

GEOGRAPHY 100
EXERCISE 8
CLIMATIC CLASSIFICATION

Climatic data

Weather patterns are short term atmospheric data usually from a day or a few days. Climatic data consisting of temperature and precipitation is simply the weather data over a long period of time. Numerous weather parameters could be useful for describing climatic patterns. However, long term weather data with world wide coverage are not always available. Therefore the most common ways of describing climates use average monthly temperature and precipitation measurements that are usually available on a world wide basis.

Mean monthly temperatures are averages of the daily average temperatures. The **daily temperature** is an average between the daily minimum temperature and the daily maximum temperature. A day having a maximum temperature of 80° F and a minimum temperature of 60° F would have an average daily temperature of 70° F. The **average monthly** temperature is calculated by totaling up the average daily temperatures and dividing that total by the number of days in the month. The **mean annual temperature** is calculated by totaling up the average monthly temperatures and dividing that total by 12 months.

The table below shows the daily maximum and minimum temperatures for the month of July in Billings, Montana over a 30 year period.

DAY	MAX.	MIN.	AVG.	DAY	MAX.	MIN.	AVG.
1	83.2	55.3	_____	17	86.0	57.9	_____
2	83.5	55.5	_____	18	86.2	58.0	_____
3	83.8	55.7	_____	19	86.2	58.1	_____
4	84.0	55.9	_____	20	86.1	58.2	_____
5	84.1	56.0	_____	21	86.2	58.2	_____
6	84.3	56.2	_____	22	86.3	58.2	_____
7	84.5	65.4	_____	23	86.4	58.4	_____
8	84.6	56.5	_____	24	86.4	58.4	_____
9	84.7	56.7	_____	25	86.5	58.5	_____
10	85.0	56.8	_____	26	86.6	58.5	_____
11	85.0	57.0	_____	27	86.7	58.6	_____
12	85.2	57.1	_____	28	86.7	58.6	_____

13	85.4	57.3	_____	29	86.6	58.6	_____
14	85.6	57.5	_____	30	86.5	58.6	_____
15	85.8	57.7	_____	31	86.5	58.6	_____

1. a) complete the table above by calculating the average daily temperatures.

b) Calculate the mean monthly temperature for Billings, Montana. _____

The table below consists of the mean monthly temperatures and precipitation values over a 58 year period for Billings, Montana.

J	F	M	A	M	J	J	A	S	O	N	D	YR.
23.5	29.3	35.5	45.4	55.3	64.3	72.5	71.0	59.8	48.8	35.5	27.0	_____
0.73	0.61	1.07	1.80	2.26	2.08	1.11	0.83	1.29	1.17	0.72	0.64	_____

2. a) Calculate the mean annual temperature for Billings, Montana. _____

b) Calculate the total yearly precipitation for Billings, Montana _____

3. Construct a climograph for Billings, Montana by plotting the mean monthly temperature and precipitation values presented above on the attached climograph. Plot temperature values as a histogram and the precipitation values as a bar graph.

Climatic classification systems

A number of climatic classification systems are used world wide. However no climatic system is perfect. A climatic classification was developed in the early 1918 by an Austrian Meteorologist named Vladimir Köppen and was based on the distribution of temperature and precipitation data that are available worldwide. The climatic classification proposed by Köppen was later modified by the American meteorologist R. Geiger in 1953. The Köppen - Geiger system of climatic classification is the most used climatic classification in the world today.

Köppen - Geiger System of Climate Classification

Letter symbol

1st 2nd 3rd

- A** **Tropical Climates** All mean monthly temperatures are over 64.4°F (18°C)
- f Rain forest sufficient precipitation in all months. (> 2.4 inches).
- s Dry season in summer of the respective hemisphere.
- w Dry season in winter of the respective hemisphere.
- m Monsoon (rain forest despite a dry season).
-

- B** **Dry Climate** Evaporation exceeds precipitation. Use graphs.
- S Steppe climate. Use graphs to determine boundaries.
- W Desert climate. Use graphs to determine boundaries.
- h Hot, mean annual temperature above 64.4°F .
- k Cold, mean annual temperature below 64.4°F .
-

- C** **Warm temperate climates.** mean temperature of coldest month between 64.4°F and 32°F . Warmest month above 50°F .
- s Dry season in summer of respective hemisphere.
- w Dry season in winter of respective hemisphere.
- f Wet in all seasons. (Criteria for s and w cannot be met).
- a mean monthly temperature of warmest month over 72°F (22°C).
- b Cool summer. Warm month below 72°F , at least four months above 50°F .

