J. FINDLAY

#8

65 METER RADIOTELESCOPE PROJECT

SITE SELECTION

PROGRESS REPORT

Victor Herrero

August 10, 1970

Summary of the trip to New Mexico and Arizona

The following mountain areas in New Mexico were surveyed from the air:

Jemez Mts.

Cebolleta Mesa and Mt. Taylor

Alegros Mt.

Luera Peak

Magdalena Mts.

Black Range and Mimbres Mts.

Black Peak

Mogollon Mts.

Tularosa Mts.

Capitan Mts.

The south portion of the Valle Grande caldera in the Jemez Mountains, and South Baldy Peak in the Magdalena Mts. were visited on the ground.

The following mountain areas in Arizona were surveyed on the ground:

Kitt Peak

Santa Catalina Mts.

Mt. Hopkins

On the basis of this preliminary exploration, these attractive locations deserving further investigation have been identified:

Valle Seco meadow (4 miles north of Redondo Peak, in the Valle Grande caldera, 8900 feet).

Saddle 300 meters NW of the Langmuir Laboratory site (10600 feet), on South Baldy Peak.

Bowl NW and below the location of the 36' telescope at Kitt Peak.

Mt. Hopkins (8585 feet), north and above Knoll 1, the location of the Smithsonian Astrophysical Observatory.

The Santa Catalina Mts. area is attractive in some respects, but being so close to the city of Tucson, is already heavily used by a diversity of electronic installations providing telephone and television service to the city and radar facilities for military installations.

This field survey was performed between July 25 and August 4, 1970.

Comparison criteria description

1 Latitude

2 Longitude

3 Altitude

4 Photometric quality

5 Seasonal climatology

6 Support facility

7 Site description

8 Nearest town

9 Nearest town with commercial scheduled air transport

10 Access road description

11 Land ownership

12 Air distance from Washington

Mount Hopkins

1 N 31° 42'

2 W 110° 53'

3 8585 ft.

4 Good ?%

5 Summer wet season

6 Good, Smithsonian Astrophysical Observatory

7 Saddle north and above Knoll 1

8 Tucson, 60 miles

9 Tucson

10 Dirt mountain road for 18 miles, 1 hour trip from Amado on US 89, 4 wheel drive convenient

11 Coronado National Forest

12 1956 miles (Tucson)

Mauna Kea

1 N 19° 49'

2 W 155° 28'

3 13796 feet

4 70-80%, very good

5 Low humidity all year round

6 Good, Institute for Astronomy, University of Hawaii

7 Crater 200 meters SW of the summit, 400 meters south of 88" telescope

8 Hilo, 27 miles

9 Hilo

10

11

12 4812 miles (Hilo)

Best site as of

August 13, 1970

Mauna Kea

Favourable factors

Very good photometric quality

High altitude

Low precipitable water vapour all year round

Low latitude

Highest, low latitude location within the national boundaries of the U.S.

Unfavourable factors

Distant (2.5 times as far as the southwest)

Hypoxia begins to have significant effects.

Hypoxia

Low oxygen pressure at high altitude sets an upper limit to the highest desirable elevation.

Some quotations extracted from different authors, that help to define the magnitude of the problem follow.

Kuiper:

Operation around 14-18000 ft is possible under strictly controlled conditions; regular use of oxygen is important since, without it, night vision and other biological functions are seriously impaired. Astronomers should be adapted a few days beforehand to 8-10000 ft elevation at the base laboratory, and only persons admitted to high altitude who have passed a heart examination and stood up well at the 9000 ft level. The body needs oxygen for work, keeping warm, and digestion of food. An overload on any one, or in combination, can be serious or fatal (e.g. the use of alcohol is dangerous since it competes for oxygen). Electrically heated suits must be used for nighttime operations (the writer has never felt so completely chilled as during open air tests on Mauna Kea).

The following data on loss of human efficiency vs. duration of high altitude exposure are of great interest.

Exposure hours	Loss of efficiency		
	0%	40%	100%
1	9	14	20
6	9	14	18
18	9	13	16

Elevations in 1000 feet 100% - unconsciousness

This would show that limited manual operation up to 17000 ft is possible with the observers returning to the base laboratory after an hour or so; and that all night operations are possible up to about 14000 ft, provided that the observers thereupon return to the base for their rest. This checks with my personal experience on Mauna Kea, with Hale Pohaku (9200 ft) used as a base (no extra oxygen was ever used in our 1964 operations).

