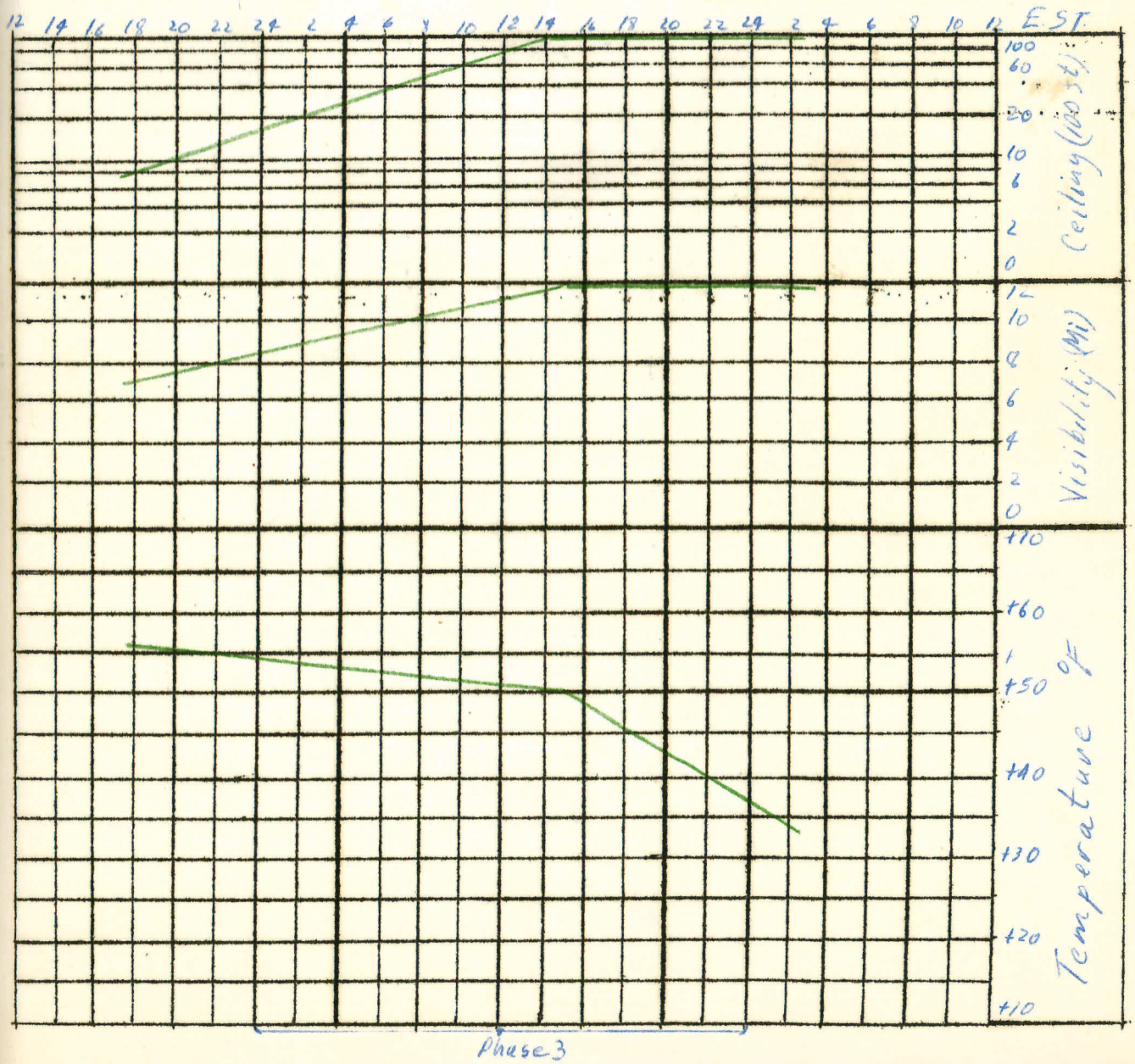




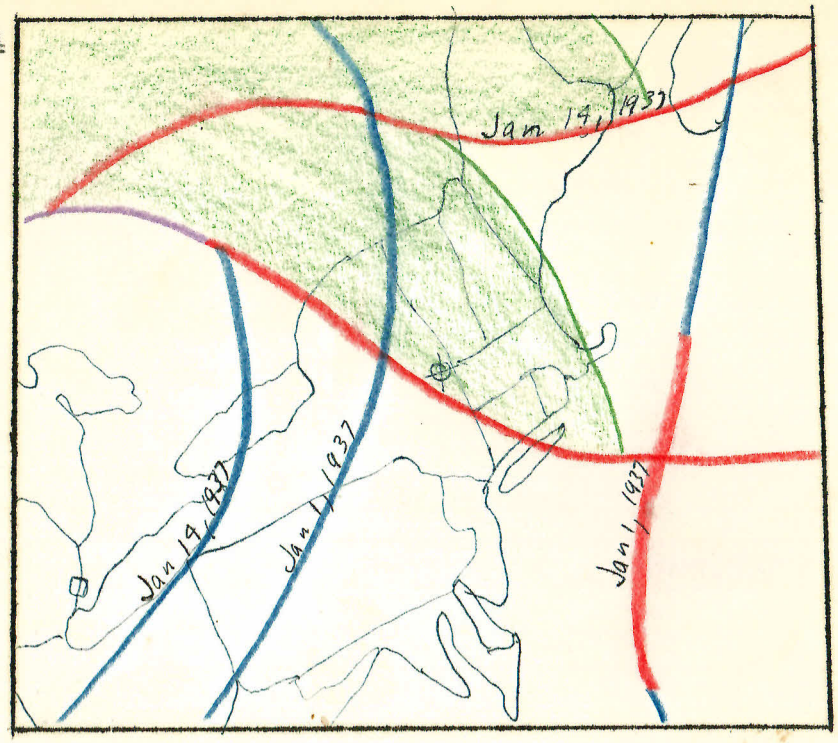


BW

Type A
Phase 3



Jan. 14
1937



Jan. 1
1937

AZ

Type A
Phase 3

12.5

15

02.5

12 14 16 18 20 22 24 2 4 6 8 10 12 14 16 18 20 22 24 2 4 6 8 10 12 EST

100
60
20
10
6
2
0
Ceiling (100 ft)

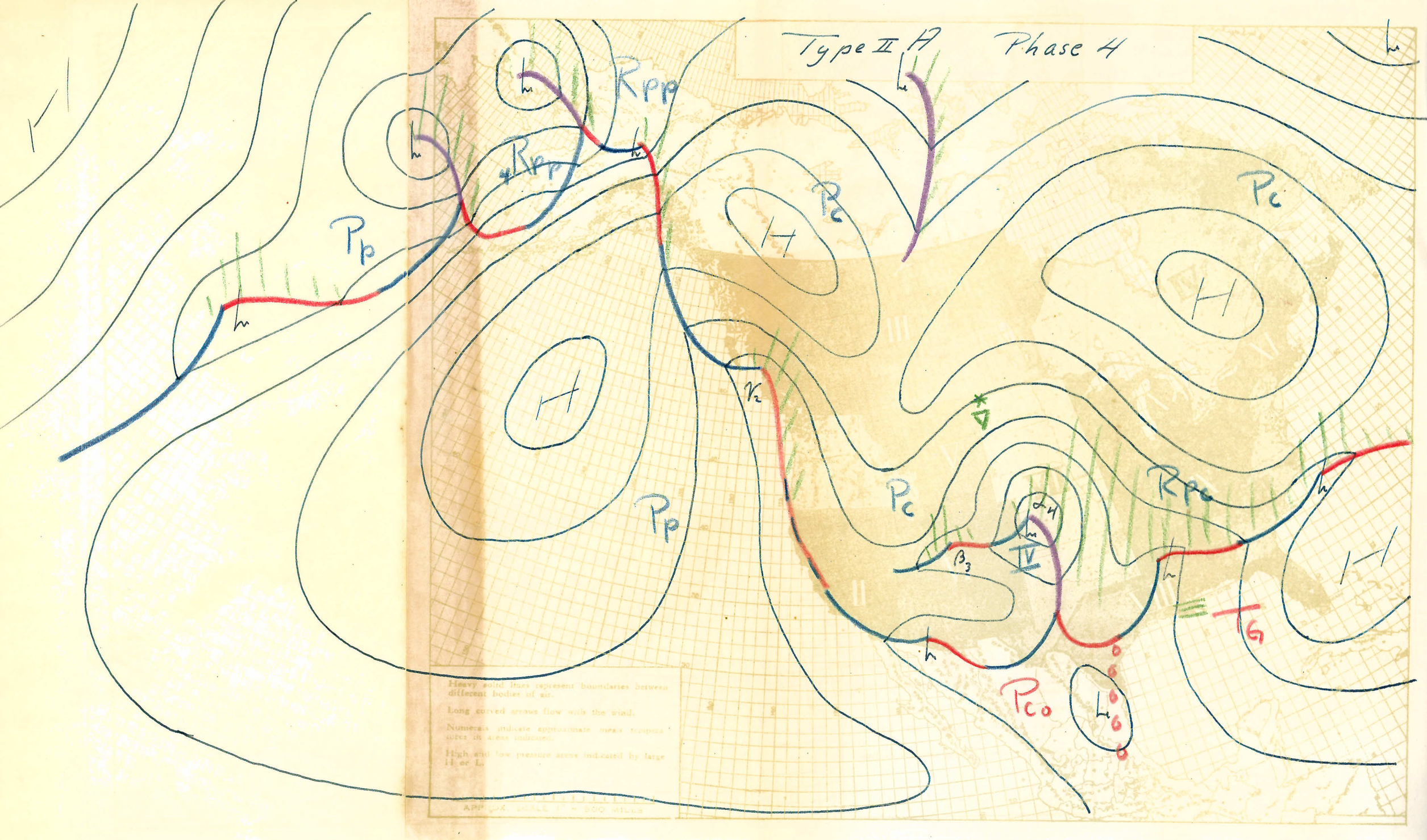
12
10
8
6
4
2
0
Visibility (Mi)

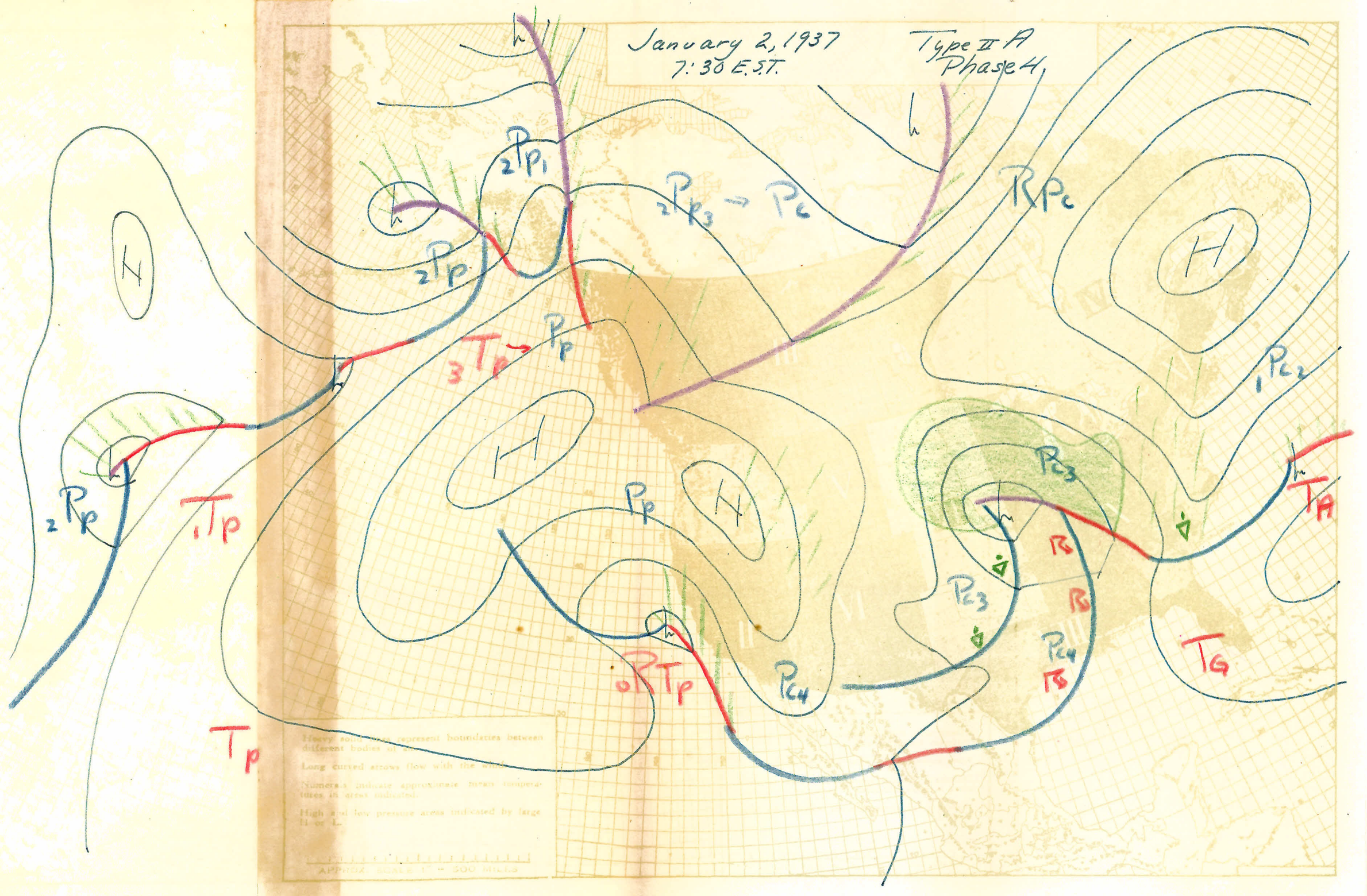
+80
+70
+60
+50
+40
+30
+20
Temperature °F

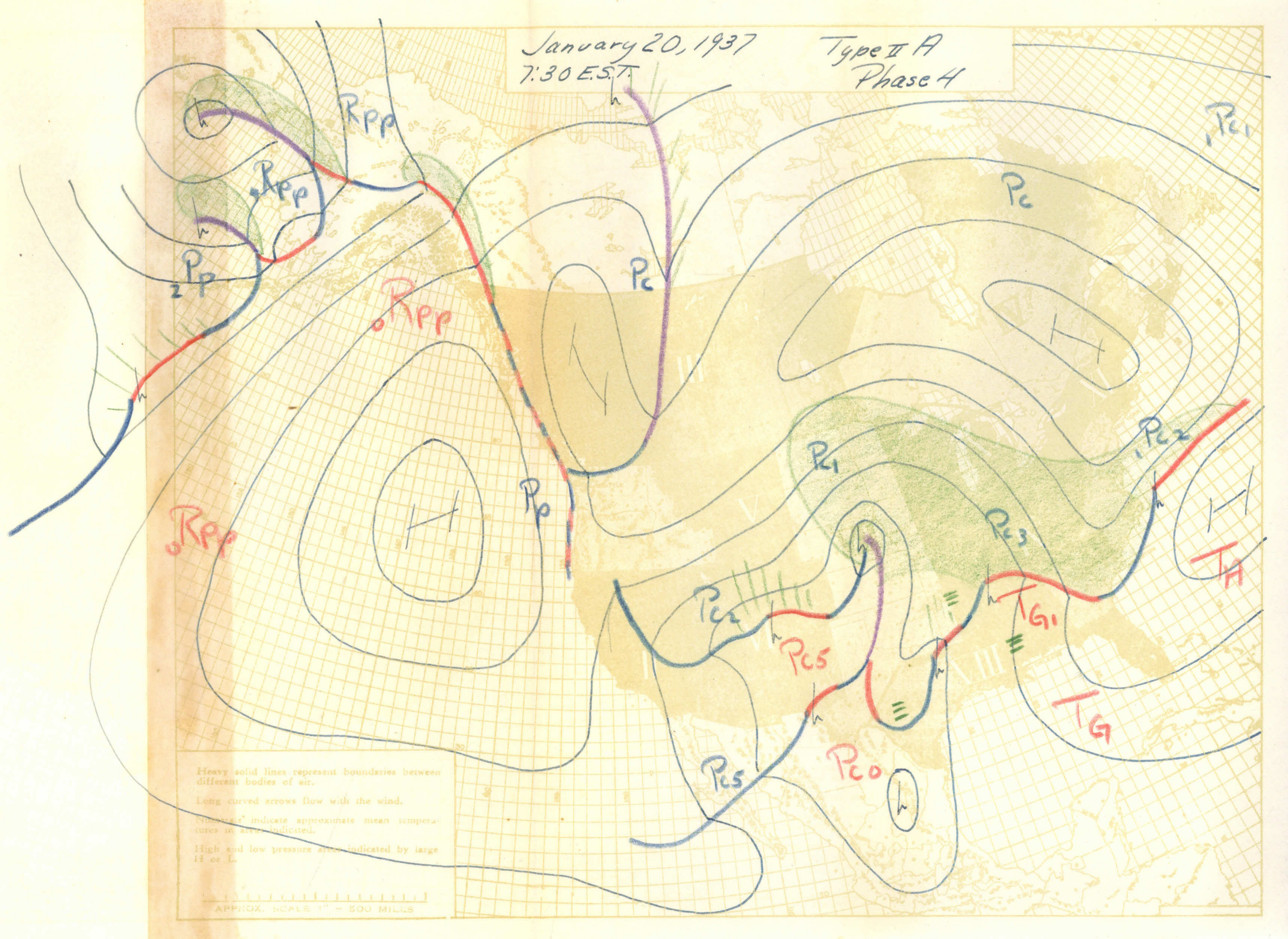
R-

Phase 3

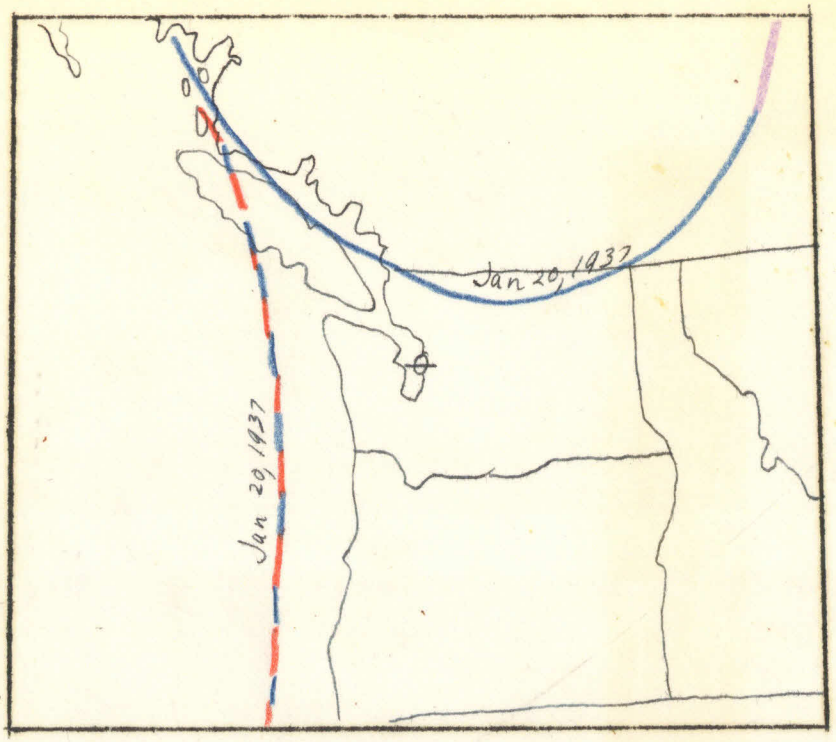
PHASE IV


Type II A Phase 4
Rpp
Rpp
Pp
Pc
Pc
Pc
Pp
Rpc
Pco
TG
Heavy solid lines represent boundaries between different bodies of air.
Long curved arrows flow with the wind.
Numerals indicate approximate mean tempera tures in areas indicated.
High and low pressure areas indicated by large H or L.


January 2, 1937
7:30 E.S.T.
Type II A
Phase 4
H
H
H
H
H
$_2P_{P_1}$
$_2P_{P_3} \rightarrow P_c$
$_2P_P$
$_3T_P \rightarrow P_P$
$_2P_P$
$_1T_P$
T_P
P_P
$_0RT_P$
P_{c4}
RP_c
$_1P_{c_2}$
P_{c3}
P_{c3}
P_{c4}
R
R
R
T_A
T_G


January 20, 1937
7:30 E.S.T.
Type II A
Phase 4
Rpp
Rpp
Rpp
Rpp
Rpp
Pp
Pc
Pc
Pc1
Pc1
Pc2
Pc2
Pc3
Pc5
Pc5
Pc0
TA
TG1
TG
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.
APPROX. SCALE 1" = 500 MILES