- D **Snow climates.** Mean temperature of warm month is above 50°F . (10°C)
Coldest month mean temperature is below 32°F . Four to eight months
above 50°F .
- s Dry season in summer of respective hemisphere.
- w Dry season in winter of respective hemisphere.
- f Sufficient precipitation in all months
- a Mean monthly temperature of warmest month is over 72°F .
- b Mean monthly temperature of warmest month is under 72°F . At least 4
months have mean temperatures above 50°F .
- c Fewer than 4 months with mean monthly temperatures above 50°F .
- d Same as c, but coldest month mean temperature below -36°F (-38°C)
-

- E **Polar climates.** Warmest mean monthly temperature is below 50°F .
- T Tundra. Warmest mean monthly temperatures is at least 32°F .
- F Ice cap. Mean monthly temperature of all months is below 32°F .
-

- H **Highland climate.** A category created to accommodate uplands where
spatial variations preclude accurate mapping.
-

4. Determine the correct Köppen climate classification for Billings, Montana. _____

Climate Controls

Along with temperature and precipitation, latitude is also a very important climatic control. Latitudes between 23.5 degrees north and south experience direct solar insolation twice annually. Therefore, low latitude locations have patterns that differ from those at latitudes outside 23.5 north and south. Land and water also constitute another climatic control. Land heats up faster than water does, while water retains the heat longer. Therefore locations of equal latitude that are near large bodies of water have their temperatures modified and are more uniform than continental locations of the same latitude. Mountain ranges enhance the precipitation on the windward side of the range and decrease the precipitation on the leeward side creating a rain shadow. Elevation is another factor that contributes to climatic variation as both temperature and pressure decrease with elevation.

Climates

5. Plot a climograph for the selected world climatic stations shown below. The station temperature data is recorded in °F. The station precipitation data is recorded in inches. Locate the station position on the world map at the bottom of the climograph. On the back of each climograph, comment on the temperature, precipitation, vegetation, soils, and the economic products related to climatic factors.

Belem, Brazil

J	F	M	A	M	J	J	A	S	O	N	D	Yr.
78.4	78.1	78.3	78.6	79.0	79.5	79.2	79.7	79.5	80.1	80.1	26.4	26.2
13.8	16.2	17.4	14.6	11.1	6.5	6.1	4.8	5.1	4.1	4.0	7.9	111.7

Akyab, Burma

70	73	79	83	84	82	81	81	82	82	78	72	78.9
0.1	0.2	0.5	2.0	13.7	49.4	53.7	42.5	24.6	11.6	5.0	0.6	203.8

Cuiaba, Brazil

81	81	81	80	78	75	76	78	82	82	82	81	79.7
9.8	8.3	8.3	4.0	2.1	0.3	0.2	1.1	2.0	4.5	5.9	8.1	54.6

Cairo, Egypt

55	57	63	70	76	80	82	82	78	74	65	58	70
0.4	0.2	0.2								0.1	0.2	1.1

Port Nolloth, South Africa

60	60	59	58	57	55	55	54	55	58	59	60	57.5
	0.1	0.2	0.2	0.4	0.3	0.2	0.4	0.3		0.2	0.1	2.1

Benares, India

60	65	77	87	91	89	84	83	83	78	68	60	77
0.7	0.6	0.4	0.2	0.6	4.8	12.1	11.6	7.1	2.1	0.2	0.2	40.6

Seattle, Washington

40	42	45	50	55	60	64	64	59	52	46	42	51.6
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4.9 3.8 3.1 2.4 1.8 1.3 1.6 1.7 1.7 2.8 4.8 55 35.4

Rome, Italy

45 47 51 57 64 71 76 76 70 62 53 46 59.8

3.2 2.7 2.9 2.6 2.2 1.6 0.7 1.0 2.5 5.0 4.4 3.9 32.7

Billings, Montana

24 29 36 45 55 64 73 71 60 49 36 27 47.4

0.73 0.61 1.07 1.80 2.26 2.08 1.11 0.83 1.29 1.17 0.72 0.64 14.3

Marquette, Michigan

16 16 25 38 49 59 65 63 57 46 33 23 40.9

2.2 1.8 2.1 2.3 3.1 3.5 3.1 2.8 3.2 3.0 3.0 2.5 32.6

Verkoyansk, U.S.S.R.