Many persons, two prominent astronomers among them, have suffered heart attacks at 9000-10000 ft. Experience at the High Altitude Solar Observatory at Climax, Colorado, 11100 ft, confirms appreciable altitude effects on the observers, even though they work in daytime in full sunlight. All this does not imply that one should not observe above 10000 ft; rather that then a new set of rules will apply, the more urgently the higher one must go and the longer one must stay.

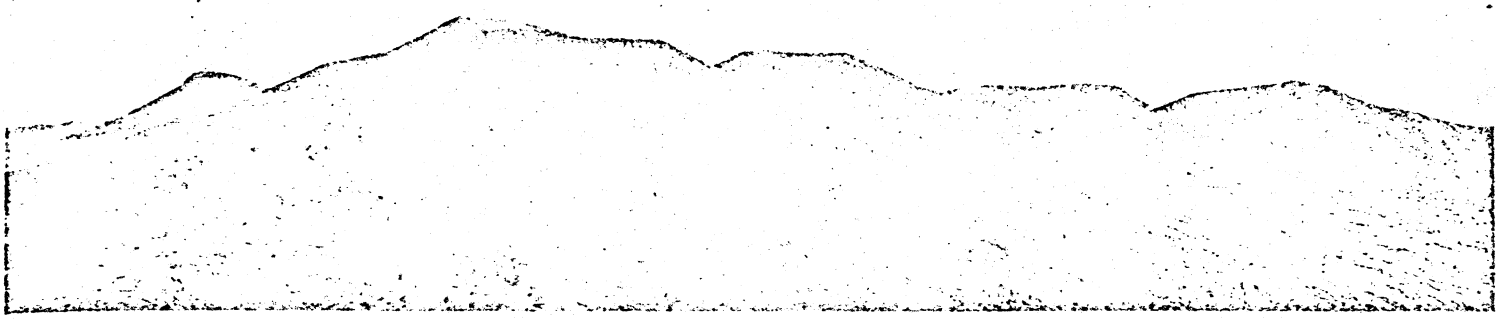
Armstrong, Principles and practice of aviation medicine:

Exposure to an altitude of 15000 to 18000 ft for a period of 2 to 6 hours may be followed by a very severe intractable headache, nausea, vomiting, dizziness, mental confusion, muscular weakness, and even complete prostration.

Chronic altitude sickness may develop from repeated exposure to altitudes as low as 12000 feet.

Topographic maps

Map of the Mauna Kea Summit Area



Another aerial view by Alika Herring, this time looking toward the summit area from the north. The highest point is the summit itself, with the observatory ridge appearing darker just in front of it. The cinder cone at far left is Puu Lilinoe; at center is the 13,441-foot cone, and at right is Puu Poliahu. Courtesy University of Arizona.

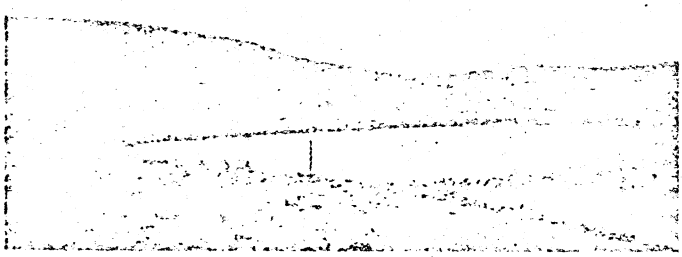
pects for an astronomical observatory were even better than on Haleakala. Largely on this basis, and after extensive further tests, the newly strengthened astronomy staff of the University of Hawaii chose Mauna Kea as the site for the NASA-supported observatory.

This mountain has several obvious attractions for astronomy. It is far from centers of population and local sources of radio-frequency or optical interference. Its summit area, barren and completely void of vegetation, is a gently rising plateau of old lava at about 13,000 feet. The red, brown, and tan-colored cinder cones rise about 600 feet above the plateau, and the observatory is being built on one of these, close to the actual summit. The site lies well above the normal trade-wind inversion level of the atmosphere, which occurs at about 6,000 to 8,000 feet in the Hawaiian Islands. Hence, the summit area is extremely dry and has a high proportion of cloud-free nights.