Jan. 20
1937

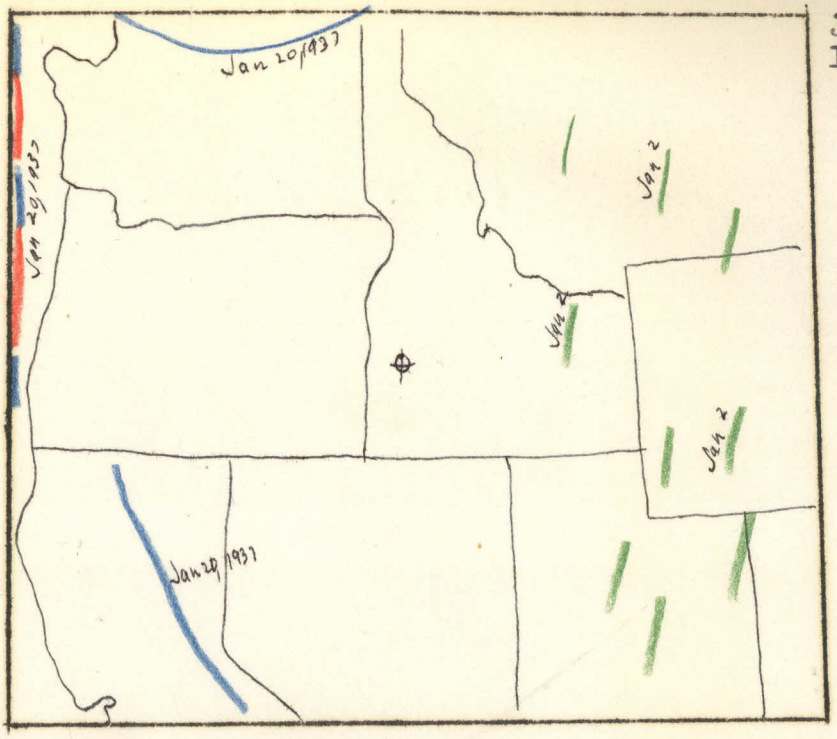


Jan. 2
1937

SA

Type A
Phase 4

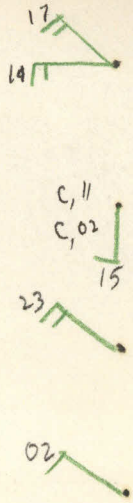
Jan. 20
1937

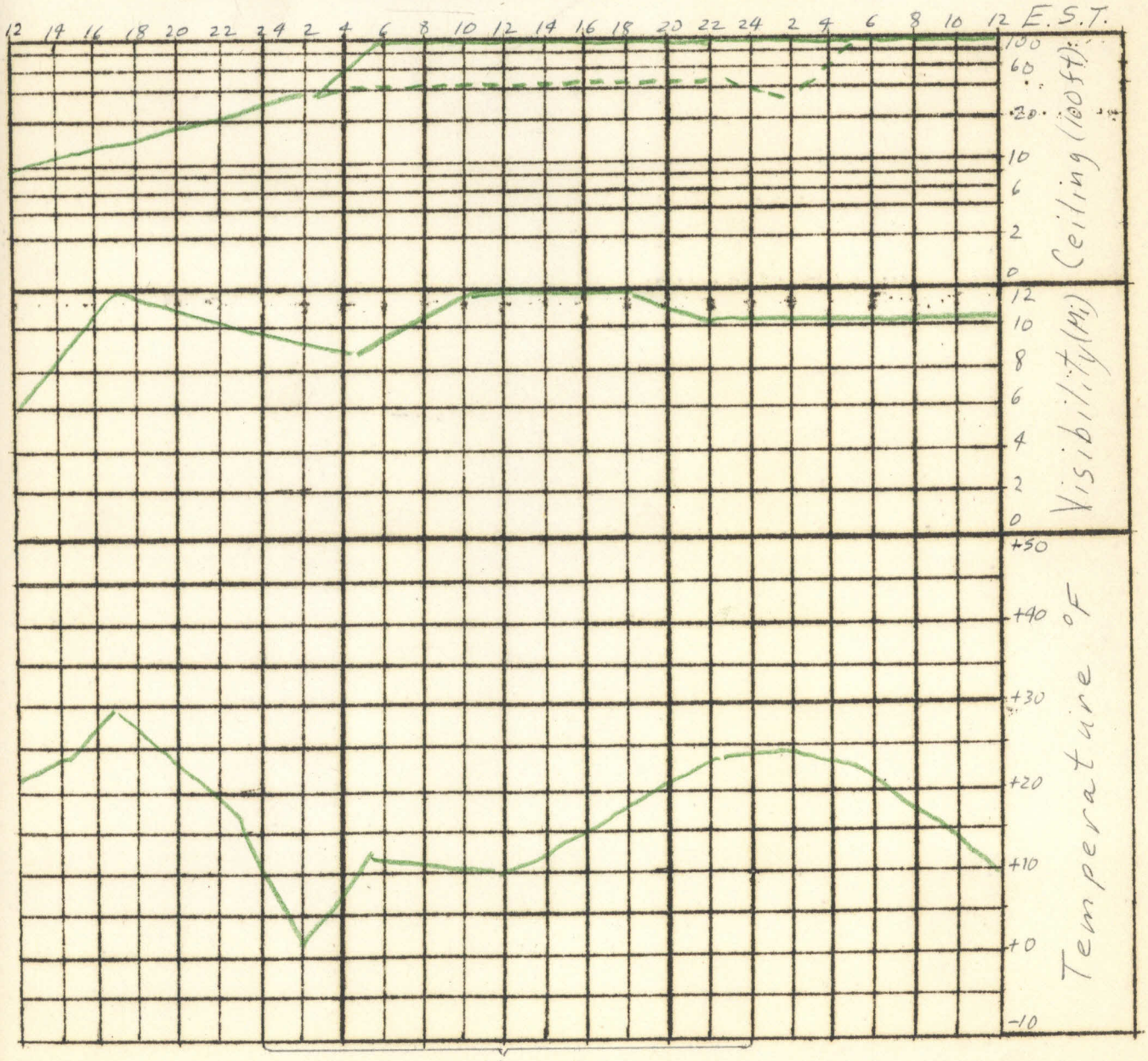


Jan. 2
1937

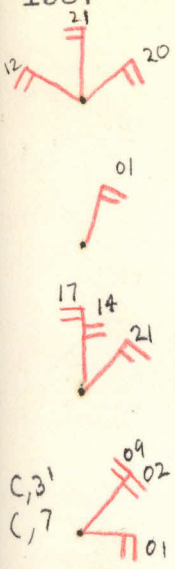
BE

Type A
Phase 4

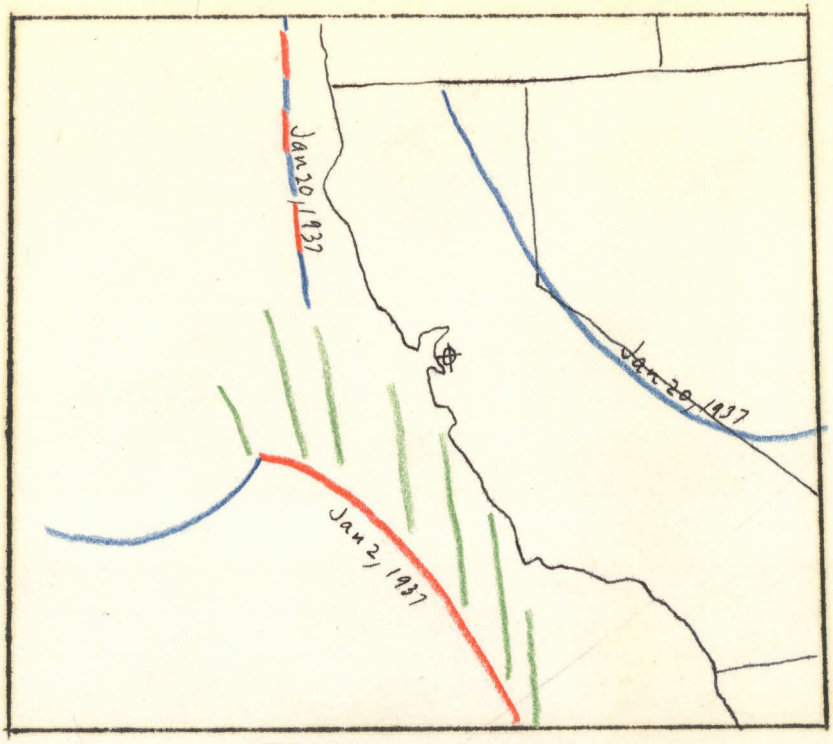




Jan. 20
1937



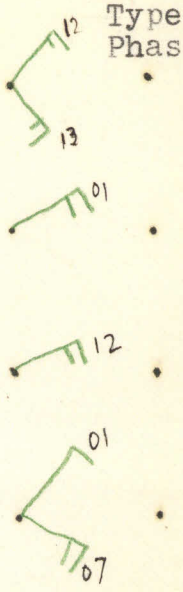
C,31
C,7

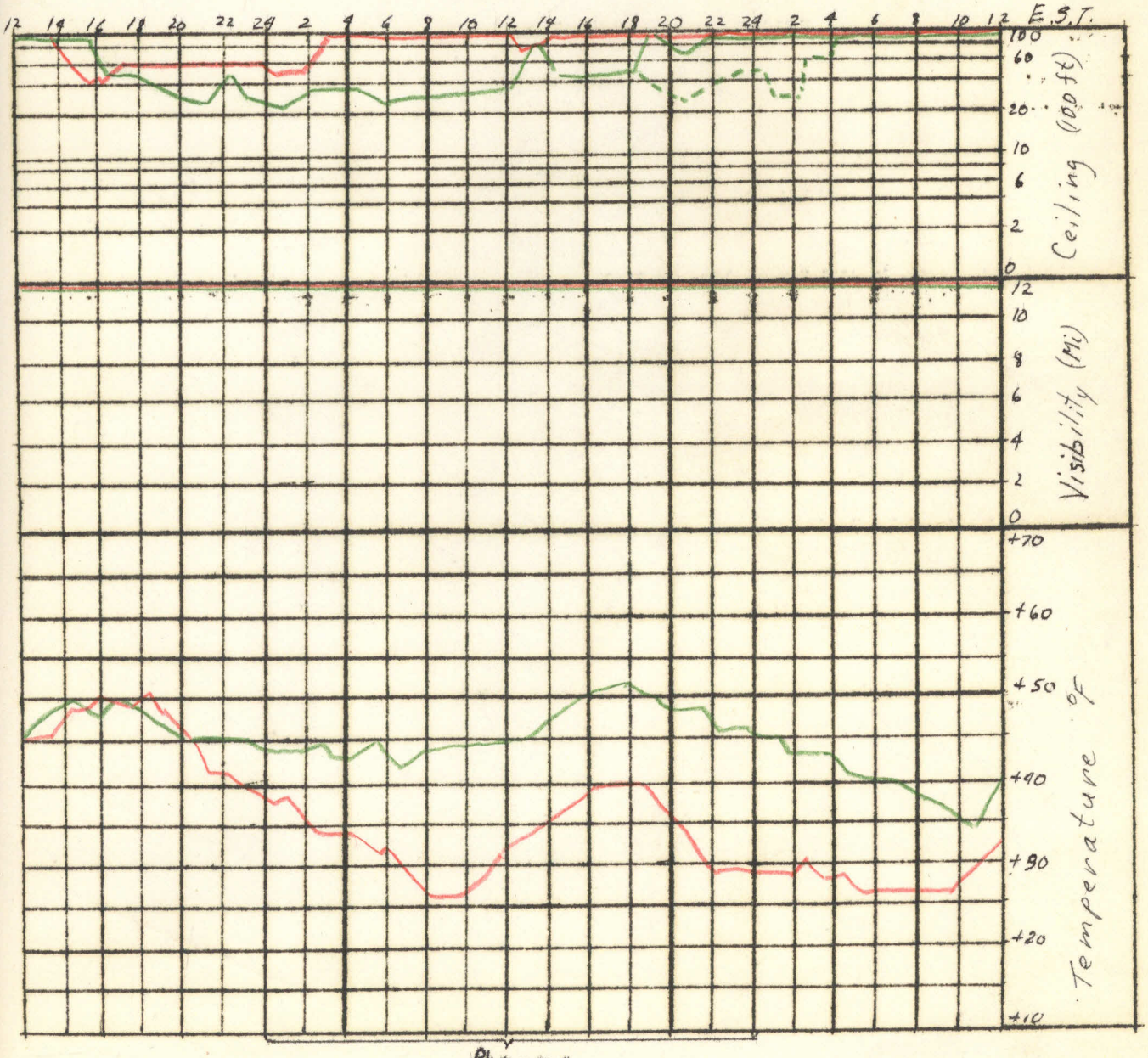


Jan. 2
1937

OA

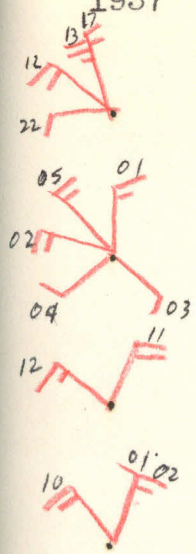
Type A
Phase 4

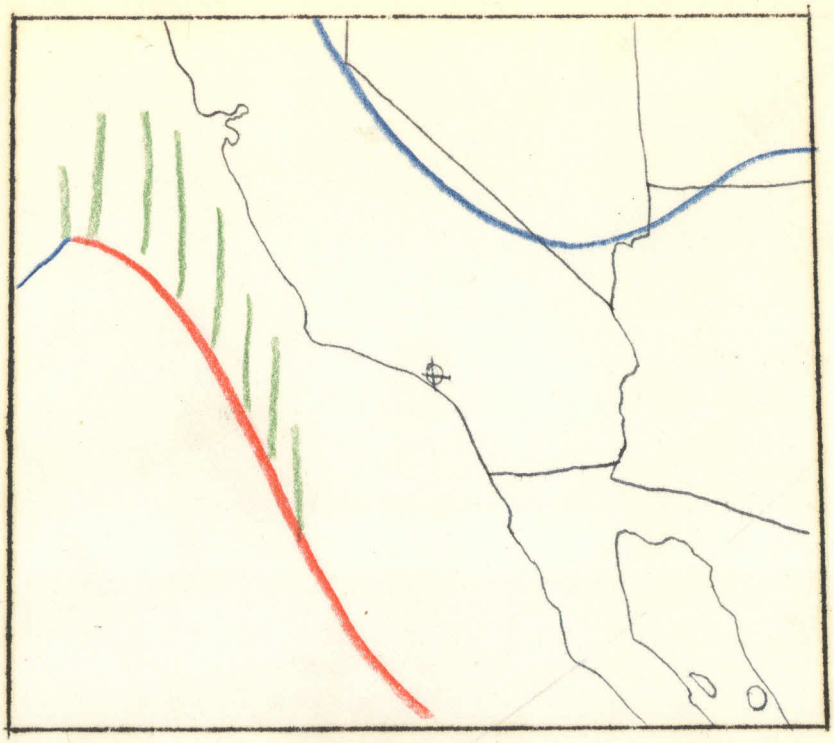




Phase 4

Jan. 20
1937

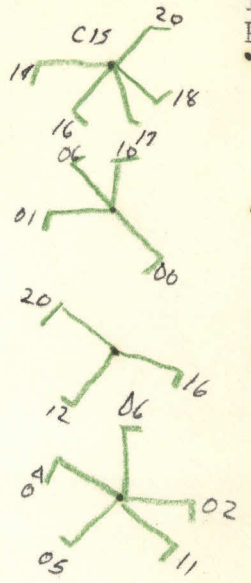


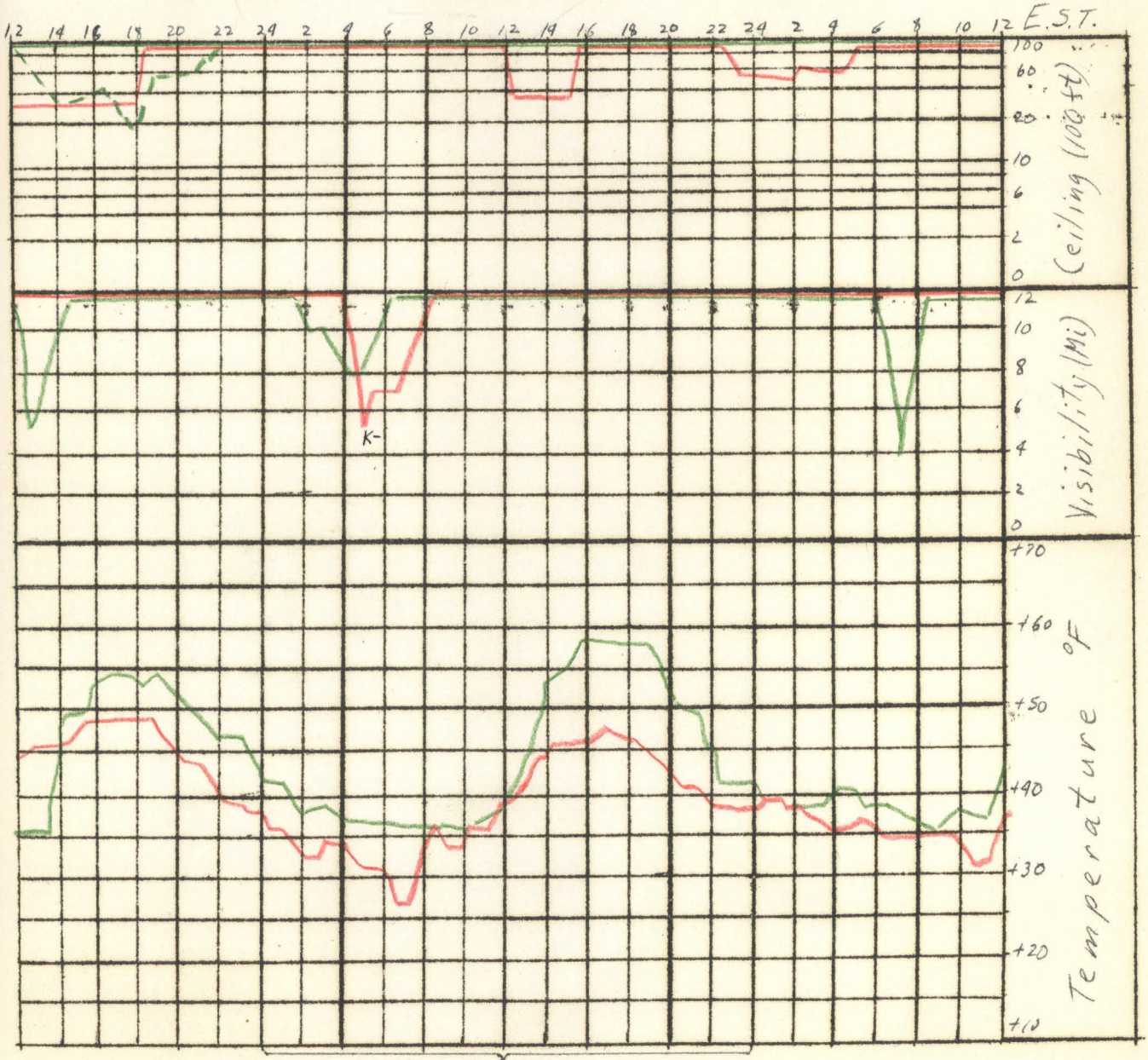


Jan. 2
1937

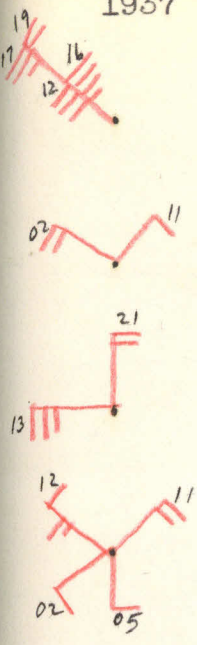
BU

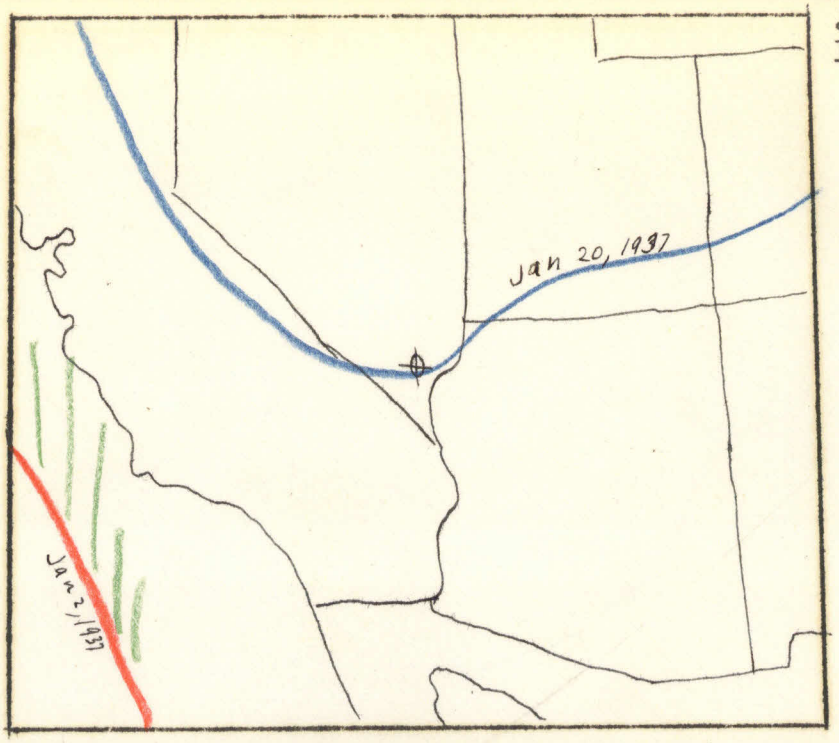
Type A
Phase 4





Jan. 20
1937

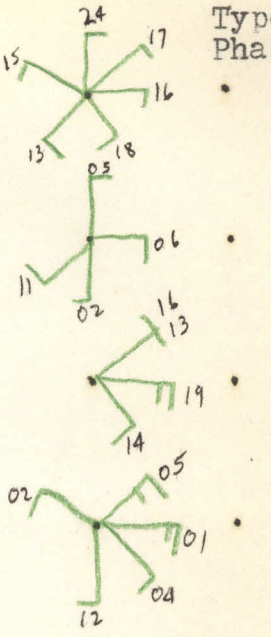


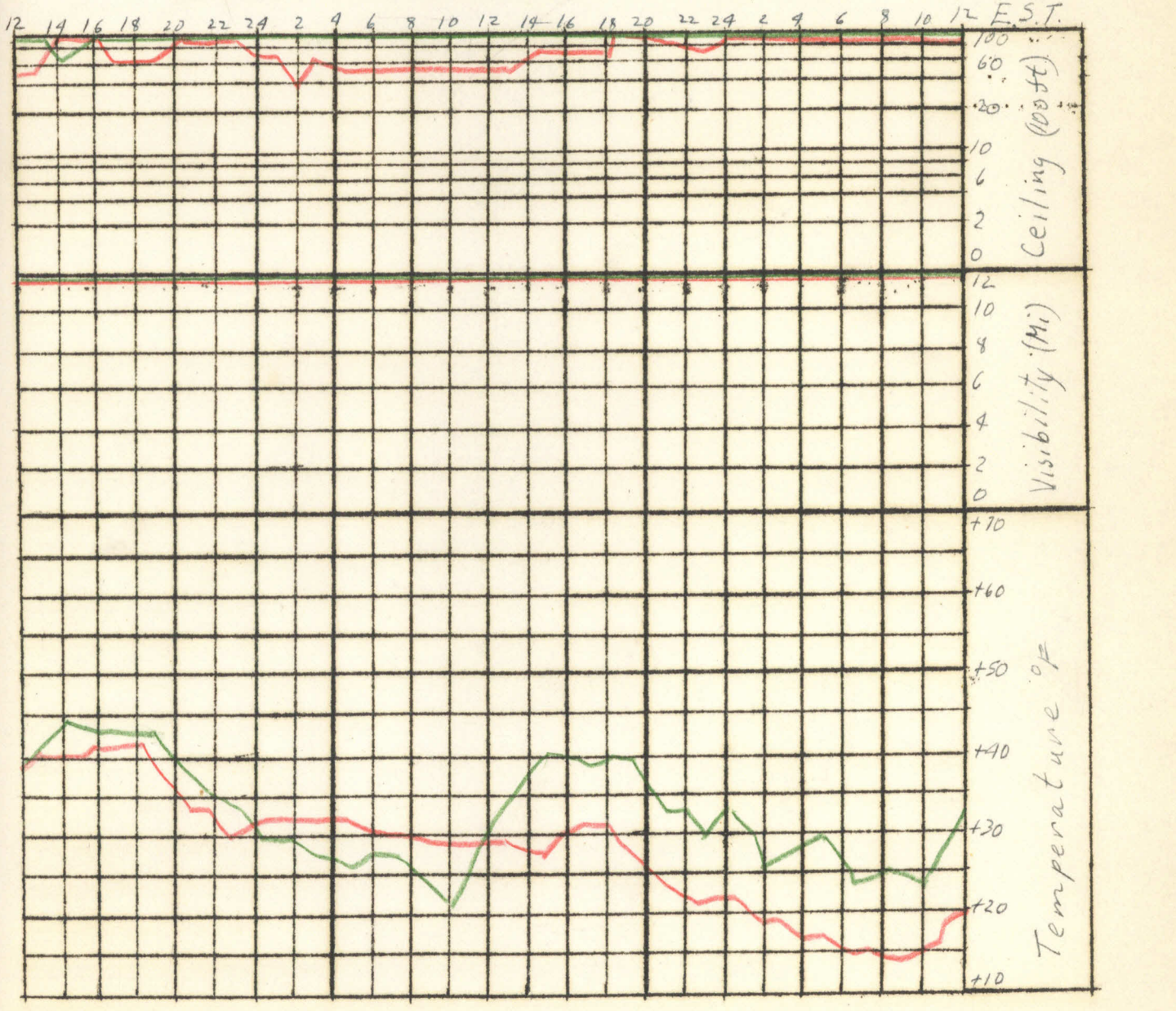


Jan. 2
1937

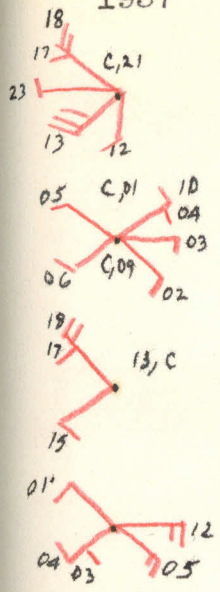
LQ

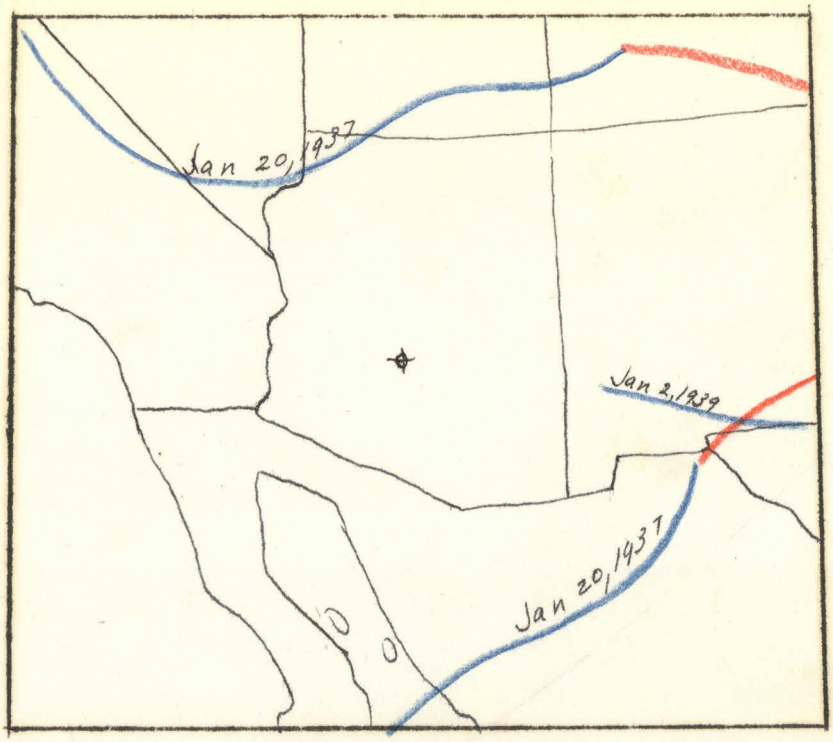
Type A
Phase 4





Jan. 20
1937

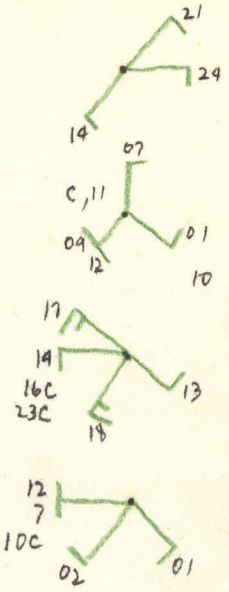


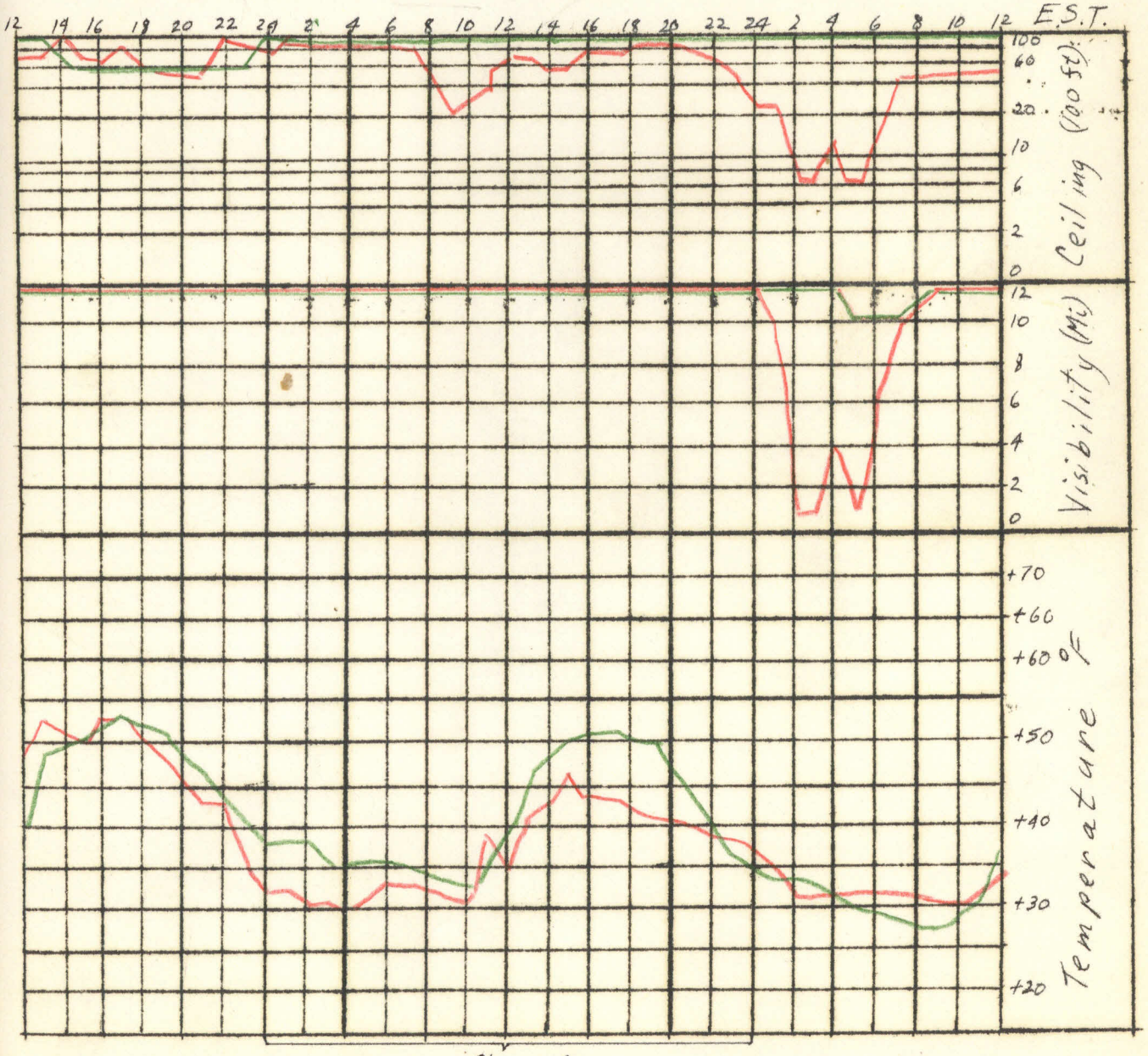


Jan. 2
1937

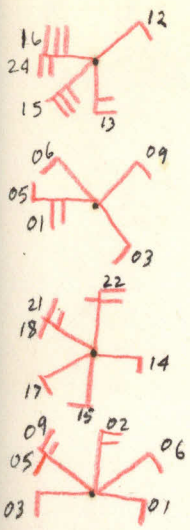
PH

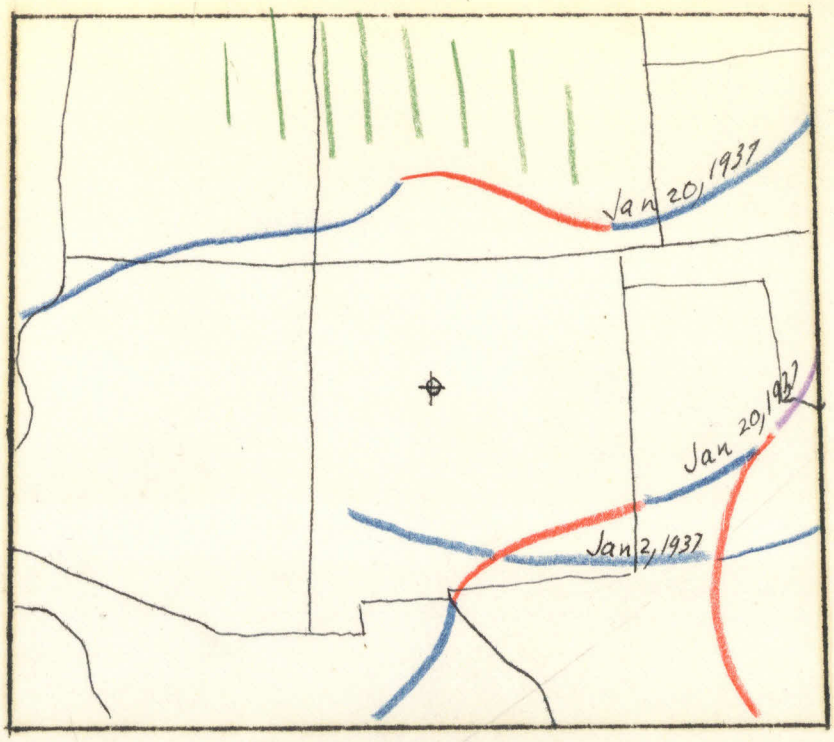
Type A
Phase 4





Jan. 20
1937

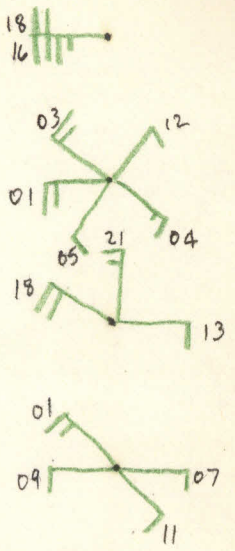


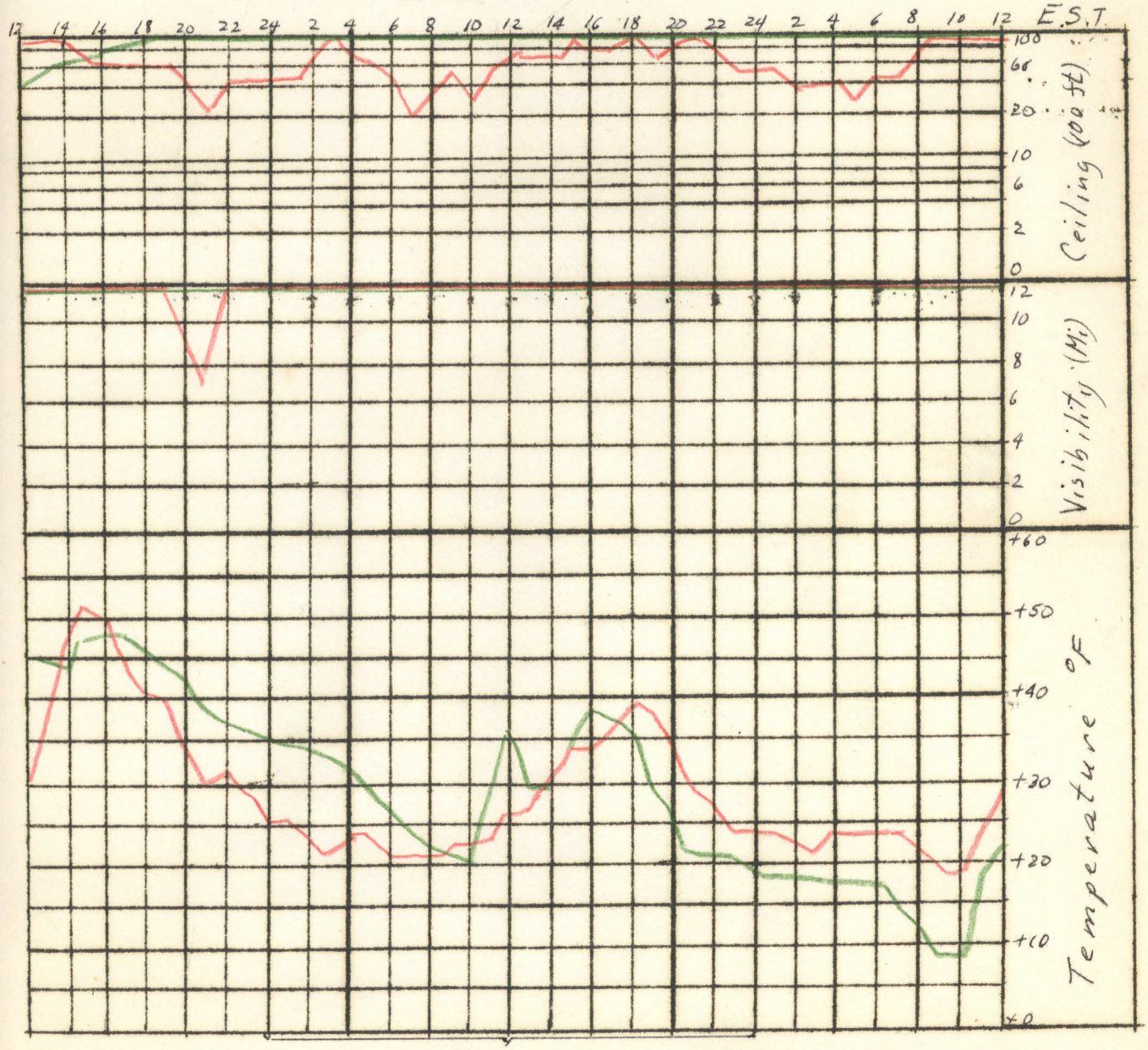


Jan. 2
1937

AB

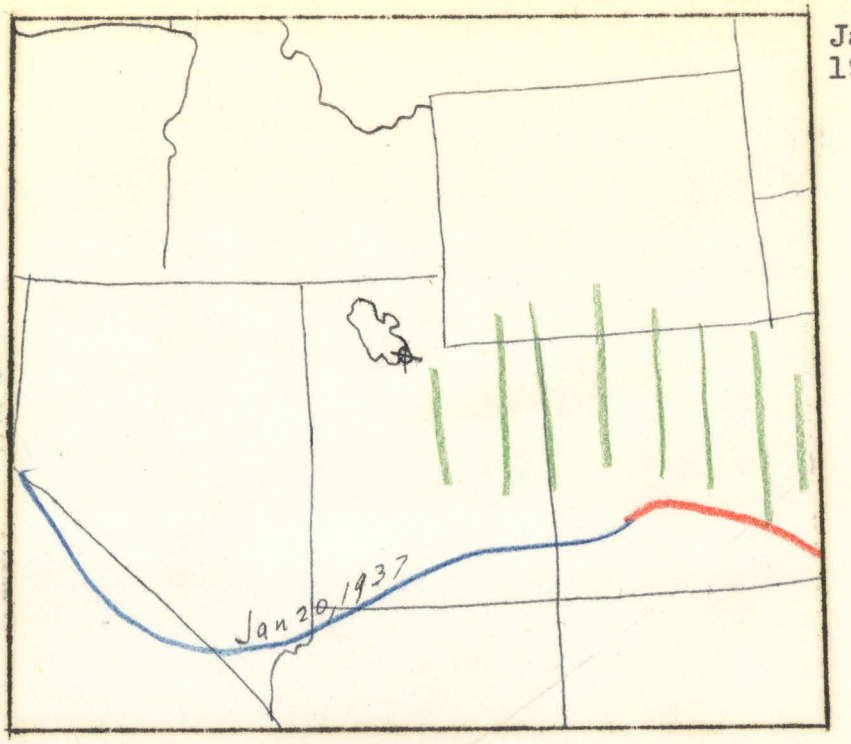
Type A
Phase 4





Phase 4

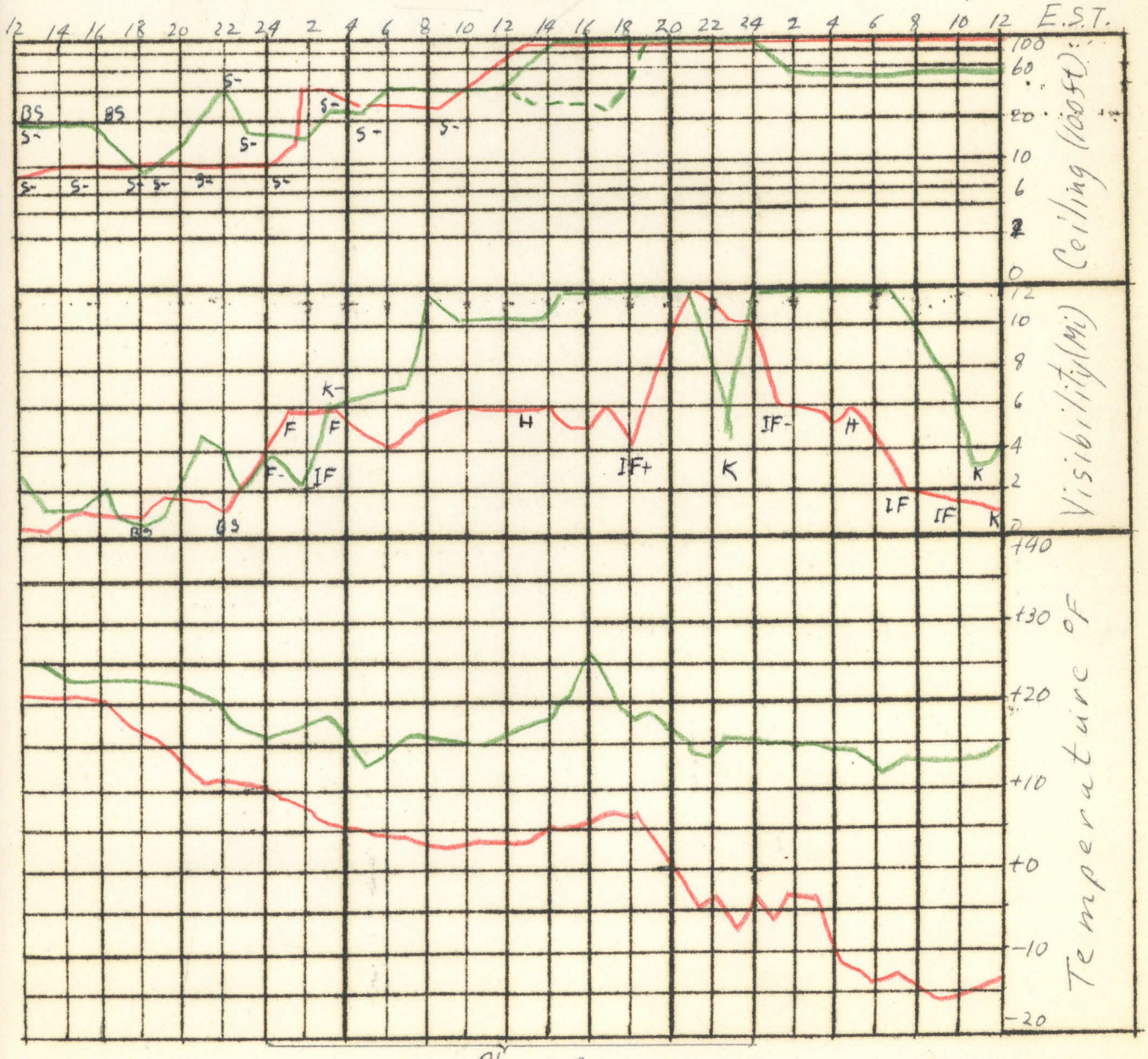
Jan. 20
1937



Jan. 2
1937

SL

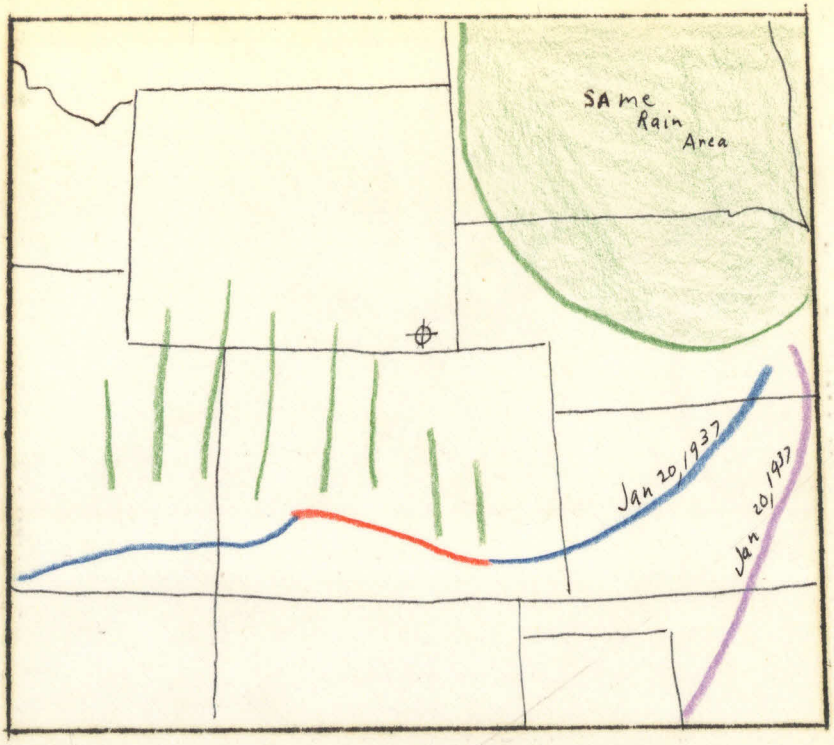
Type A
Phase 4

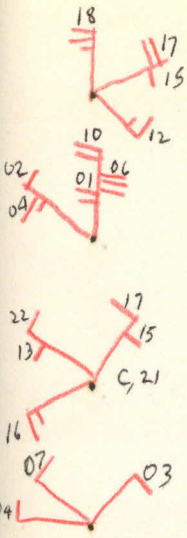


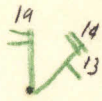
Phase 4

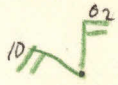
Jan. 20
1937

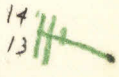
Jan. 2 CX
1937 Type A
Phase 4

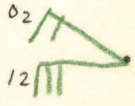


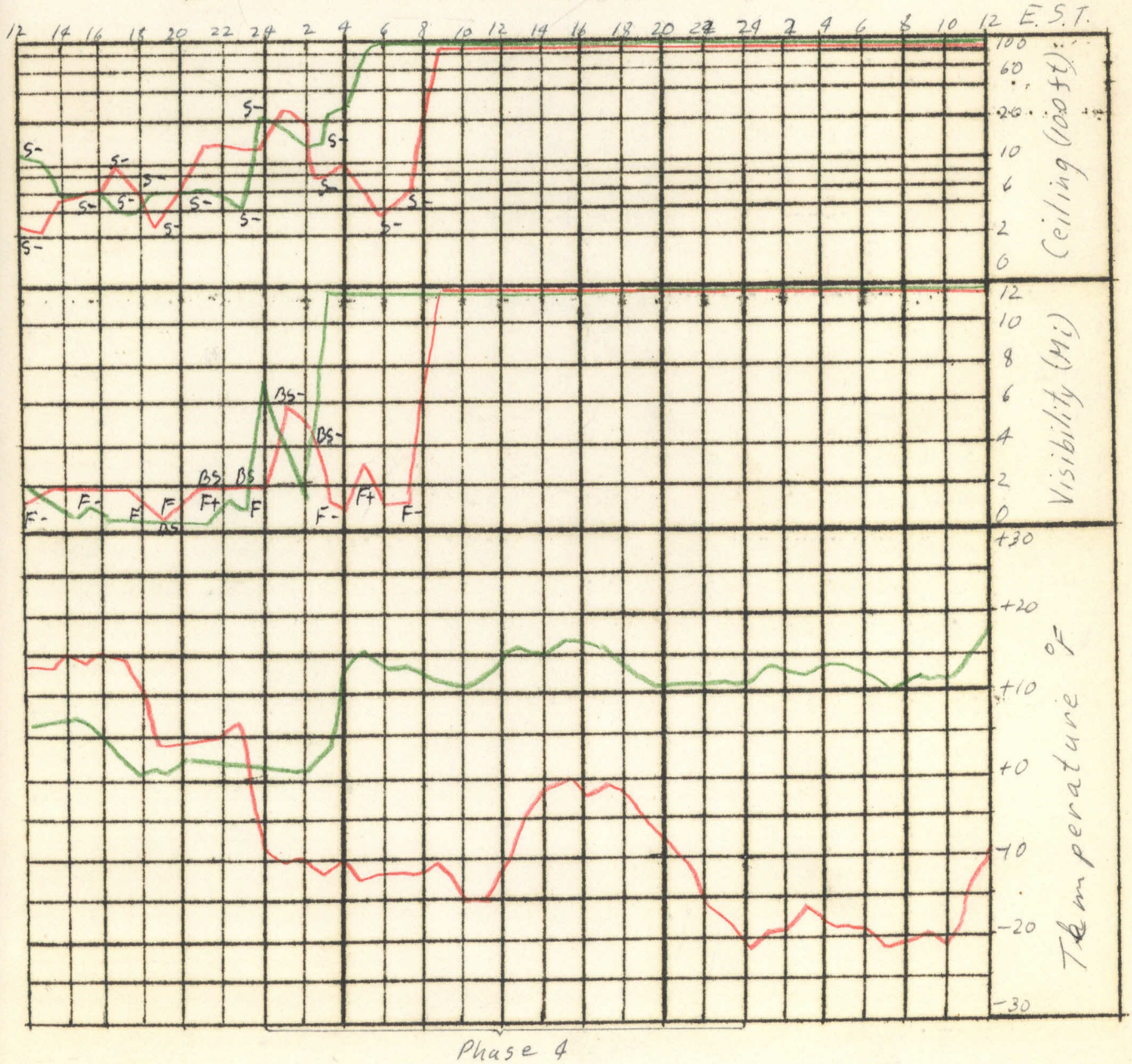












Phase 4

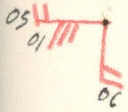
Jan. 20
1937

Jan. 2
1937

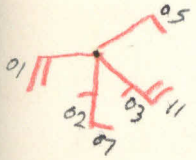
E6

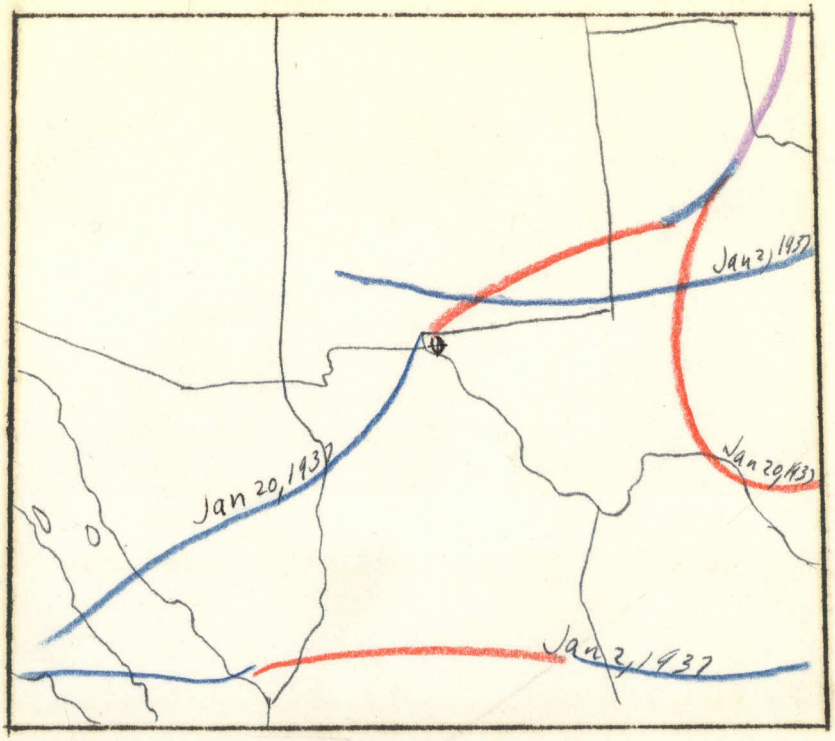
Type A
Phase 4

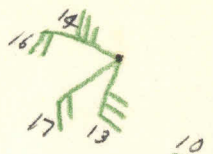


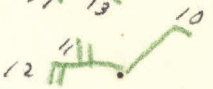


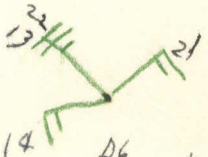


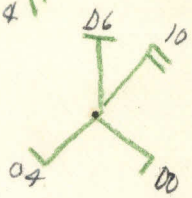


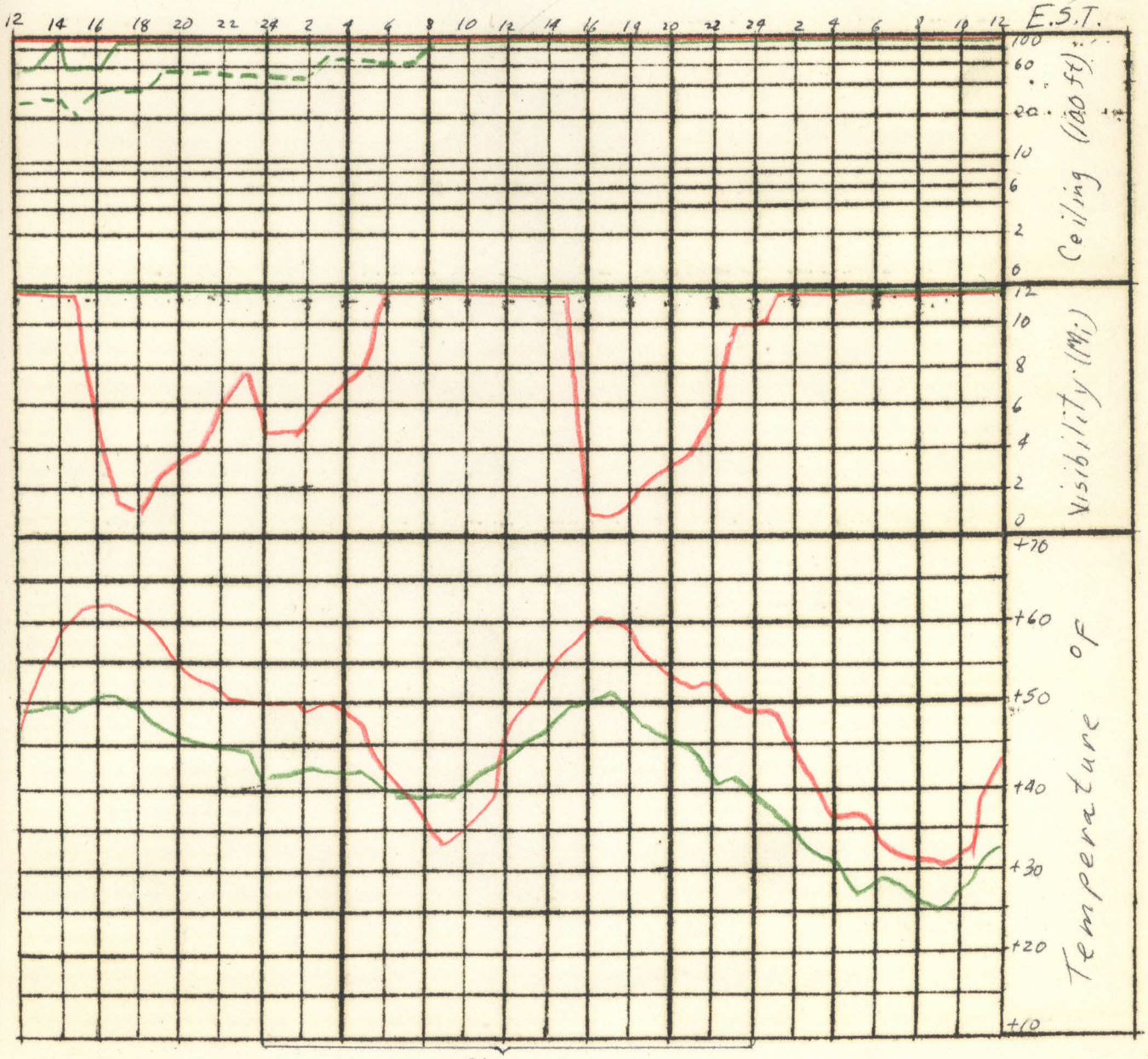










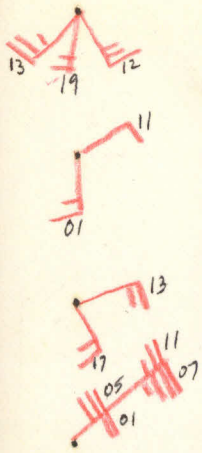


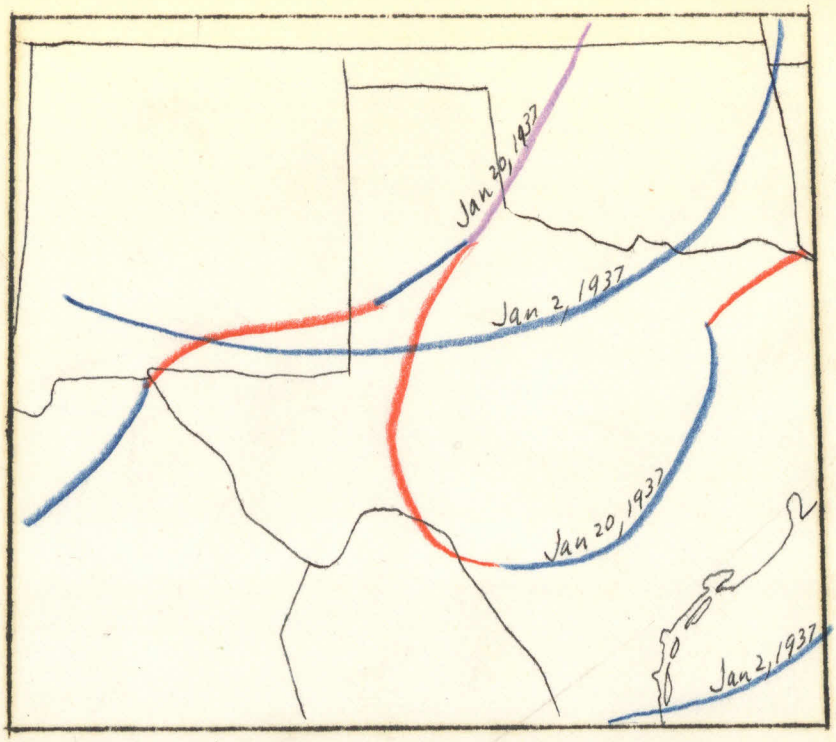
Jan. 20
1937

Jan. 2
1937

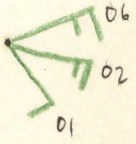
BZ

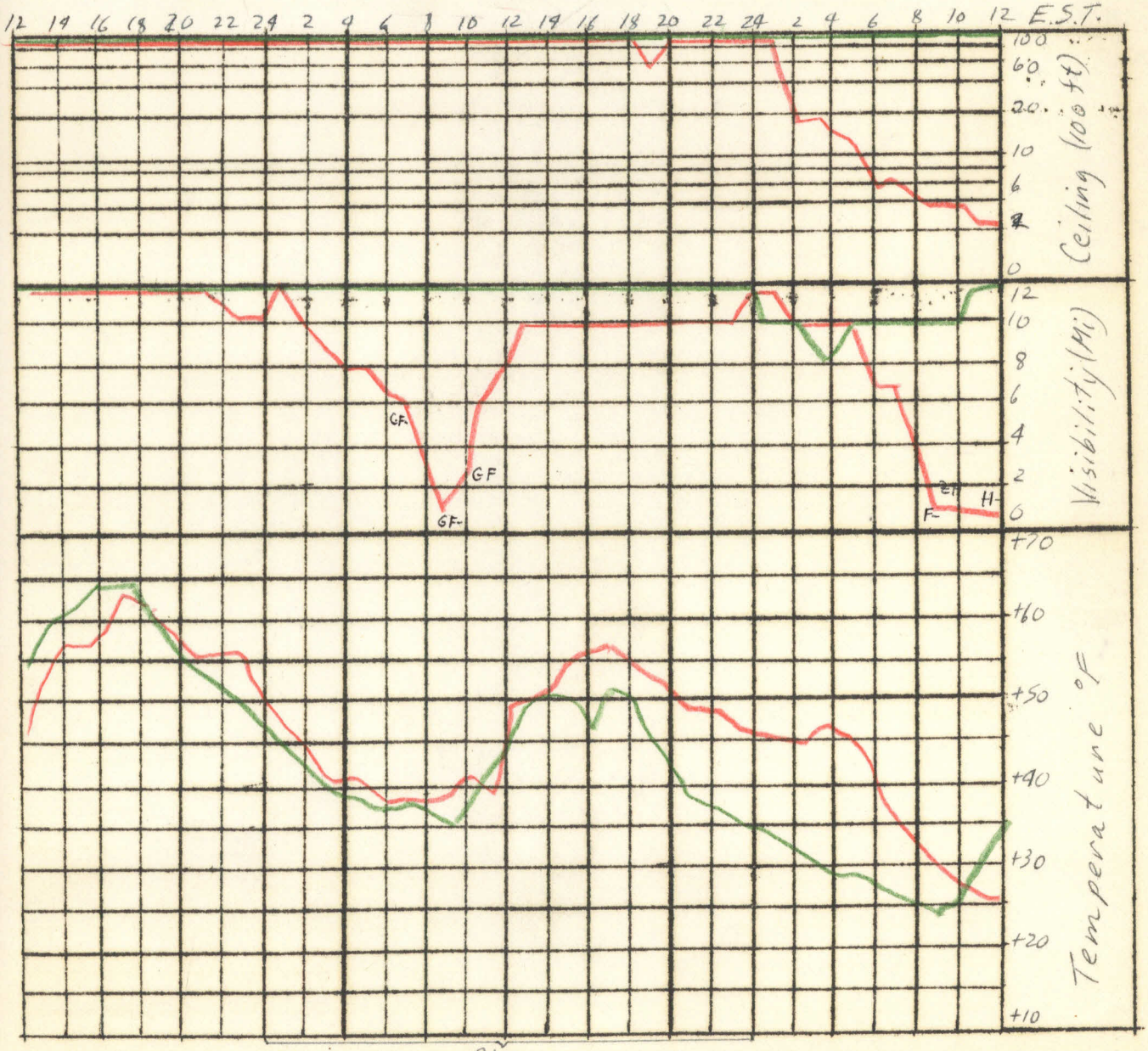
Type A
Phase 4











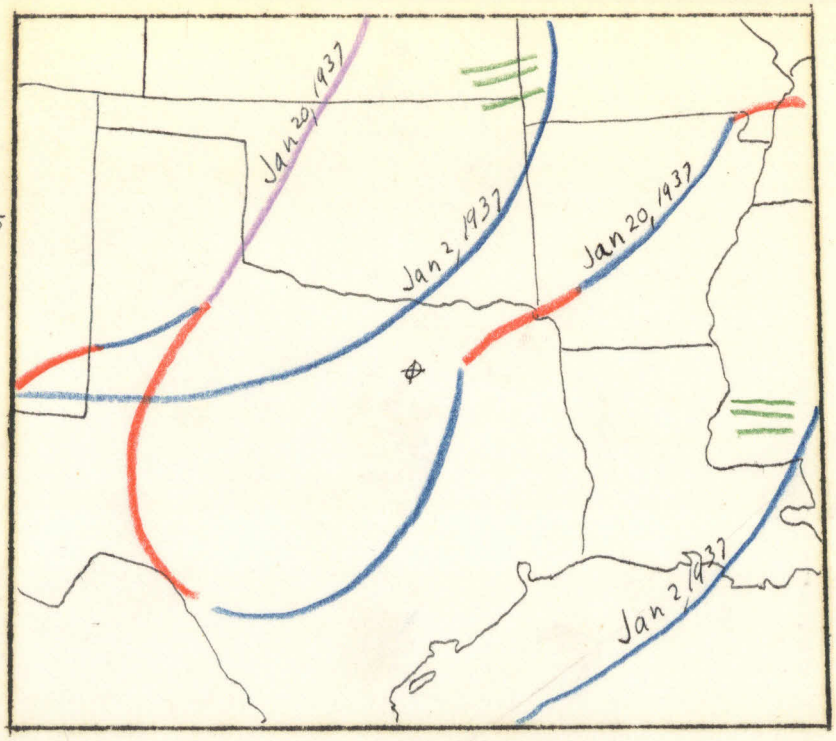
Phase 4

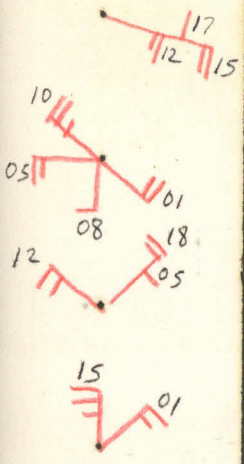
Jan. 20
1937

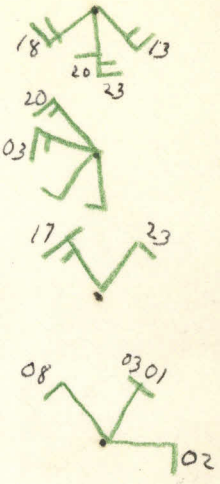
Jan. 2
1937

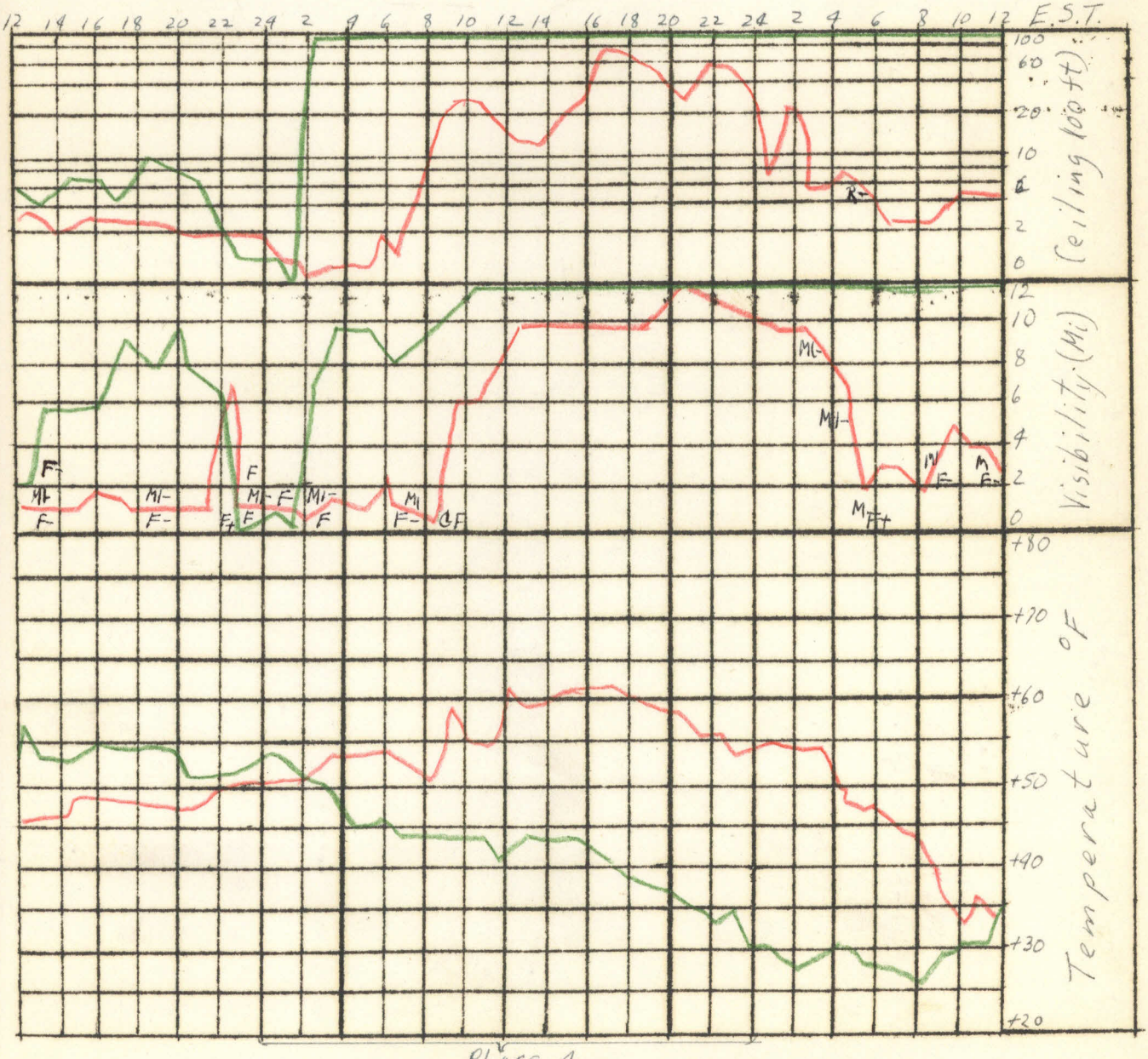
DL

Type A
Phase 4







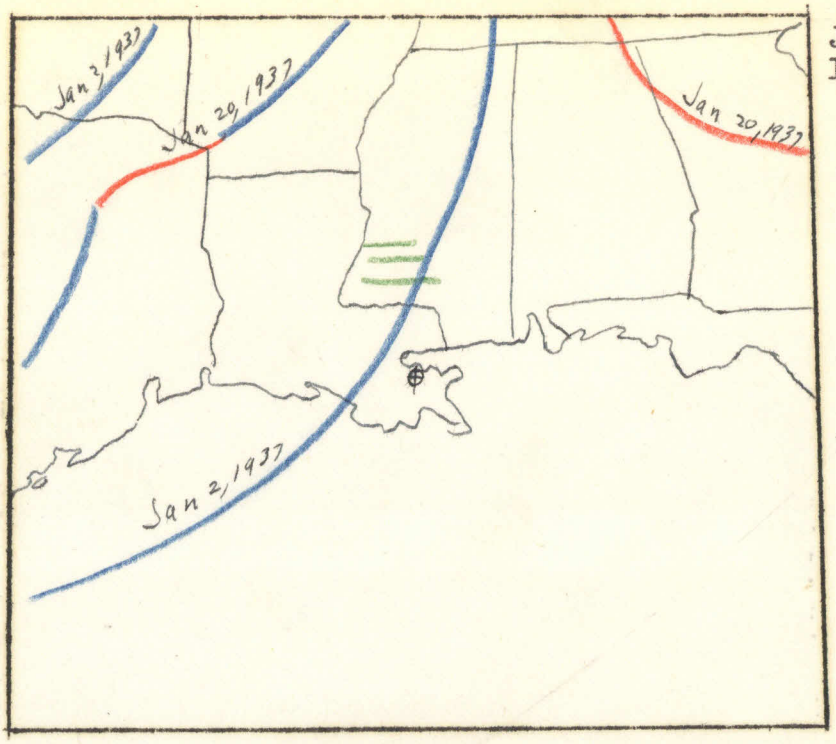