-58 -48 -24 9 36 56 60 52 36 6 -34 -51 3.5

0.2 0.1 0.1 0.2 0.3 0.9 1.0 1.0 0.5 0.4 0.3 0.3 5.3

Point Barrow, Alaska

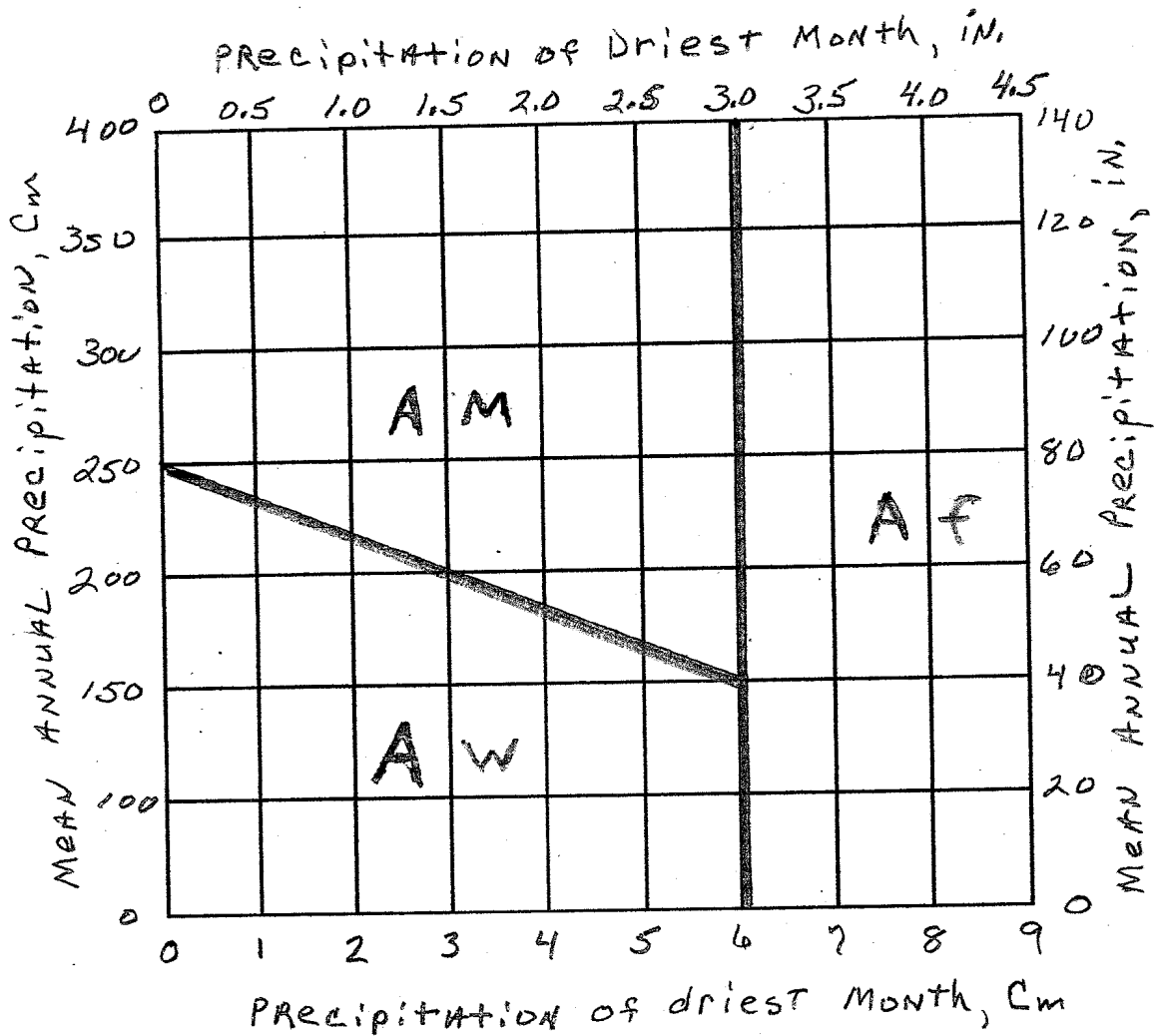
-19 -13 -14 -2 21 35 40 39 31 16 0 -15 8.9