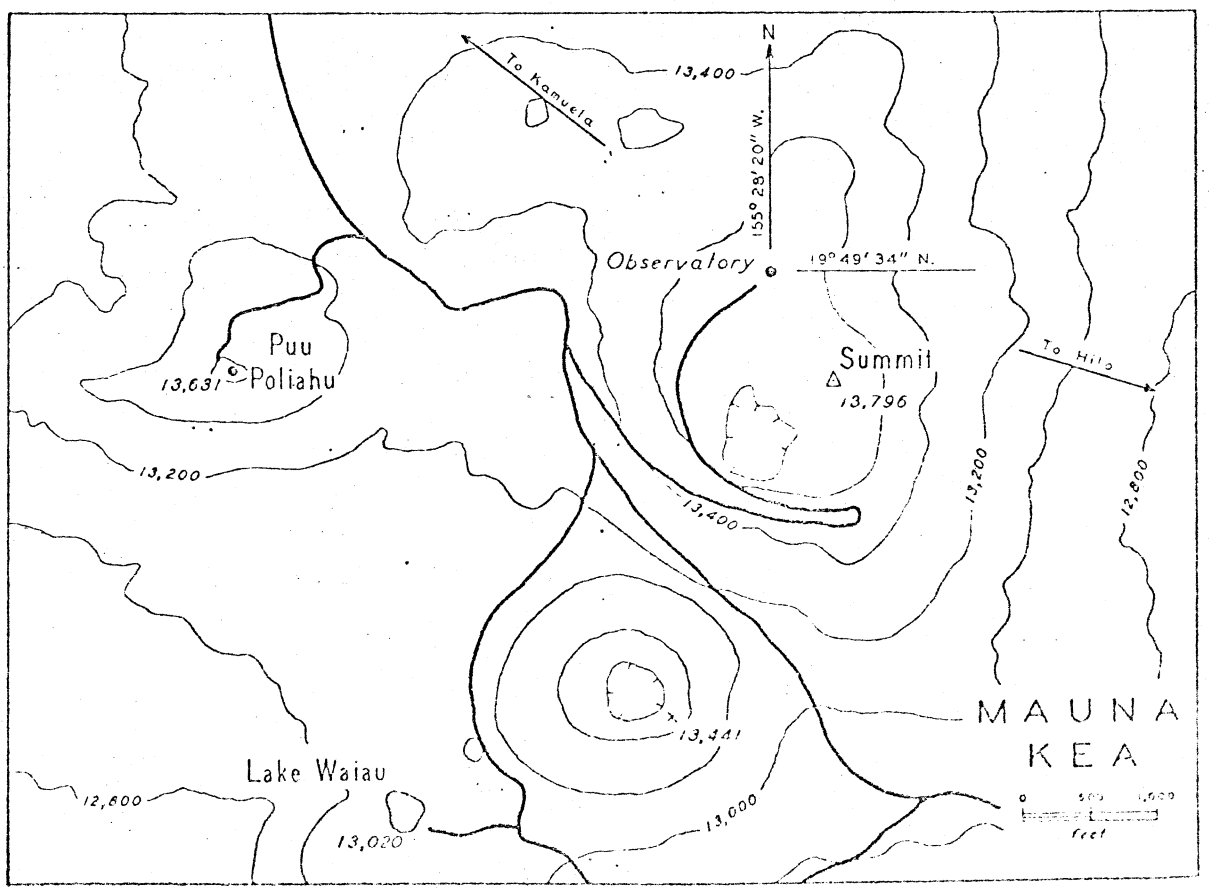
Among the disadvantages are the great altitude, nearly 14,000 feet above sea level, and the lack of water, power, and accessibility. Our development of Mauna Kea for this observatory has been essentially a pioneering venture.

Site Testing. The meteorology of Mauna Kea's summit had not been studied at all before our survey. We have estimated that about 50 percent of the nights in a year are totally clear, and somewhere between 70 and 80 percent of all the nighttime hours should be usable either for photometry or spectroscopy. Precipitation, largely in the form of snow, falls mainly in the so-called *kona* season, between November and February, when the trade-wind circulation breaks down. At that time, strong south winds occur.

We have been particularly impressed by



The location of the blue water of Lake Waiau is shown in the map below. It is surrounded by vari-colored volcanic rocks and lava flows, but the entire summit area is without trees. Photograph by John T. Jefferies.