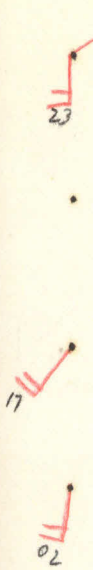
Phase 4

Jan 20
1937

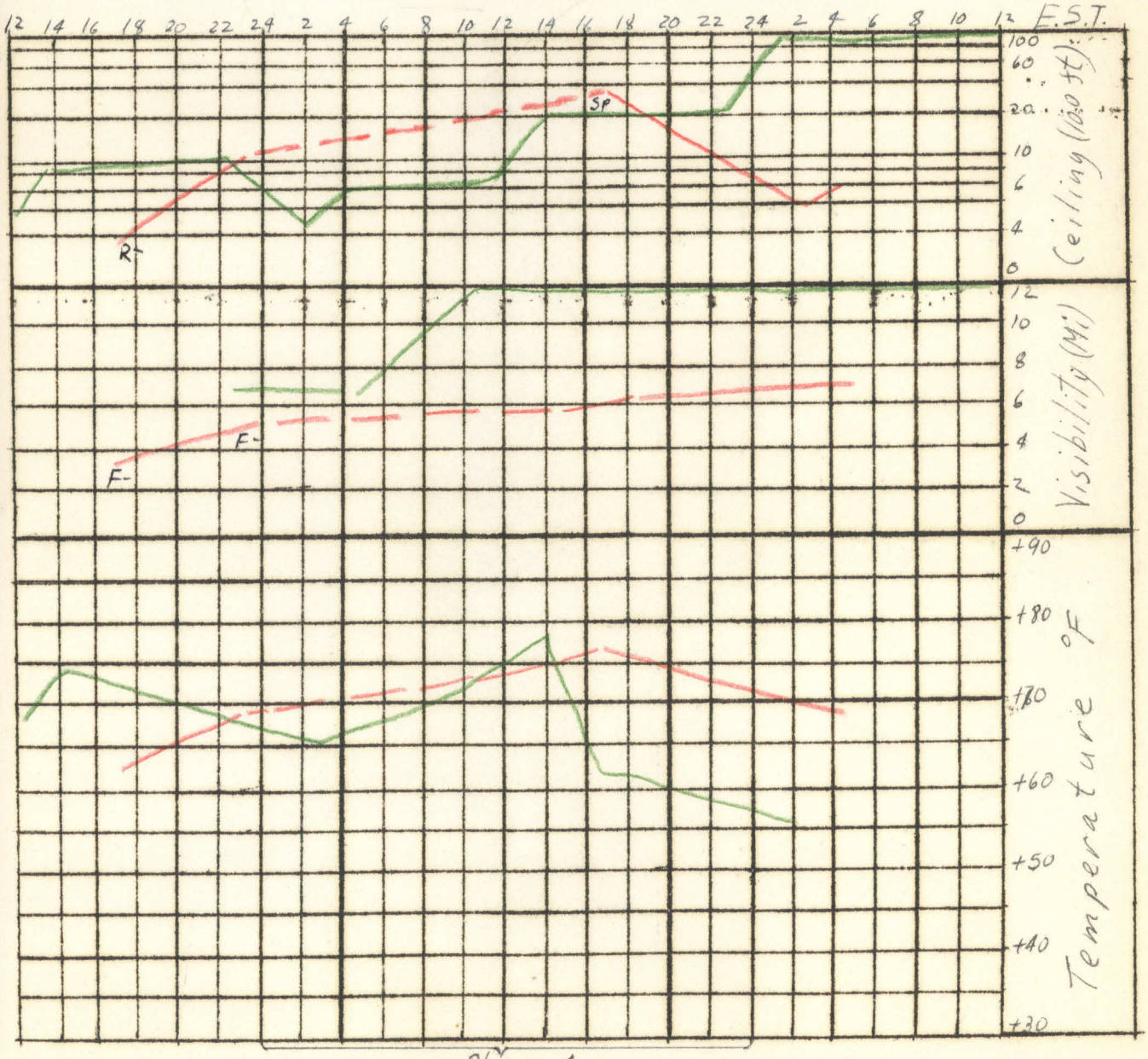
Jan. 2
1937

Type A
Phase 4









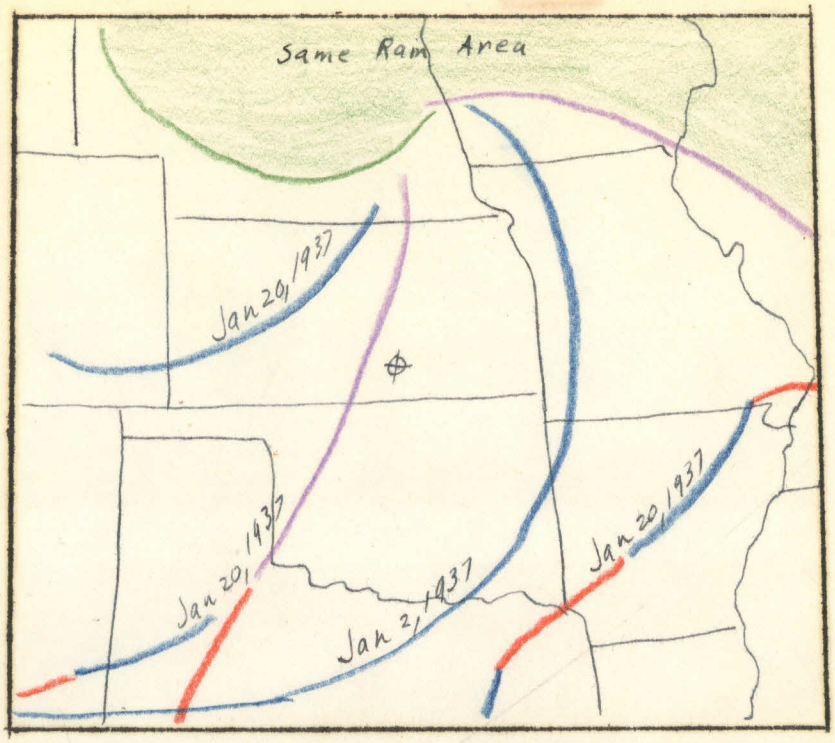
Phase 4

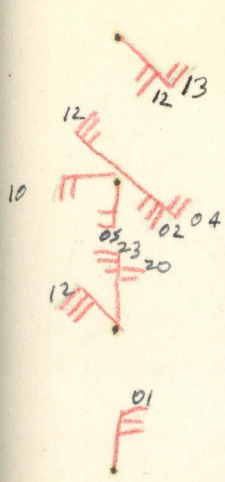
Jan. 20
1937

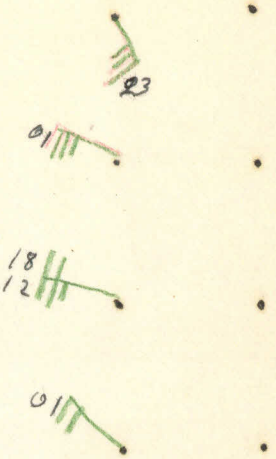
Jan. 2
1937

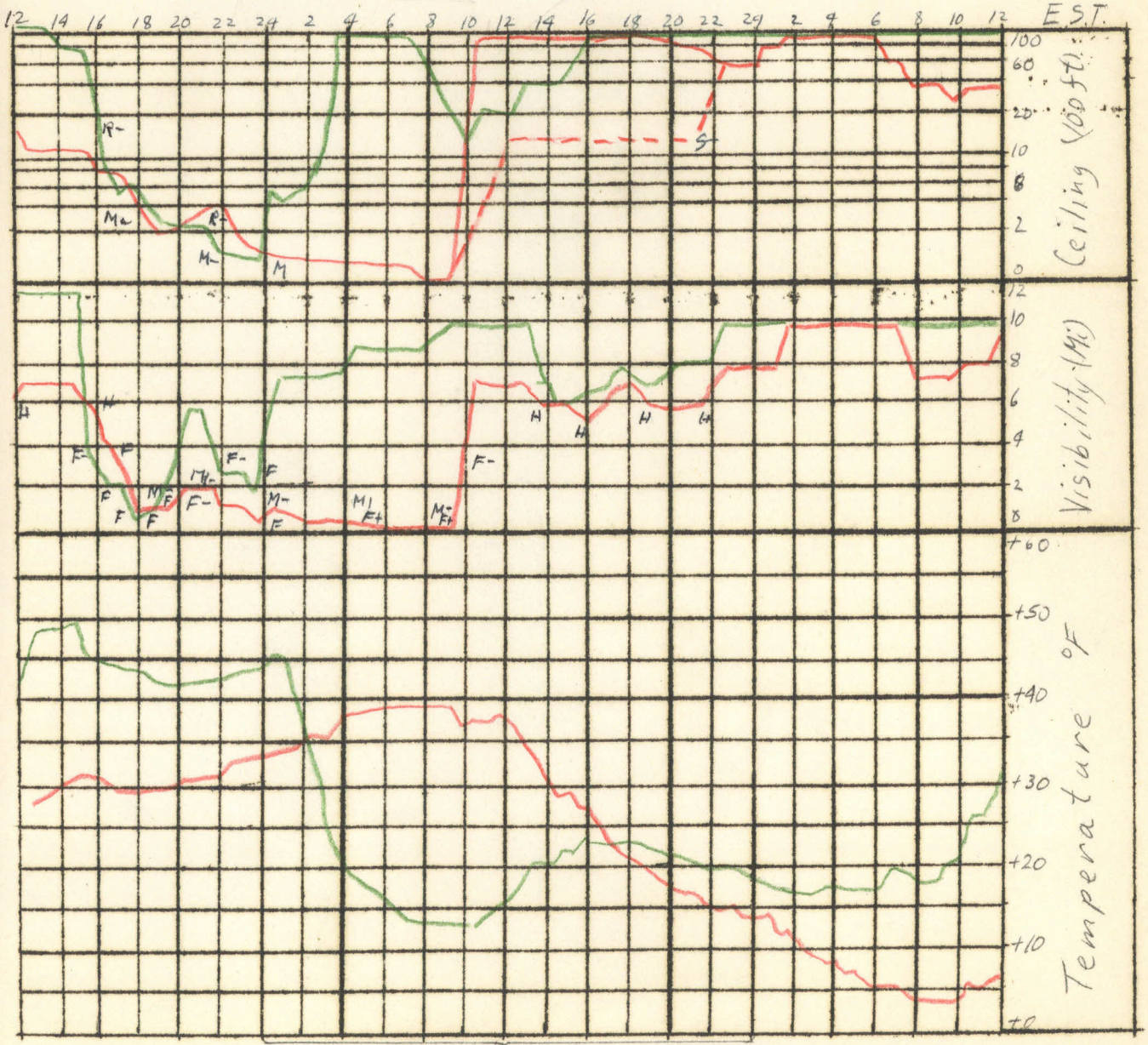
WD

Type A
Phase 4



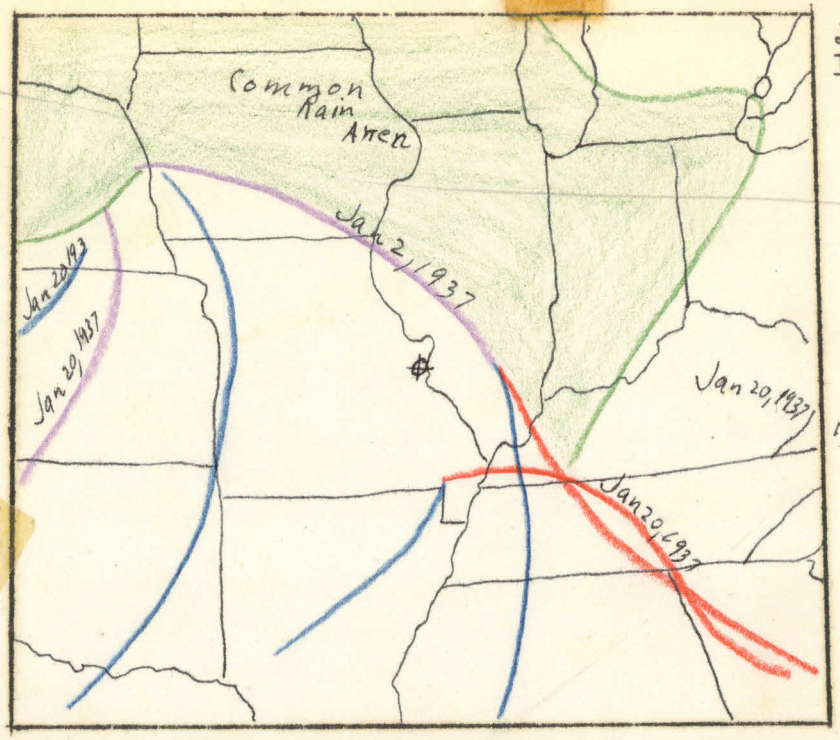






Phase 4

Jan. 20
1937



Jan. 2
1937

LS

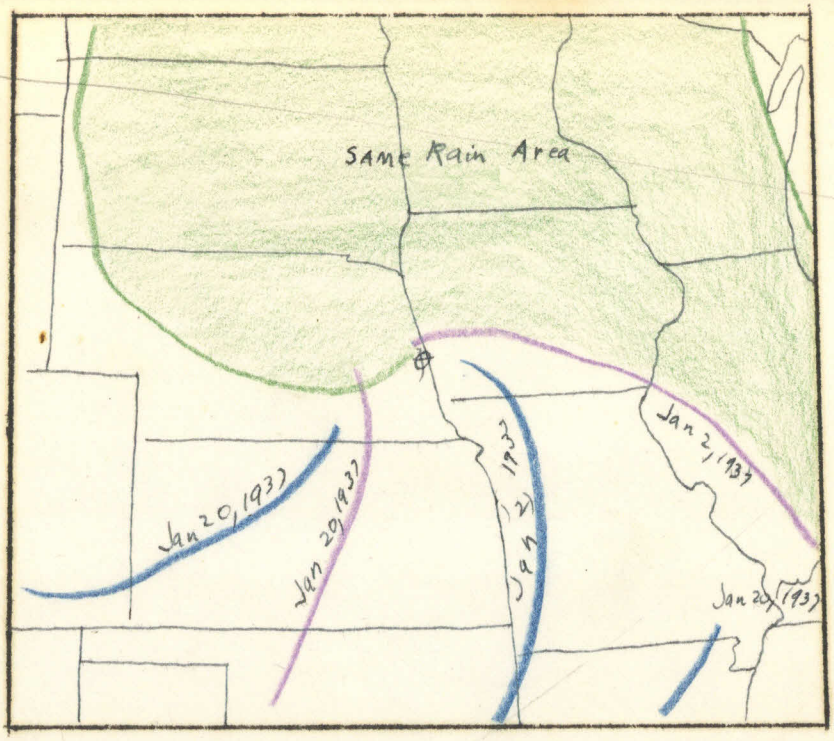
Type A
Phase 4

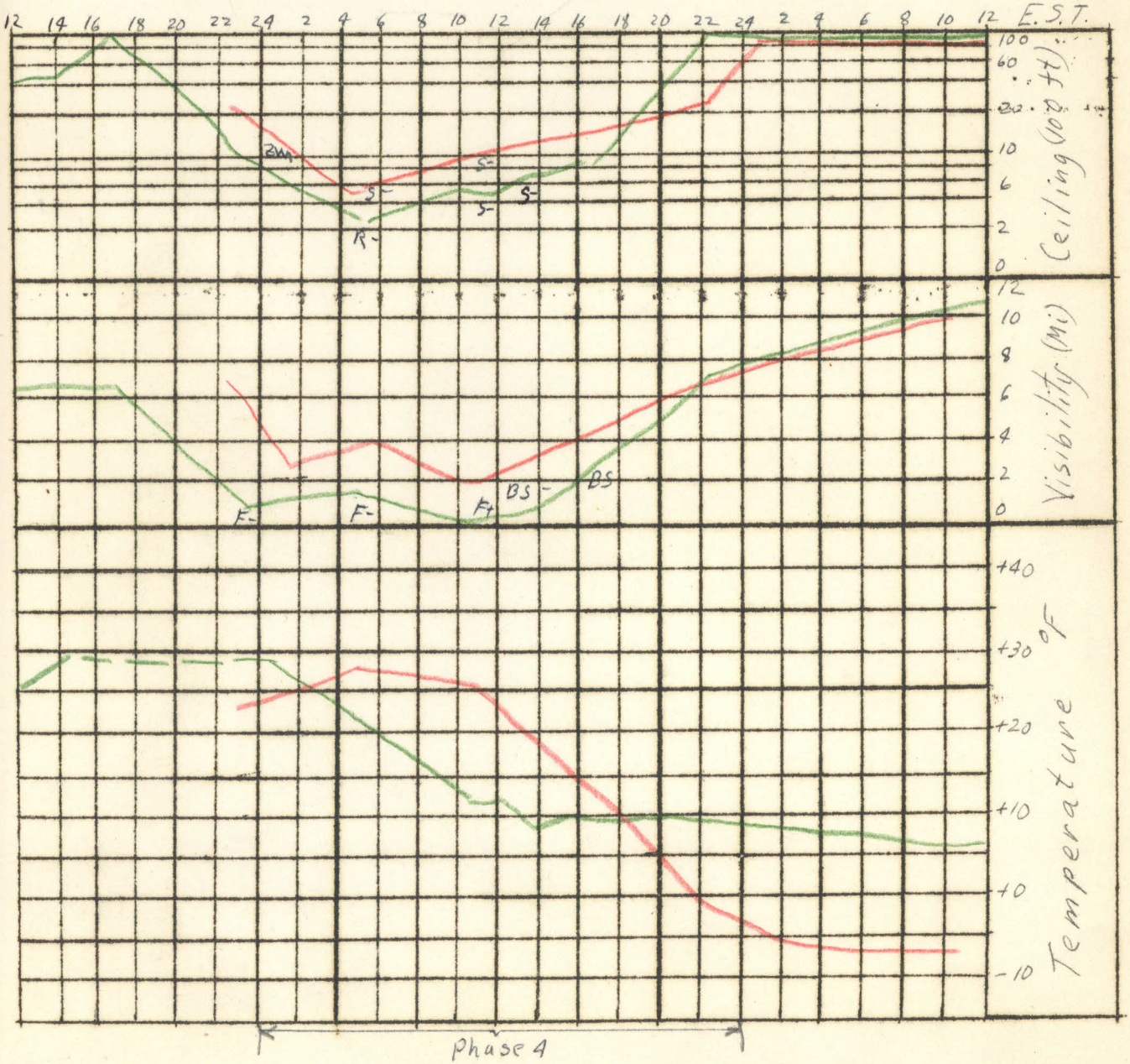
Jan. 20
1937

Jan. 2
1937

OH

Type A
Phase 4



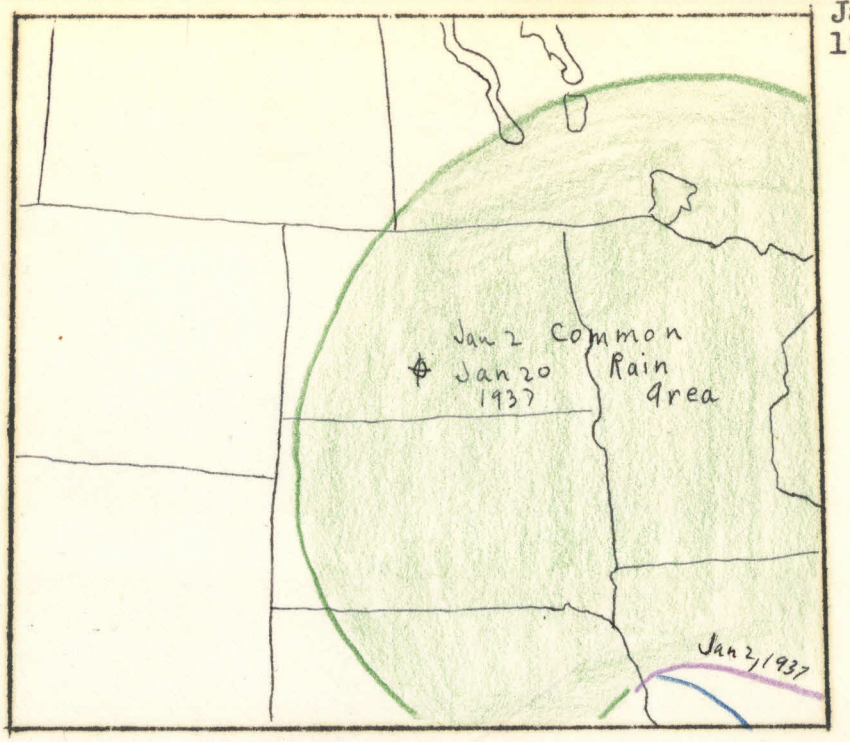


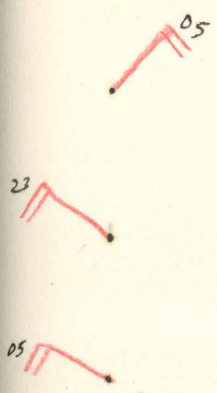
Jan. 20
1937

Jan. 2
1937

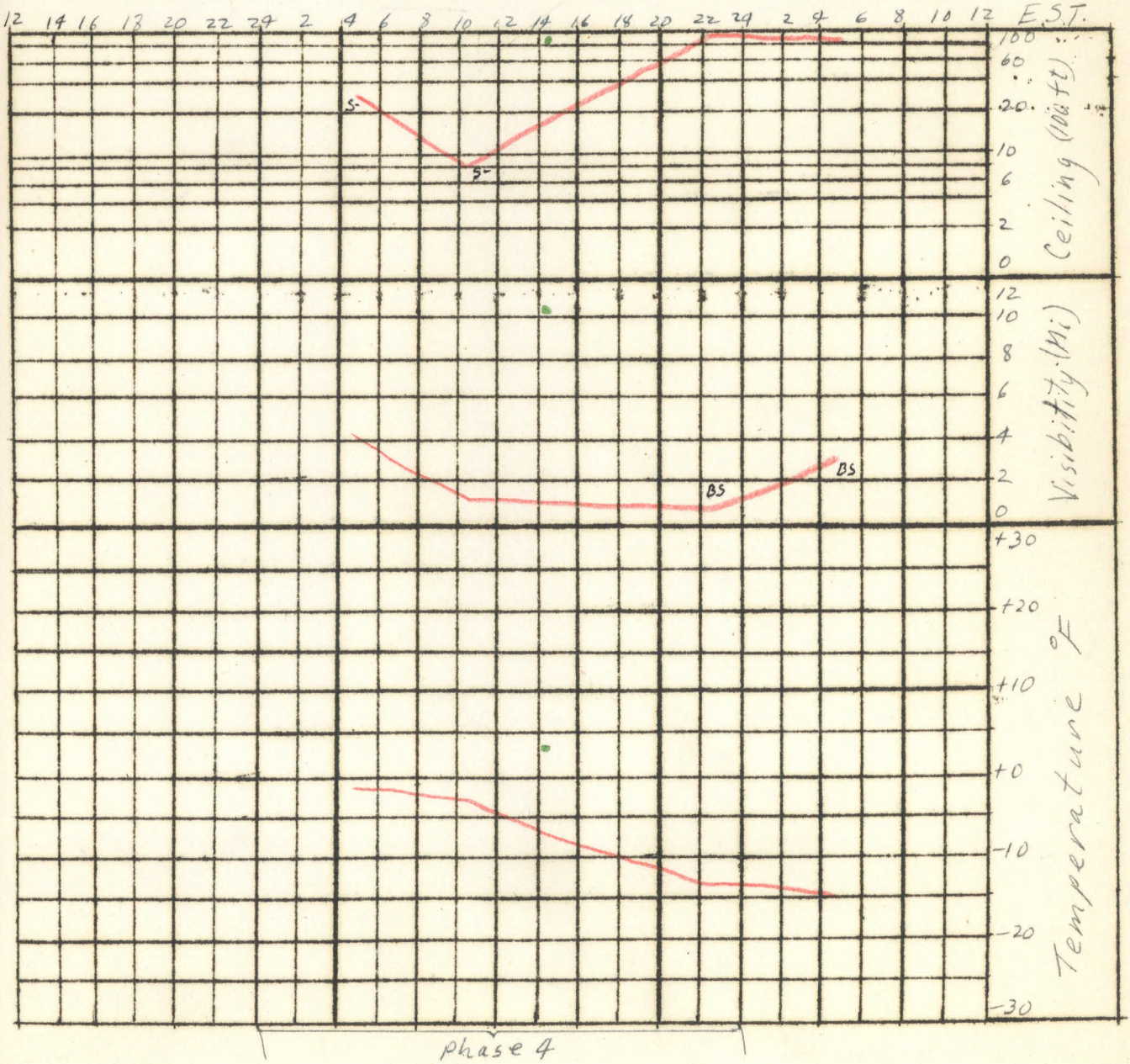
RK

Type A
Phase 4

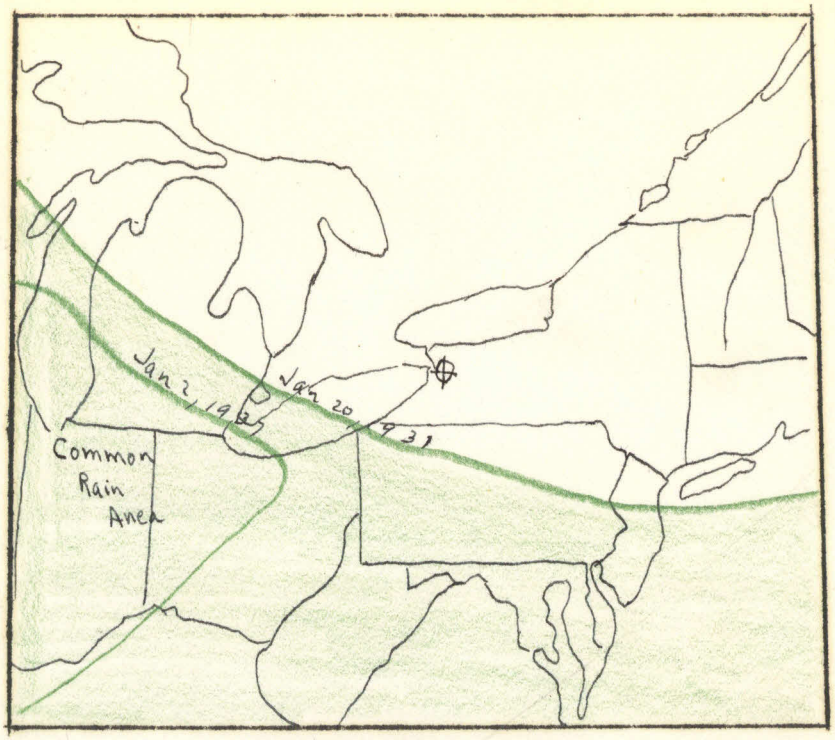








Jan. 20
1937



Jan. 2
1937

BJ

Type A
Phase 4

12 14 16 18 20 22 24 2 4 6 8 10 12 14 16 18 20 22 24 2 4 6 8 10 12 E.S.T.

Ceiling (100 ft)
100
60
20
10
6
2
0

Visibility (Mi.)
12
10
8
6
4
2
0

Temperature °F
+50
+40
+30
+20
+10
+0

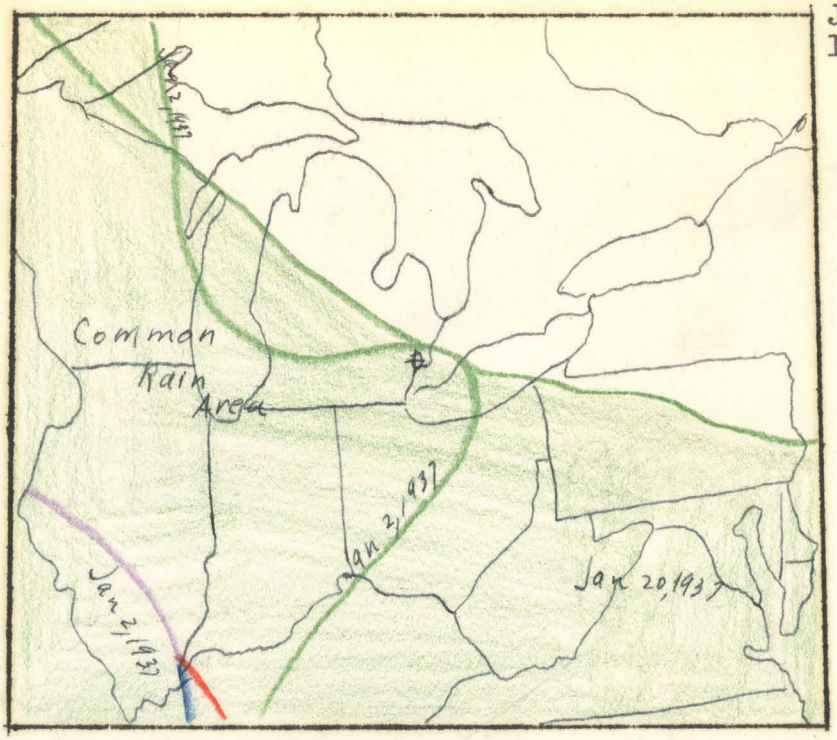
Phase 4

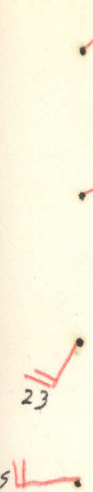
Jan. 20
1937

Jan. 2
1937

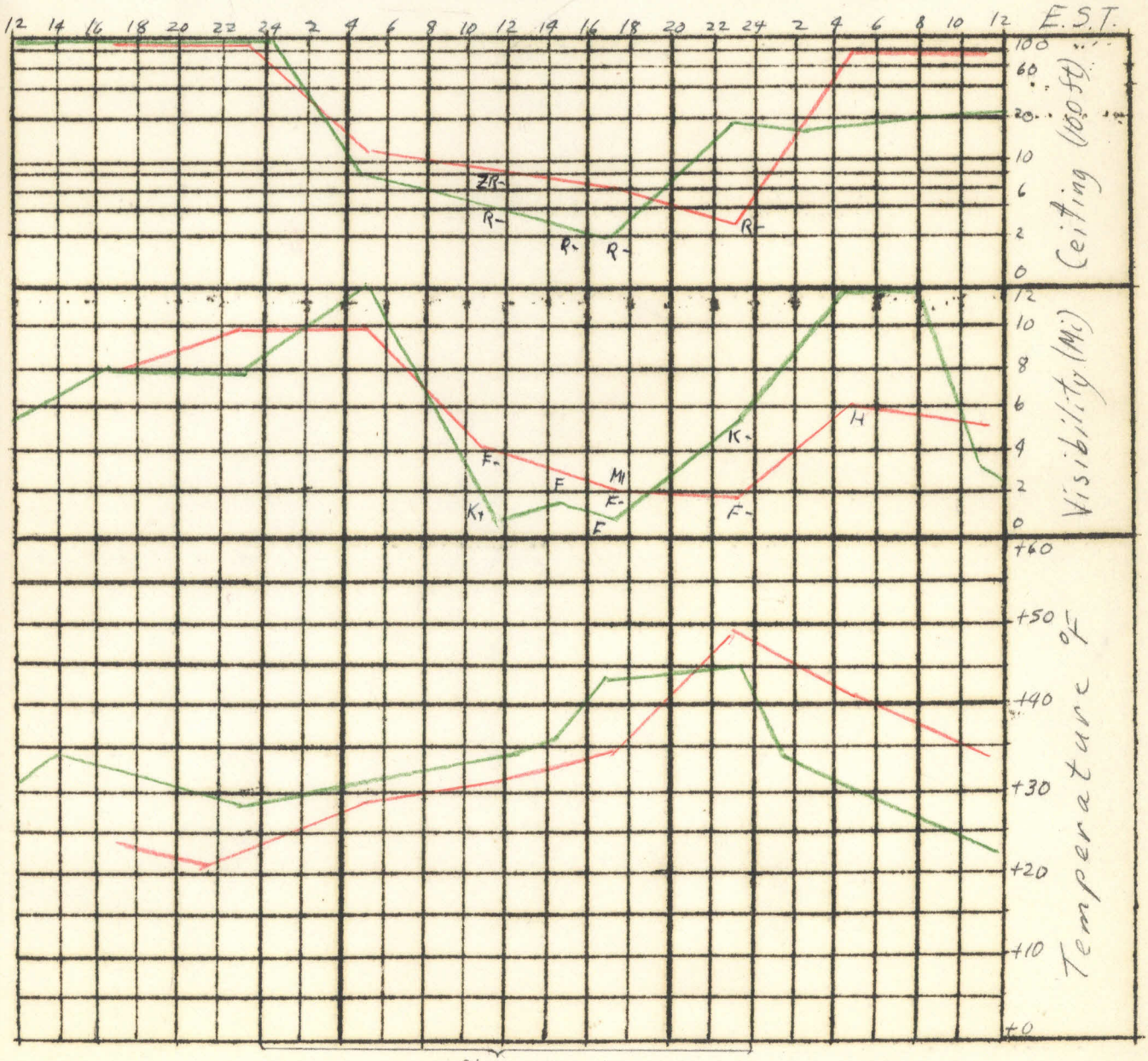
D6

Type A
Phase 4



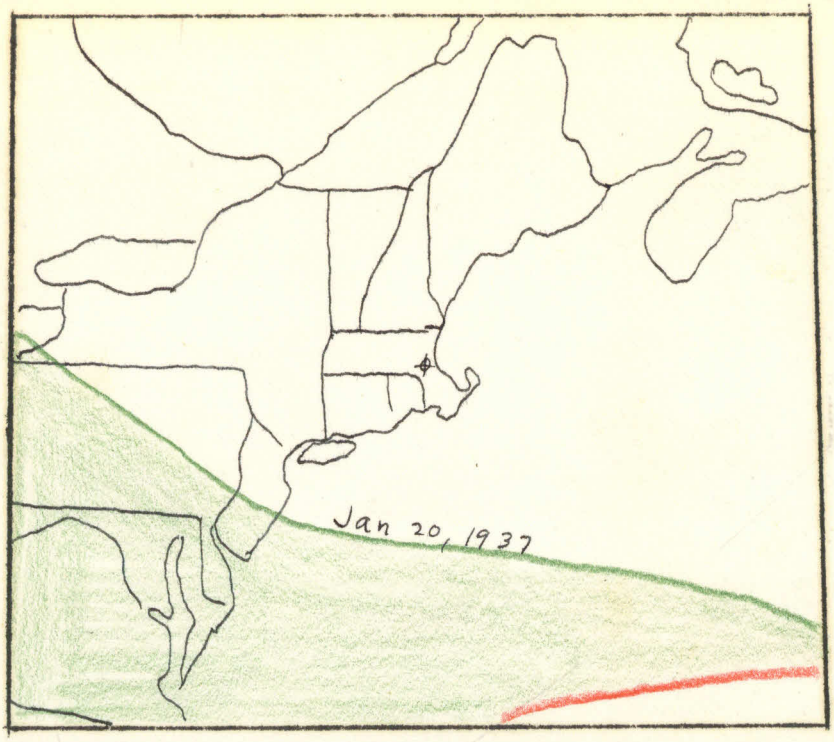






Phase 4

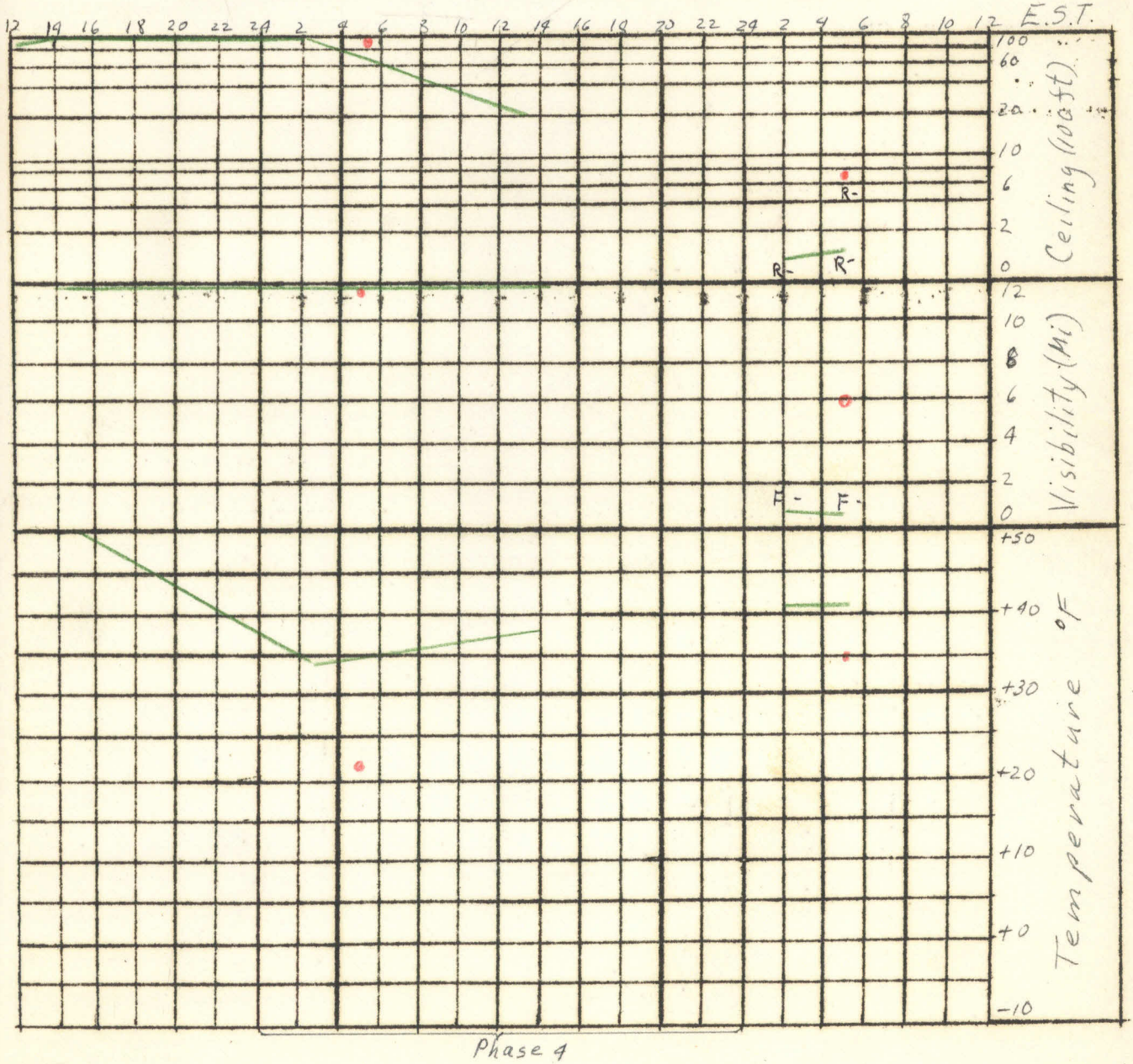
Jan. 20
1937



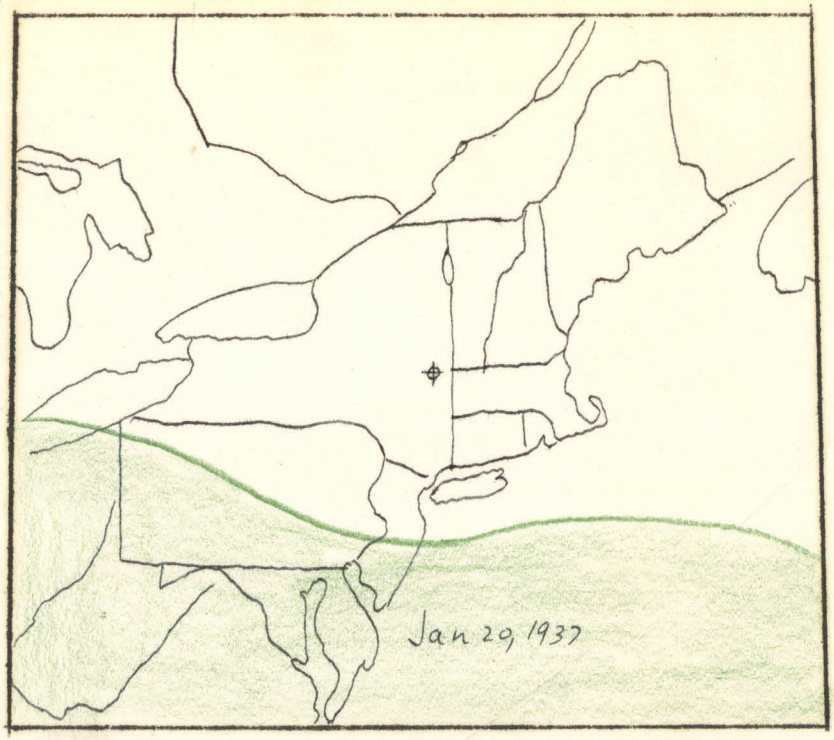
Jan. 2
1937

BW

Type A
Phase 4



Jan. 20
1937



Jan. 2
1937

AZ

Type A
Phase 4

12 14 16 18 20 22 24 2 4 6 8 10 12 14 16 18 20 22 24 2 4 6 8 10 12 E.S.T.

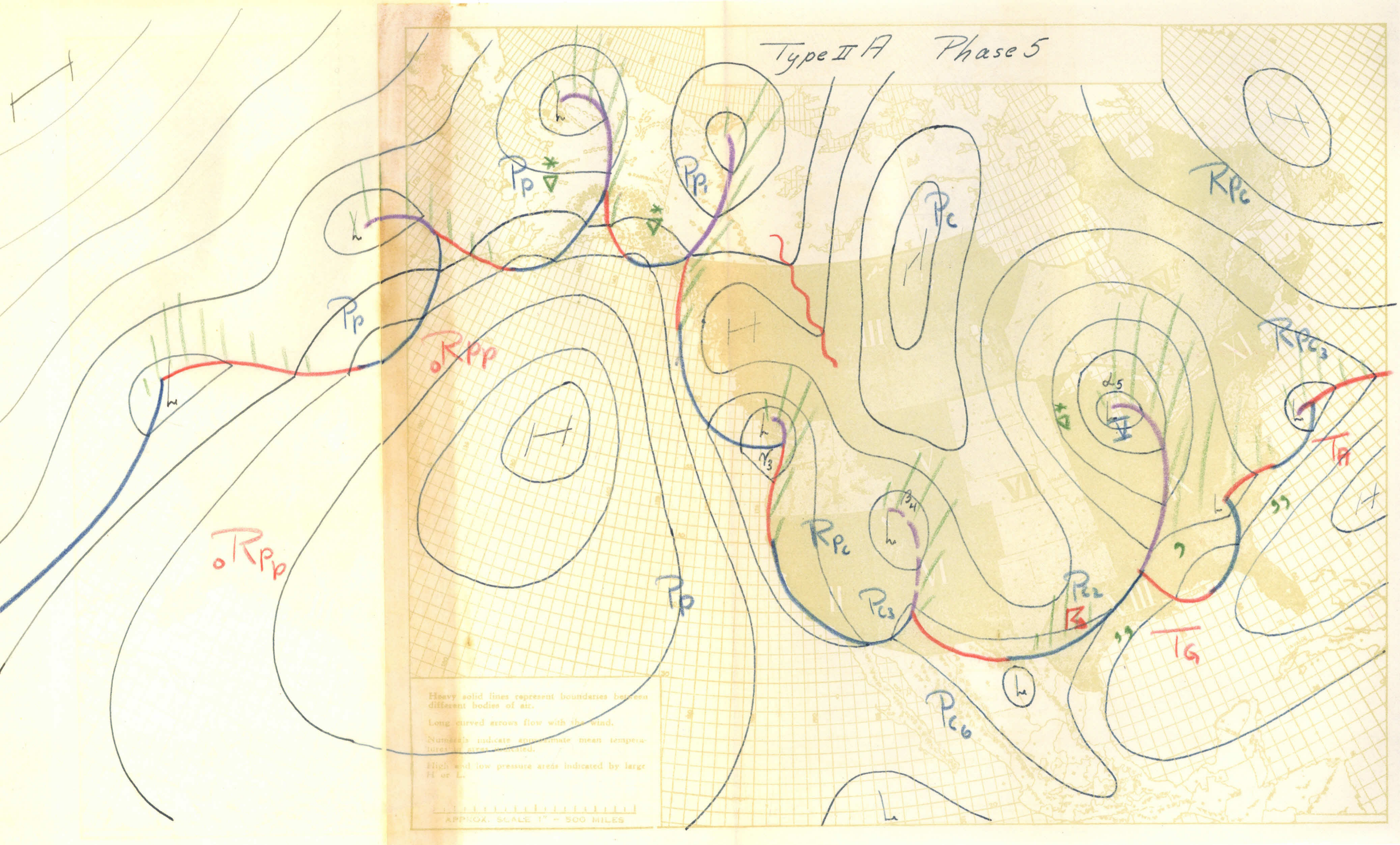
Ceiling (100 ft): 100 60 20 10 6 2 0

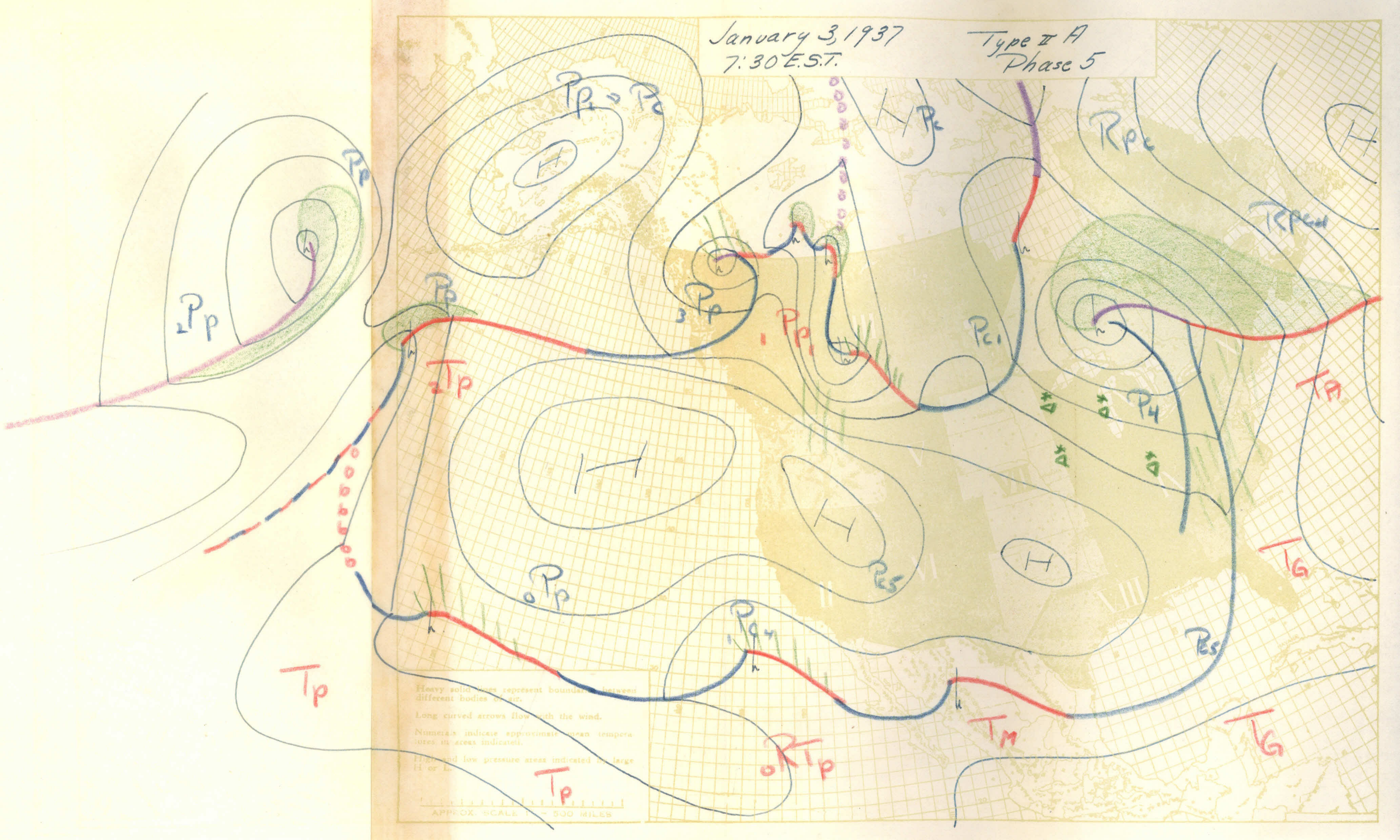
Visibility (Mi): 12 10 8 6 4 2 0

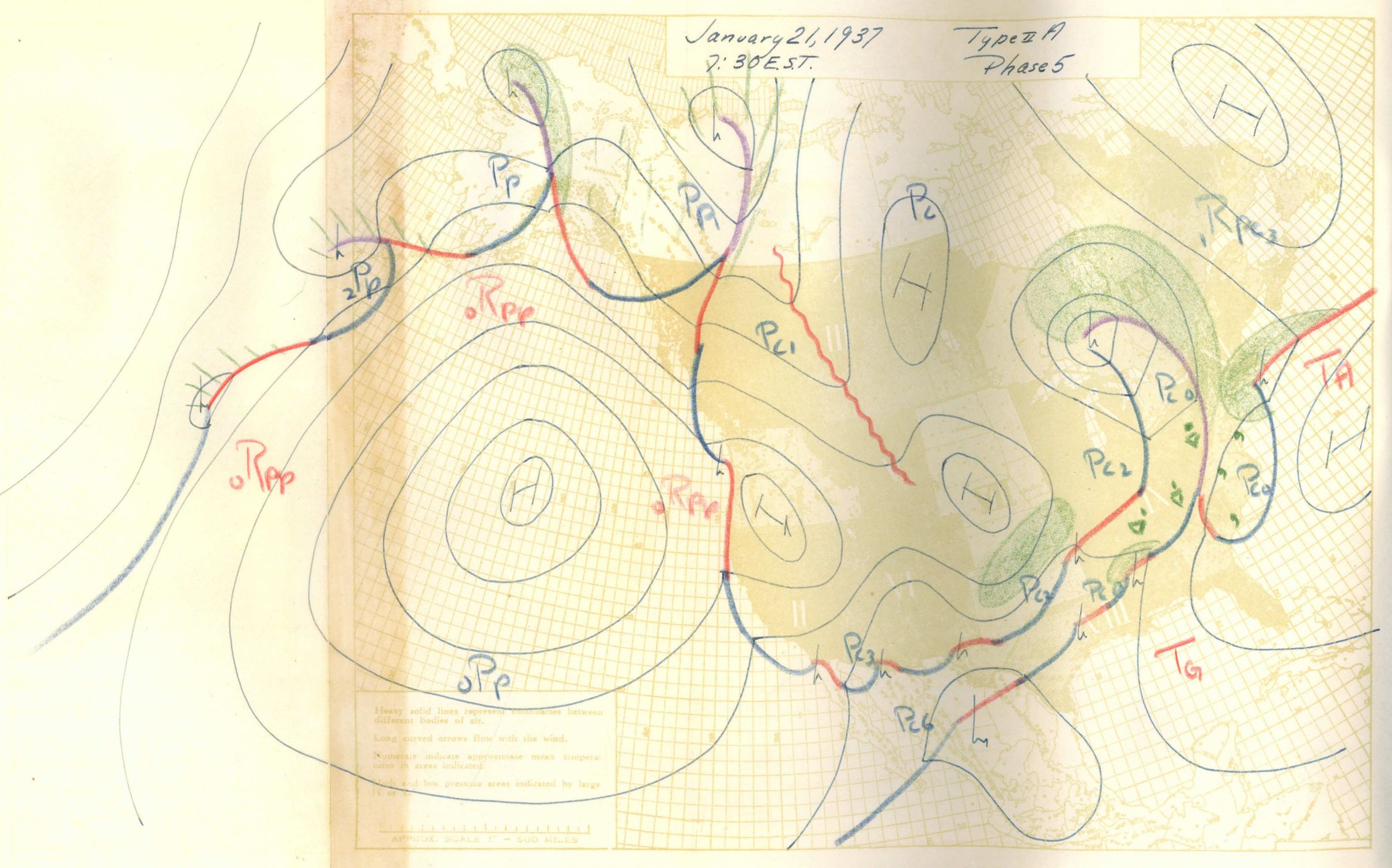
Temperature °F: +50 +40 +30 +20 +10 +0

Phase 4

PHASE V


Type II A Phase 5
Pp
Pp1
Pc
RPc
RPc3
RPp
RPp
Pp
RPc
Pc3
Pc2
Pc6
TA
TG
Heavy solid lines represent boundaries between different bodies of air.
Long curved arrows flow with the wind.
Numerals indicate approximate mean temperatures over areas indicated.
High and low pressure areas indicated by large H or L.
APPROX. SCALE 1" = 500 MILES


January 3, 1937
7:30 E.S.T.
Type II A
Phase 5
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.
APPROX. SCALE 1" = 500 MILES

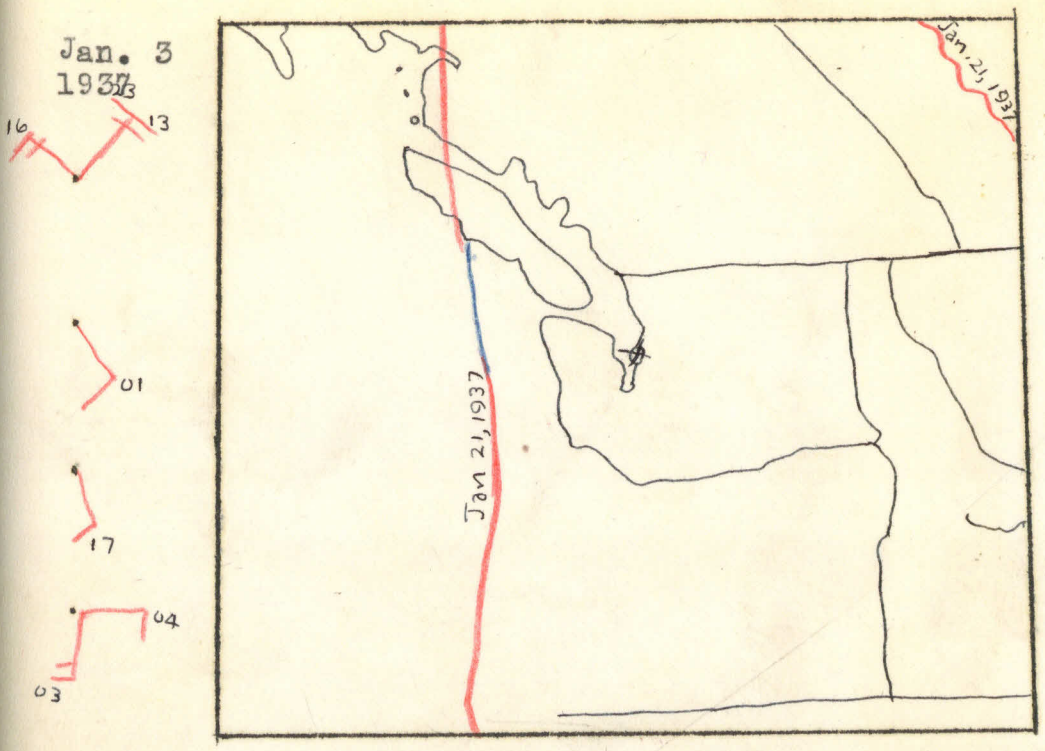

January 21, 1937
7:30 E.S.T.
Type II A
Phase 5
Pp
PA
2Pp
Rpp
Rpp
Rpp
Rpp
Pc
Pc1
Rpc3
Pc0
Pc2
Pc3
Pc4
Pc4
Pc5
TH
TG
H
Heavy solid lines represent boundaries between different bodies of air.
Long curved arrows flow with the wind.
Numerals indicate approximate mean temperatures in areas indicated.
Highs and low pressure areas indicated by large H. or L.
APPROX. SCALE 1" = 500 MILES