0.3 0.2 0.2 0.3 0.3 0.3 1.1 0.8 0.5 0.8 0.4 0.4 5.6

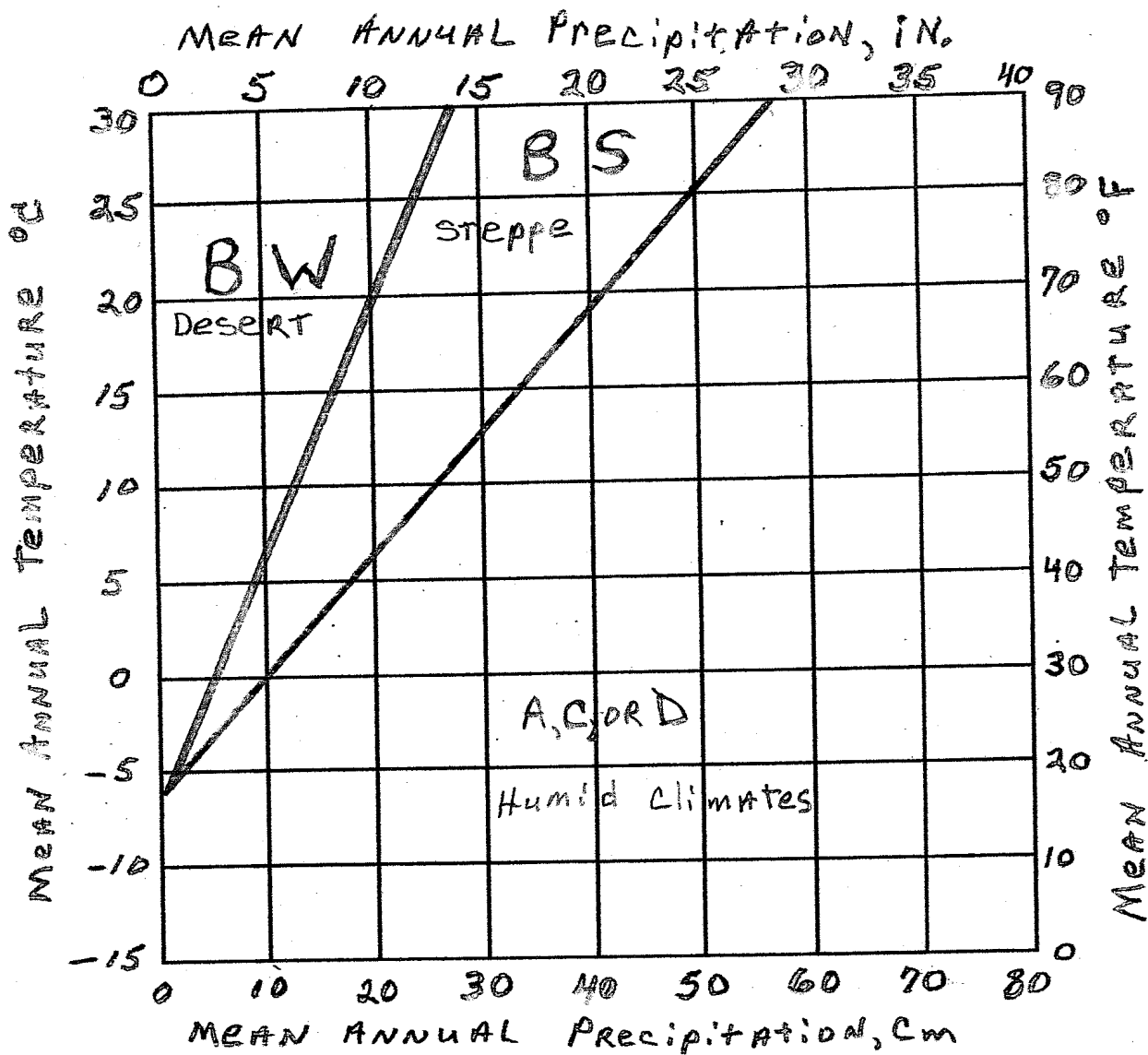
Vostok, Antarctic Station (near South Pole)