This simplified map of the summit area, with a contour interval of 200 feet, is adapted from one with 40-foot contours. Contours with ticks indicate craters, one of which is on the summit cone. The heavy lines are roads, including the switchback that leads to the observatory site at upper right. Before it was bulldozed lower and wider, the observatory ridge was only six feet lower than the summit itself. At upper left is Puu Poliahu, with a dot marking the location of the University of Arizona's temporary observing station of a few years ago. Arrows indicate the direction of the Kamuela Airport, about 18 air miles away, and of Hilo, on the island's east coast some 27 miles distant.

South Baldy Peak

1 N33° 58'

2 W 107° 11'

3 10670 feet

4 Good ?%

5 Summer wet season

6 Good, Langmuir Atmospheric Physics Laboratory, New Mexico Institute of Mining and Technology

7 Saddle, 300 meters NW of the Langmuir Laboratory

8 Socorro, 35 miles

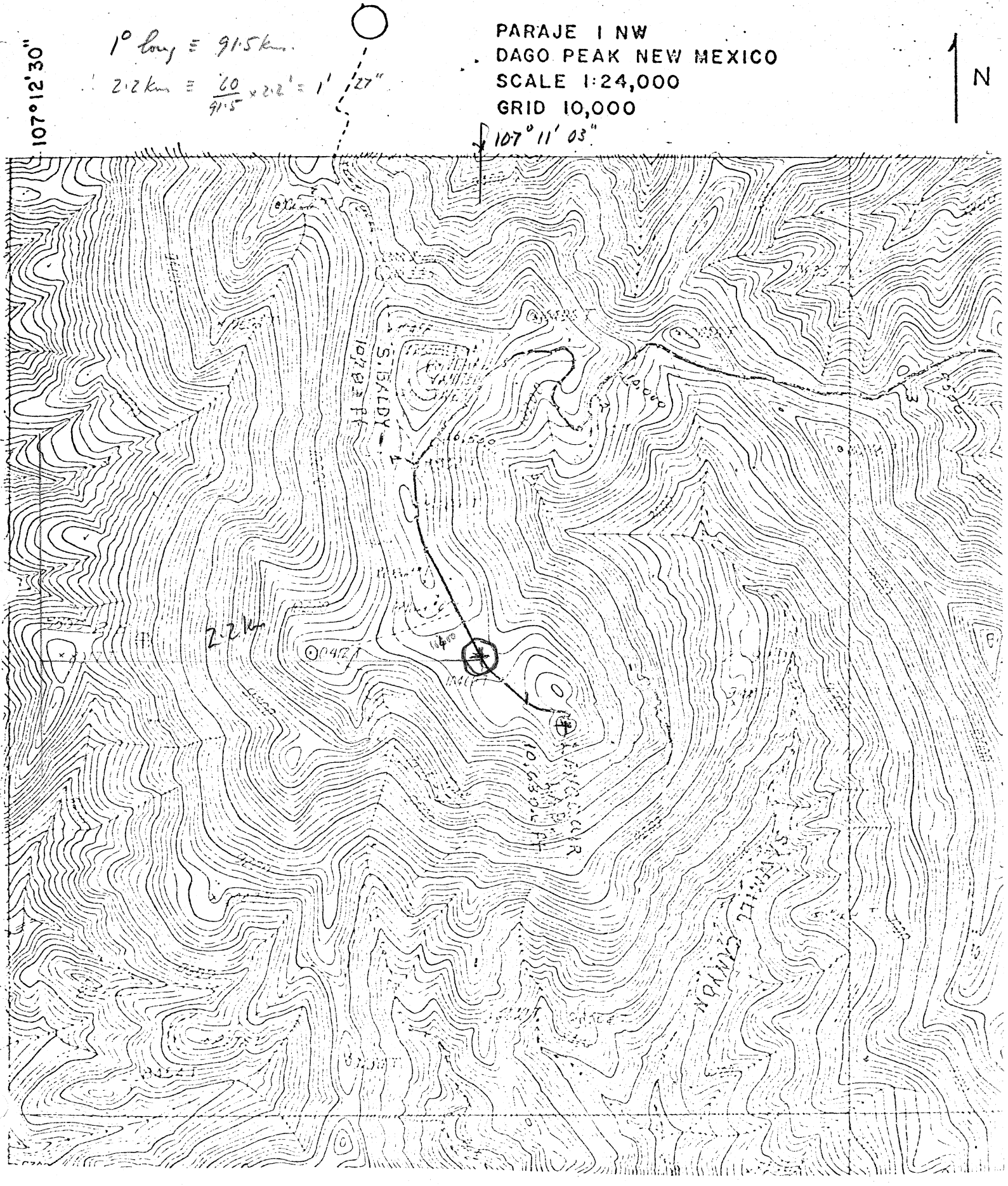
9 Albuquerque

10 Dirt mountain road for 20 miles, 4 wheel drive vehicle convenient, 45 minute trip from US highway 60, plus 15 minutes on US 60 to Socorro (15 miles).