Jan. 3
1937

Jan. 21
1937

SA

Type A
Phase 5



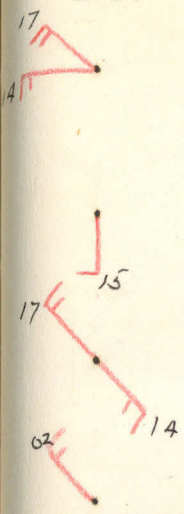
Phase 5

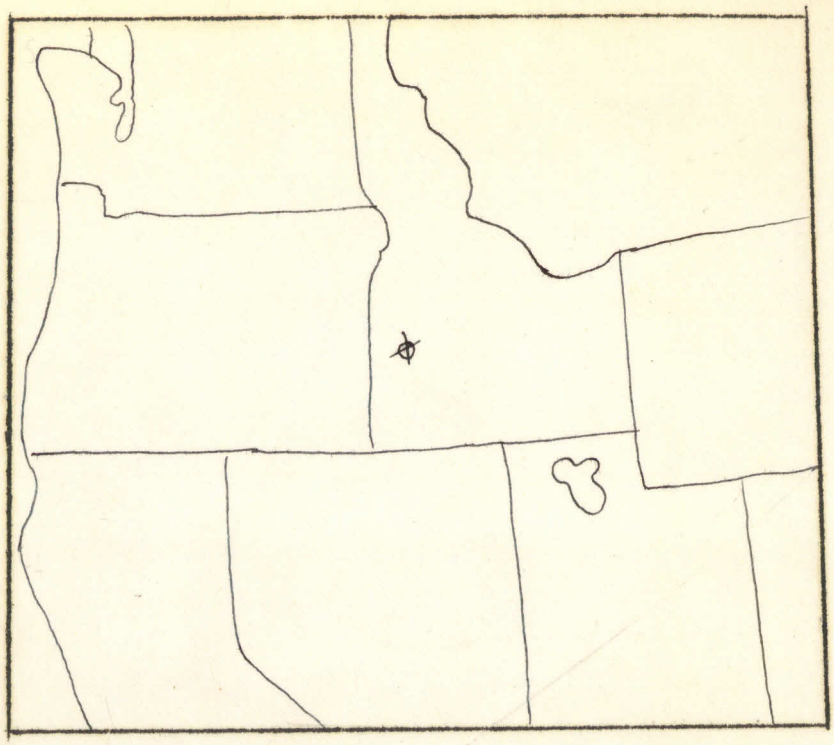
Jan. 3
1937

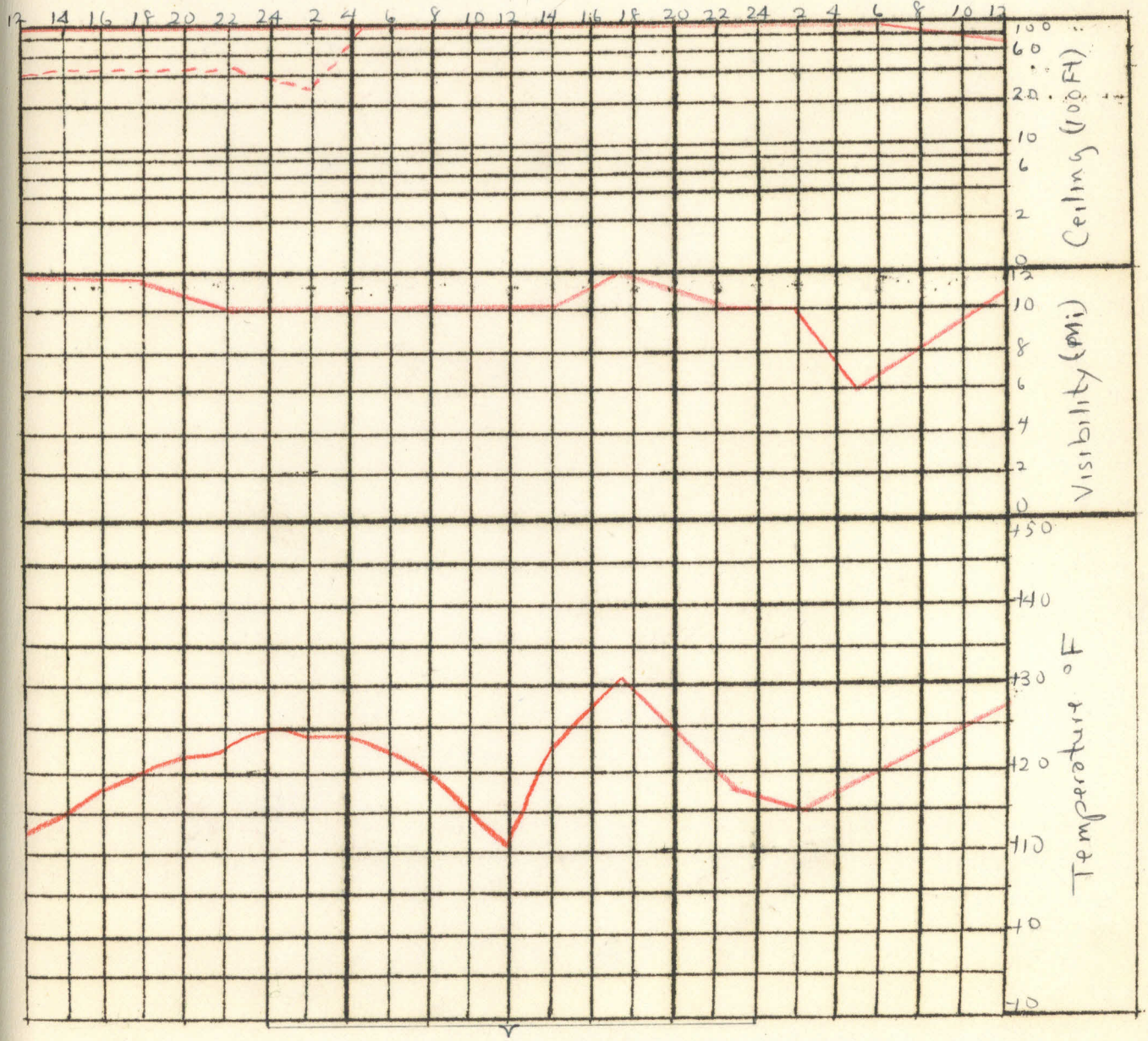
Jan. 21
1937

BE

Type A
Phase 5

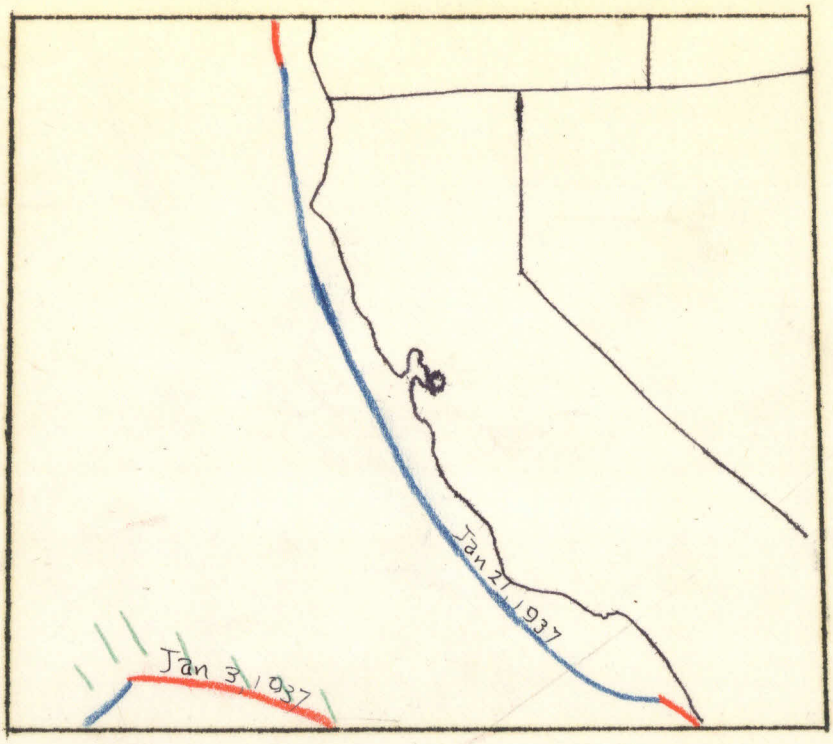






Jan. 3
1937

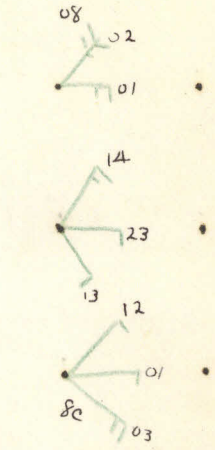


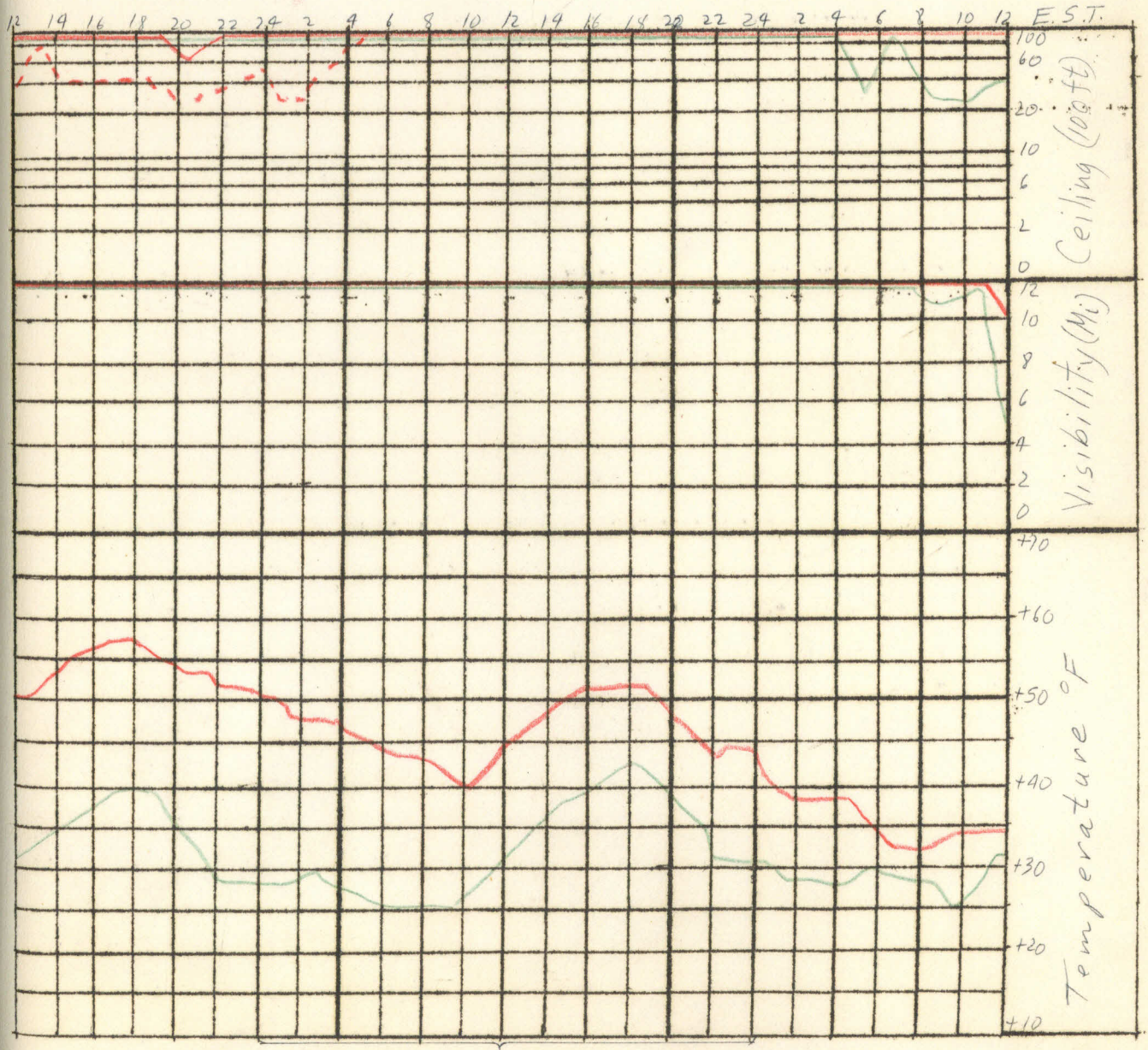


Jan. 21
1937

OA

Type A
Phase 5



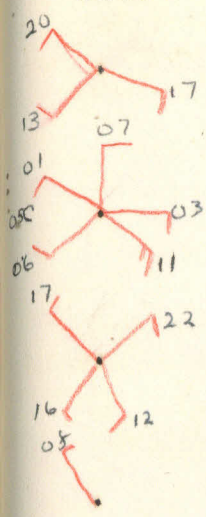


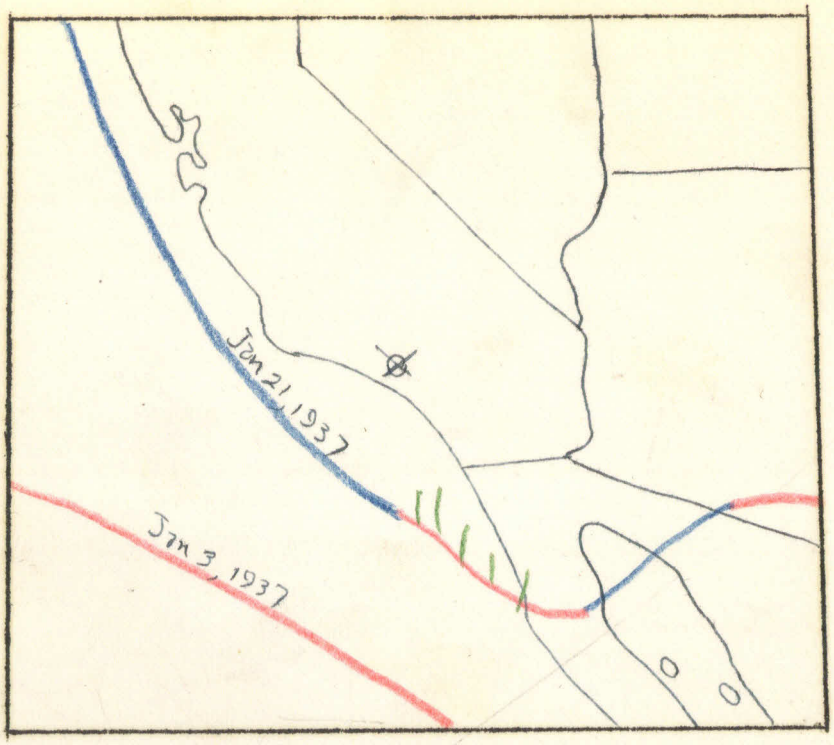
Phase 5

BU

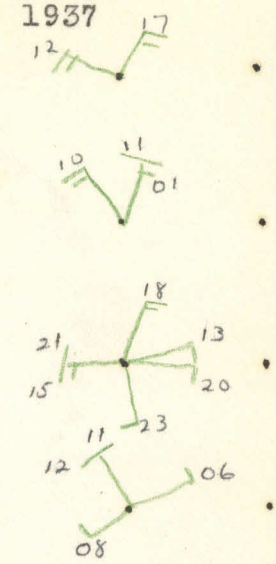
Type A
Phase 5

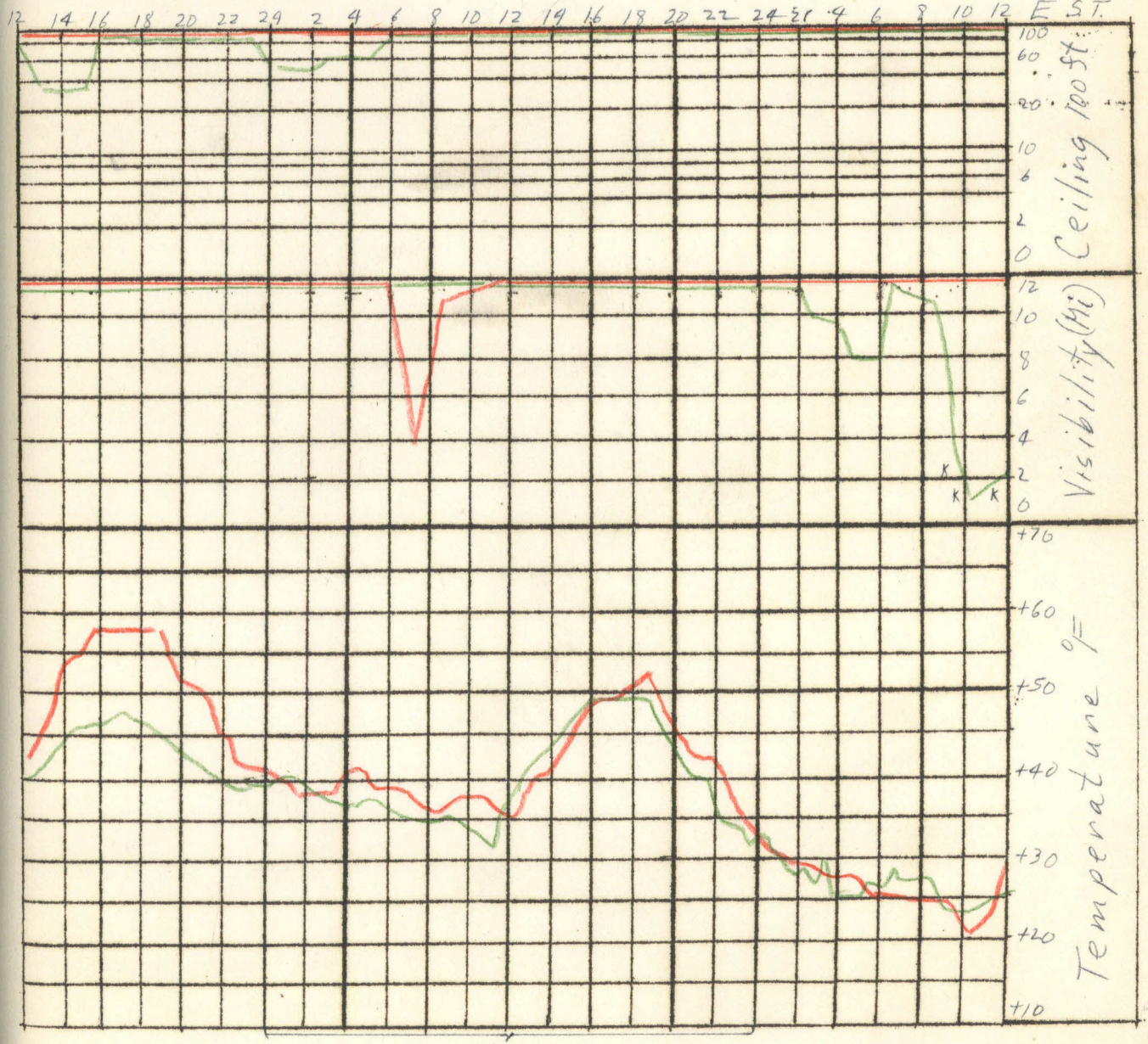
Jan. 3
1937





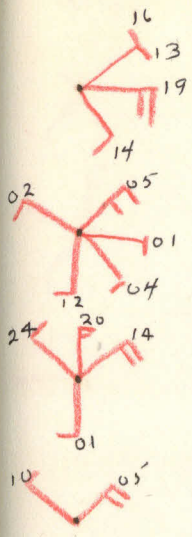
Jan. 21
1937

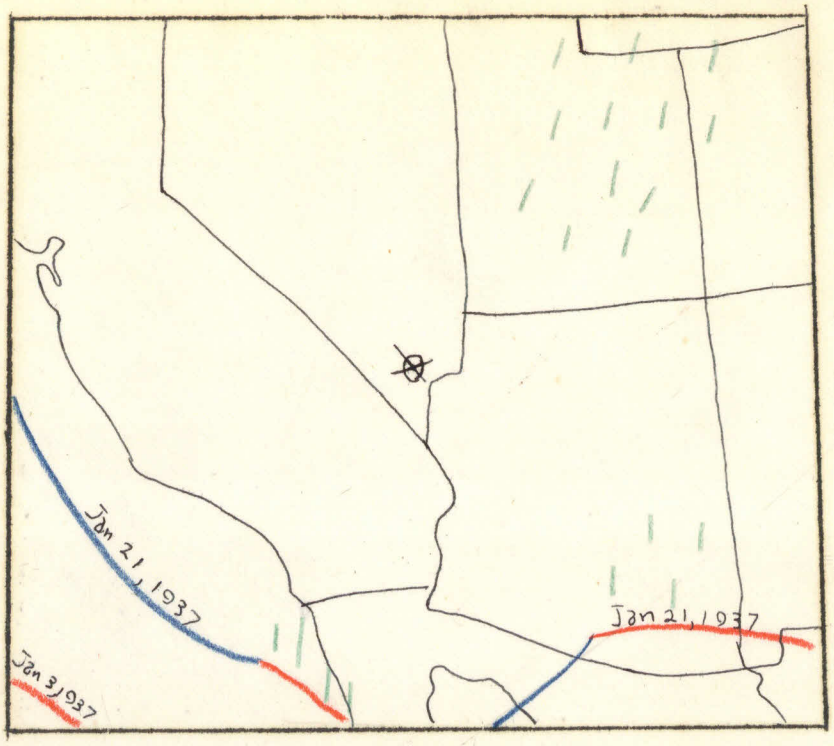




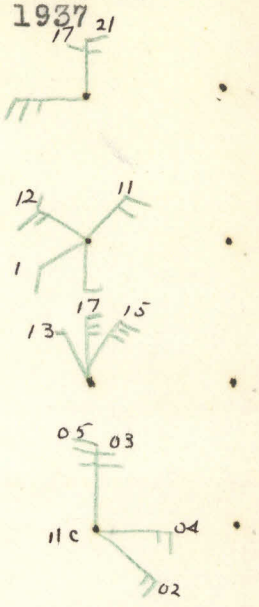
Phase 5

Jan. 3
1937



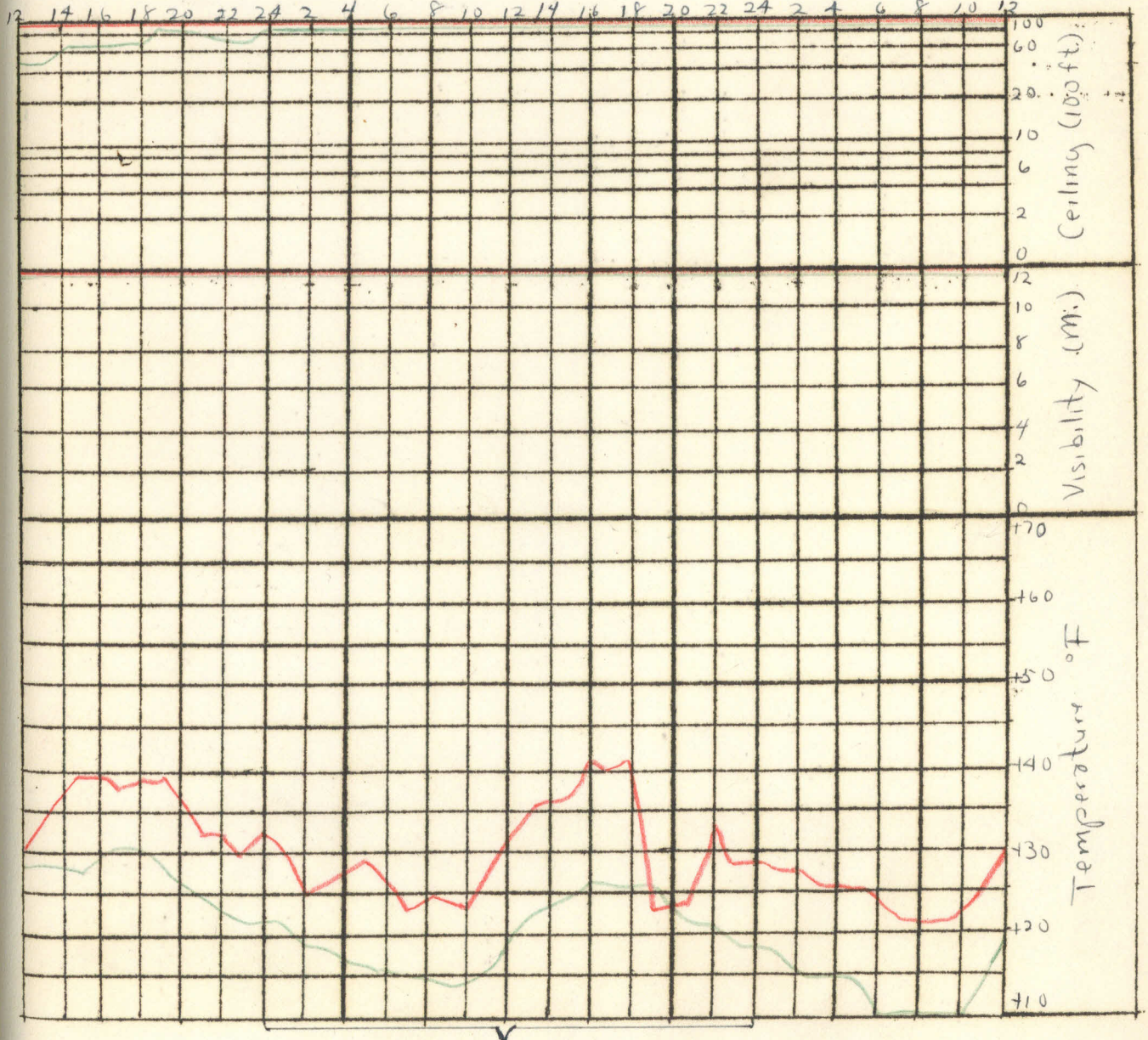


Jan. 21
1937

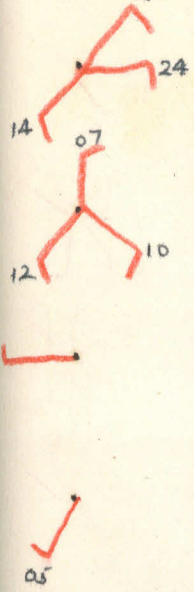


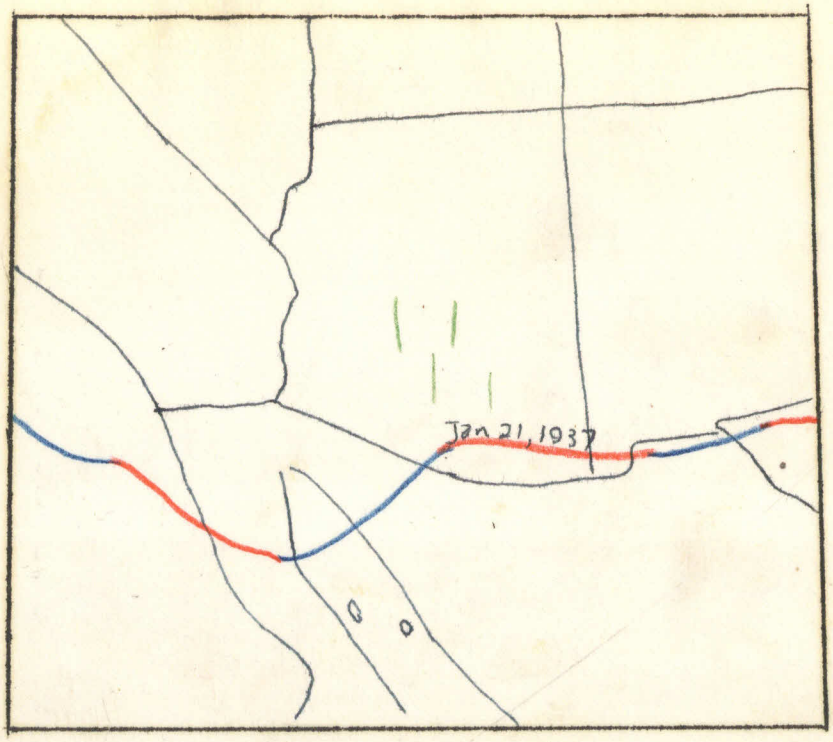
LQ

Type A
Phase 5

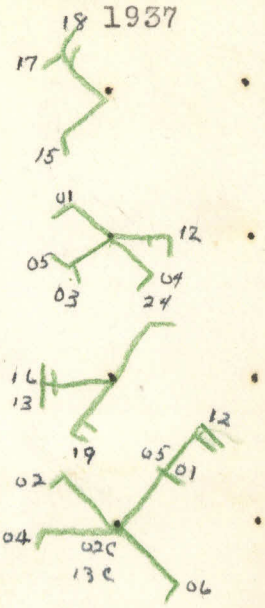


Jan. 3
1937



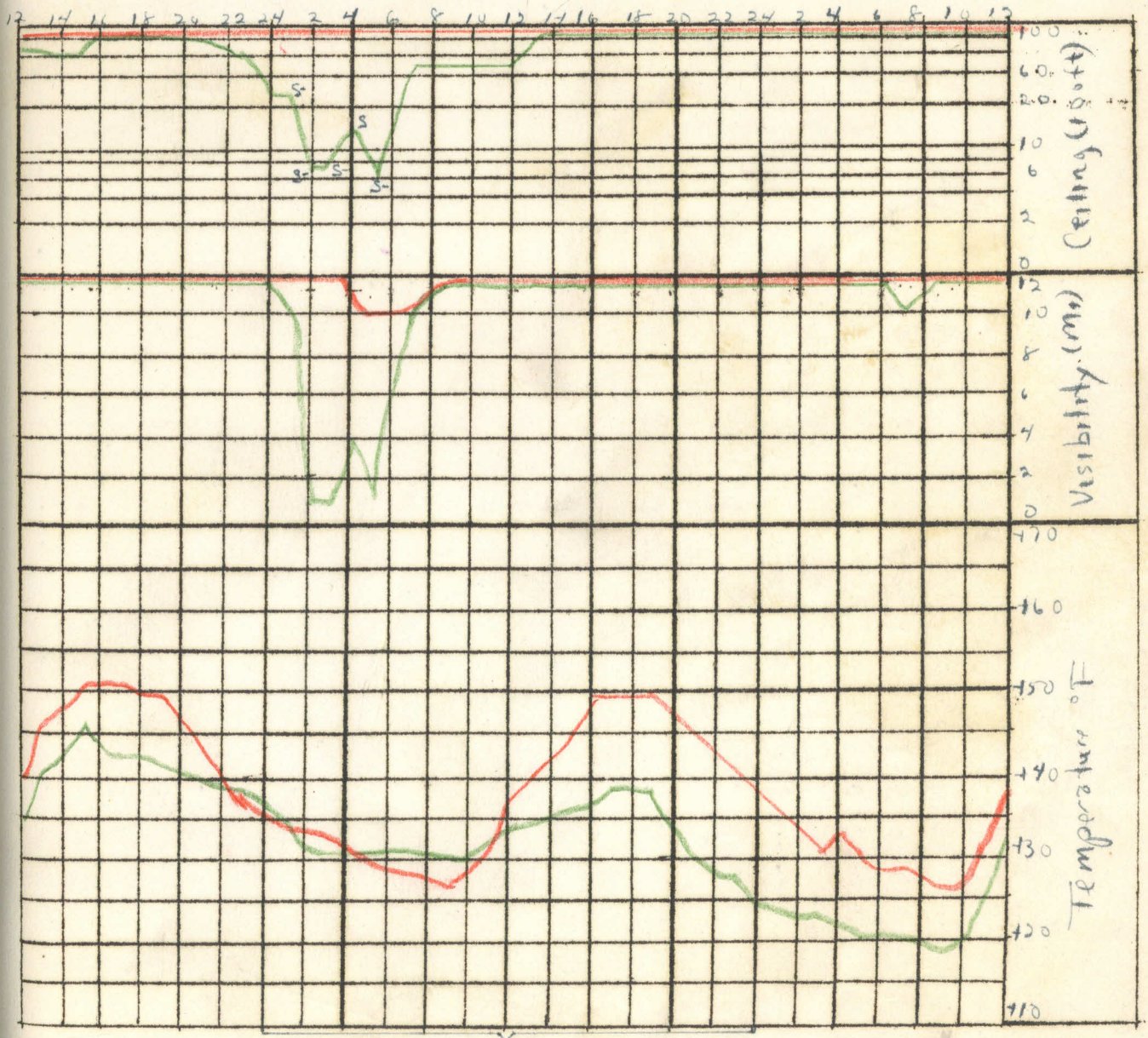


Jan. 21
1937

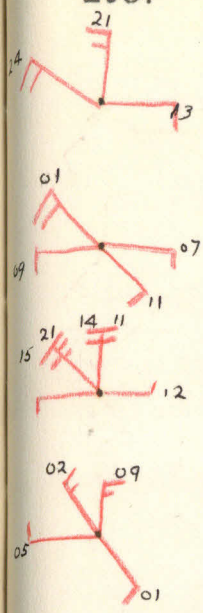


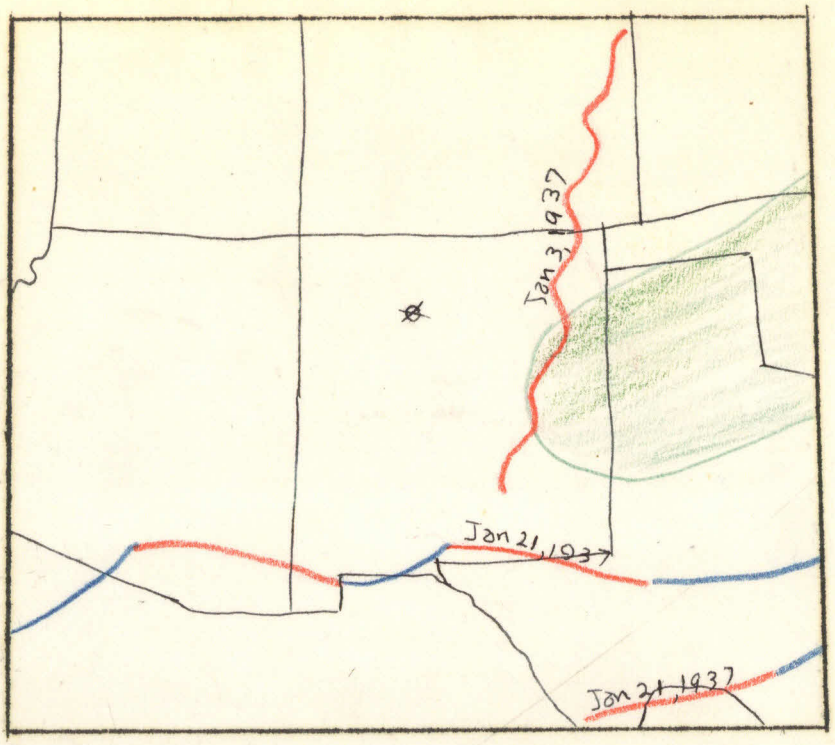
PH

Type A
Phase 5

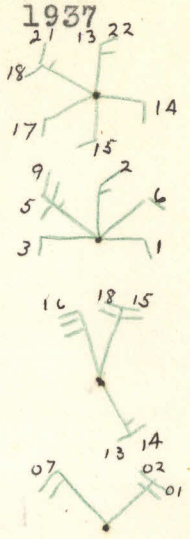


Jan. 3
1937



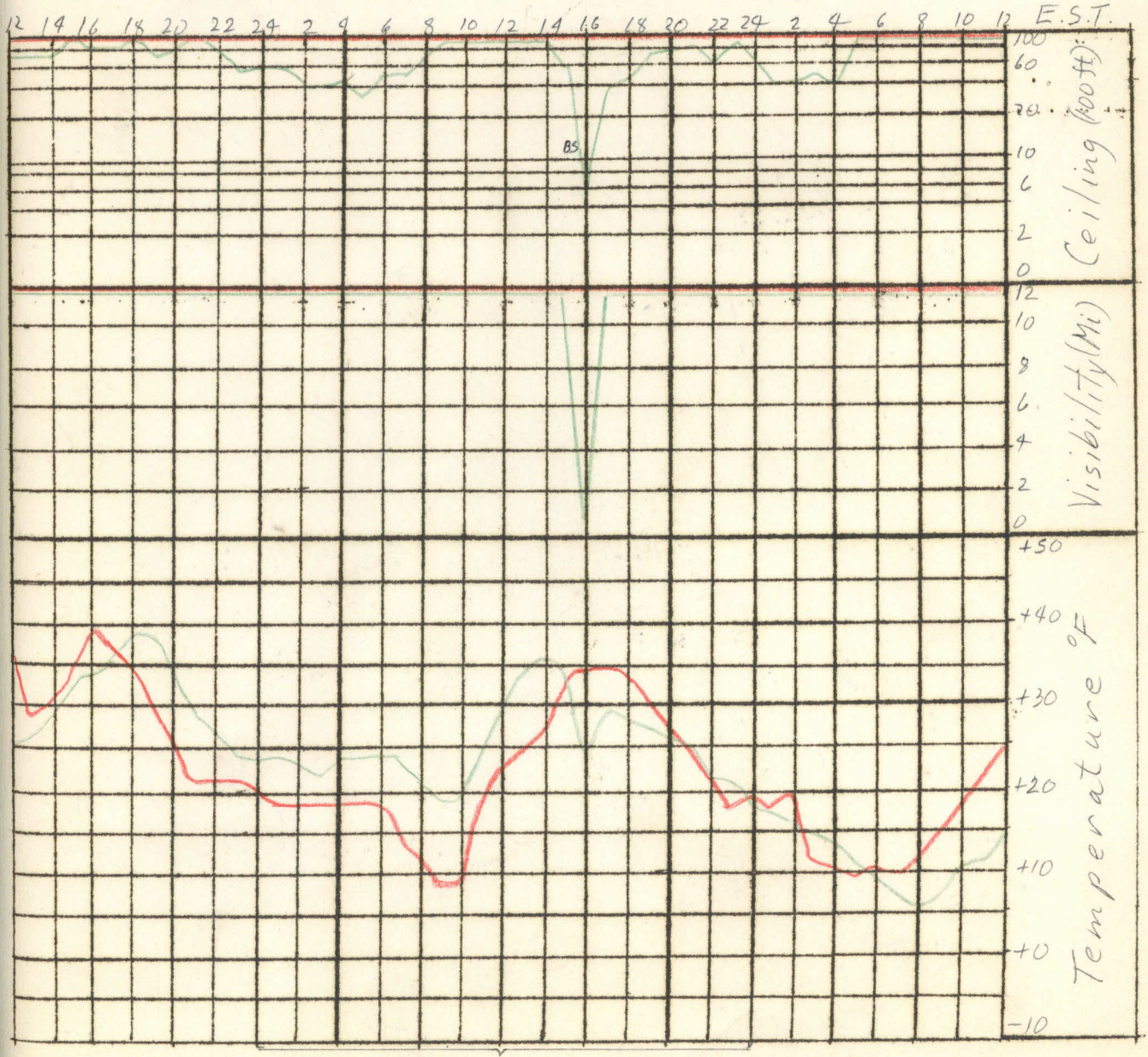


Jan. 21
1937



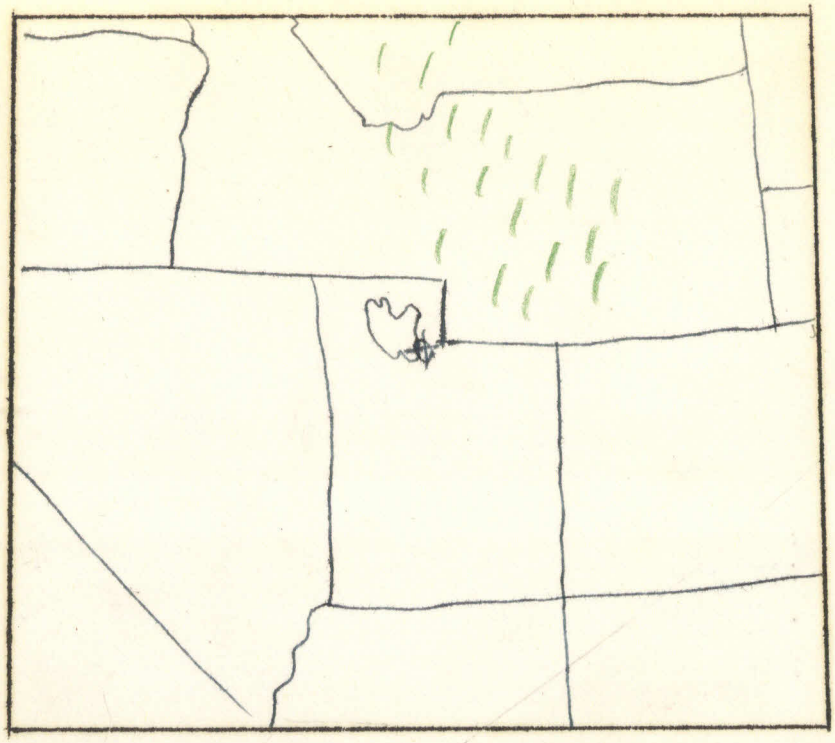
AB

Type A
Phase 5



Phase 5

Jan. 3
1937



Jan. 21
1937

SL

Type A
Phase 5

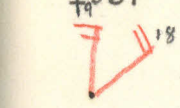
Ceiling (100 ft.)

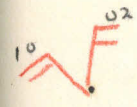
Visibility (M.)