-26 -48 -72 -84 -86 -85 -88 -90 -87 -71 -46 -26 -67

0.1 0 0 0 0 0 0 0 0 0 0 0 0.1 0.2

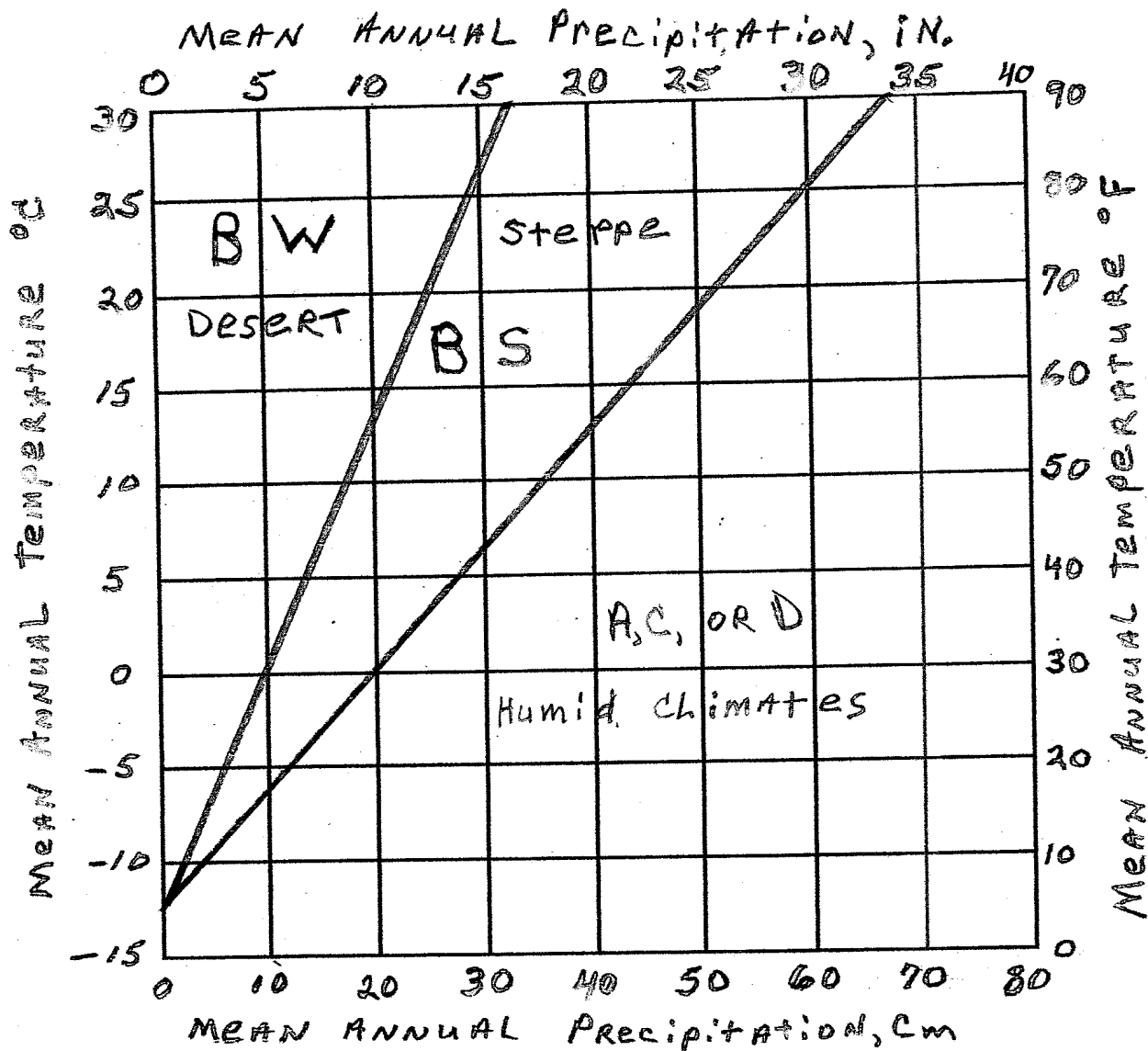


BOUNDARIES OF THE A CLIMATES



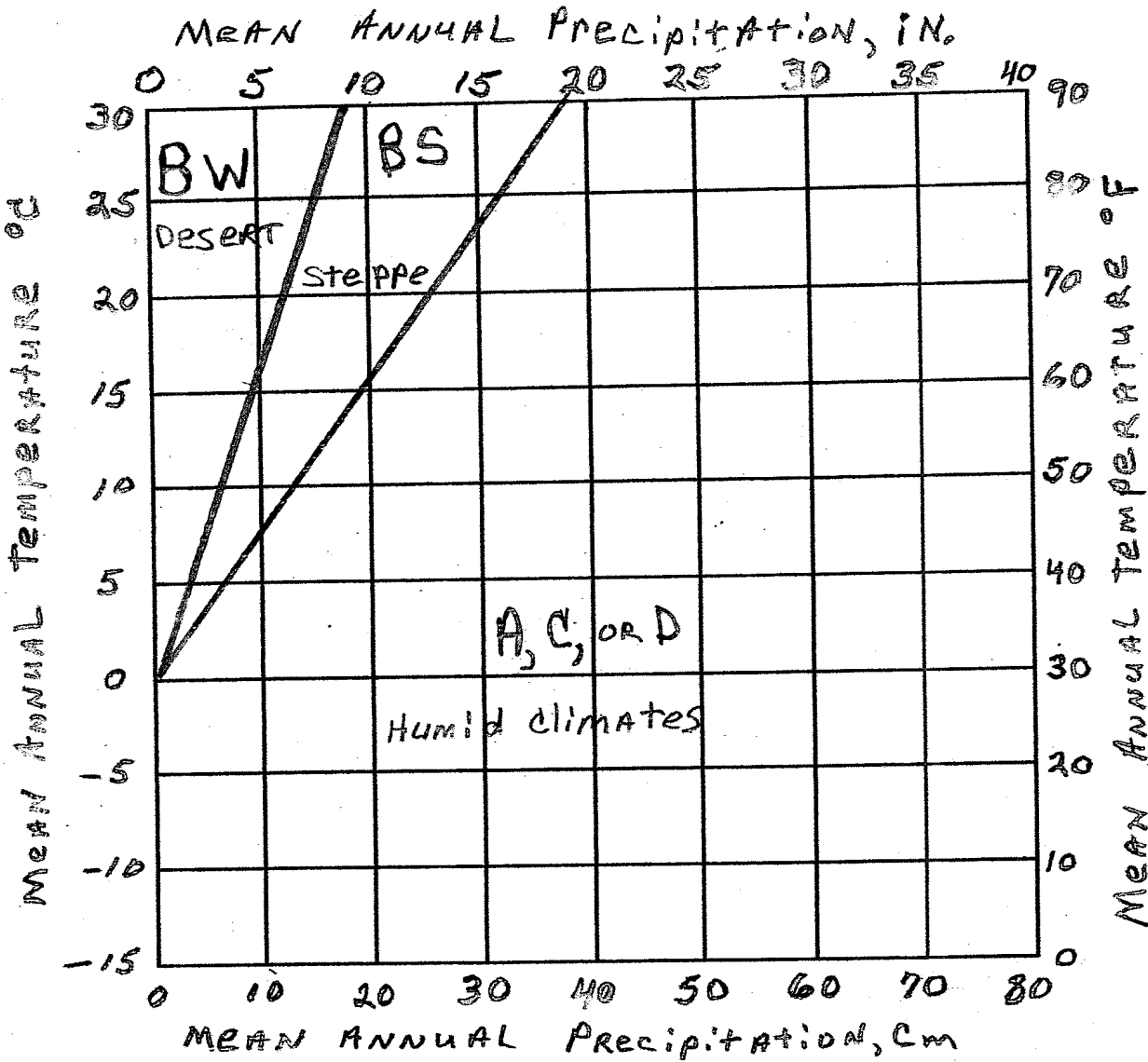