Temperature °F

Phase 5

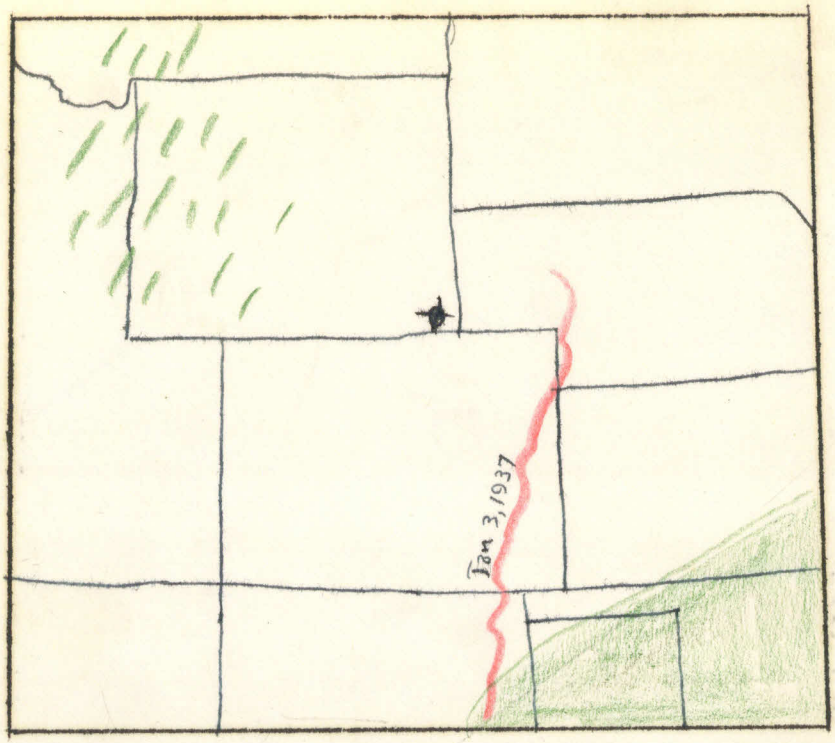
Jan. 3
1937



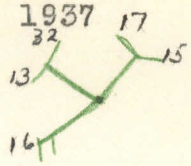


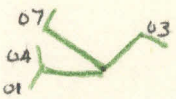


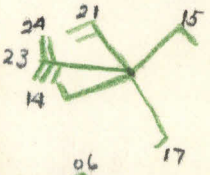


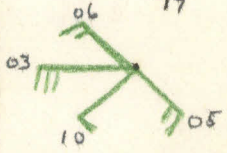


Jan. 21
1937



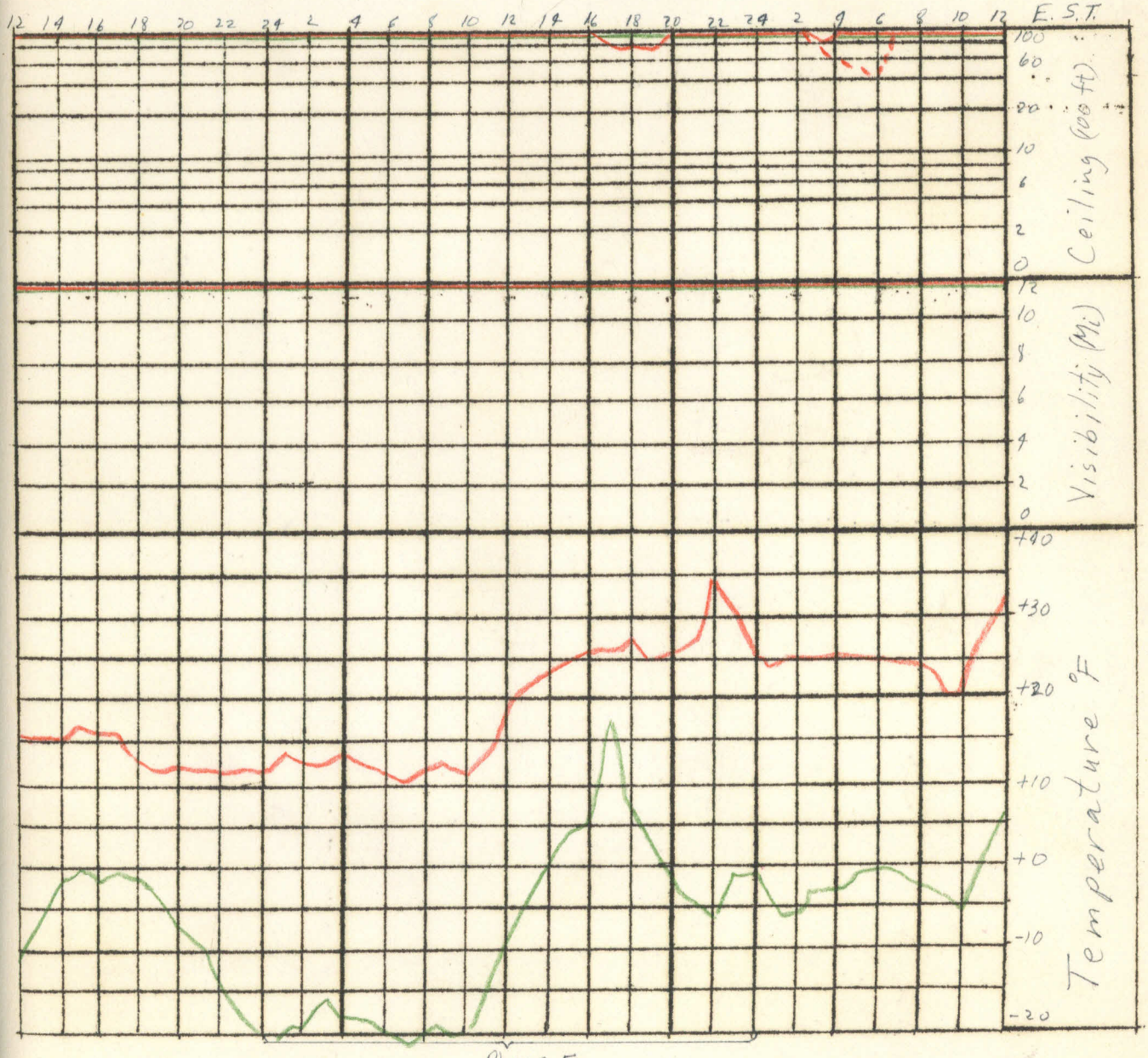




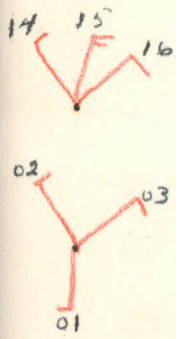


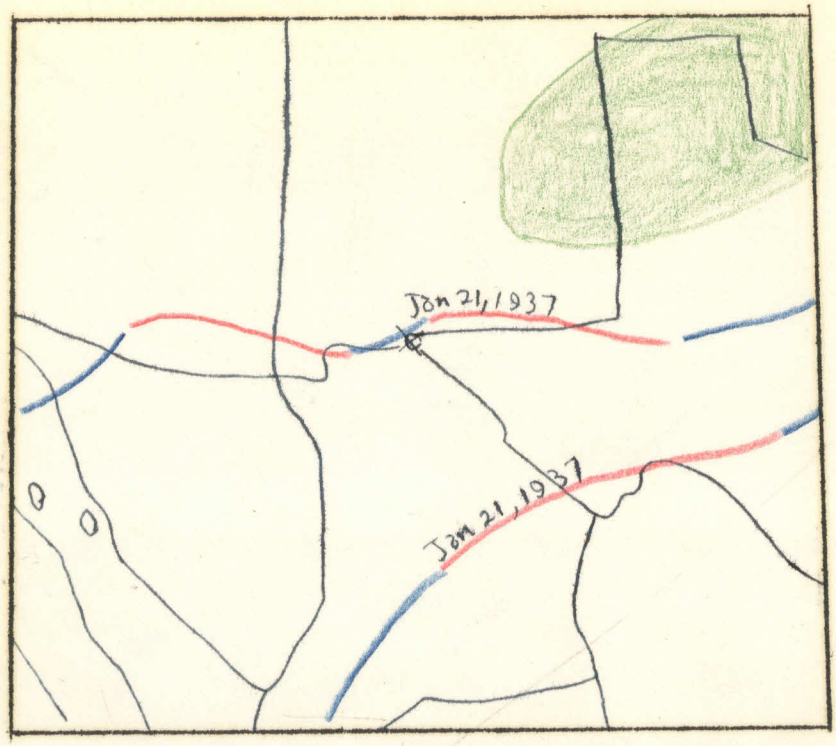
CX

Type A
Phase 5

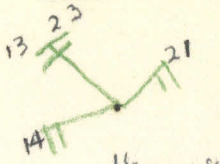


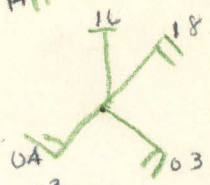
Jan. 3
1937

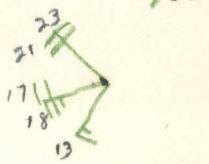




Jan. 21
1937



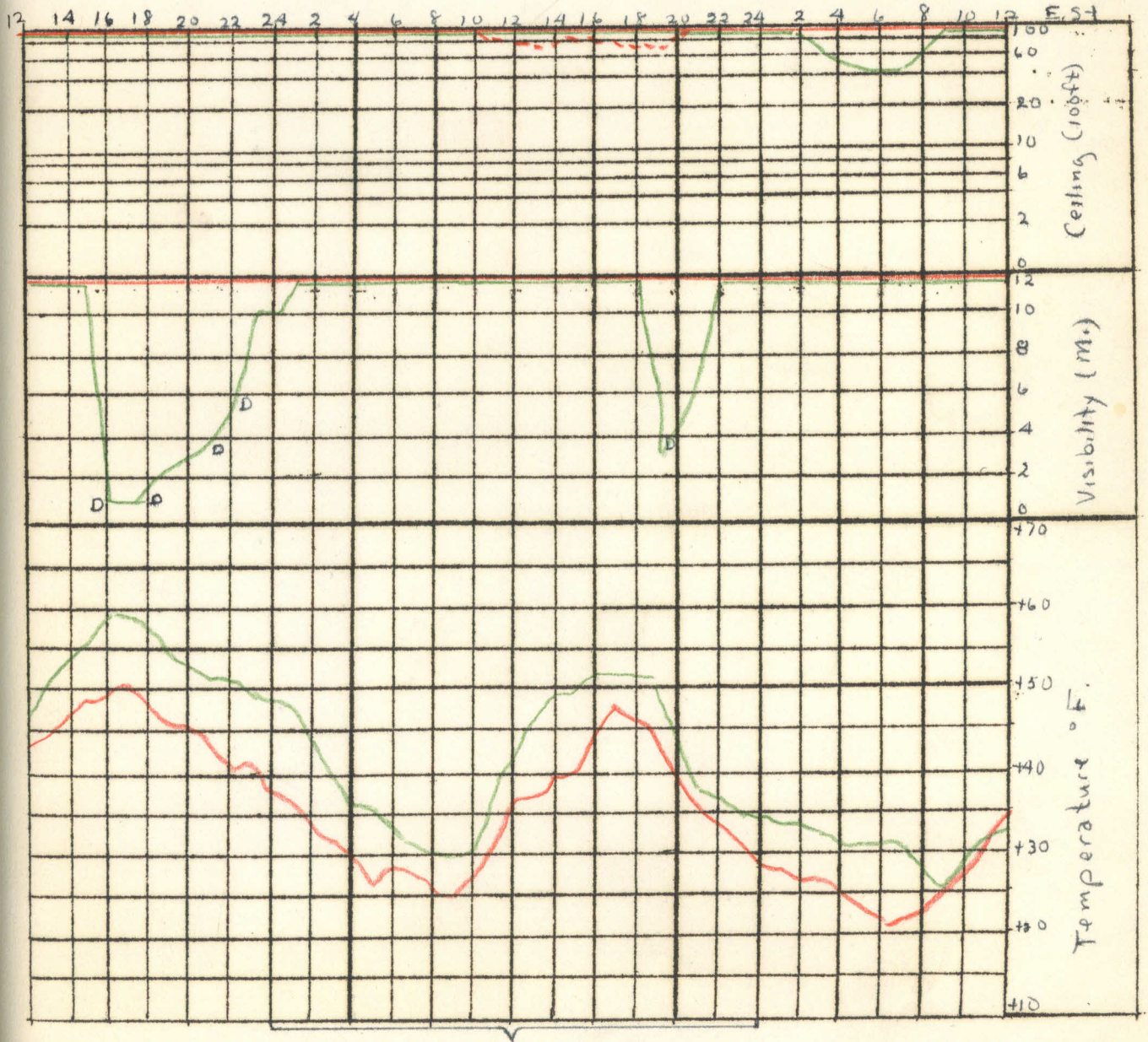






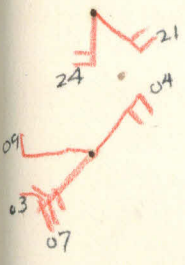
EO

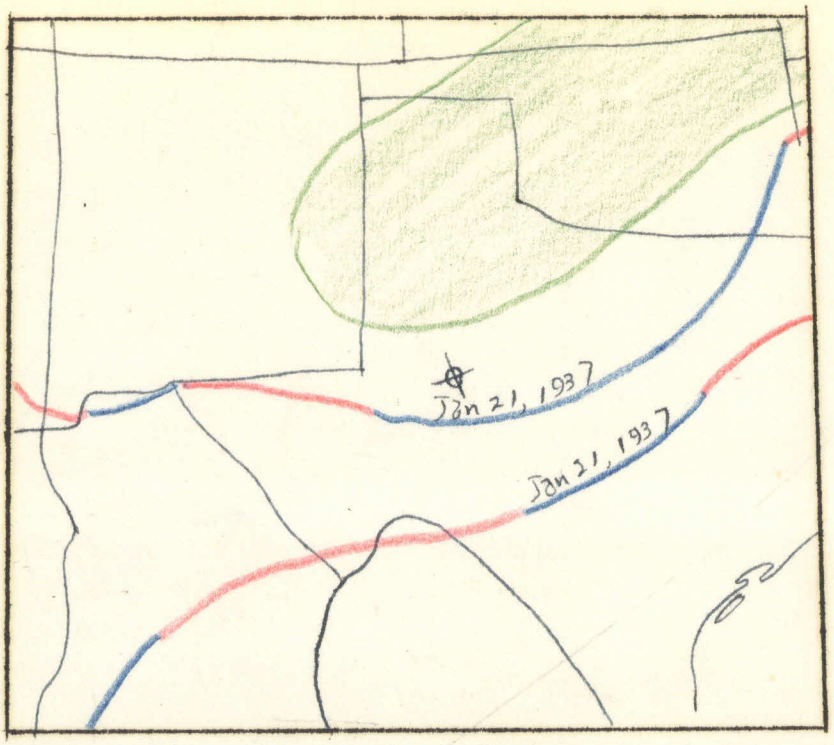
Type A
Phase 5



Jan. 3
1937







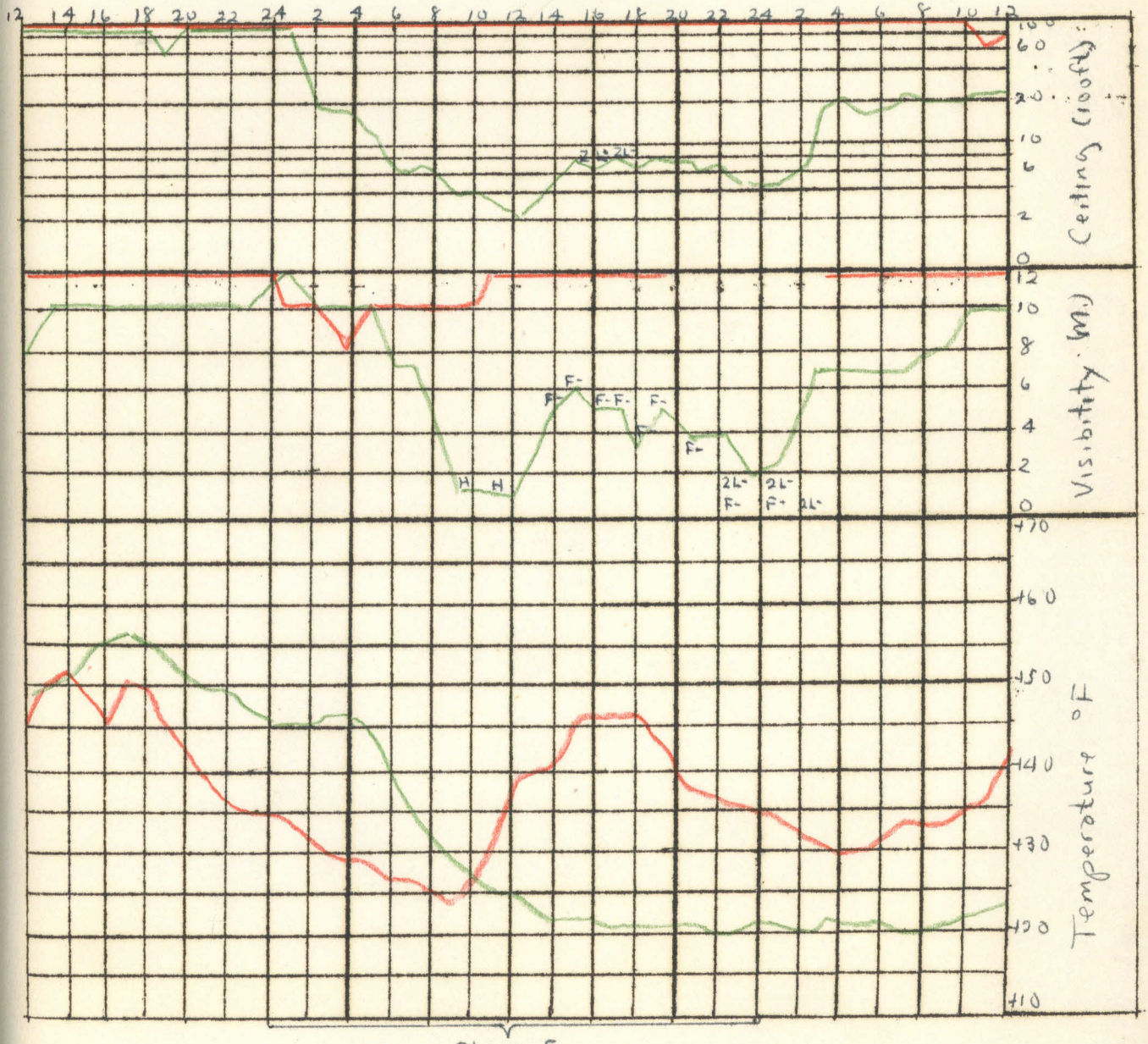
Jan. 21
1937





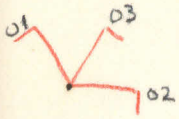
B~~Z~~

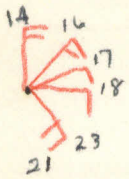
Type A
Phase 5

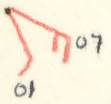


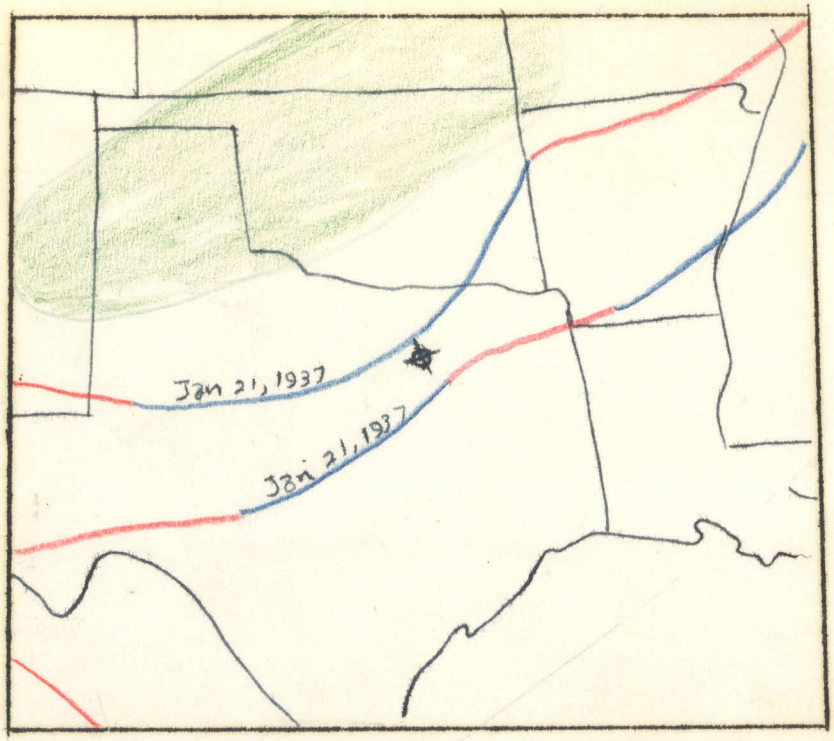
Jan. 3
1937



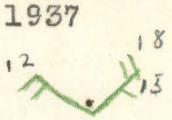


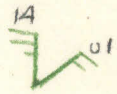






Jan. 21
1937



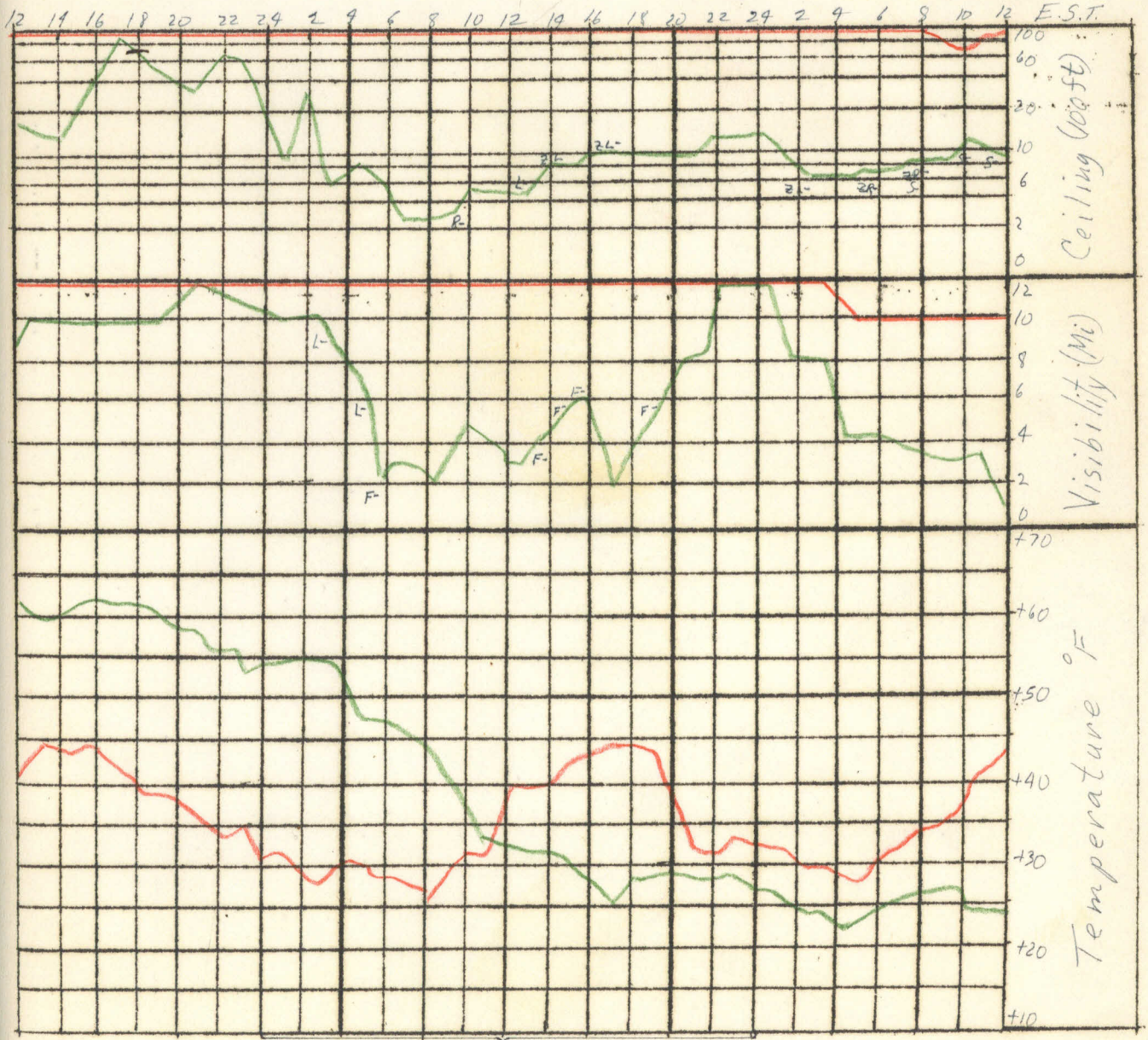






DL

Type A
Phase 5



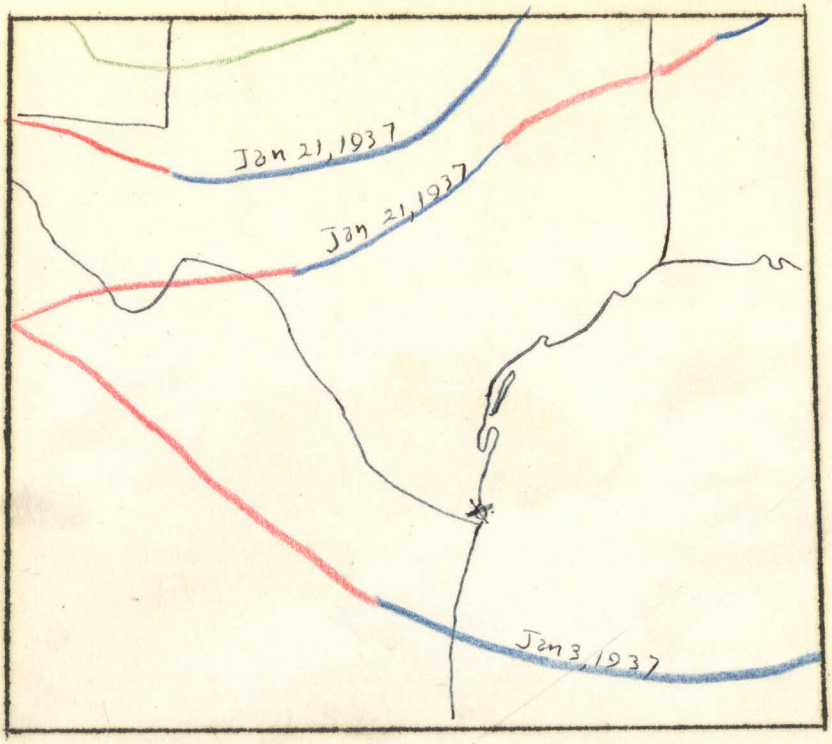
Phase 5

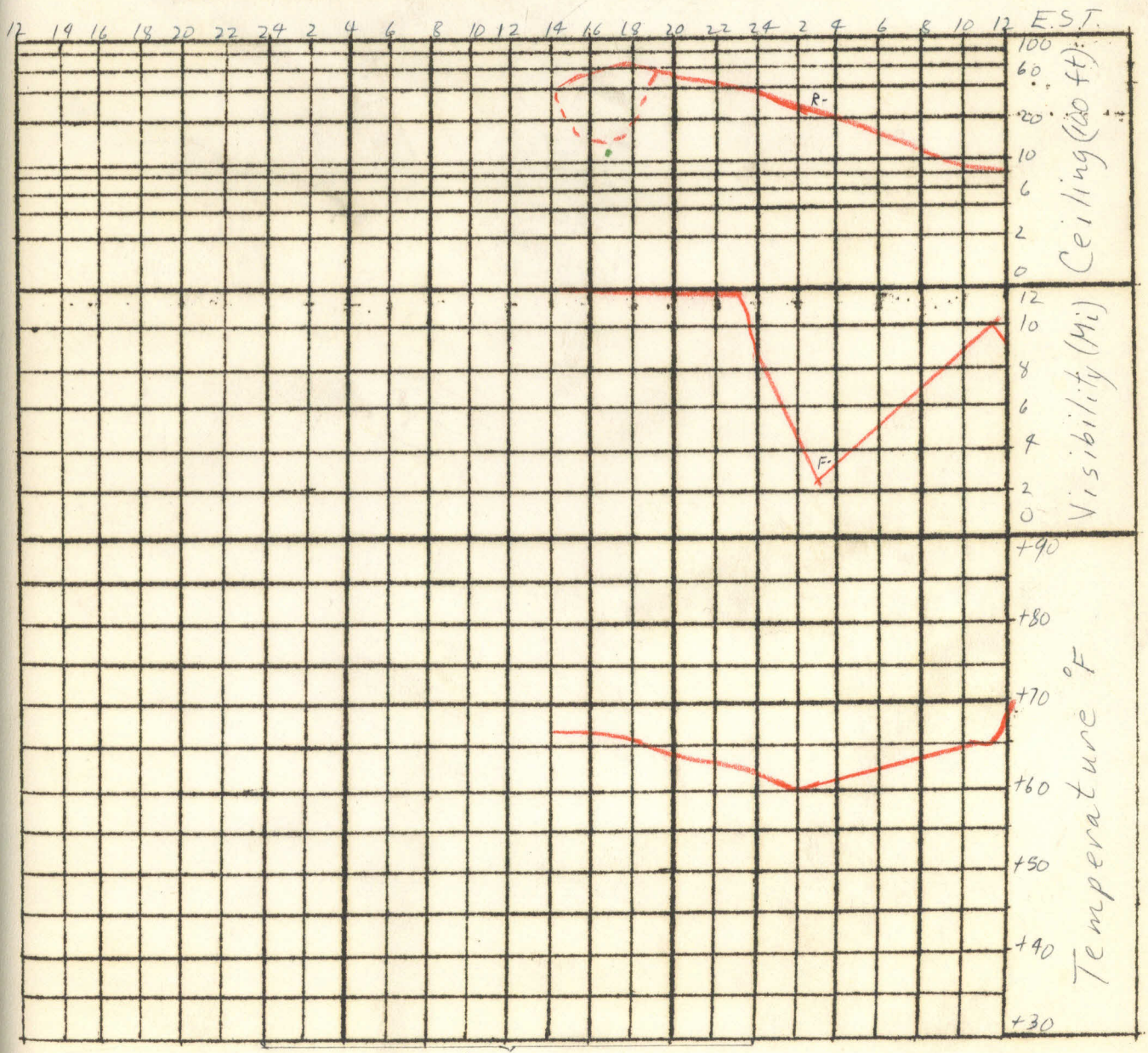
Jan. 3
1937

Jan. 21
1937

JI

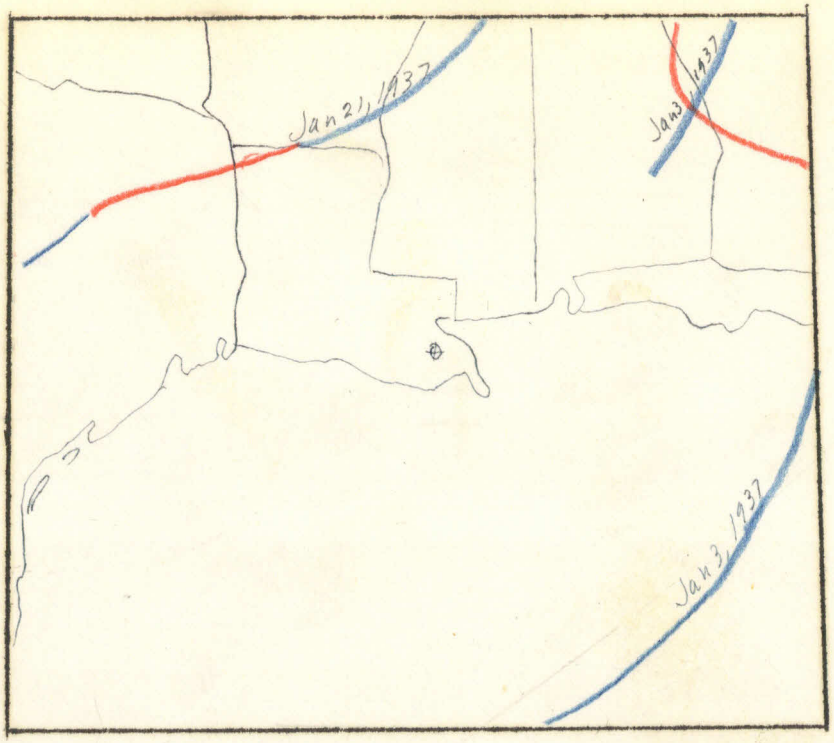
Type A
Phase 5





Phase 5

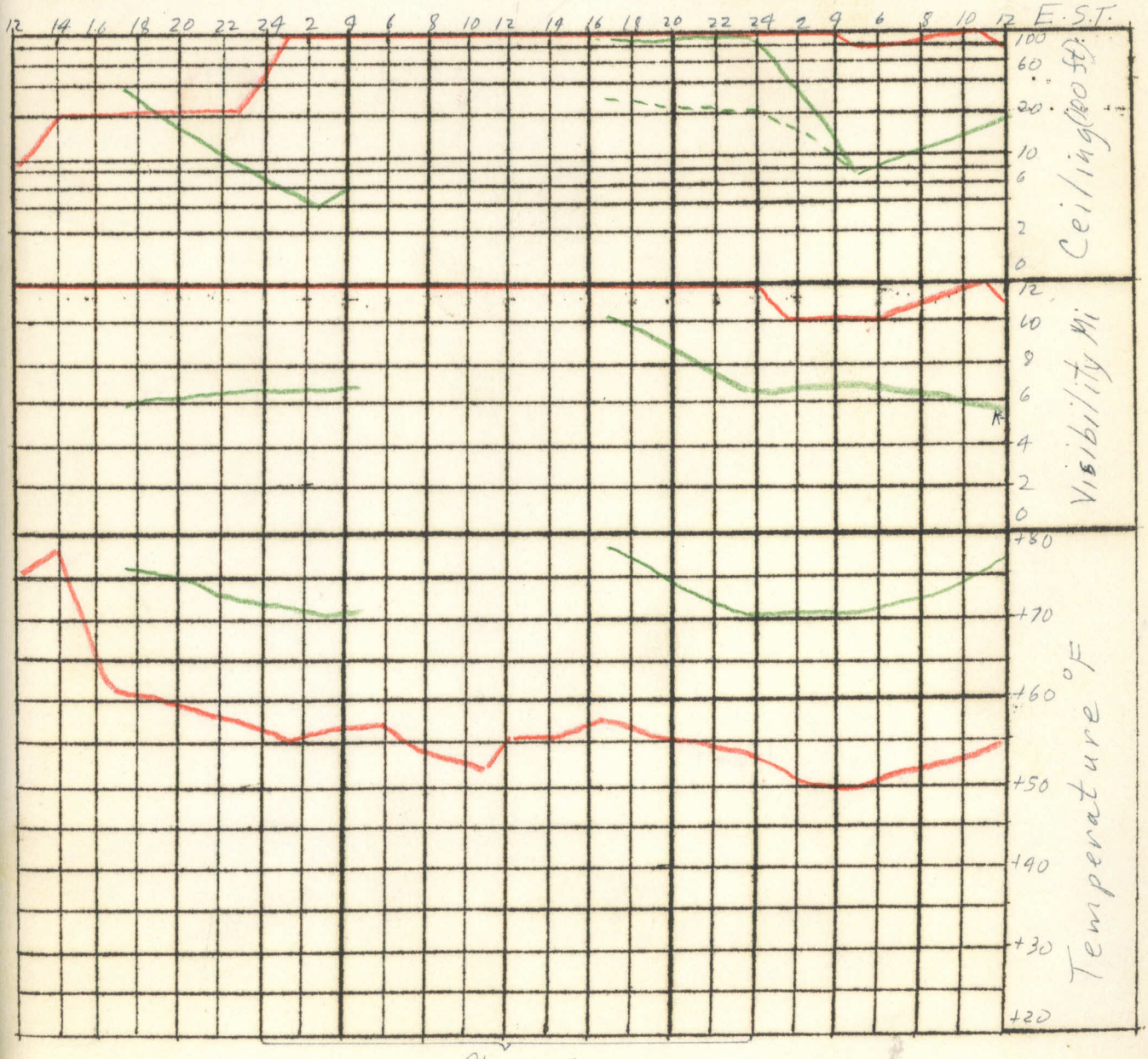
Jan. 3
1937



Jan. 21
1937

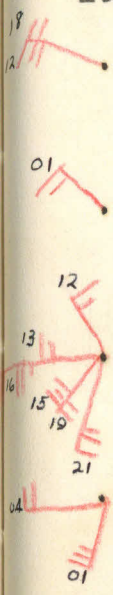
NO

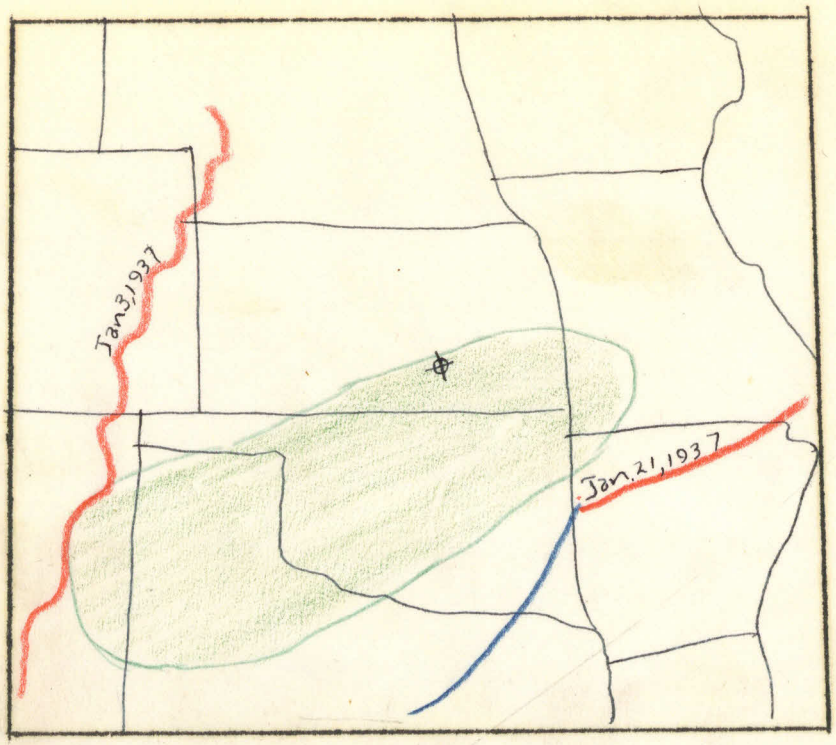
Type A
Phase 5



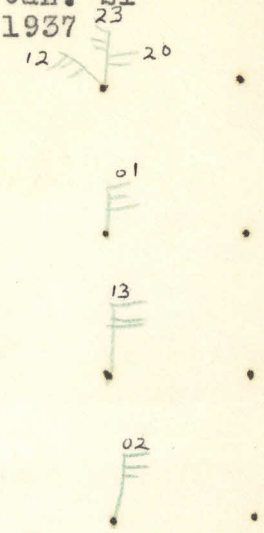
Phase 5

Jan. 3
1937



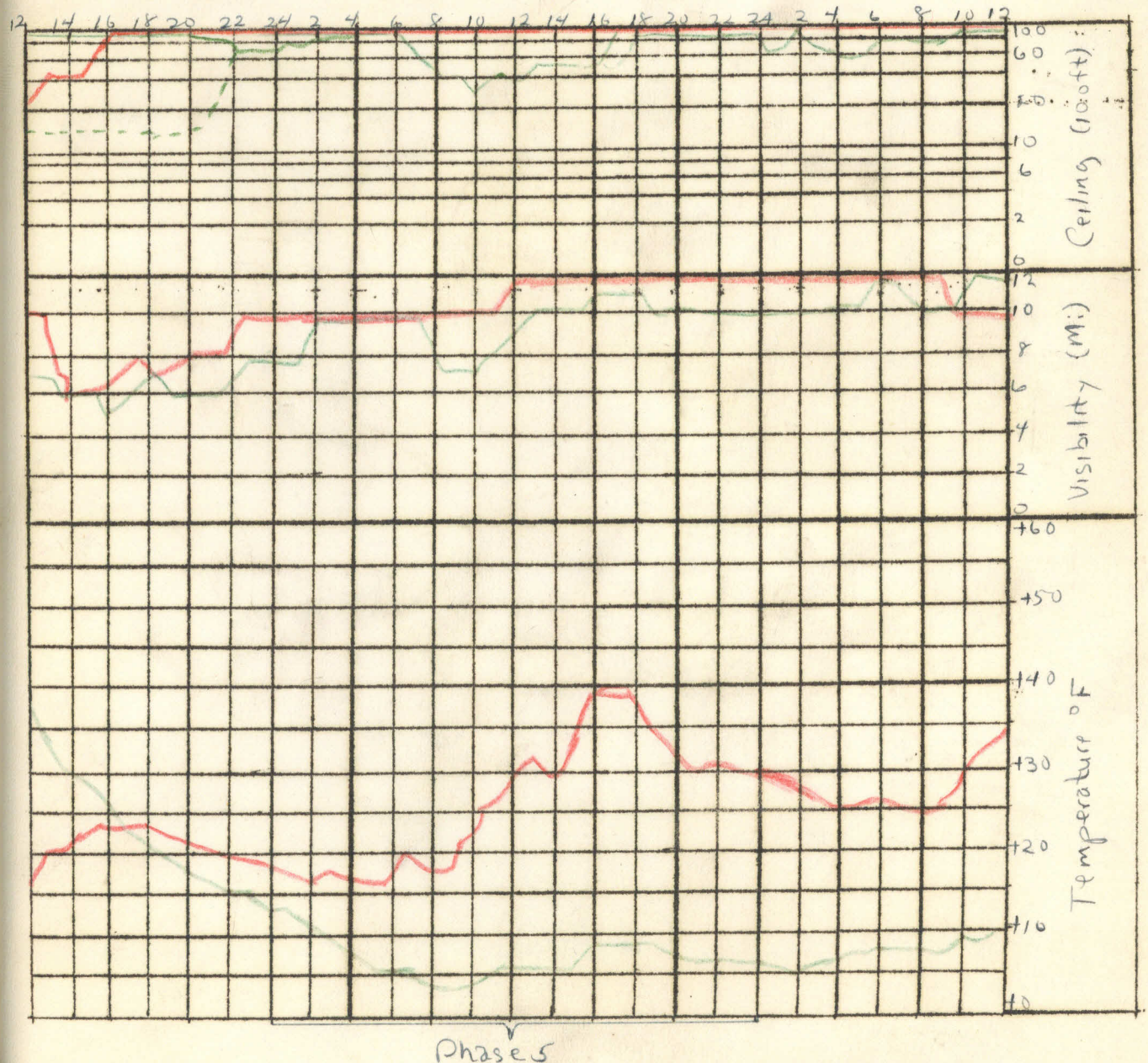


Jan. 21
1937

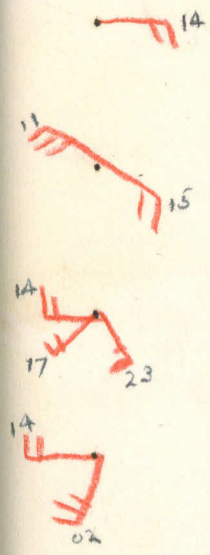


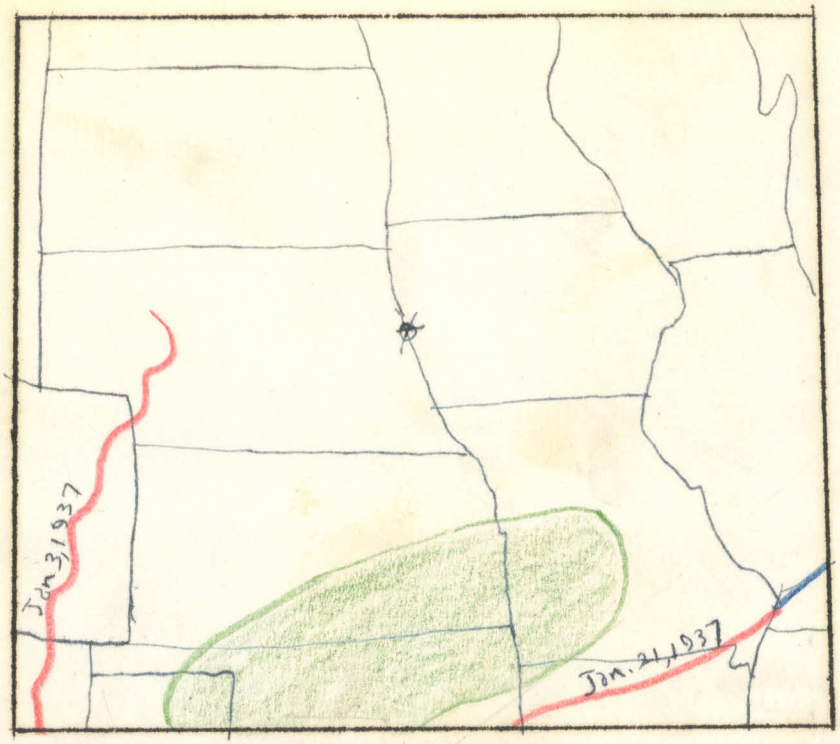
WD

Type A
Phase 5

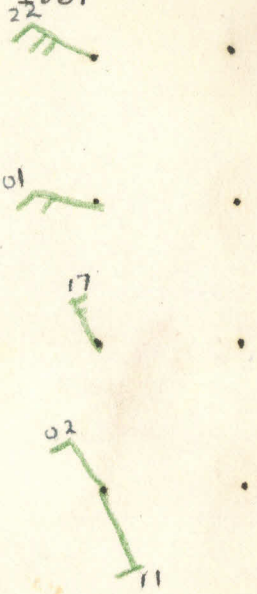


Jan. 3
1937



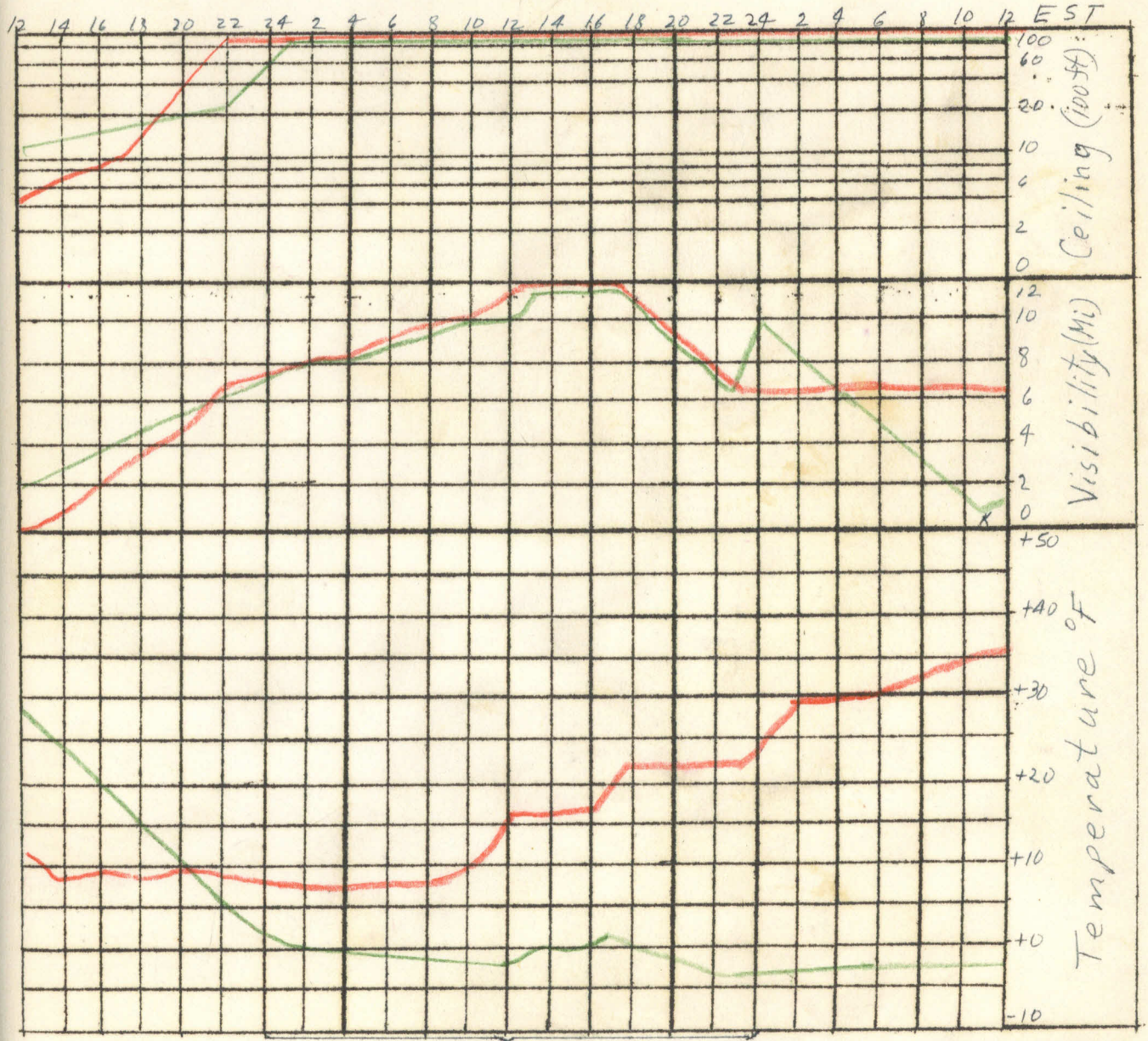


Jan. 21
1937



OH

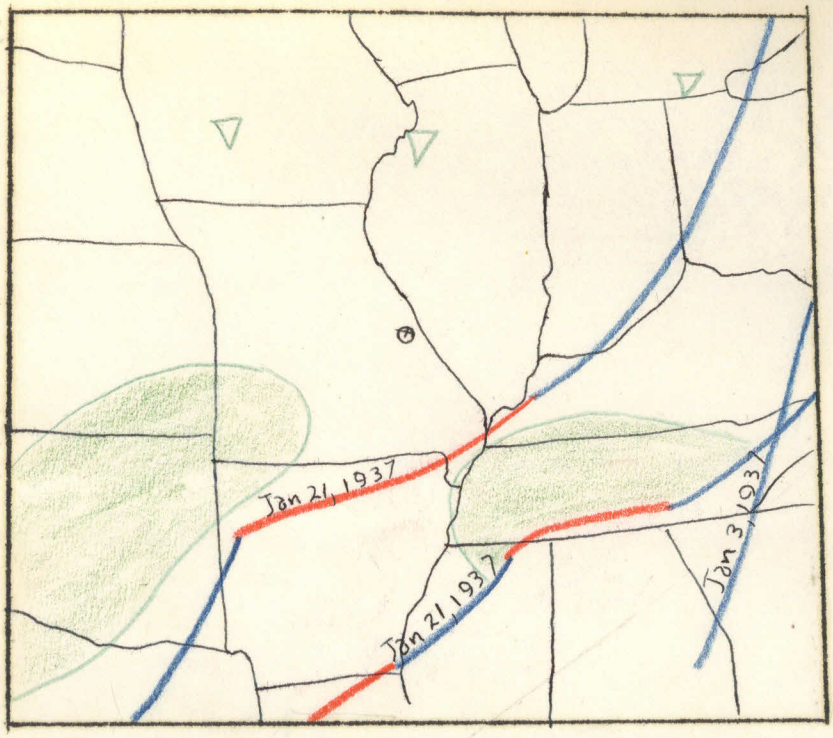
Type A
Phase 5



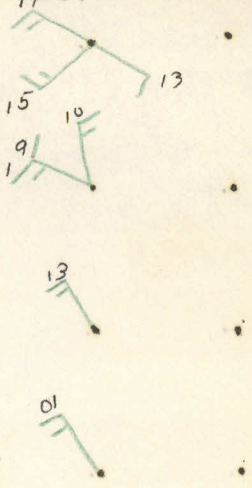
Phase 5

Jan. 3
1937



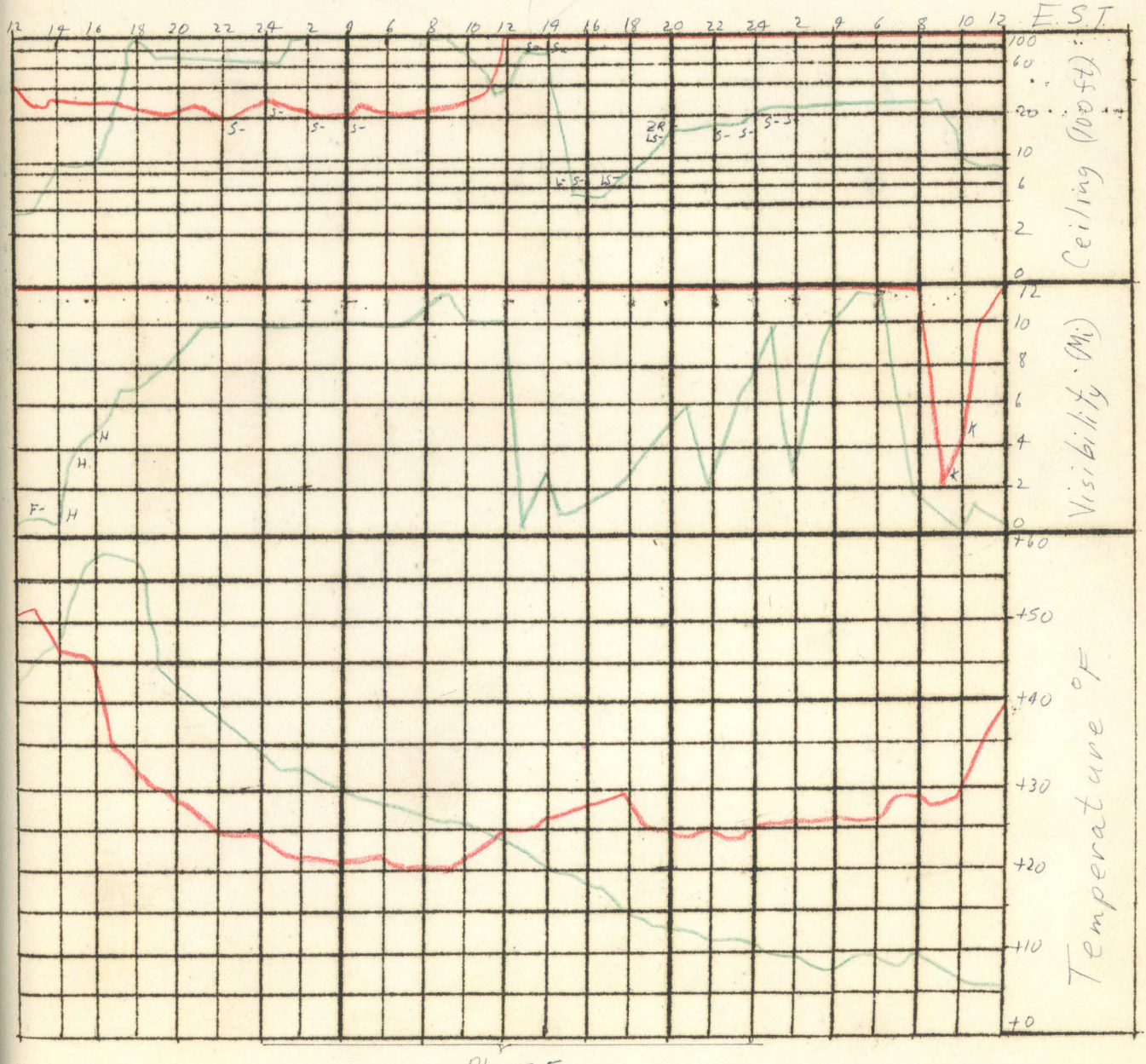


Jan. 21
1937



LS

Type A
Phase 5



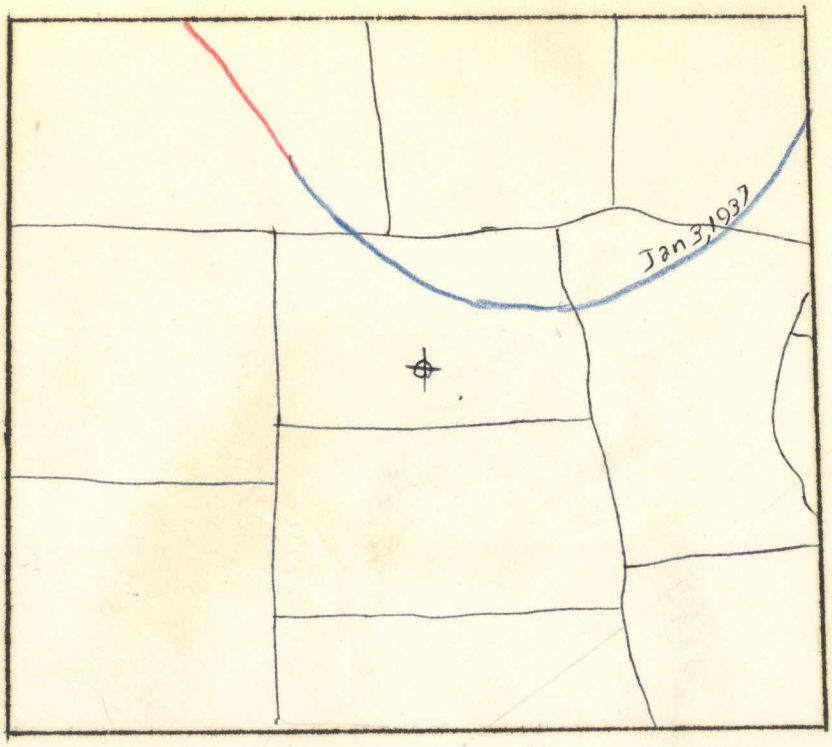
Phase 5

Jan. 3
1937

Jan. 21
1937

RK

Type A
Phase 5



13

14

04

17

05C

12 14 16 18 20 22 24 2 4 6 8 10 12 14 16 18 20 22 24 2 4 6 8 10 12 E.S.T.

100
60
20
10
6
2
0
Ceiling (100 ft)

12
10
8
6
4
2
0
Visibility (Mi)

+40
+30
+20
+10
+0
-10
-20
Temperature °F

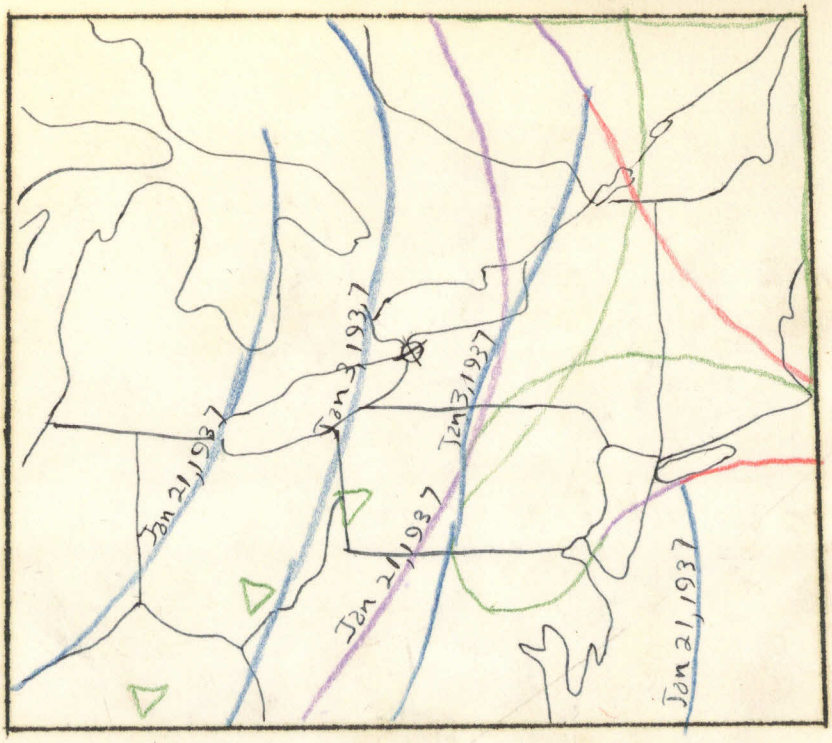
Phase 5

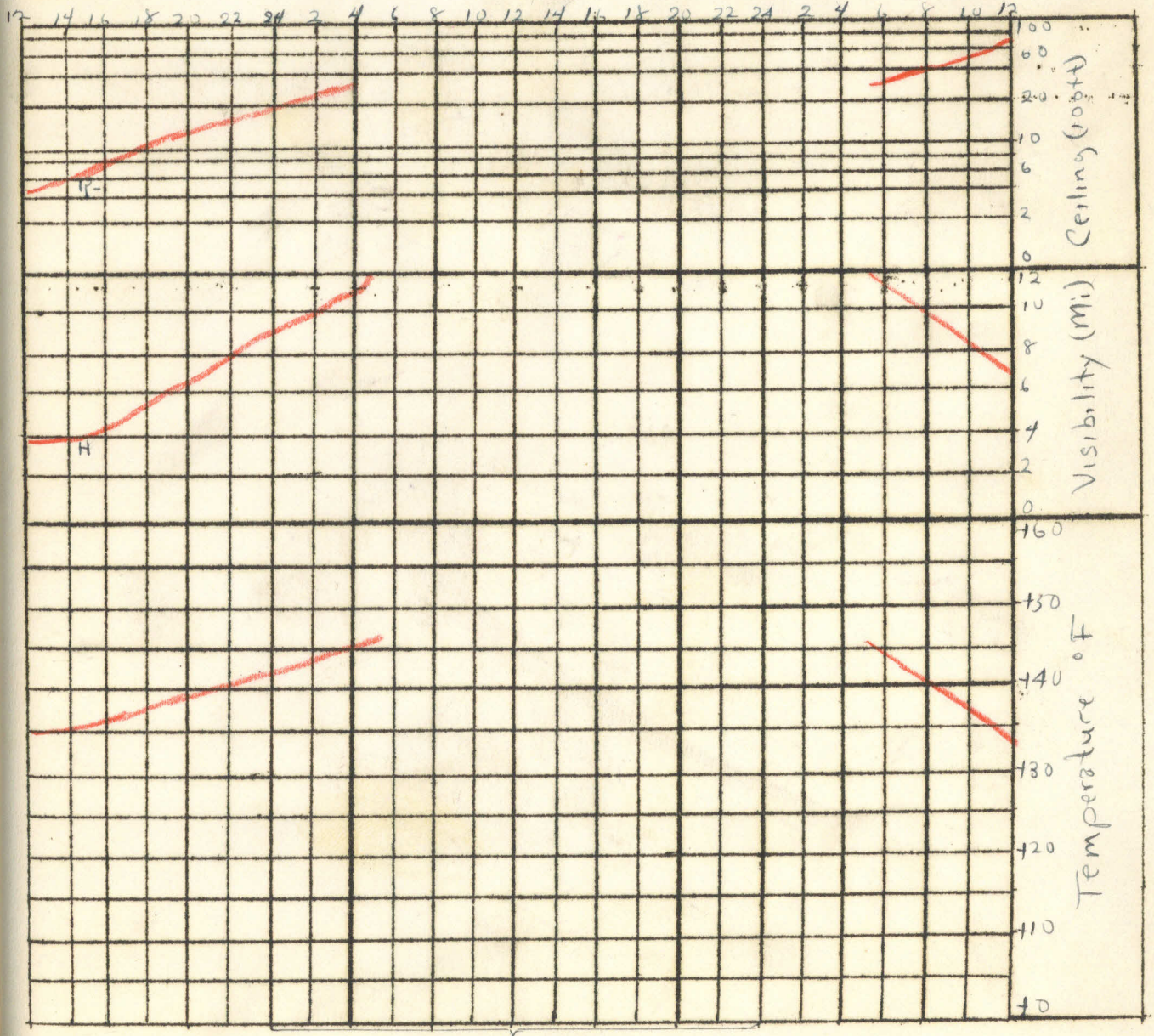
Jan. 3
1937

Jan. 21
1937

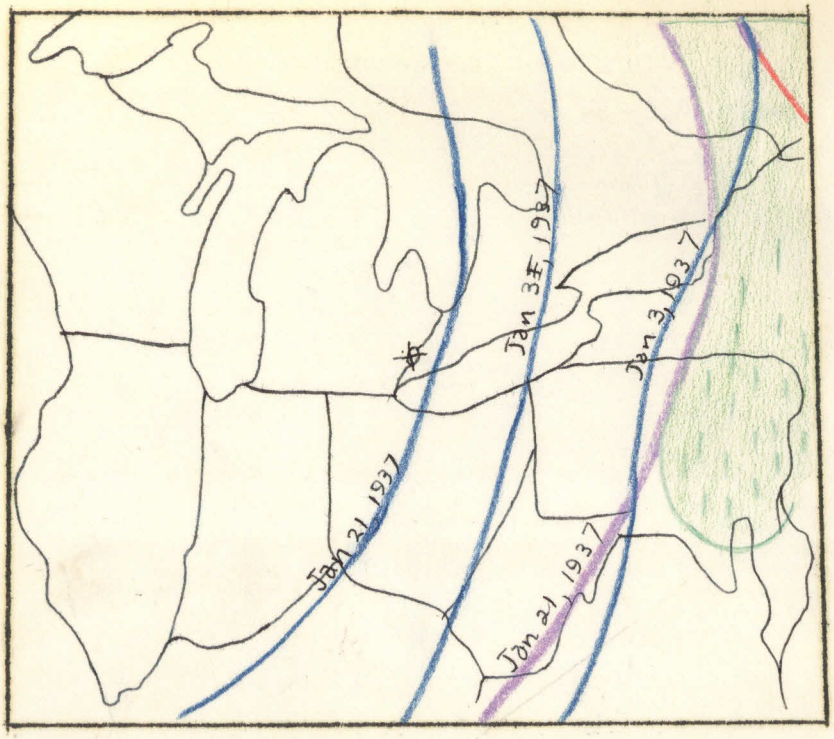
BJ

Type A
Phase 5





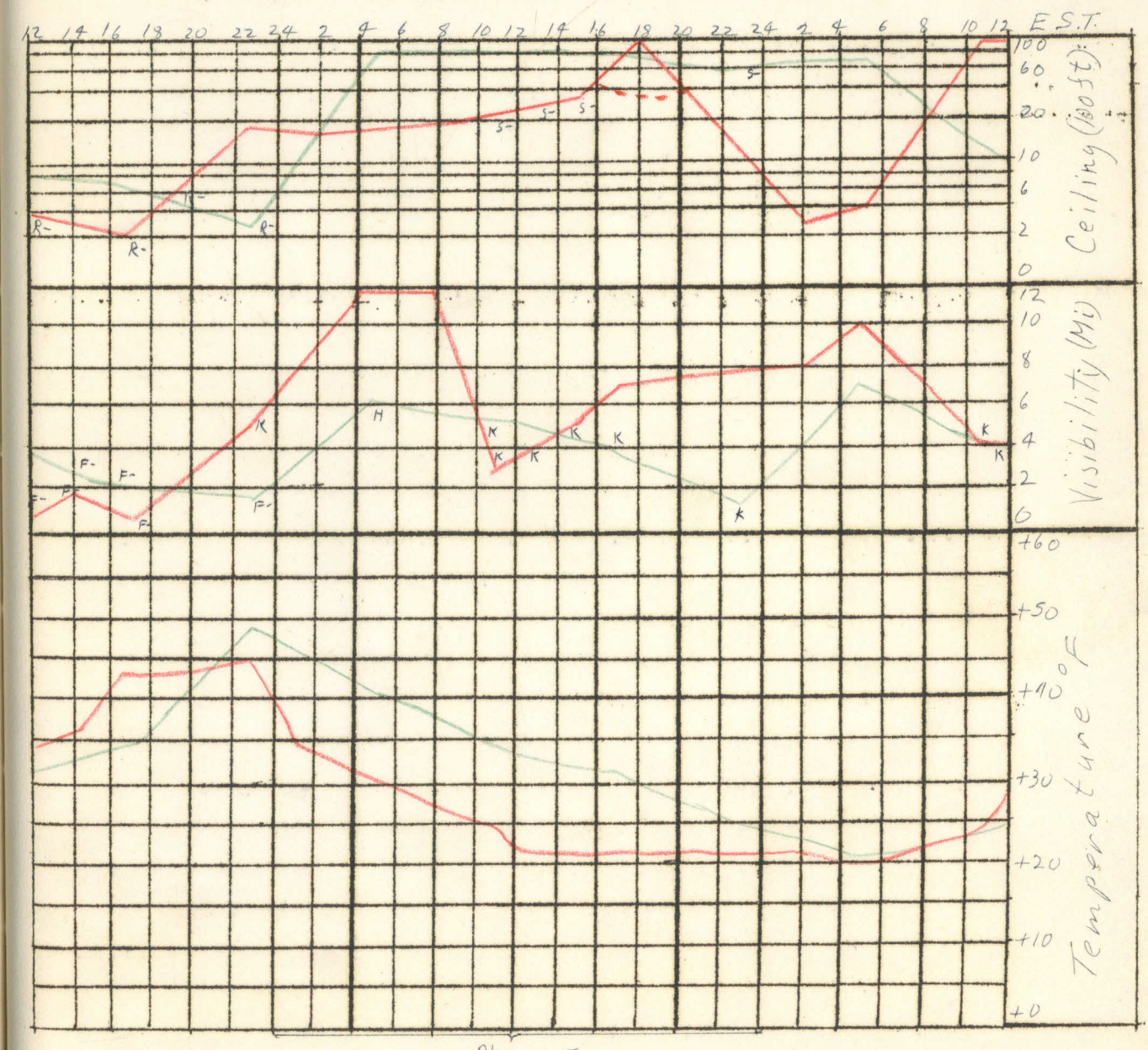
Jan. 3
1937



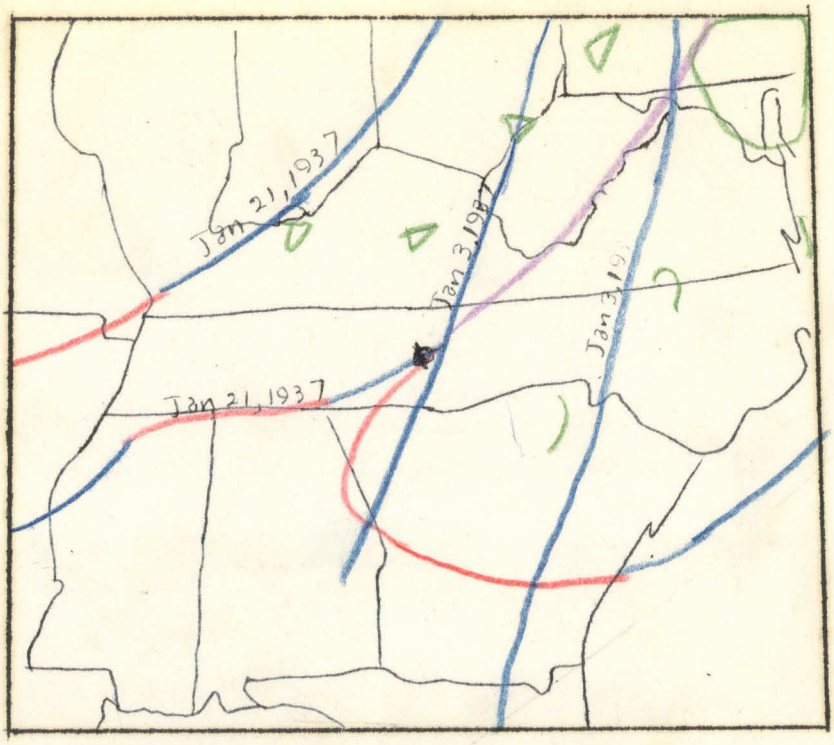
Jan. 21
1937

DO

Type A
Phase 5



Jan. 3
1937



Jan. 21
1937

KX

Type A
Phase 5

12 14 16 18 20 22 24 2 4 6 8 10 12 14 16 18 20 22 24 2 4 6 8 10 12 E.S.T.