Boundaries of the B climates

Precipitation evenly distributed throughout the year



Boundaries of the B climates

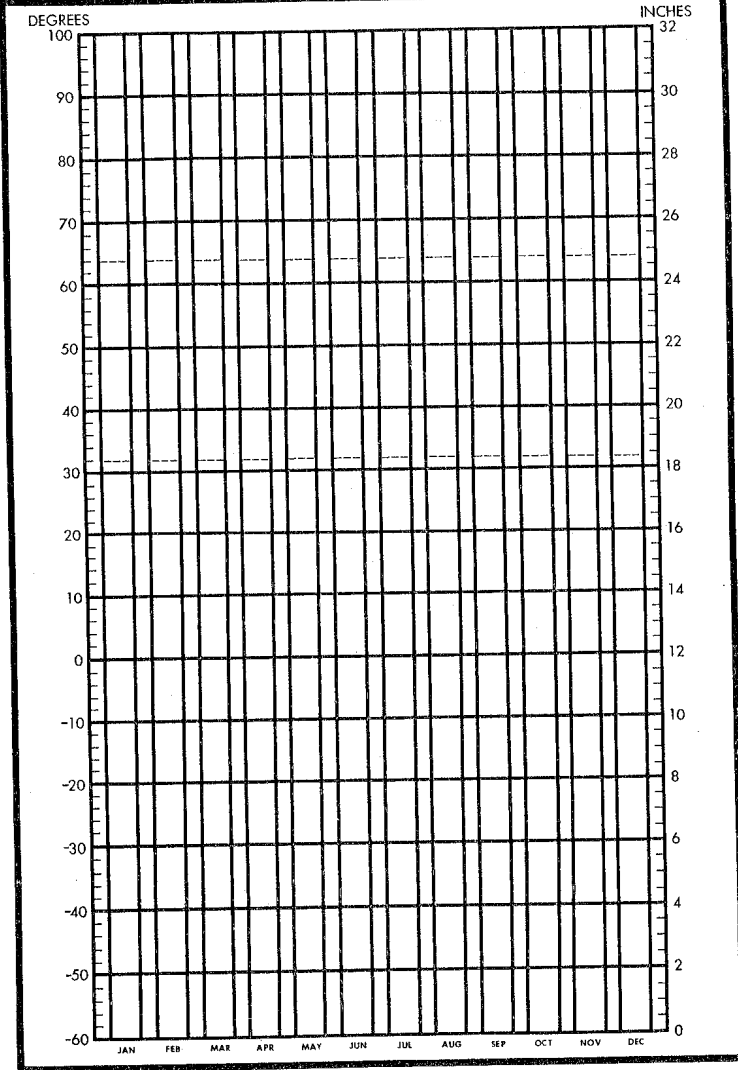
Precipitation concentrated in summer
(High sun season)