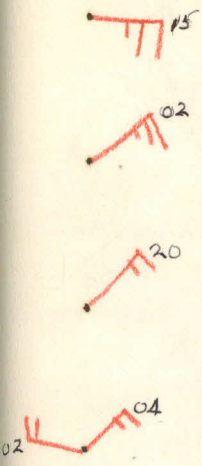
Ceiling (100 ft)
100 60 20 10 6 2 0

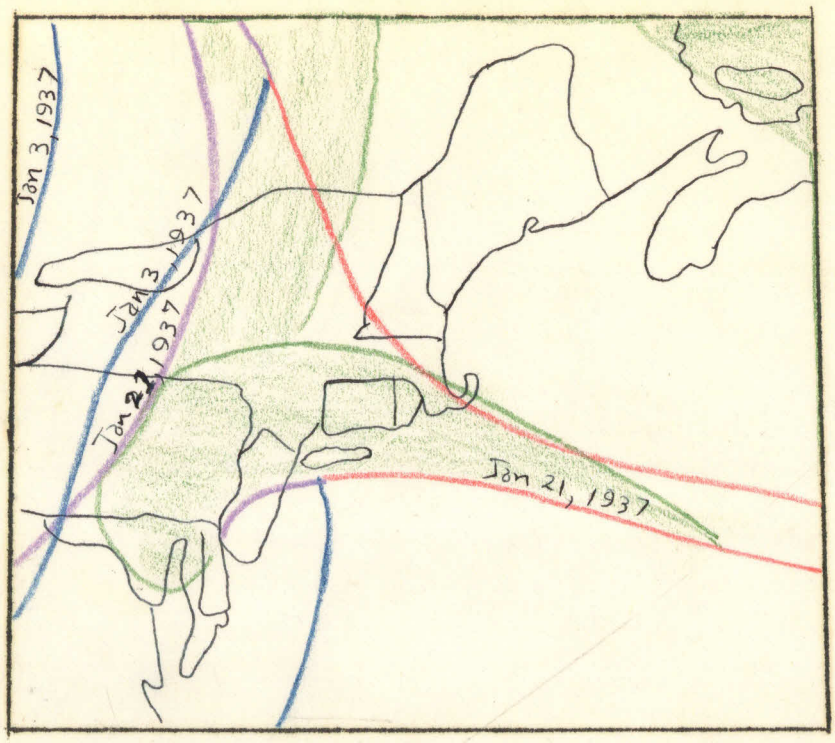
Visibility (M.)
12 10 8 6 4 2 0

Temperature °F
+70 +60 +50 +40 +30 +20 +10

Phase 5

Jan. 3
1937

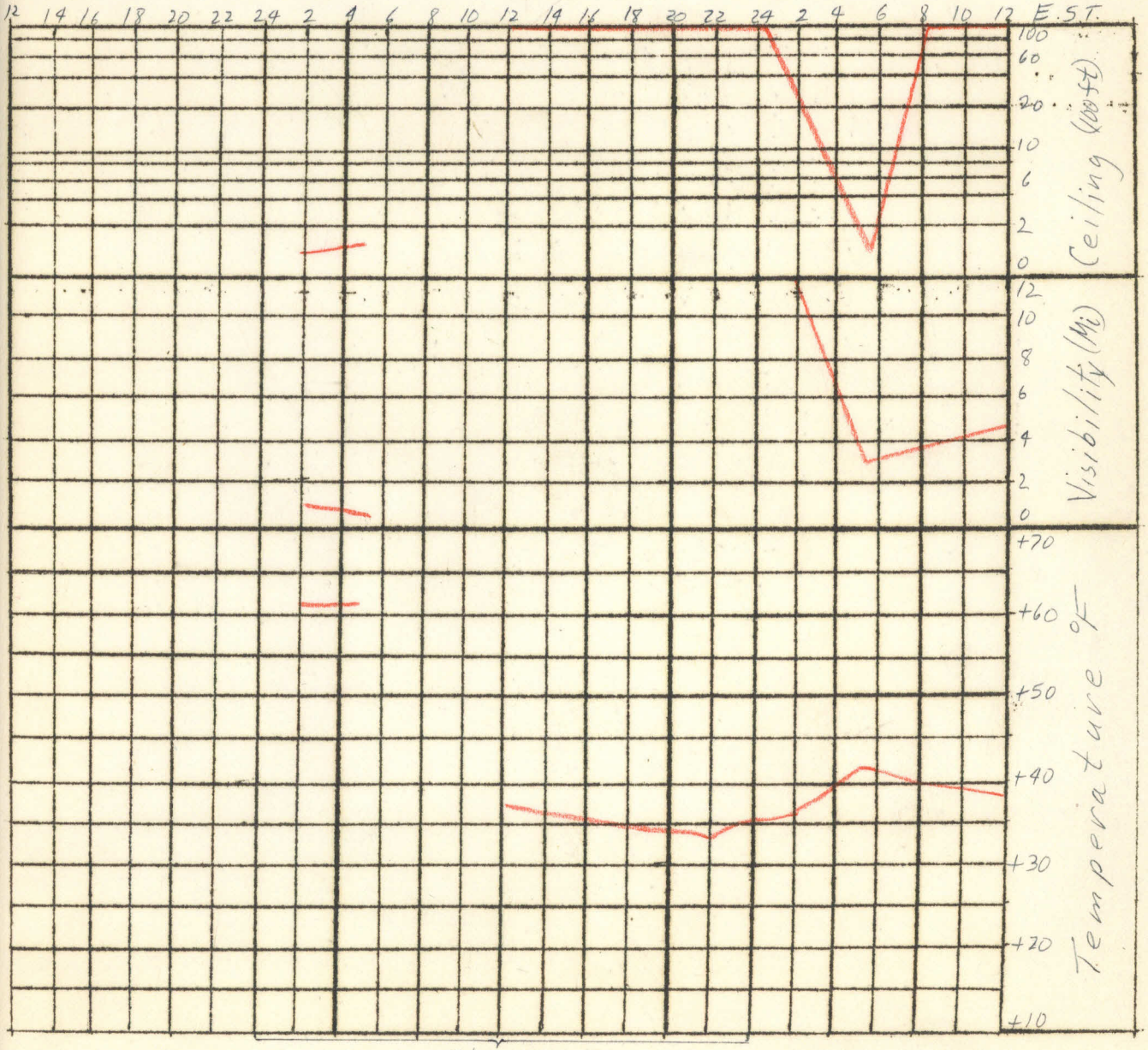




Jan. 21
1937

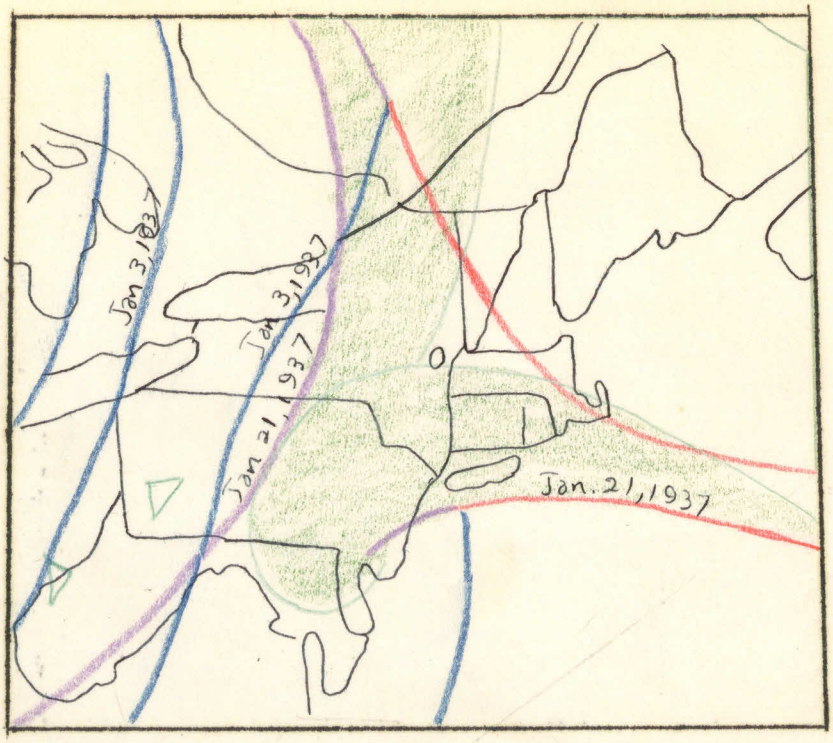
BW

Ty pe A
Phase 5



Phase 5

Jan. 3
1937



Jan. 21
1937

AZ

Type A
Phase 5

12 14 16 18 20 22 24 2 4 6 8 10 12 14 16 18 20 22 24 2 4 6 8 10 12 E.S.T.

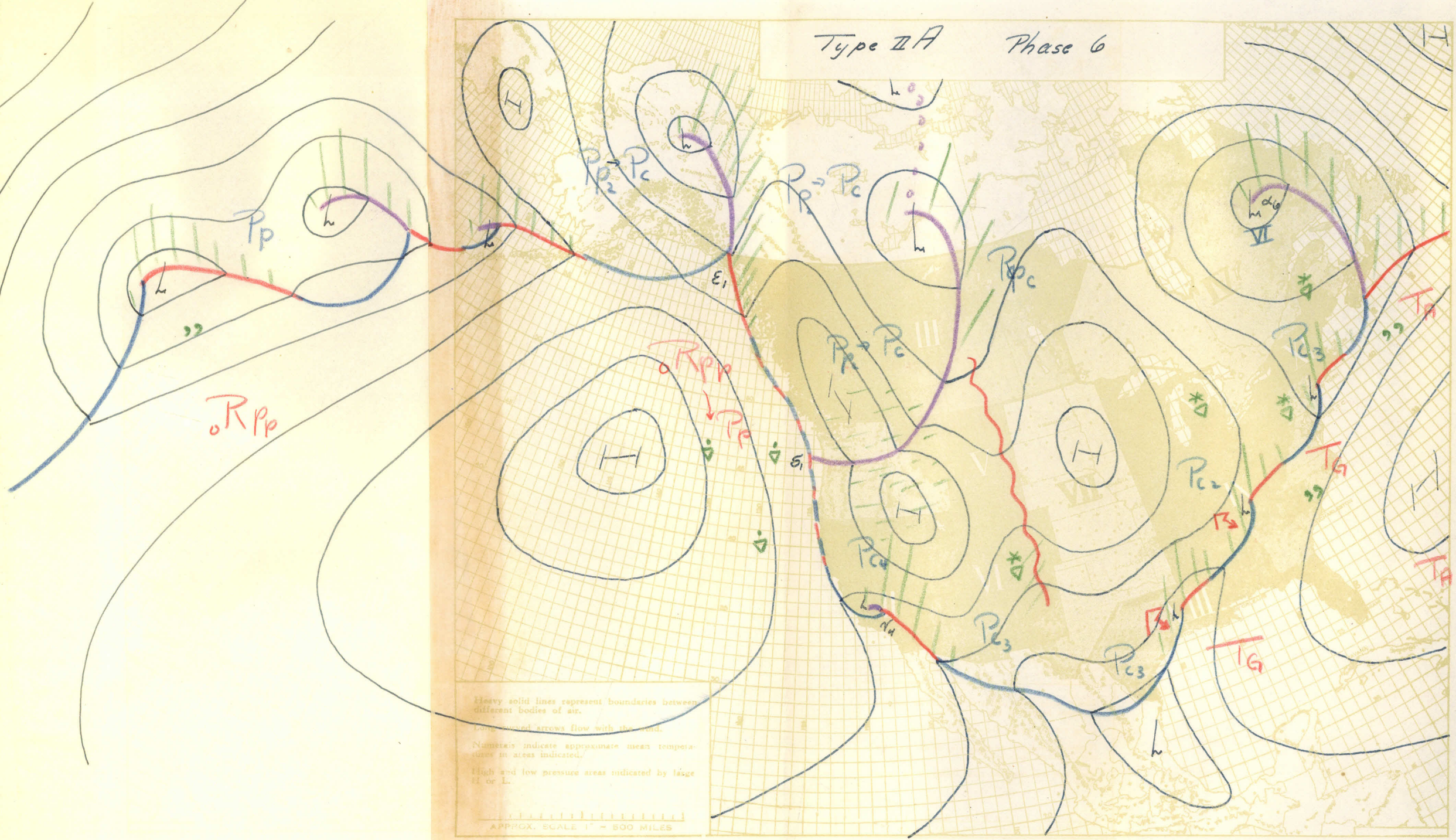
Ceiling (100 ft): 100 60 20 10 6 2 0

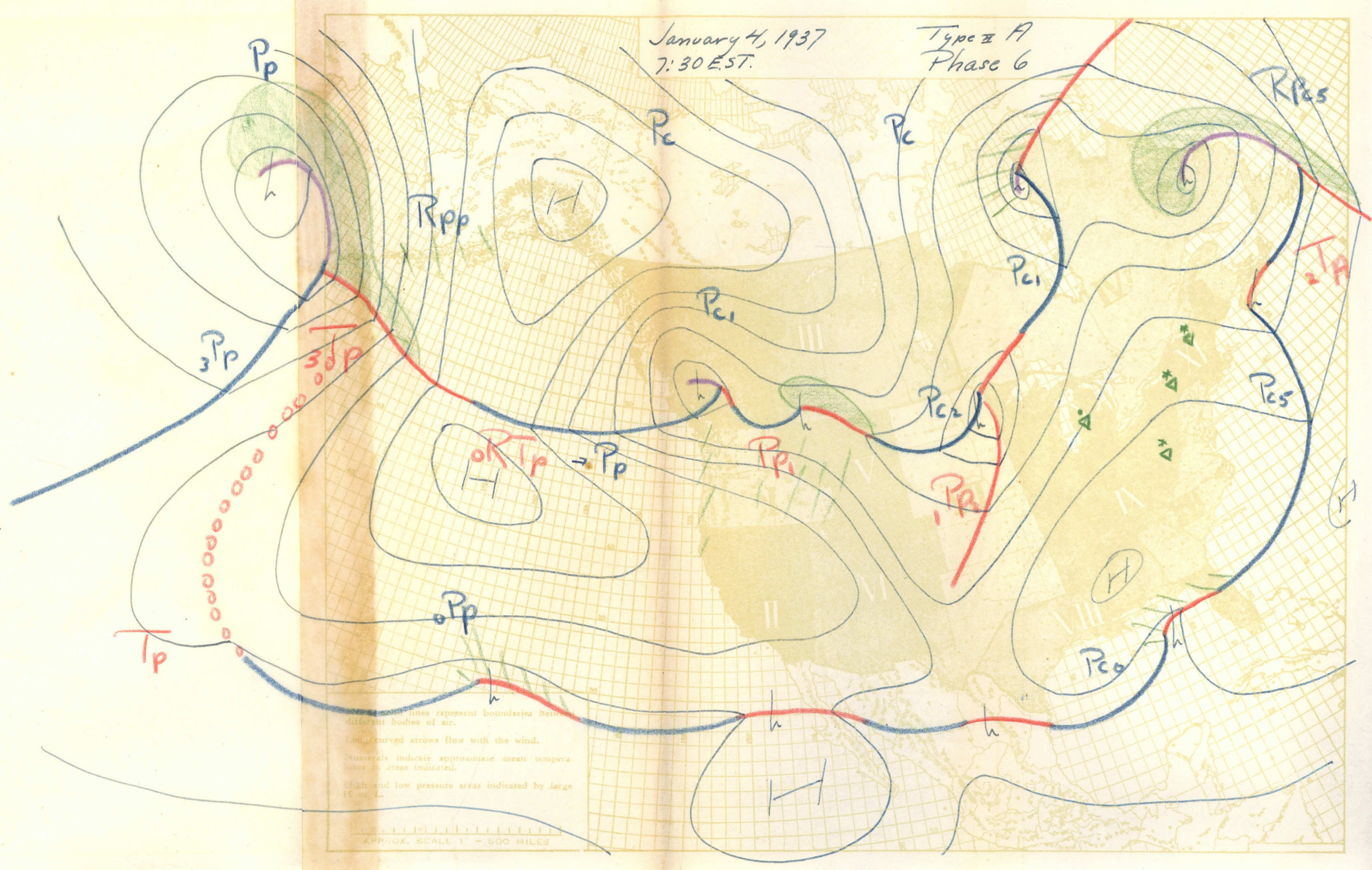
Visibility (Mi) 12 10 8 6 4 2 0

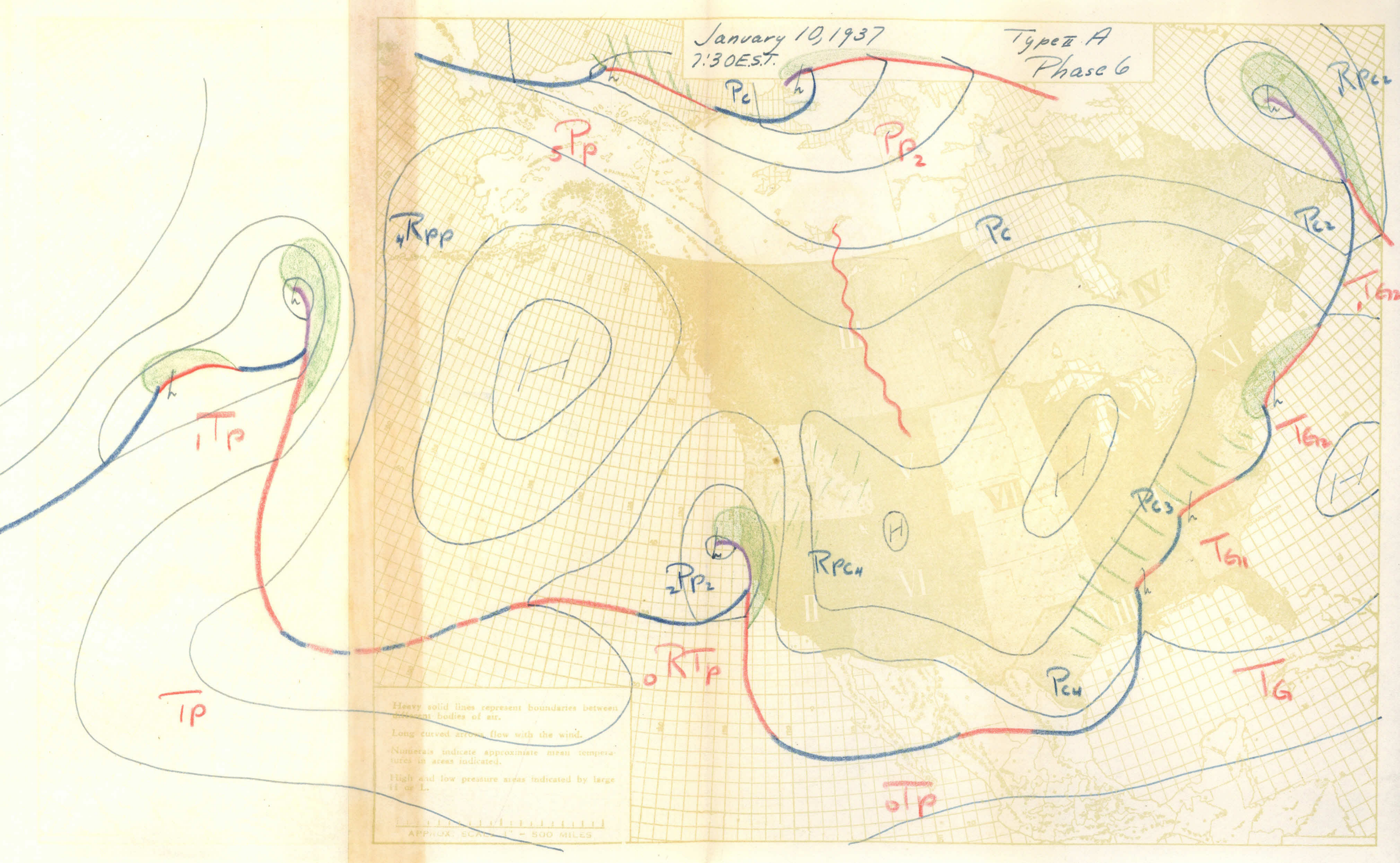
Temperature °F +60 +50 +40 +30 +20 +10 +0

Phase 5

PHASE VI


Type IIA Phase 6
Heavy solid lines represent boundaries between different bodies of air.
Dotted arrows flow with 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


January 4, 1937
7:30 E.S.T.
Type II A
Phase 6
Pp
Rpp
Pc
Pc
RPc5
Pc1
Pc1
3Pp
3dp
Pc2
Pc5
oRTp → Pp
Pp1
Pp
2TA
Pp
Tp
Pc6
APPROX. SCALE 1" = 500 MILES

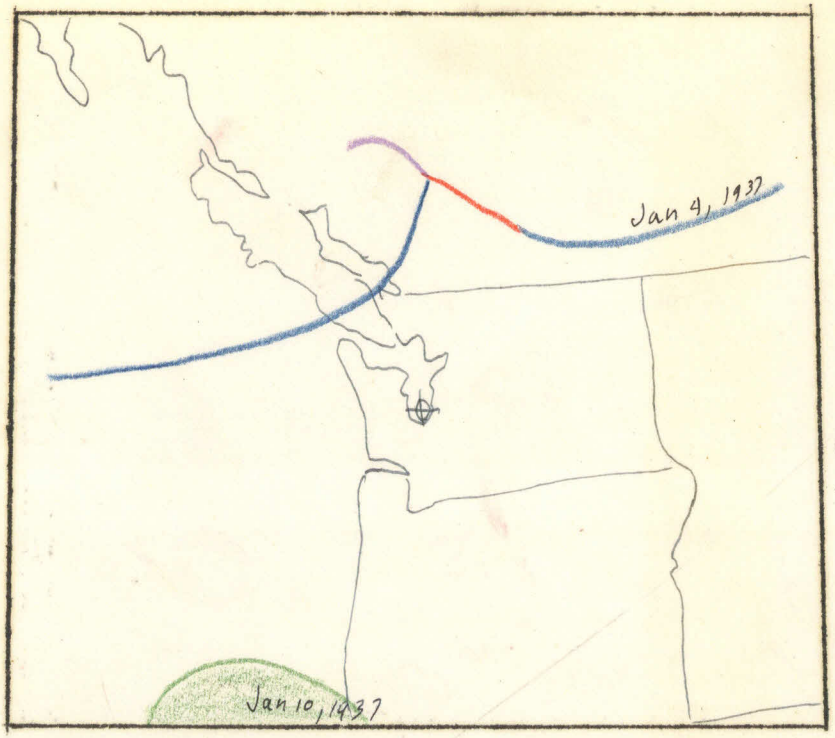

January 10, 1937
7:30 E.S.T.
Type II A
Phase 6
Pc
5Pp
Pp2
4RPP
Pc
RPc2
Pc2
1Tp
1Tm
Tm2
Pc3
Tm1
2Pp2
RPc4
H
0RTp
Pc4
TG
0Tp
Tp
Heavy solid lines represent boundaries between different bodies of air.
Long curved arrows flow with the wind.
Numerals indicate approximate mean temperatures in areas indicated.
High and low pressure areas indicated by large H or L.
APPROX. SCALE 1" = 500 MILES

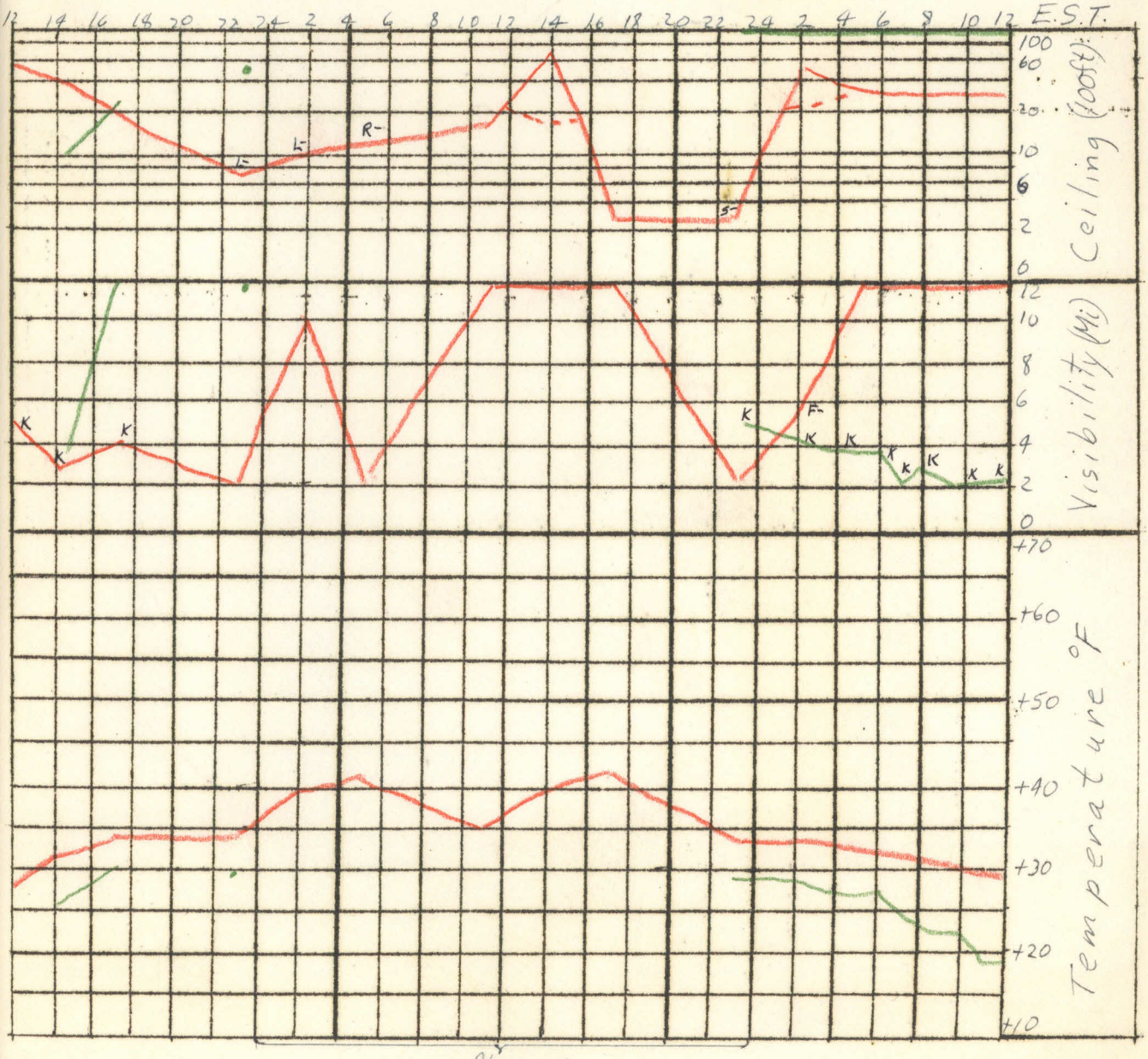
Jan. 4
1937

Jan. 10
1937

SA

Type A
Phase 6



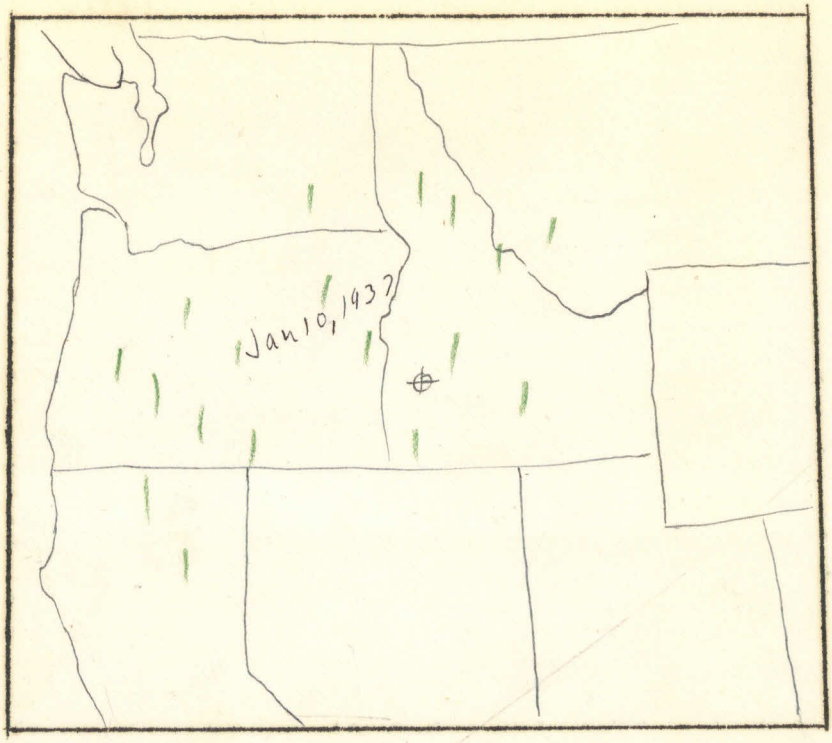


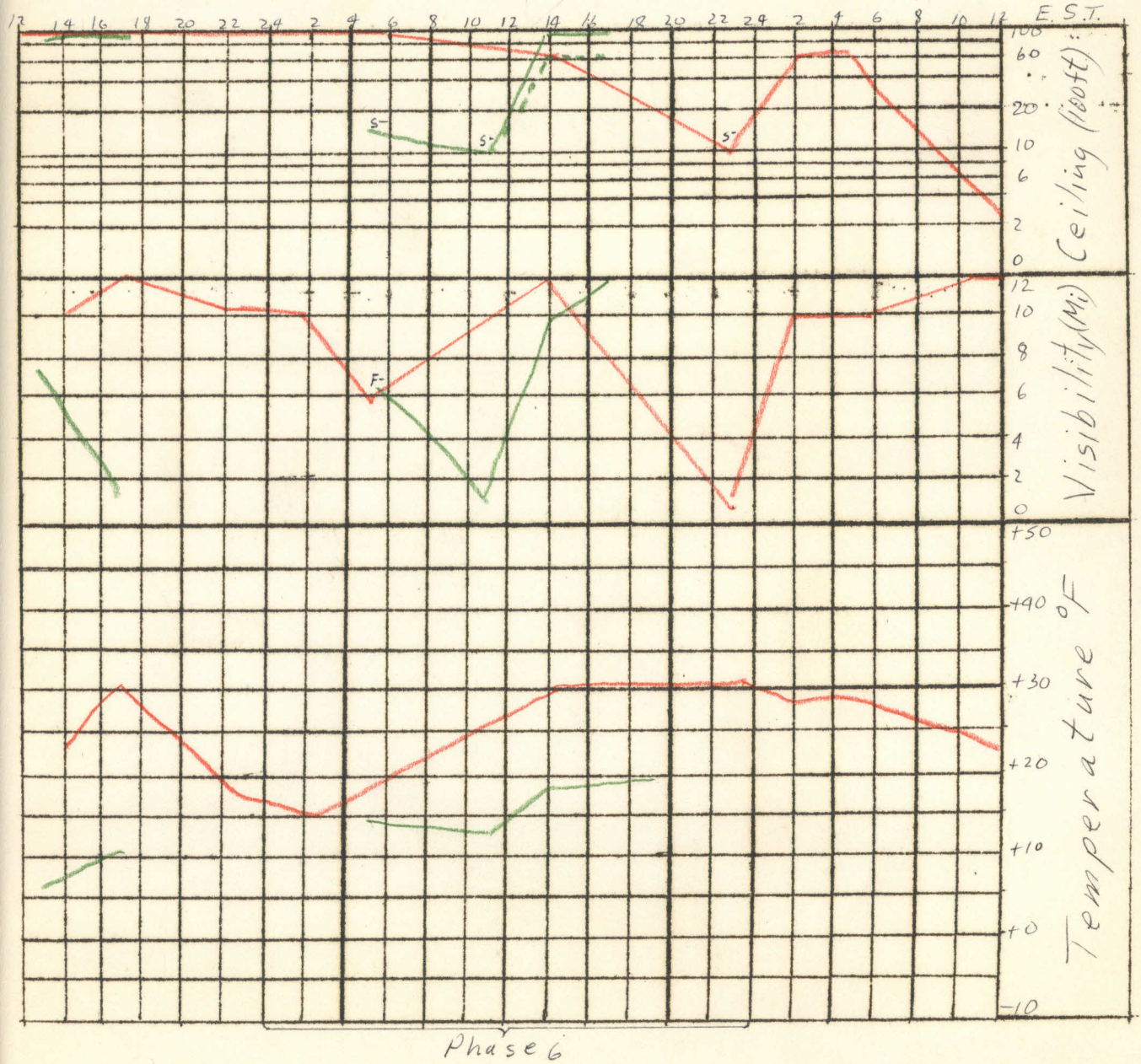
Jan. 4
1937

Jan. 10
1937

BE

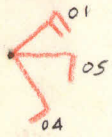
Type A
Phase 6



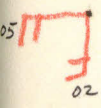


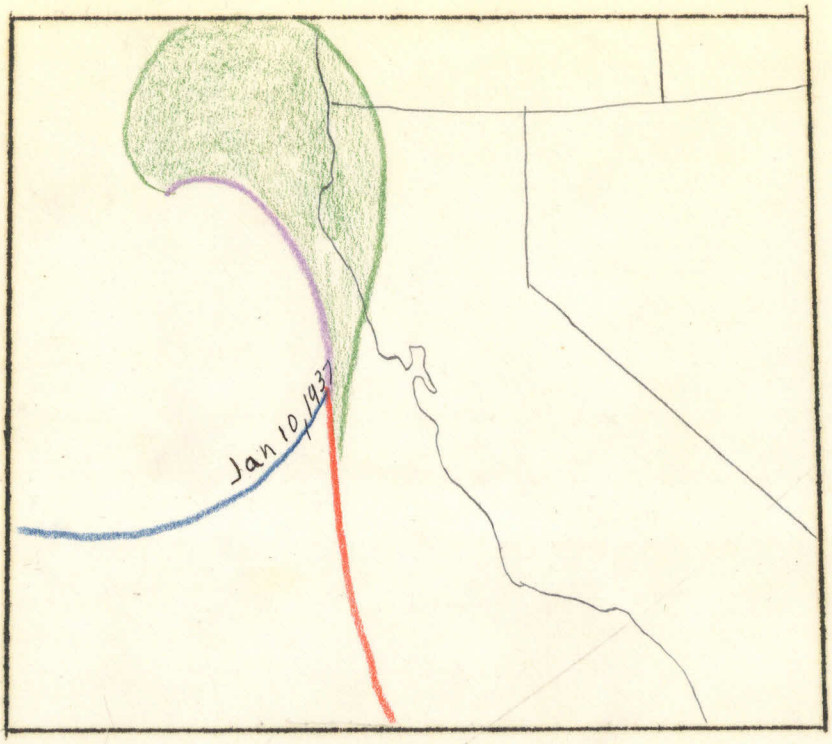
Jan. 4
1937



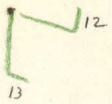






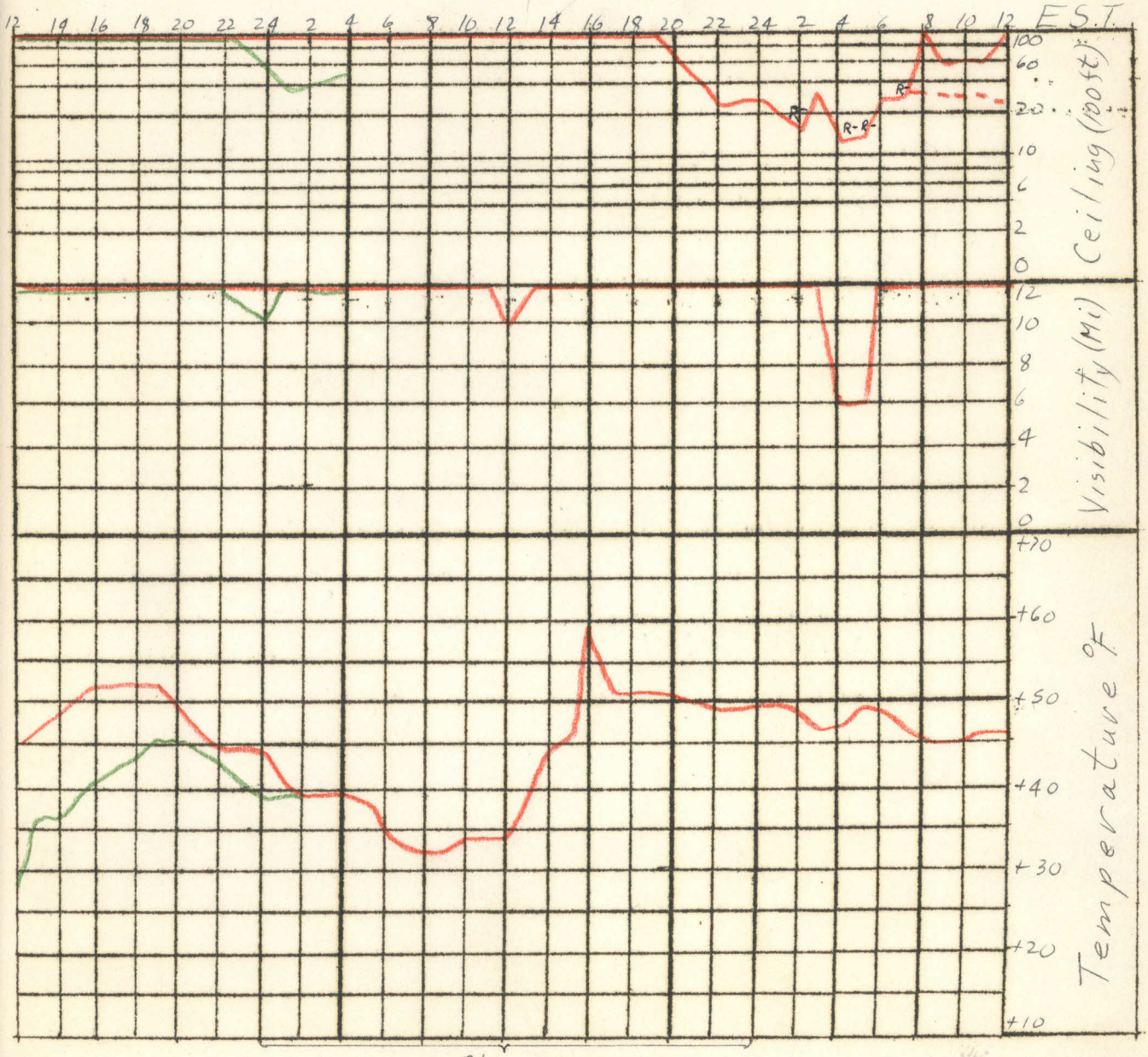


Jan. 10
1937

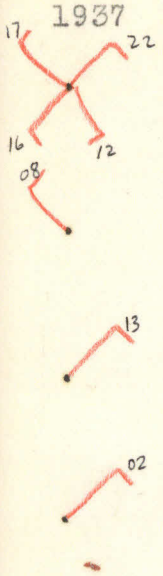


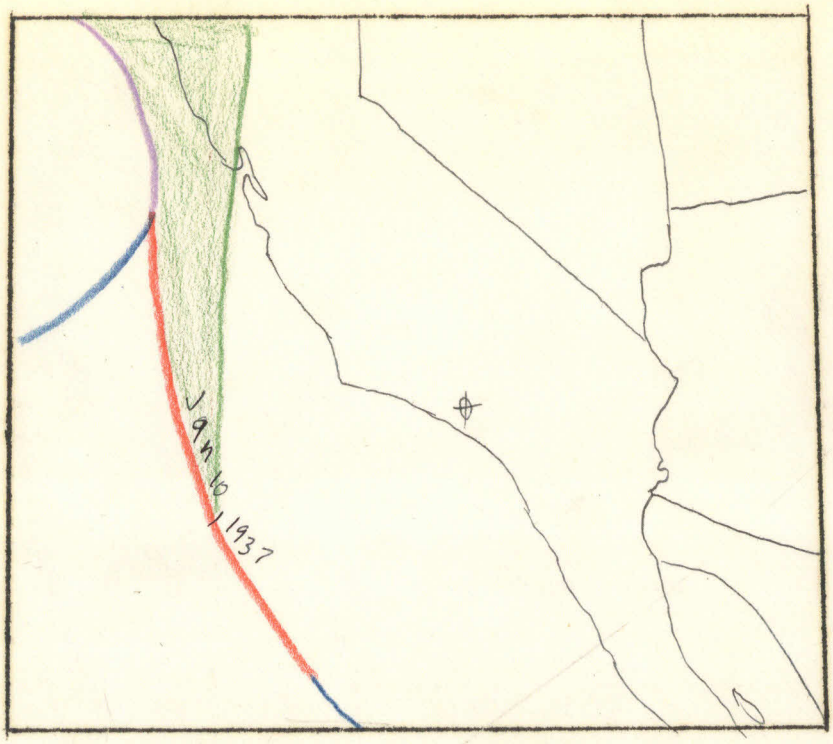
0A

Type A
Phase 6



Jan. 4
1937



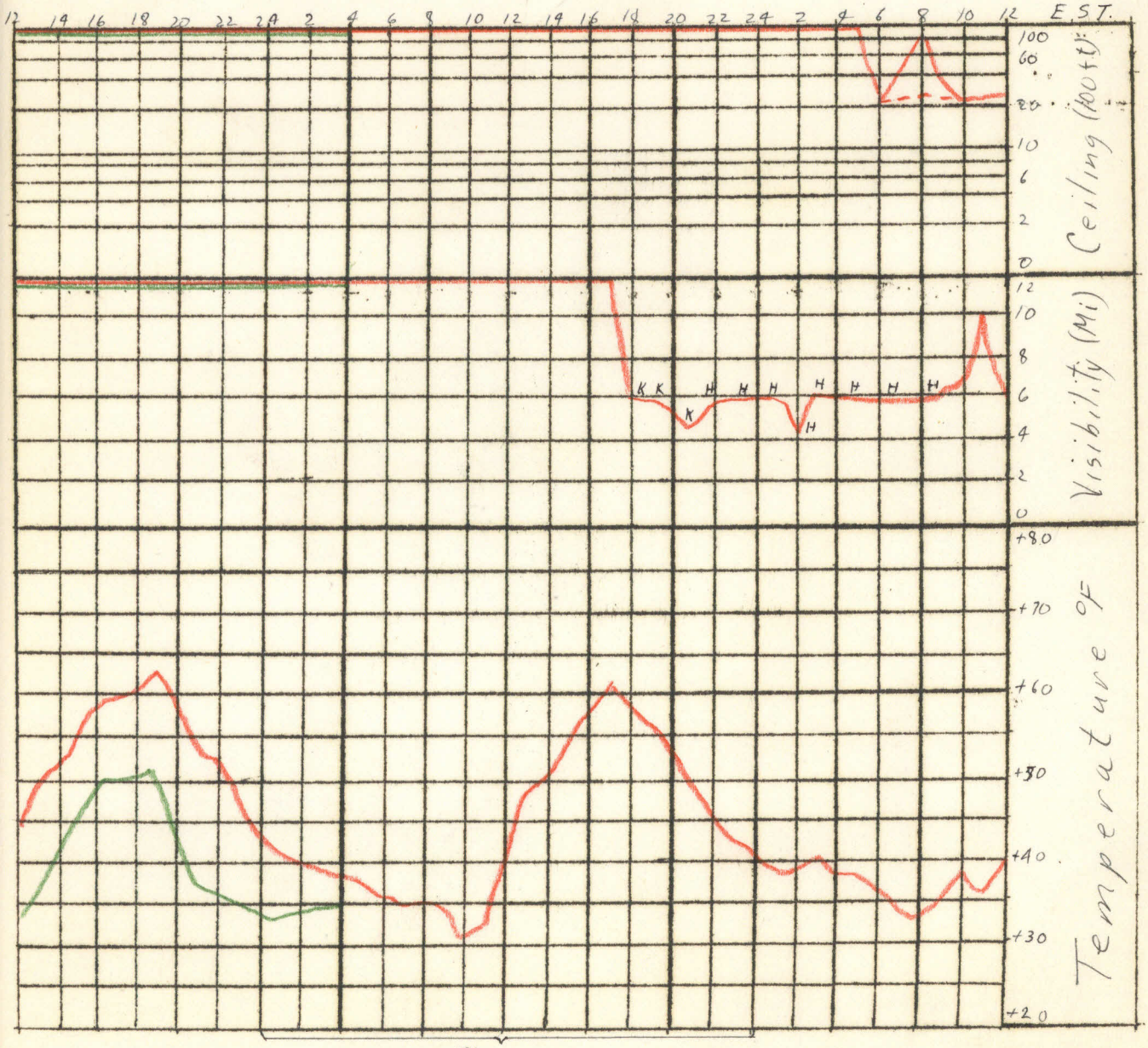


Jan. 10
1937



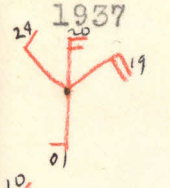
BU

Type A
Phase 6

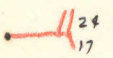


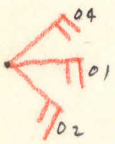
Phase 6

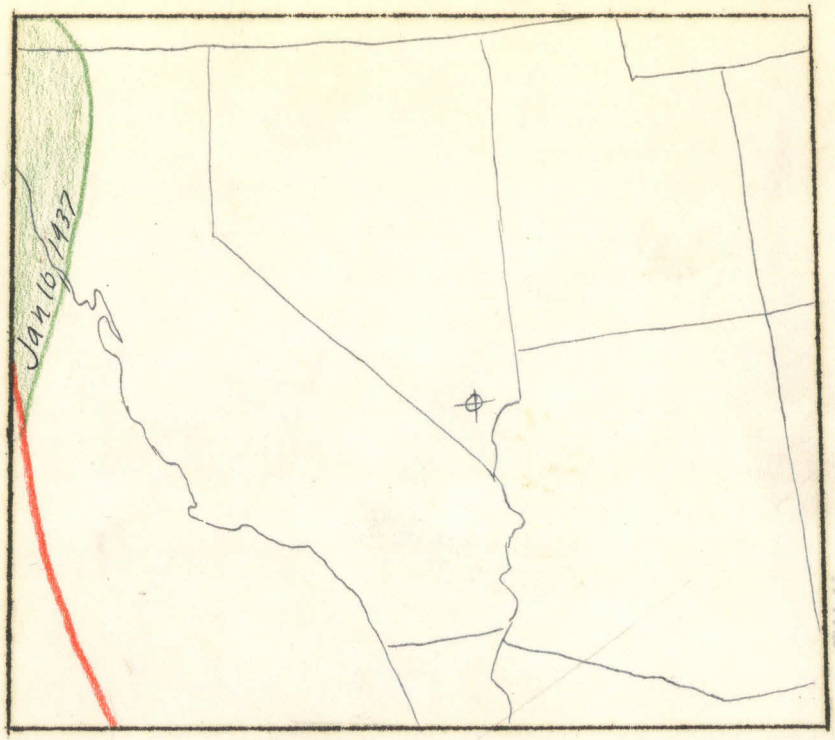
Jan. 4
1937









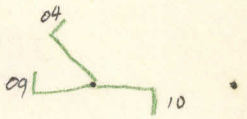


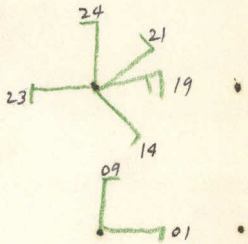
Jan. 10
1937

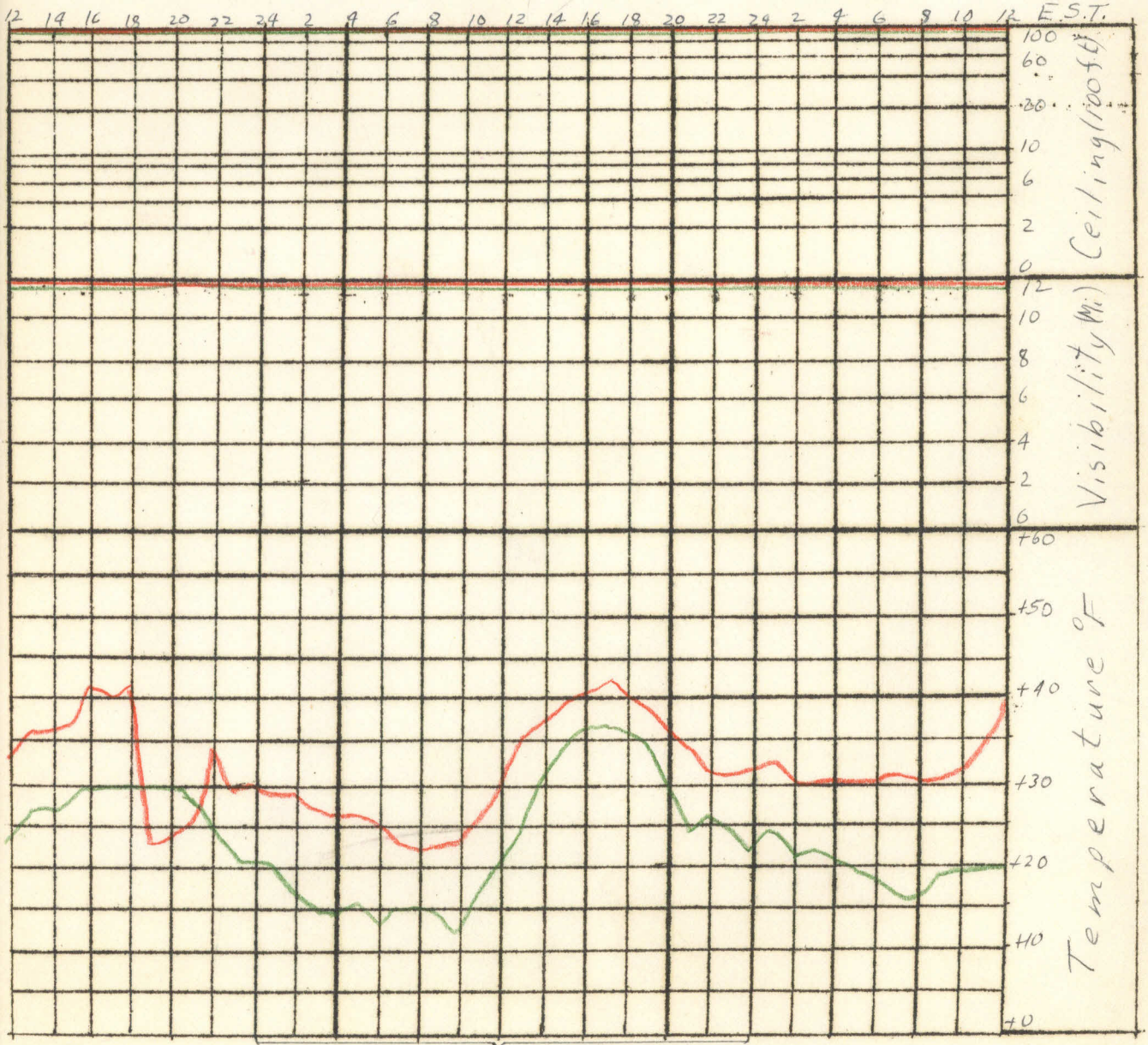


LQ

Type A
Phase 6







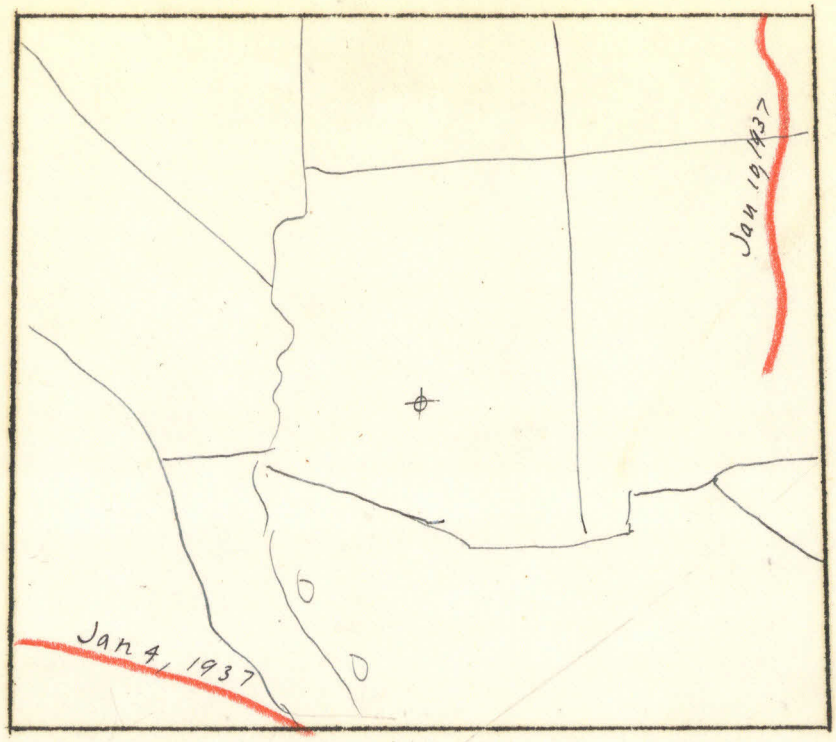
Phase 6

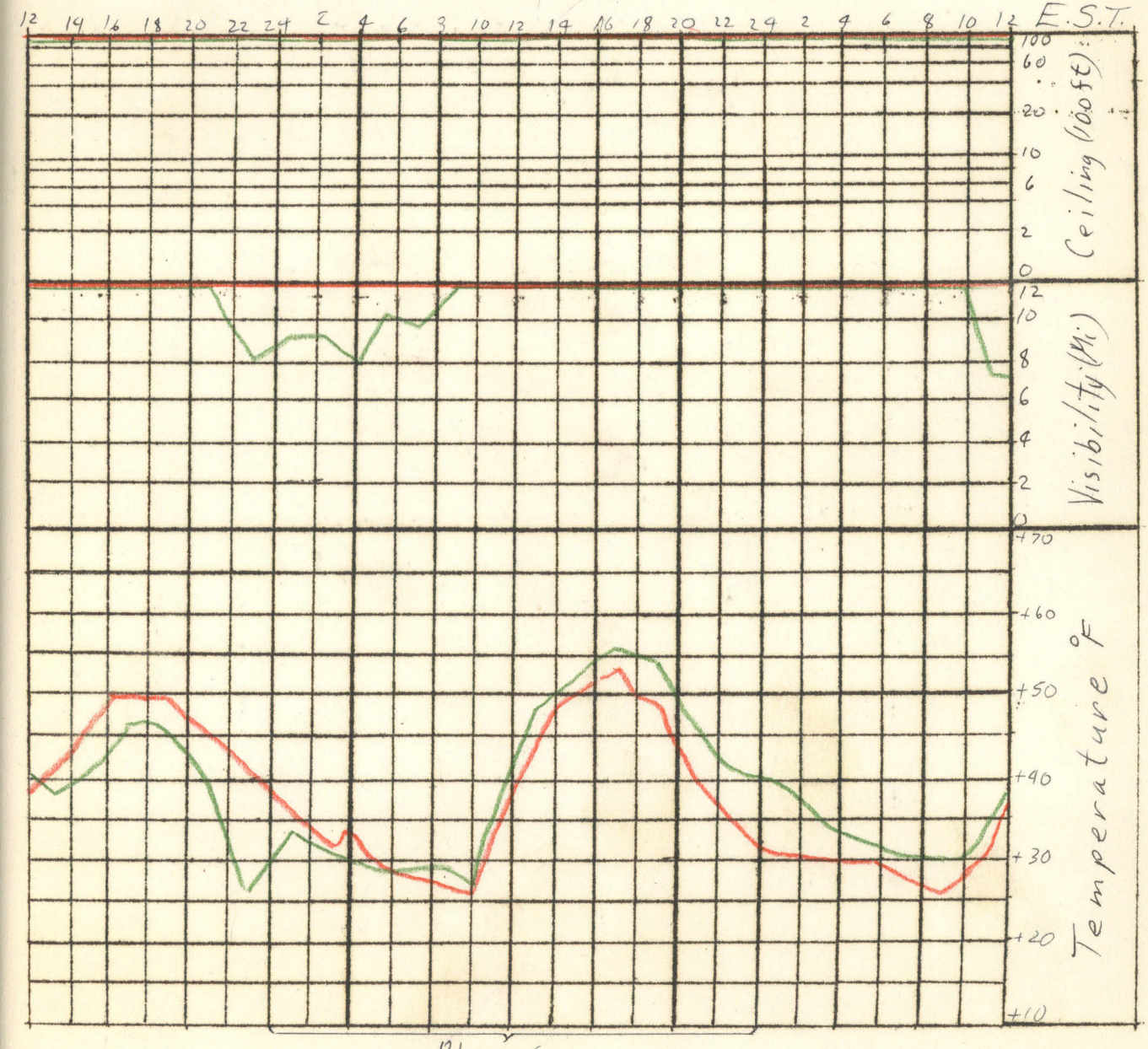
Jan. 4
1937

Jan. 10
1937

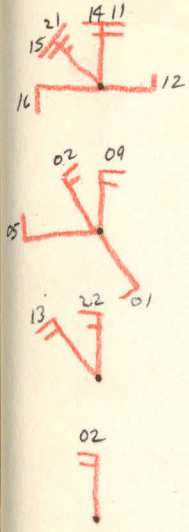
PH

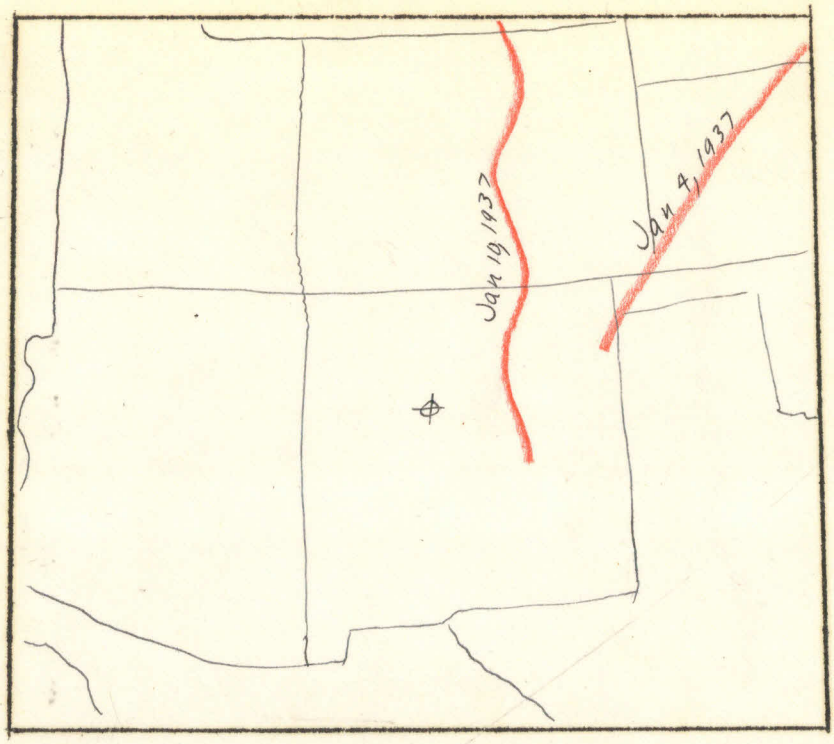
Type A
Phase 6



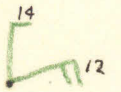


Jan. 4
1937



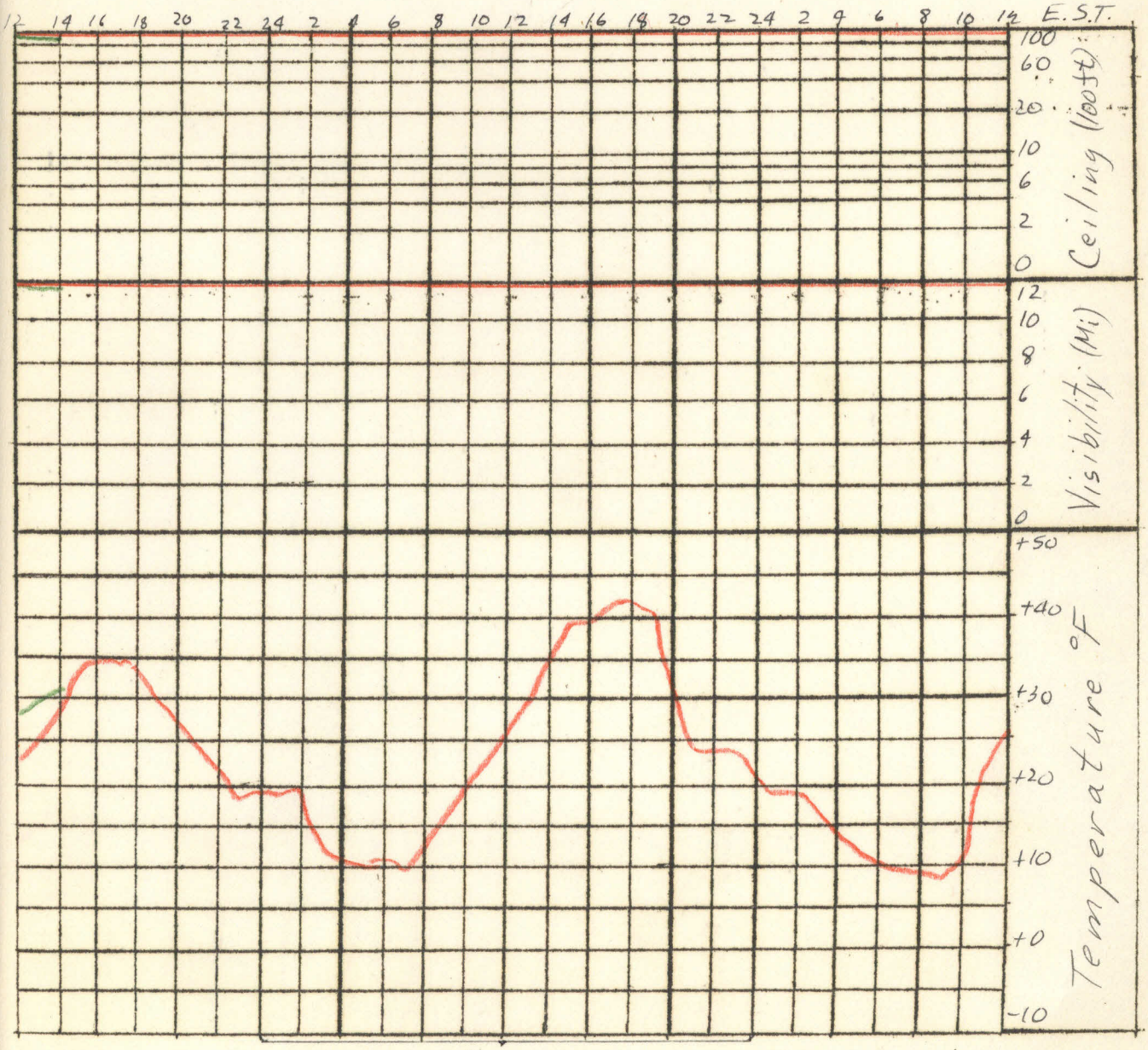


Jan. 10
1937



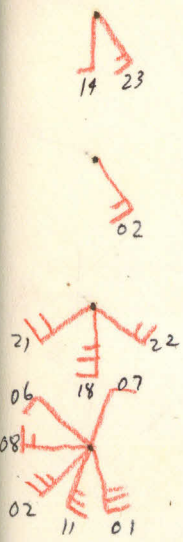
AB

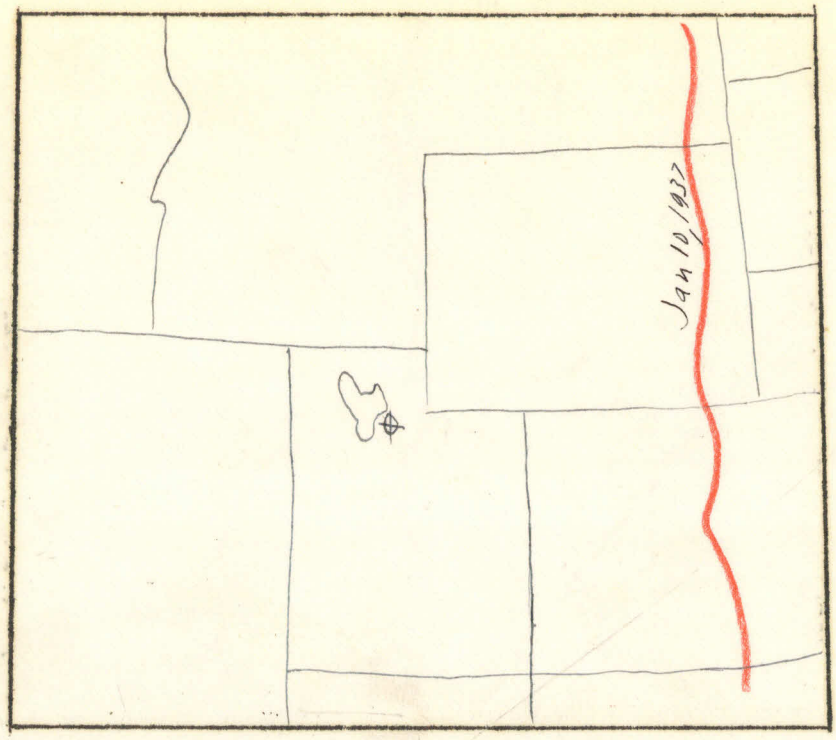
Type A
Phase 6



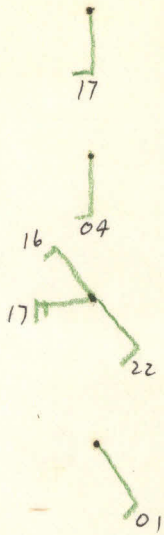
Phase 6

Jan. 4
1937



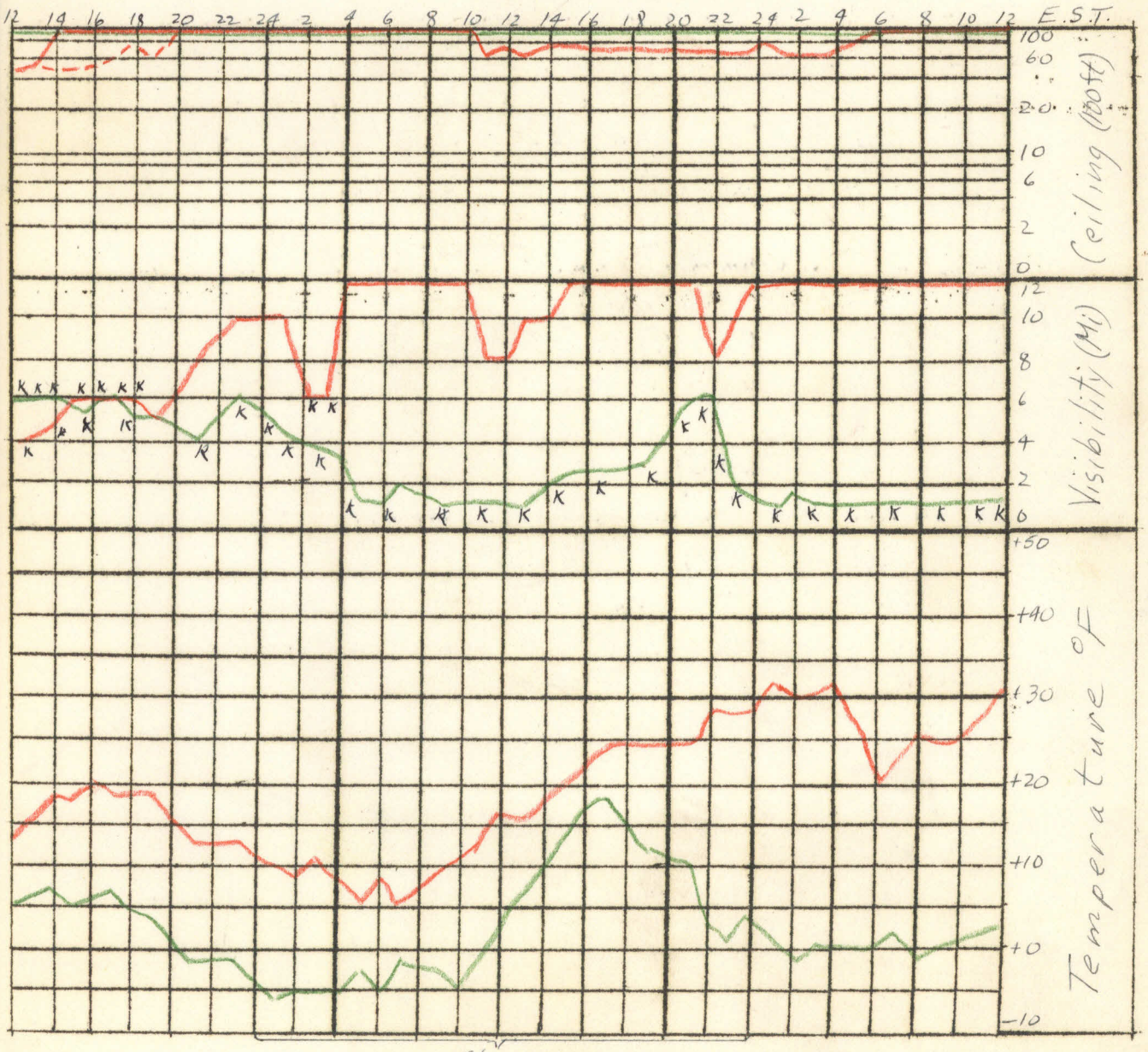


Jan. 10
1937

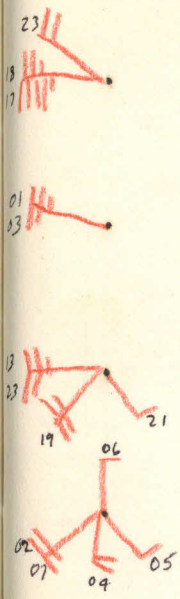


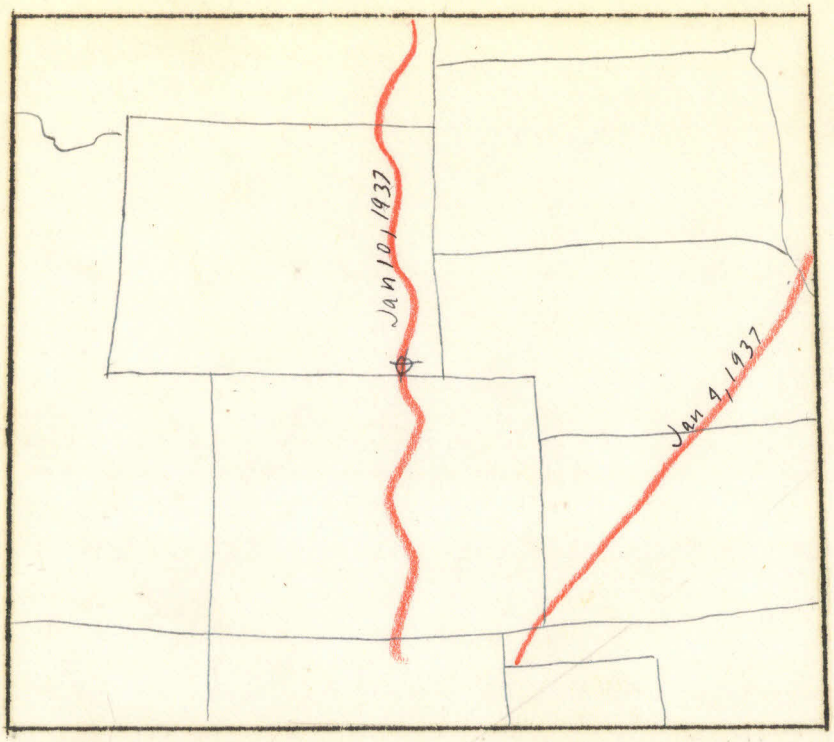
SL

Type A
Phase 6



Jan. 4
1937

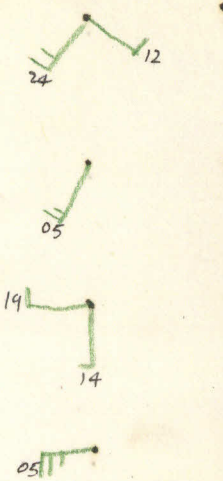


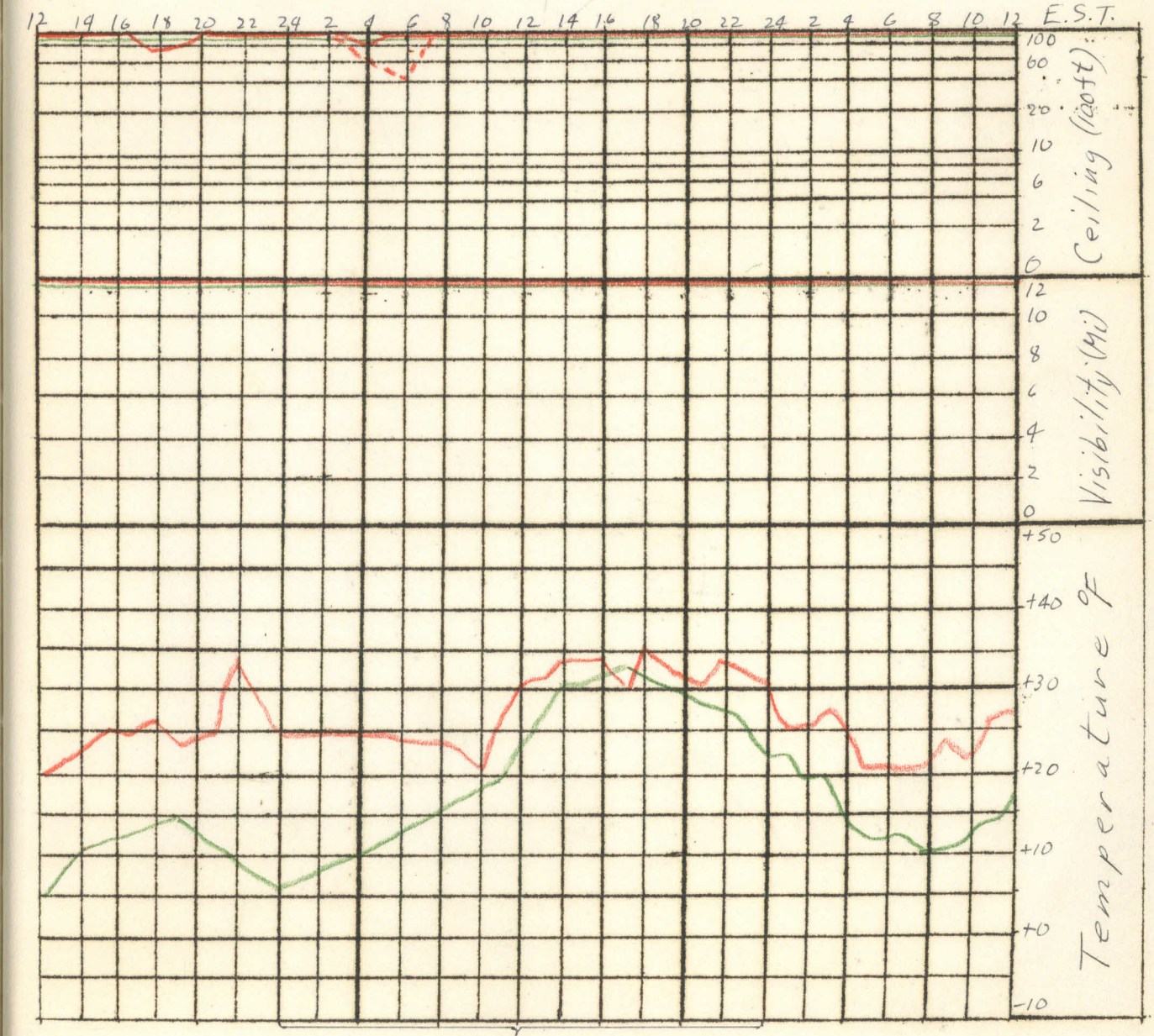


Jan. 10
1937

CX

Type A
Phase 6

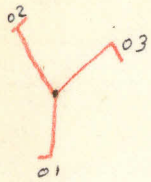


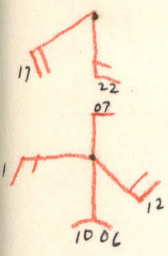


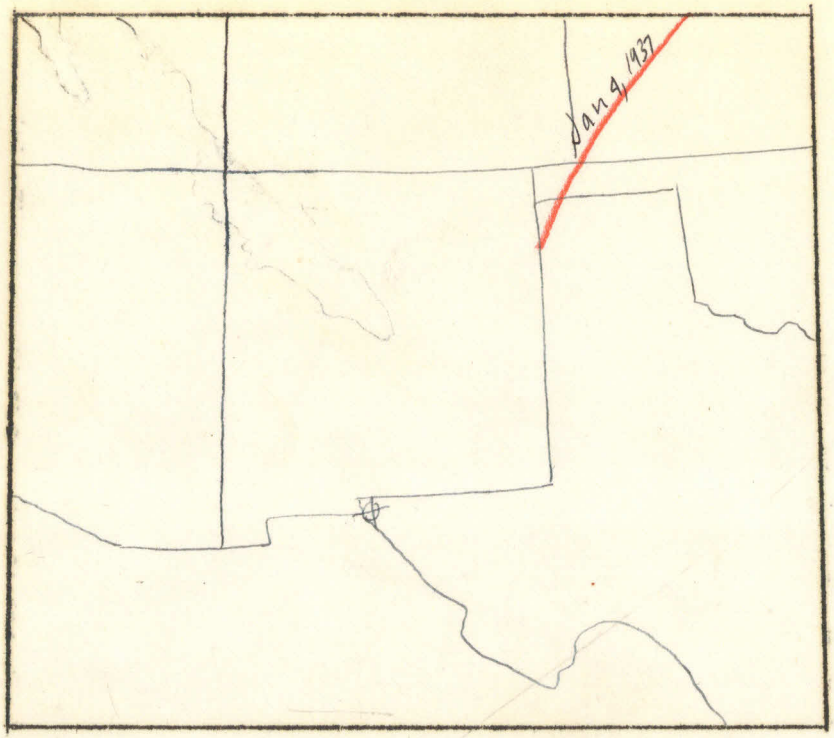
Phase 6

Jan. 4
1937

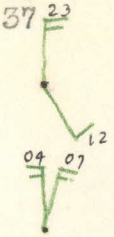


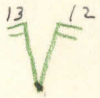






Jan. 10
1937

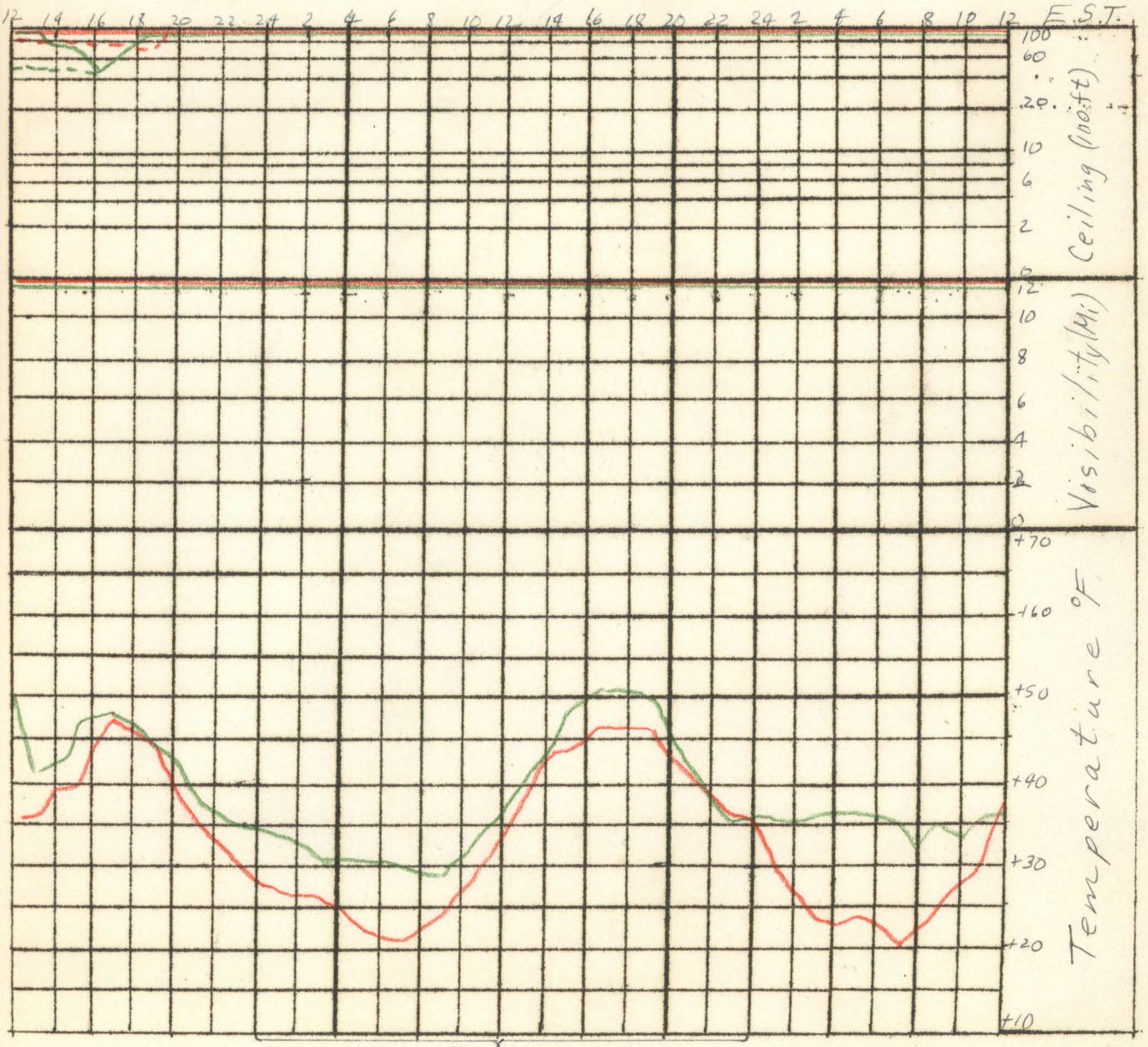






EO

Type A
Phase 6