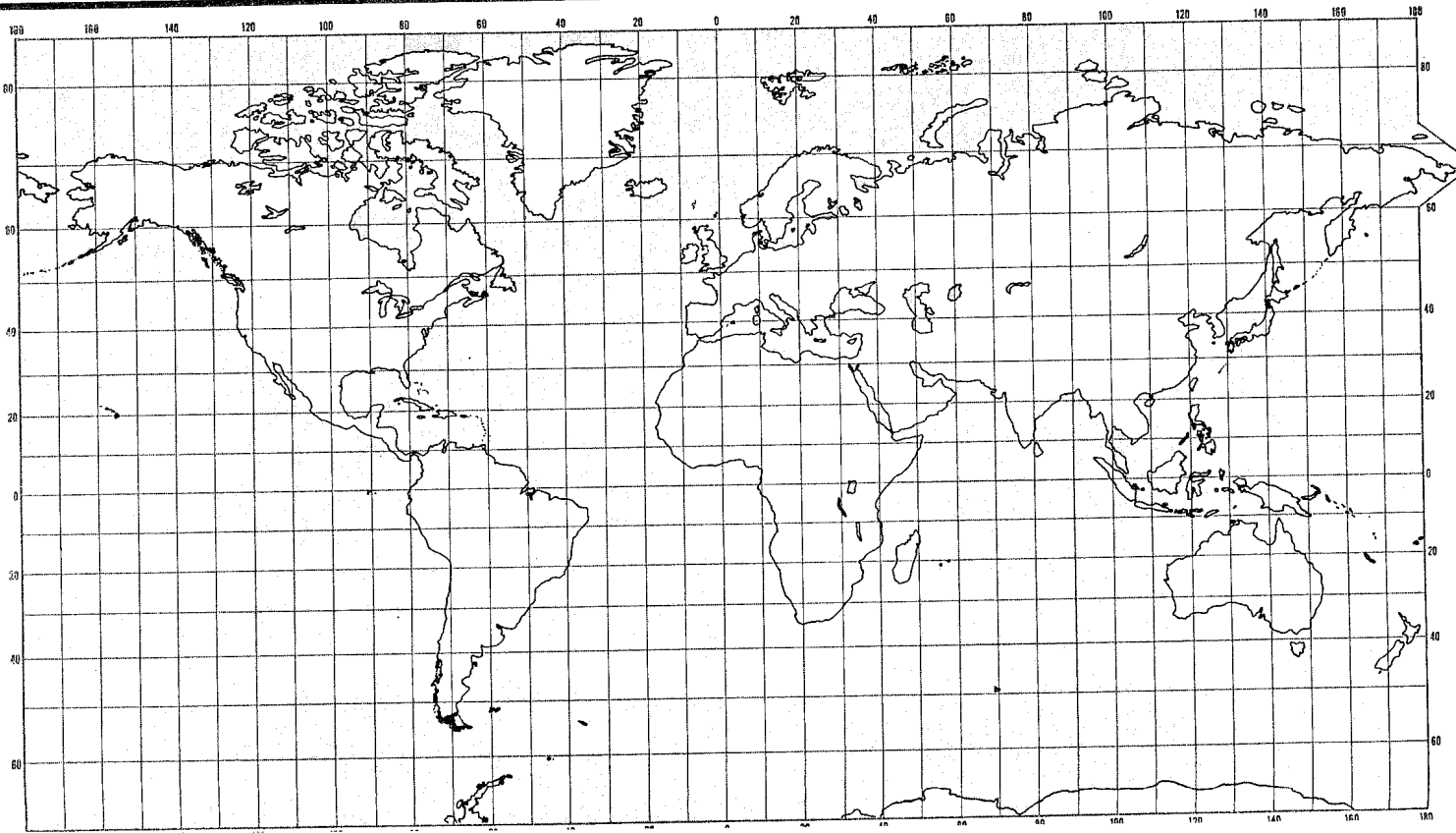
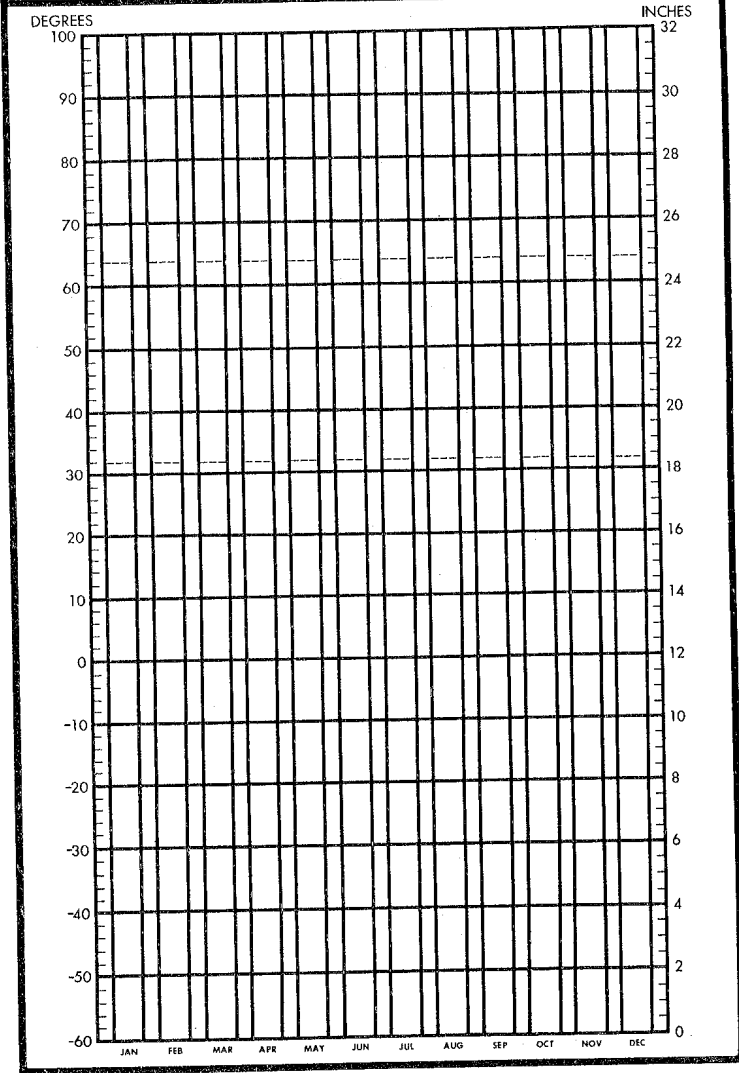
Boundaries of the B climates

Precipitation concentrated in winter
(Low sun season)

STATION _____ CLIMATIC TYPE _____
 LAT. _____ LONG. _____ MEAN ANNUAL TEMP. _____
 MEAN ANNUAL RANGE OF TEMP. _____
 MEAN ANNUAL PRECIP. _____



STATION _____ CLIMATIC TYPE _____
 LAT. _____ LONG. _____ MEAN ANNUAL TEMP. _____
 MEAN ANNUAL RANGE OF TEMP. _____
 MEAN ANNUAL PRECIP. _____



Regional temperature character

Regional temperature character

Regional precipitation character

Regional precipitation character

Typical vegetation

Typical vegetation

Soil type

Soil type

Economic products related to climate

Economic products related to climate