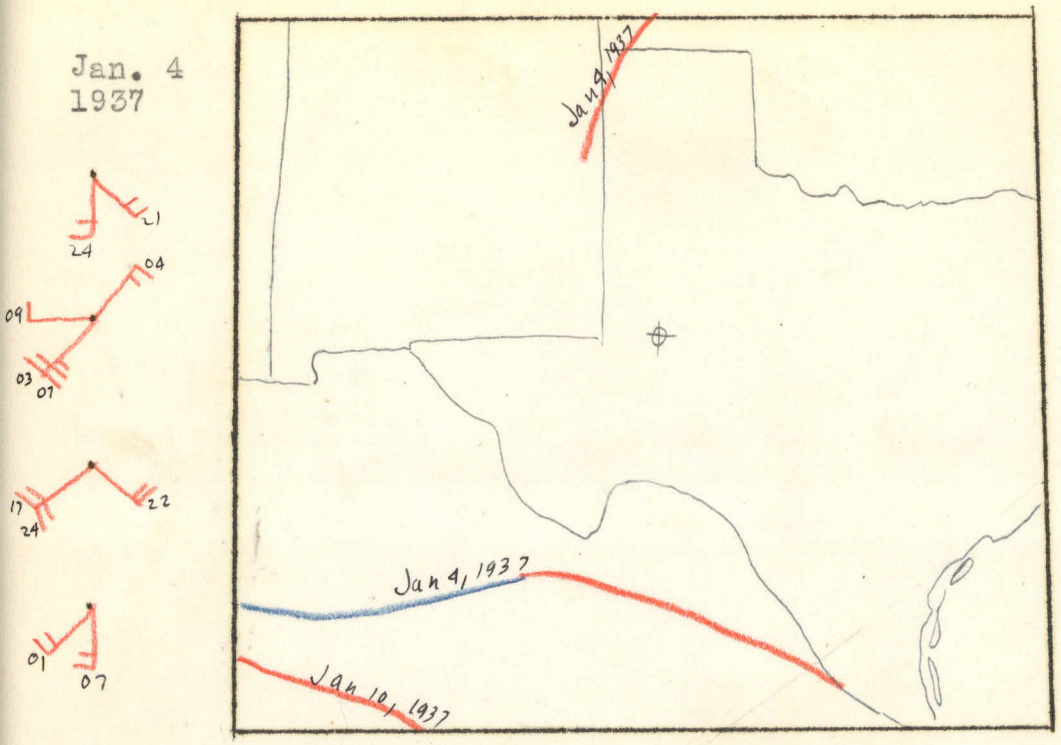
Phase 6

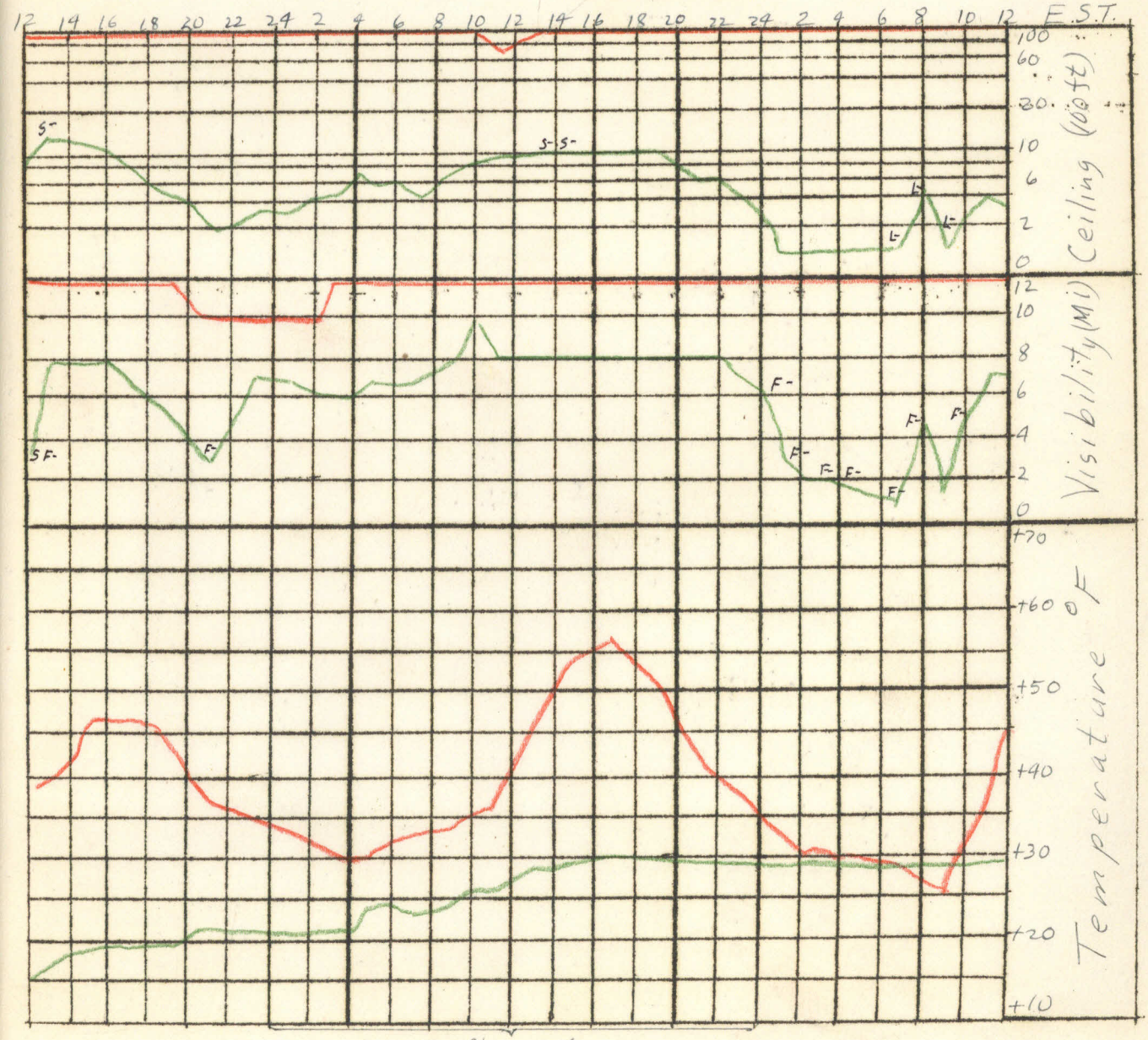
Jan. 4
1937

Jan. 10
1937

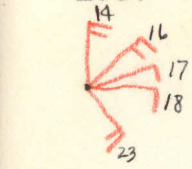
BZ

Type A
Phase 6





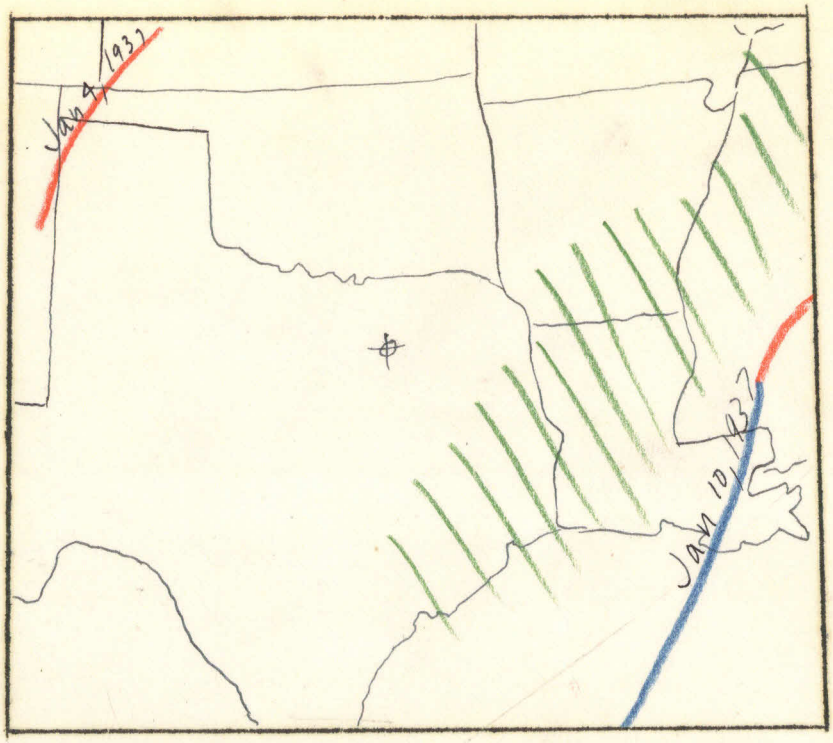
Jan. 4
1937



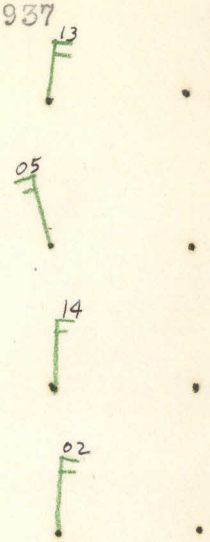






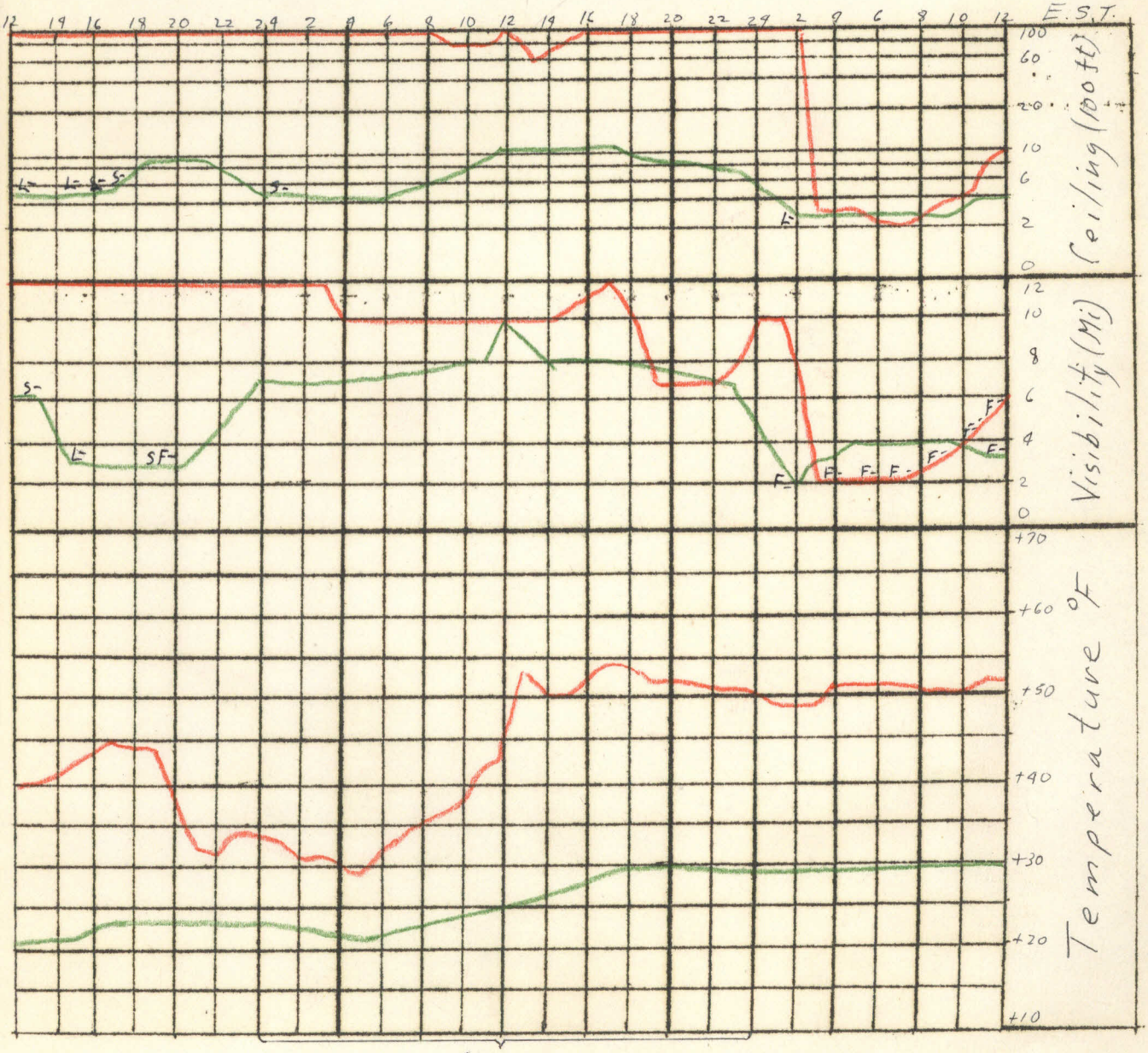


Jan. 10
1937



DL

Type A
Phase 6

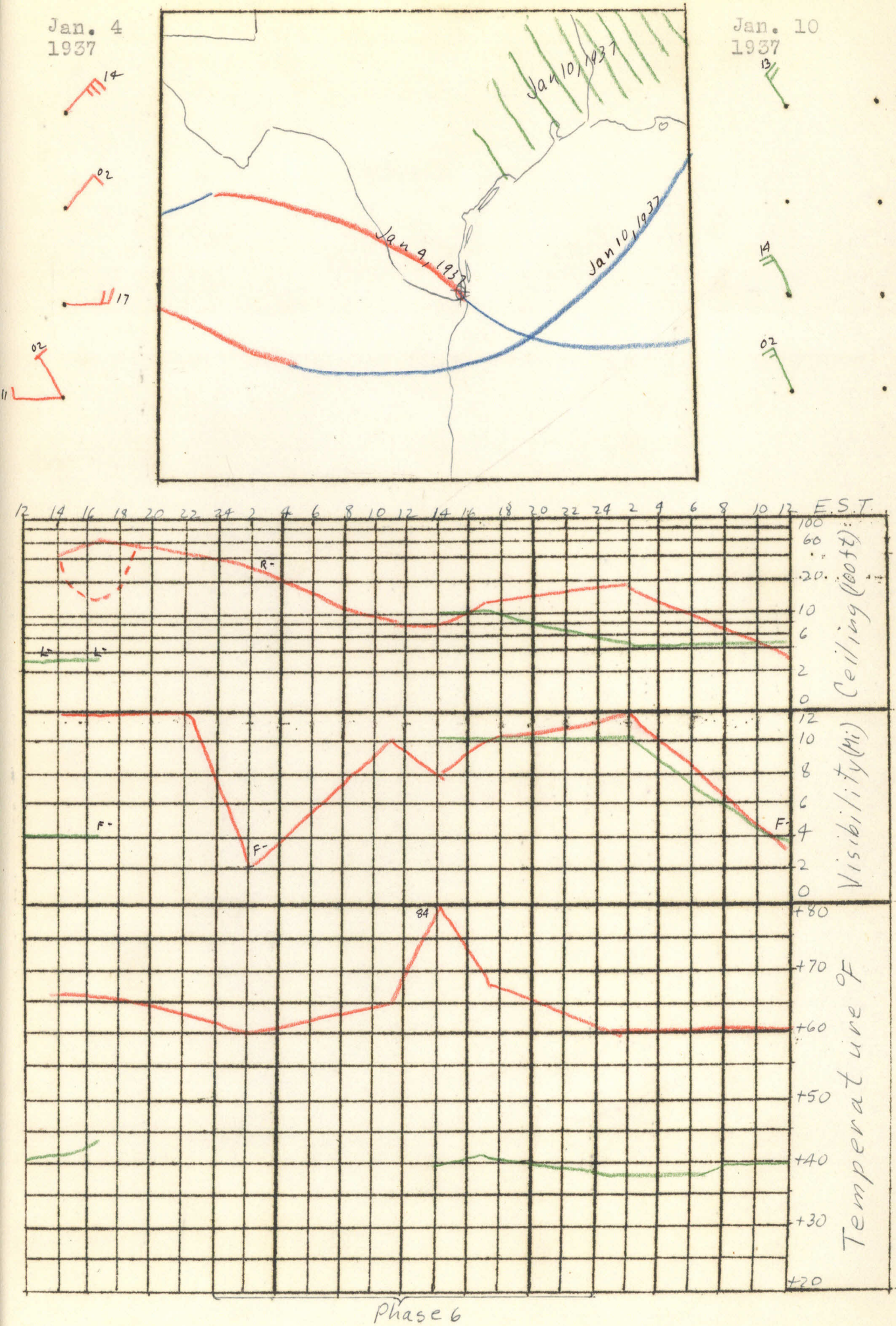


Jan. 4
1937

Jan. 10
1937

JI

Type A
Phase 6



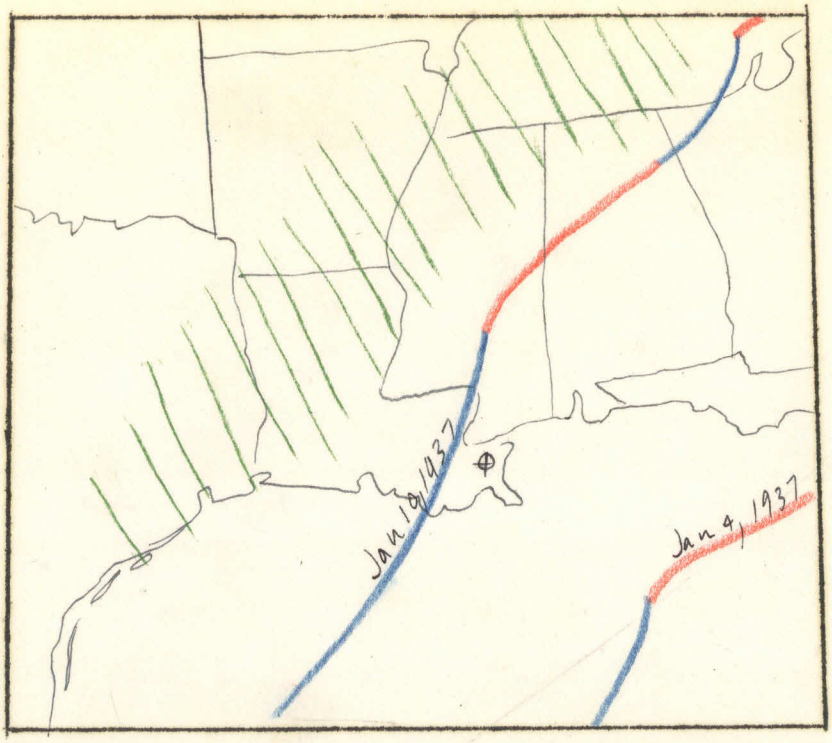
Phase 6

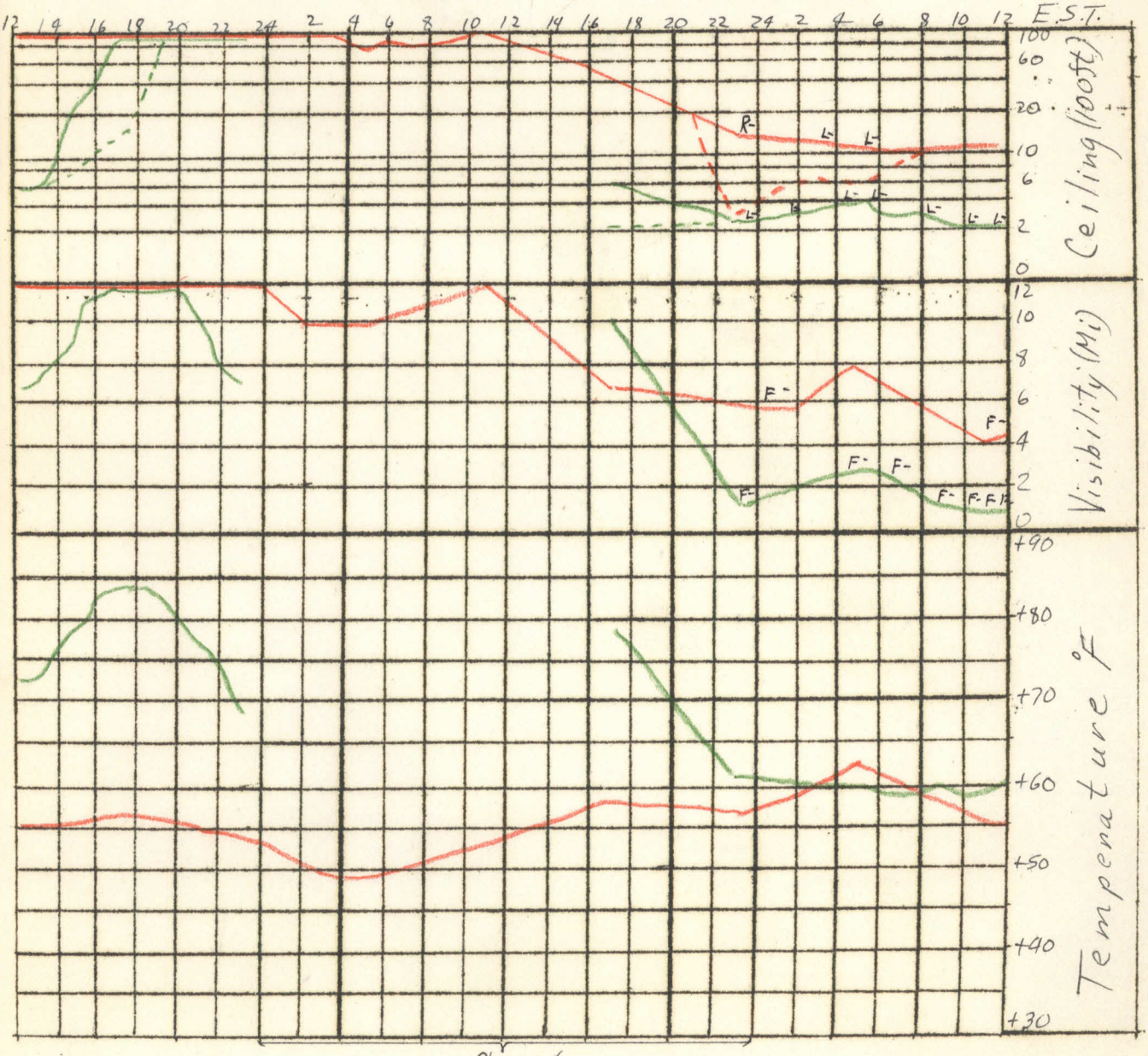
Jan. 4
1937

Jan. 10
1937

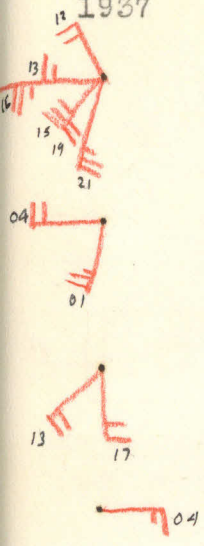
NO

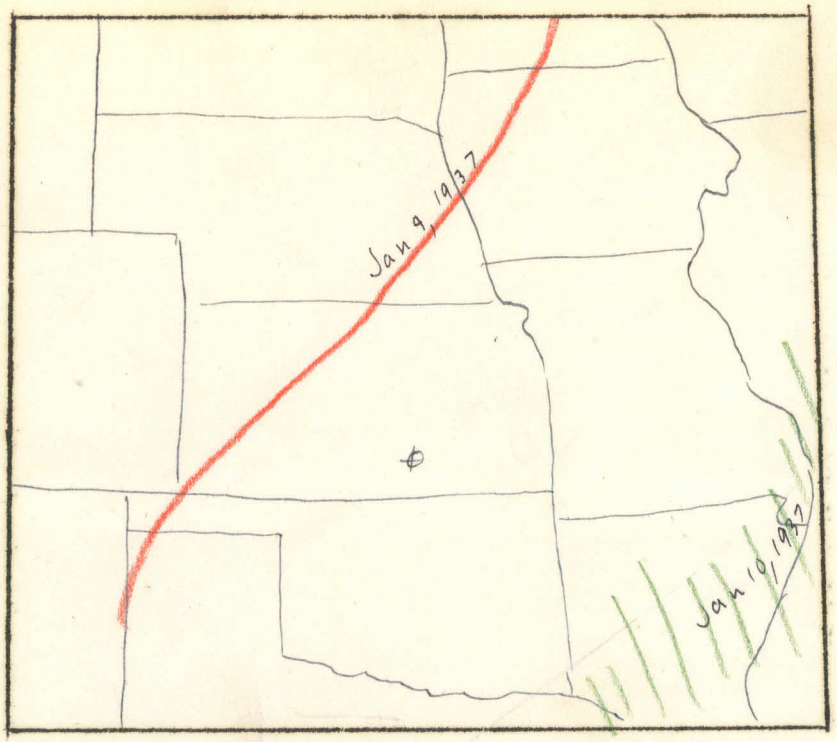
Type A
Phase 6





Jan. 4
1937

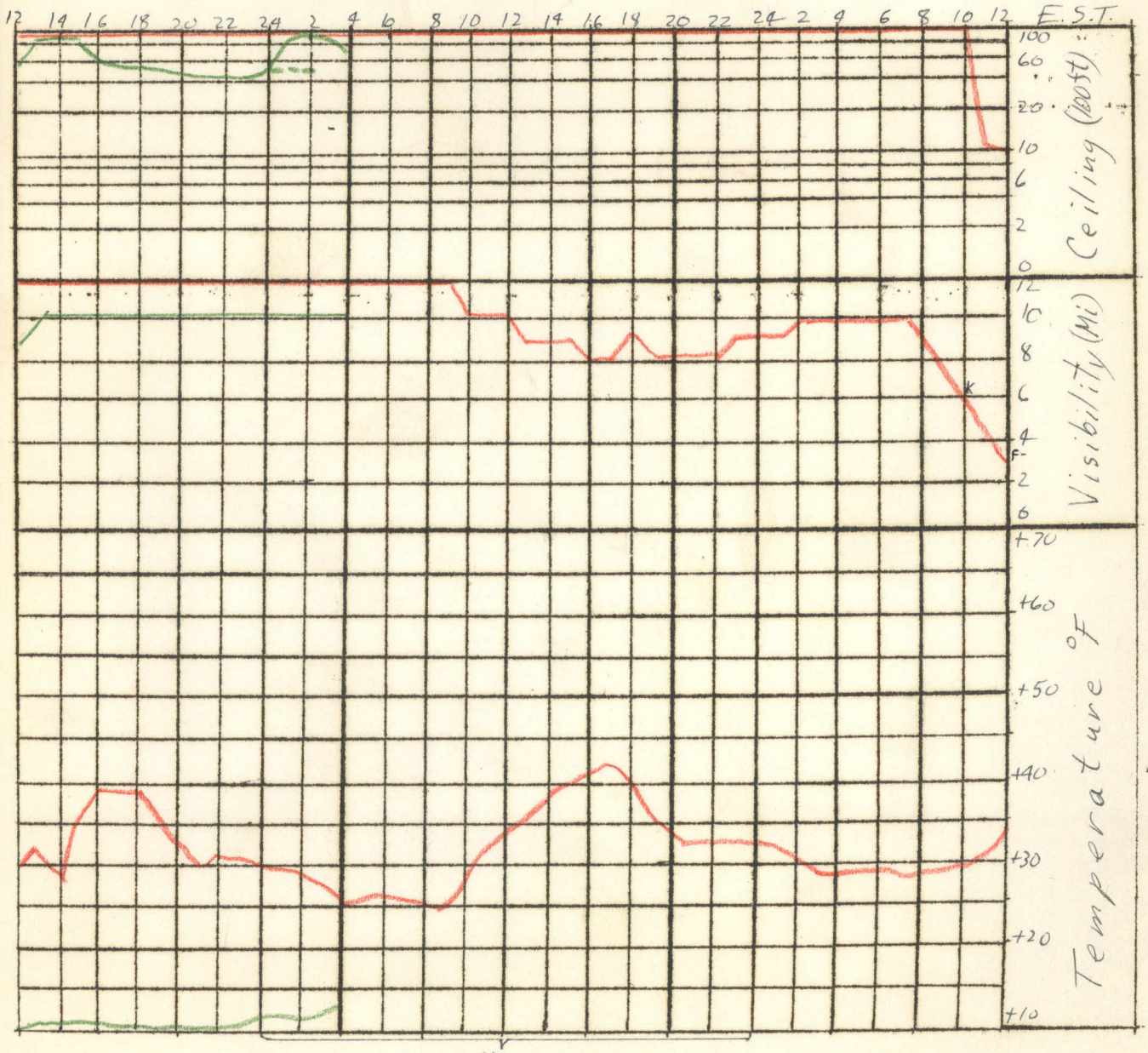




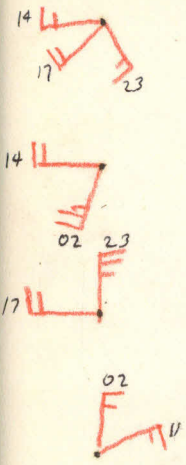
Jan. 10
1937

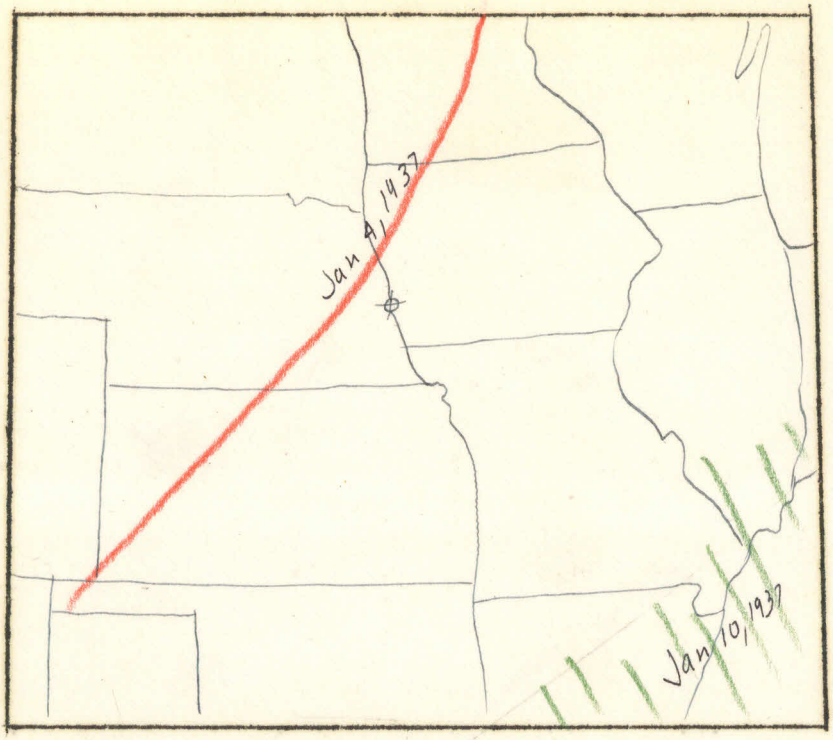
WD

Type A
Phase 6



Jan. 4
1937

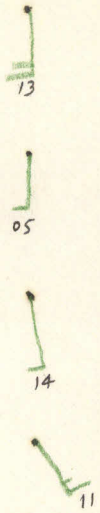


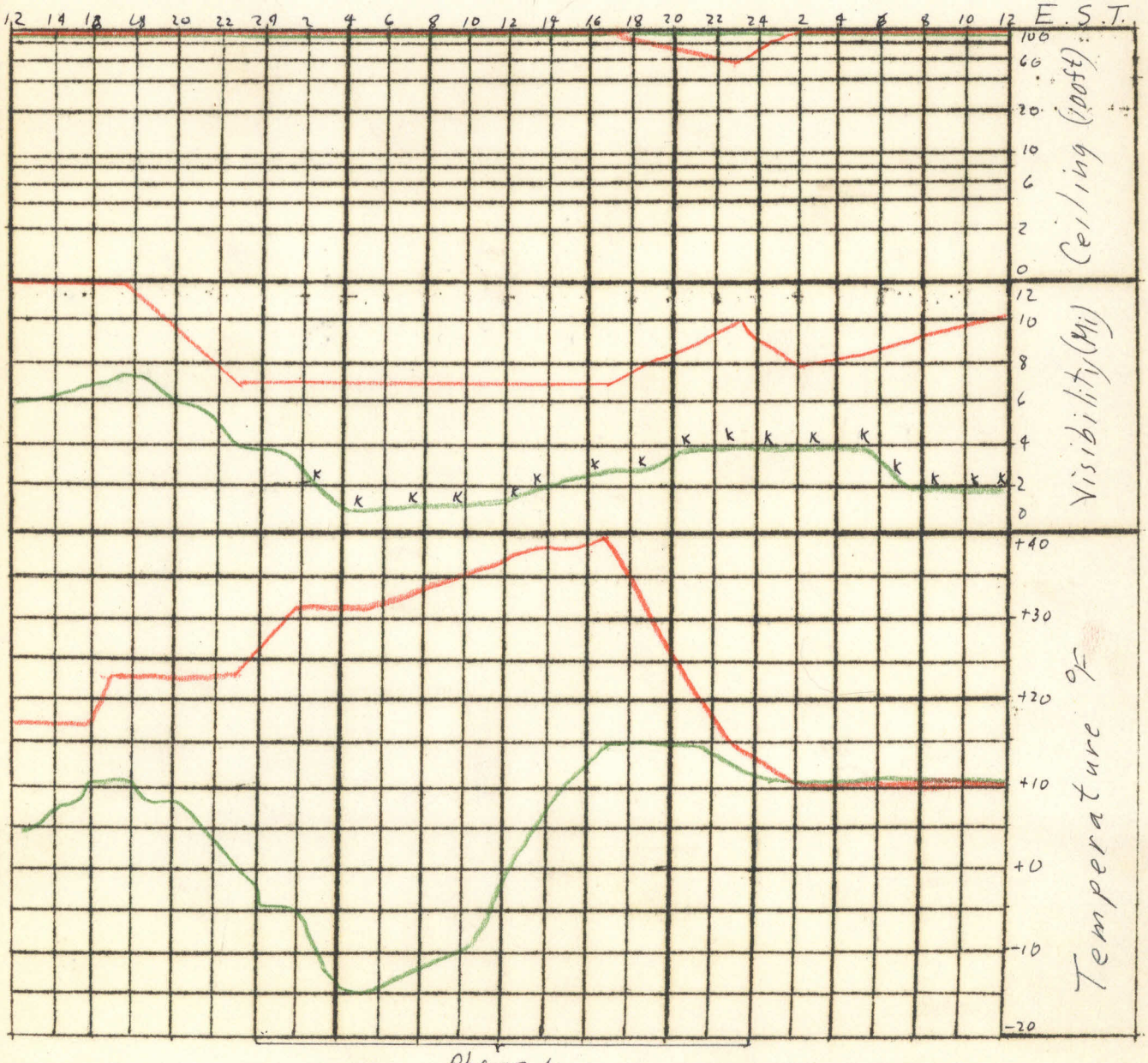


Jan. 10
1937

OH

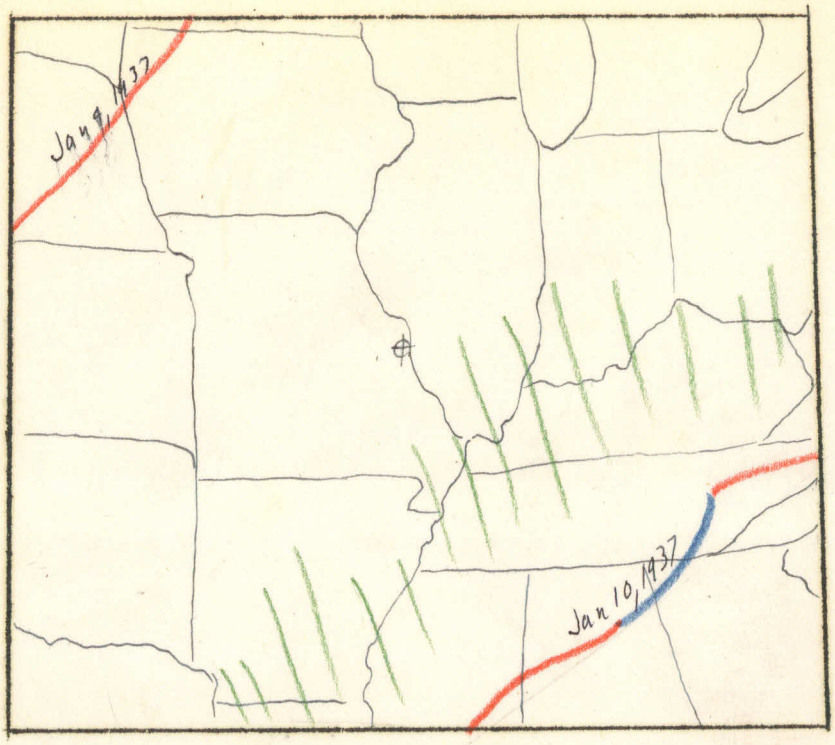
Type A
Phase 6



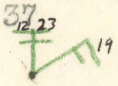


Jan. 4
1937



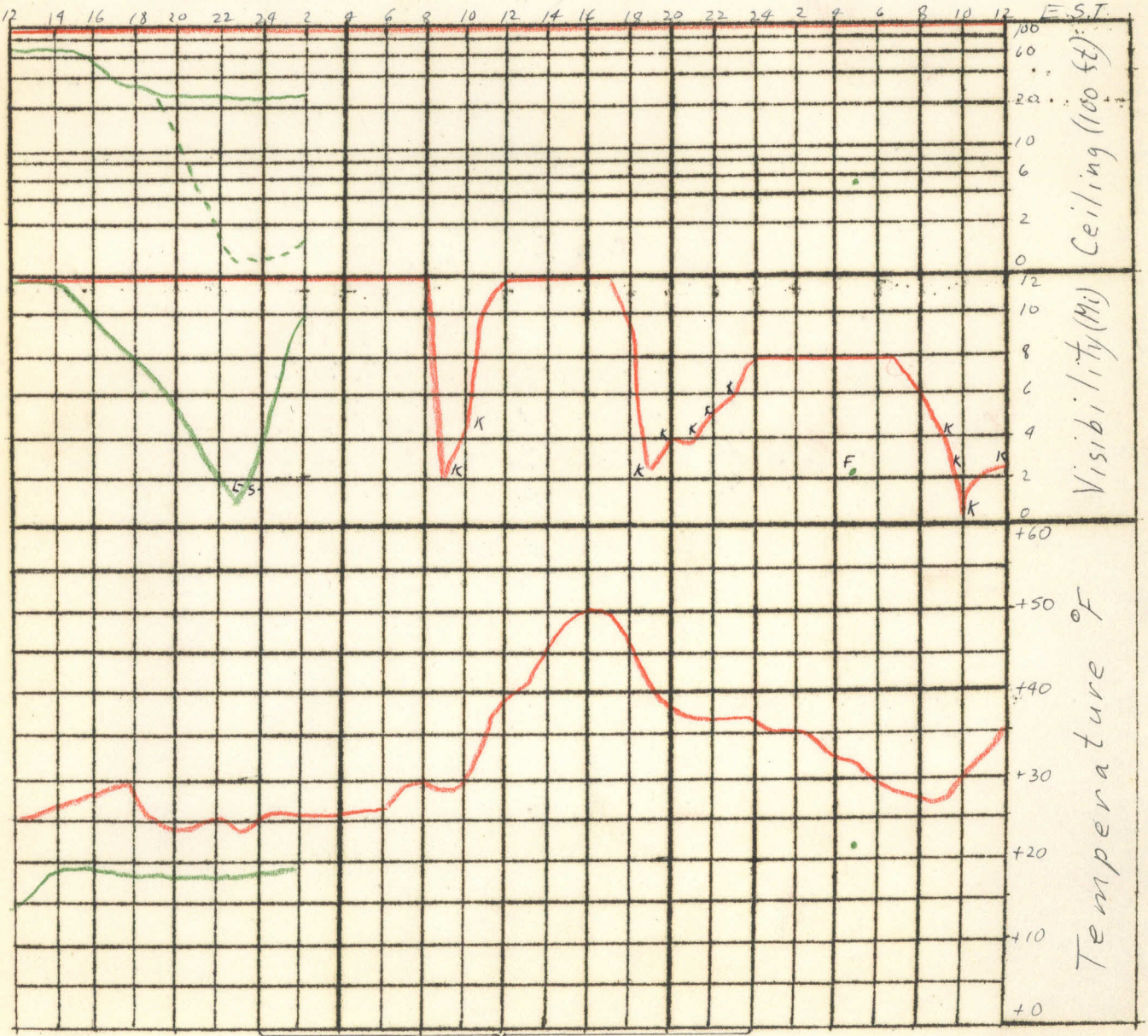


Jan. 10
1937



LS

Type A
Phase 6

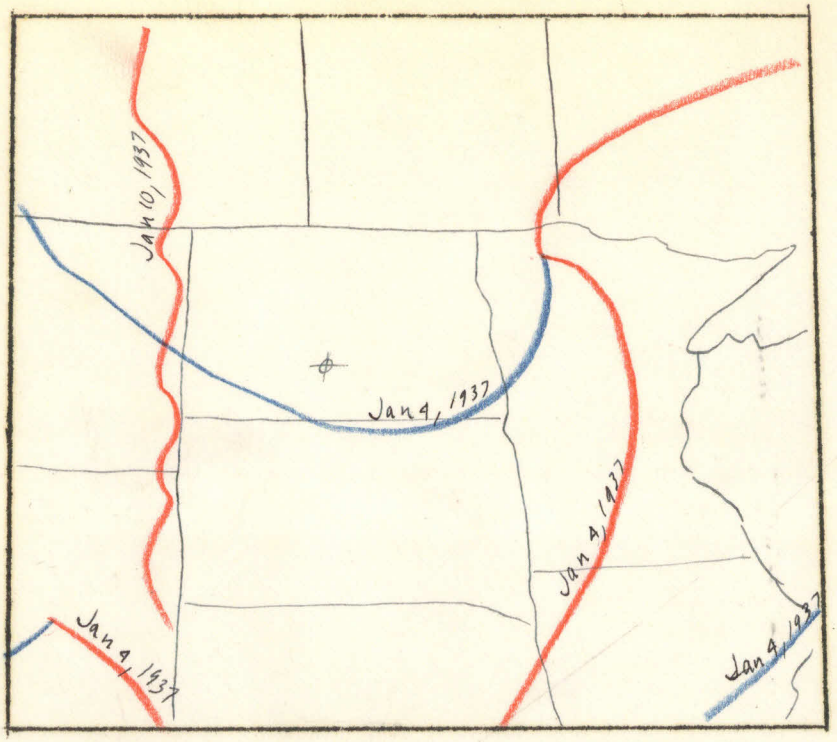


Jan. 4
1937

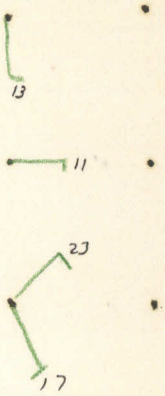
Jan. 10
1937

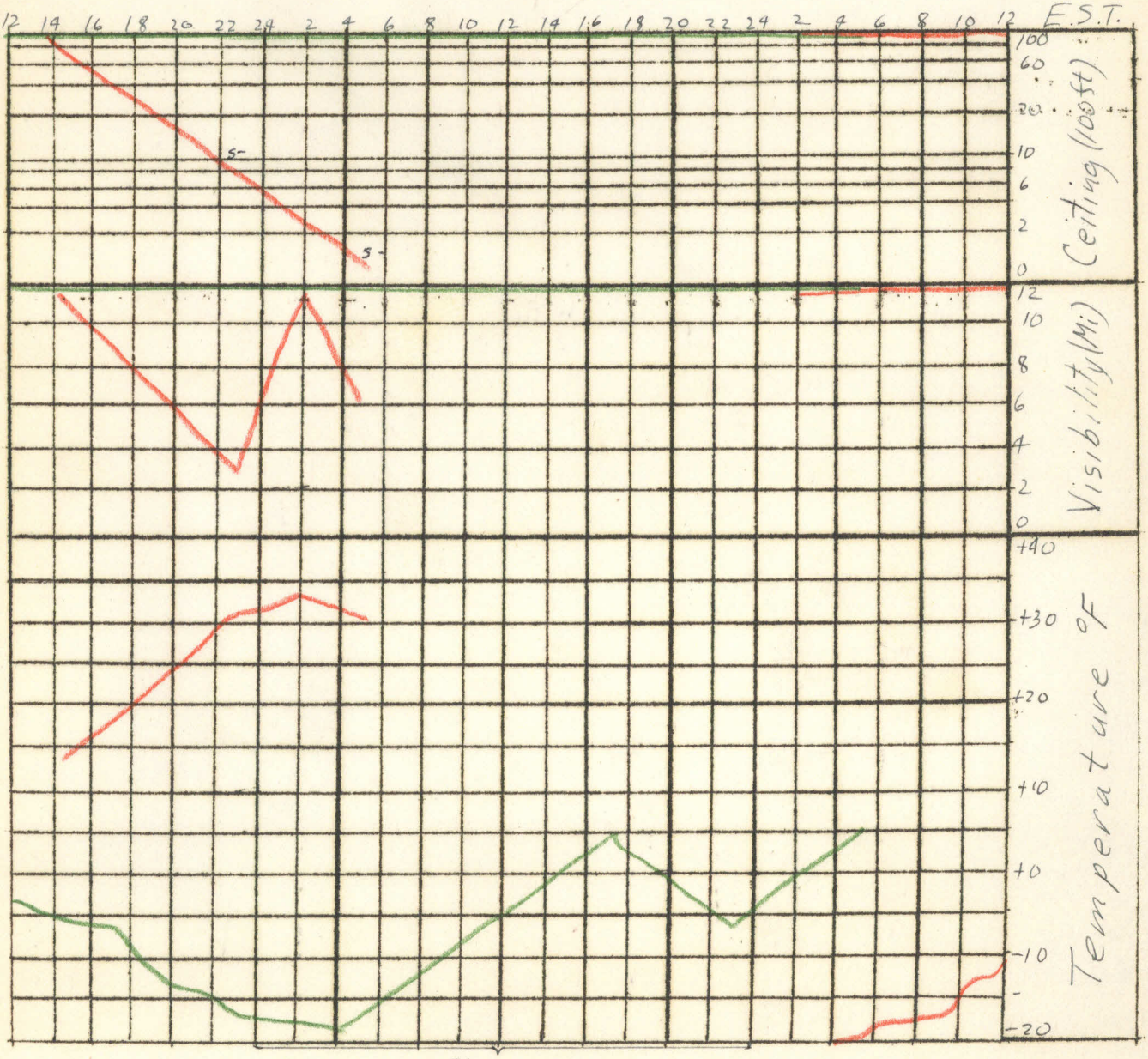
RK

Type A
Phase 6



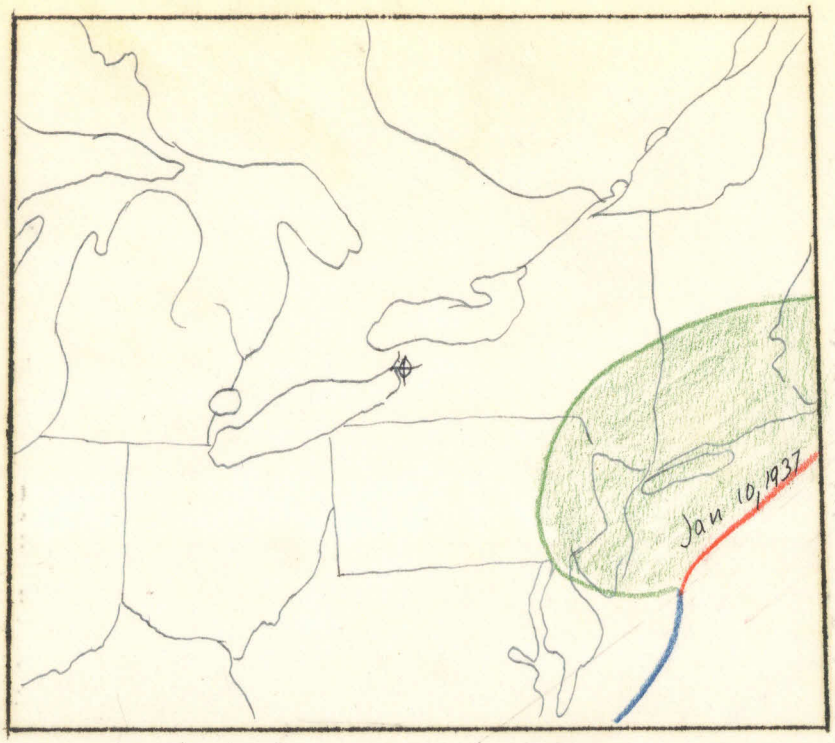






Phase 6

Jan. 4
1937

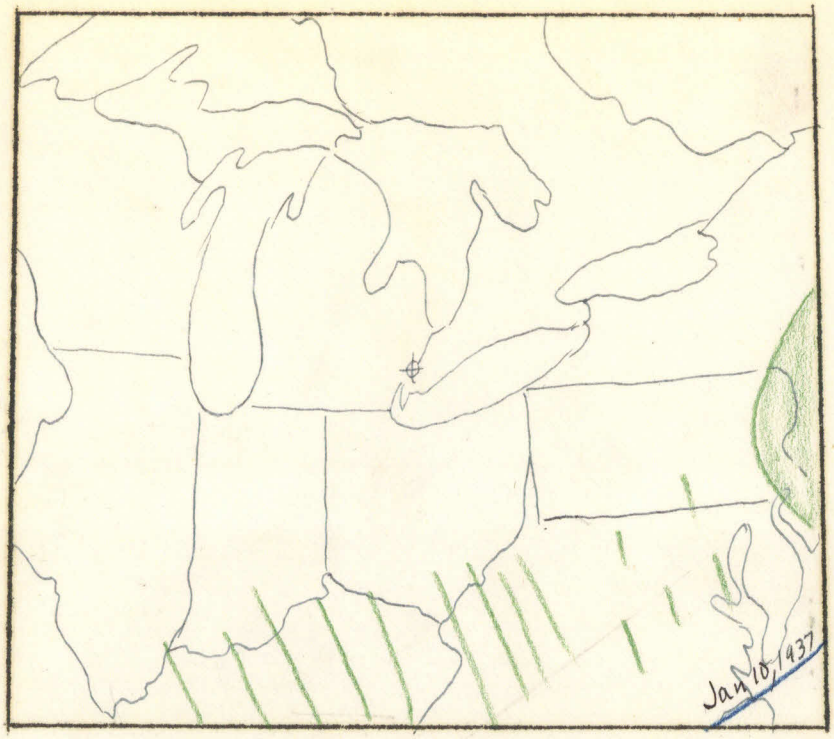


Jan. 10
1937

BJ

Type A
Phase 6

Jan. 4
1937



Jan. 10
1937

DO

Type A
Phase 6

12 14 16 18 20 22 24 2 4 6 8 10 12 14 16 18 20 22 24 2 4 6 8 10 12 E.S.T.

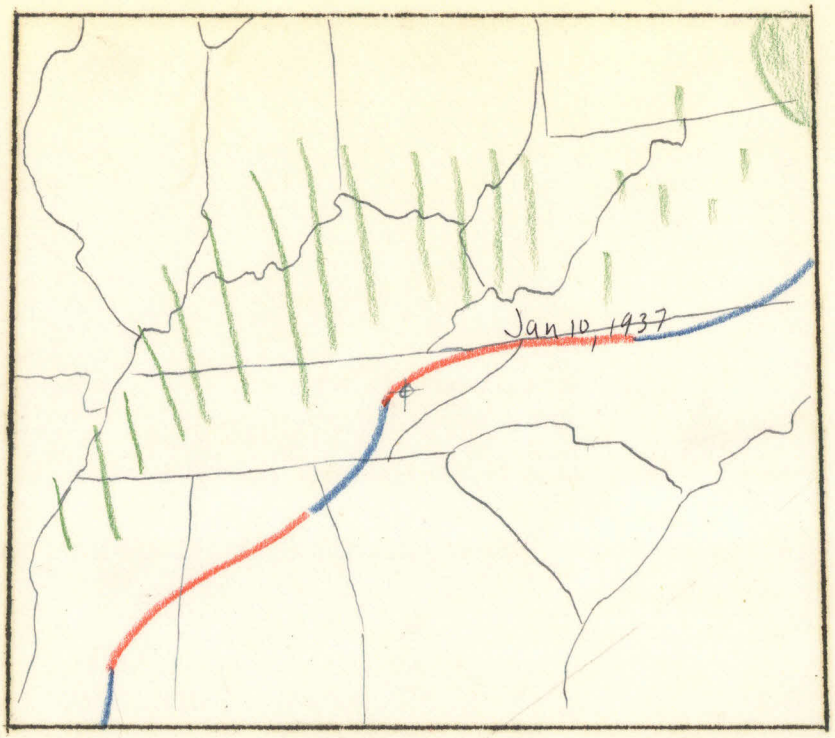
Ceiling (100 ft)

Visibility (Mi)

Temperature °F

Phase 6

Jan. 4
1937



Jan. 10
1937

KX

Type A
Phase 6

Ceiling (100 ft)

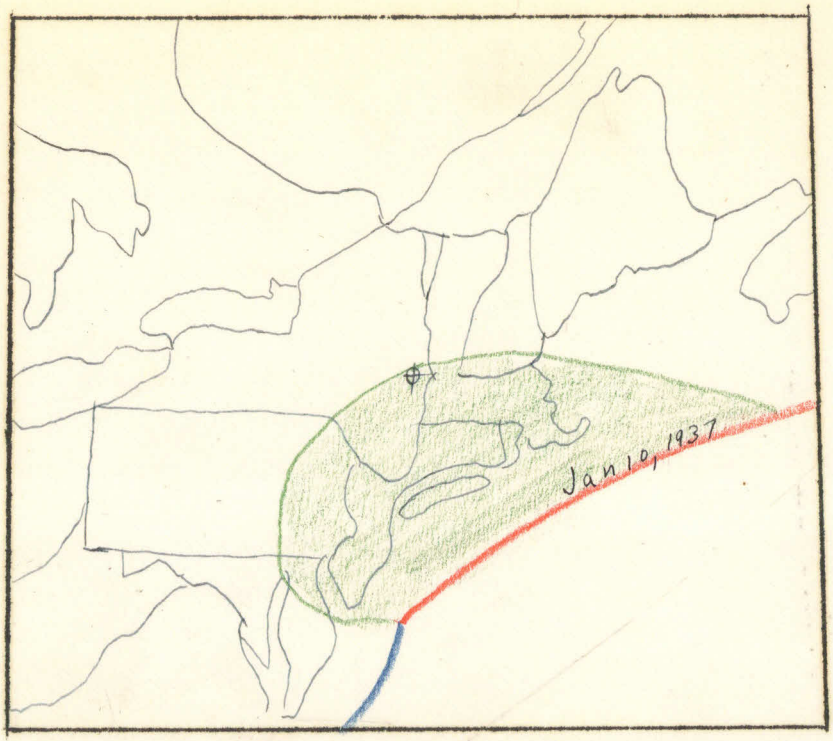
Visibility (Mi)

Temperature °F

E.S.T.

Phase 6

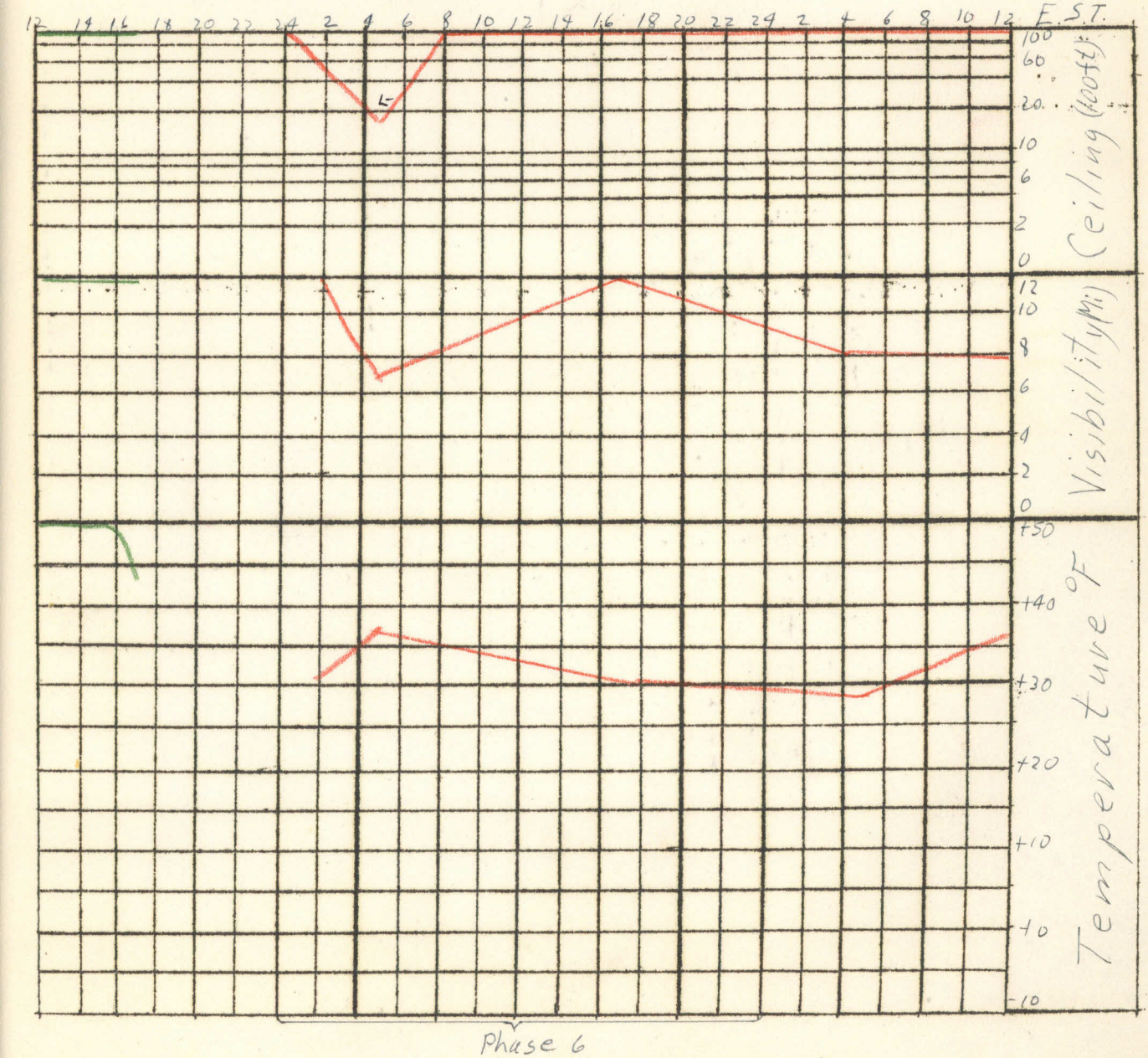
Jan. 4
1937



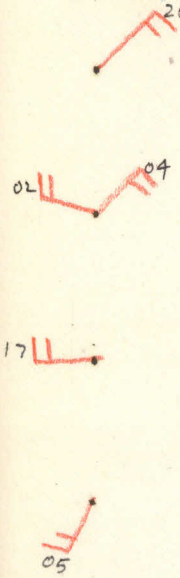
Jan. 10
1937

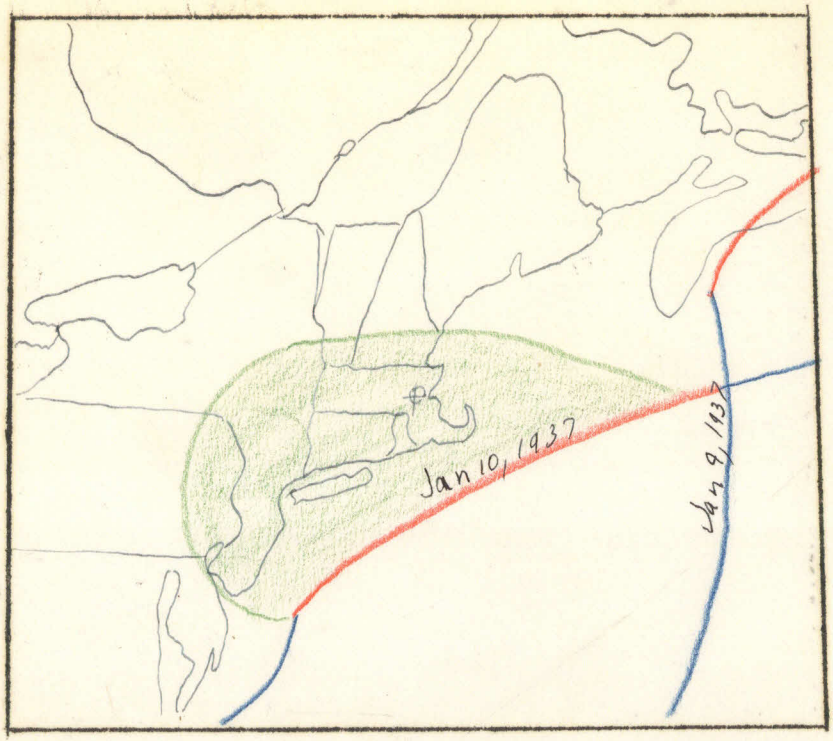
AZ

Type A
Phase 6



Jan. 4
1937



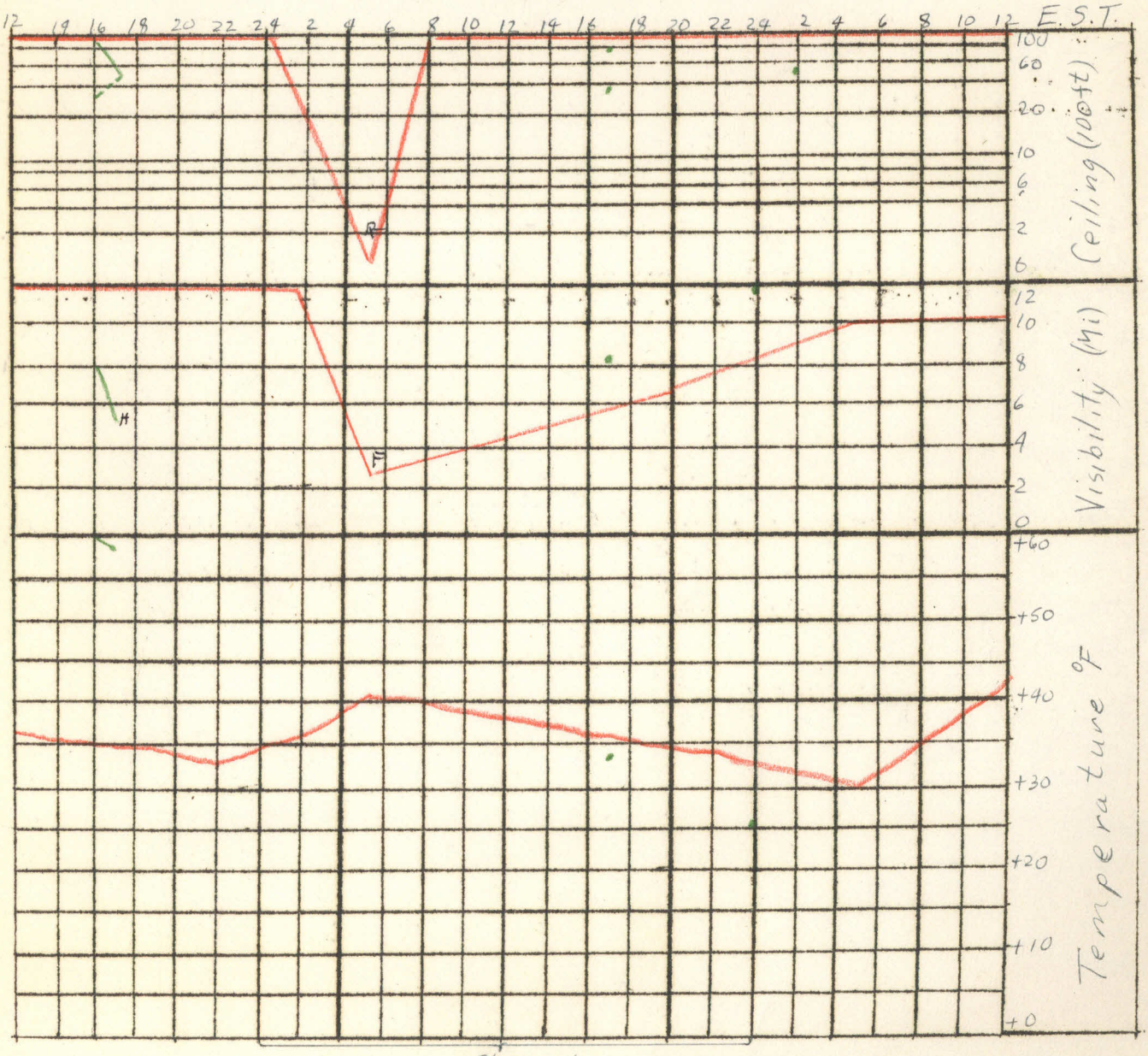


Jan. 10
1937

BW

Type A
Phase 6





Phase 6