11 Cibola National Forest

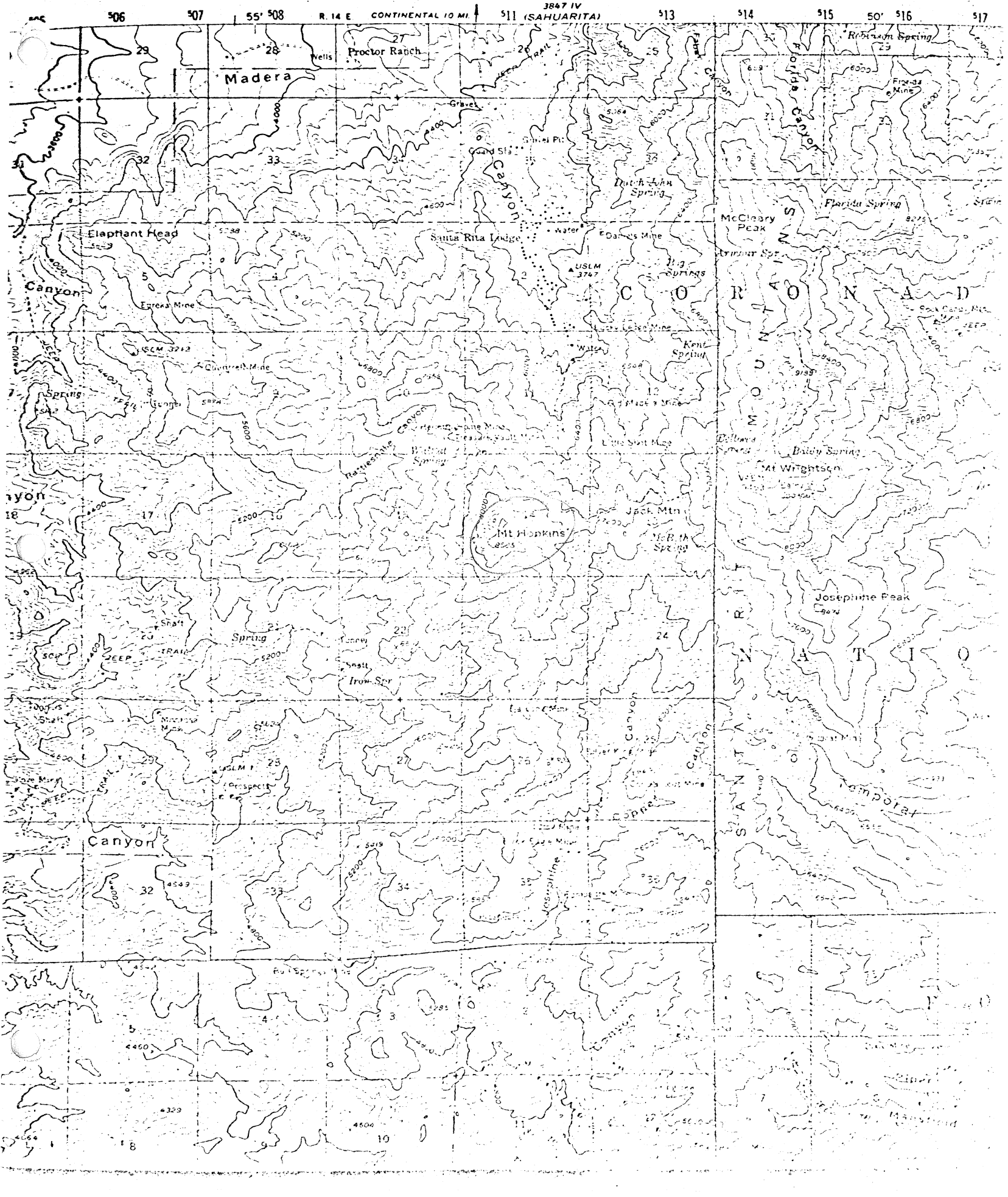
12 1700 miles (Albuquerque)

Topography of the South Baldy Peak and Langmuir Laboratory Area

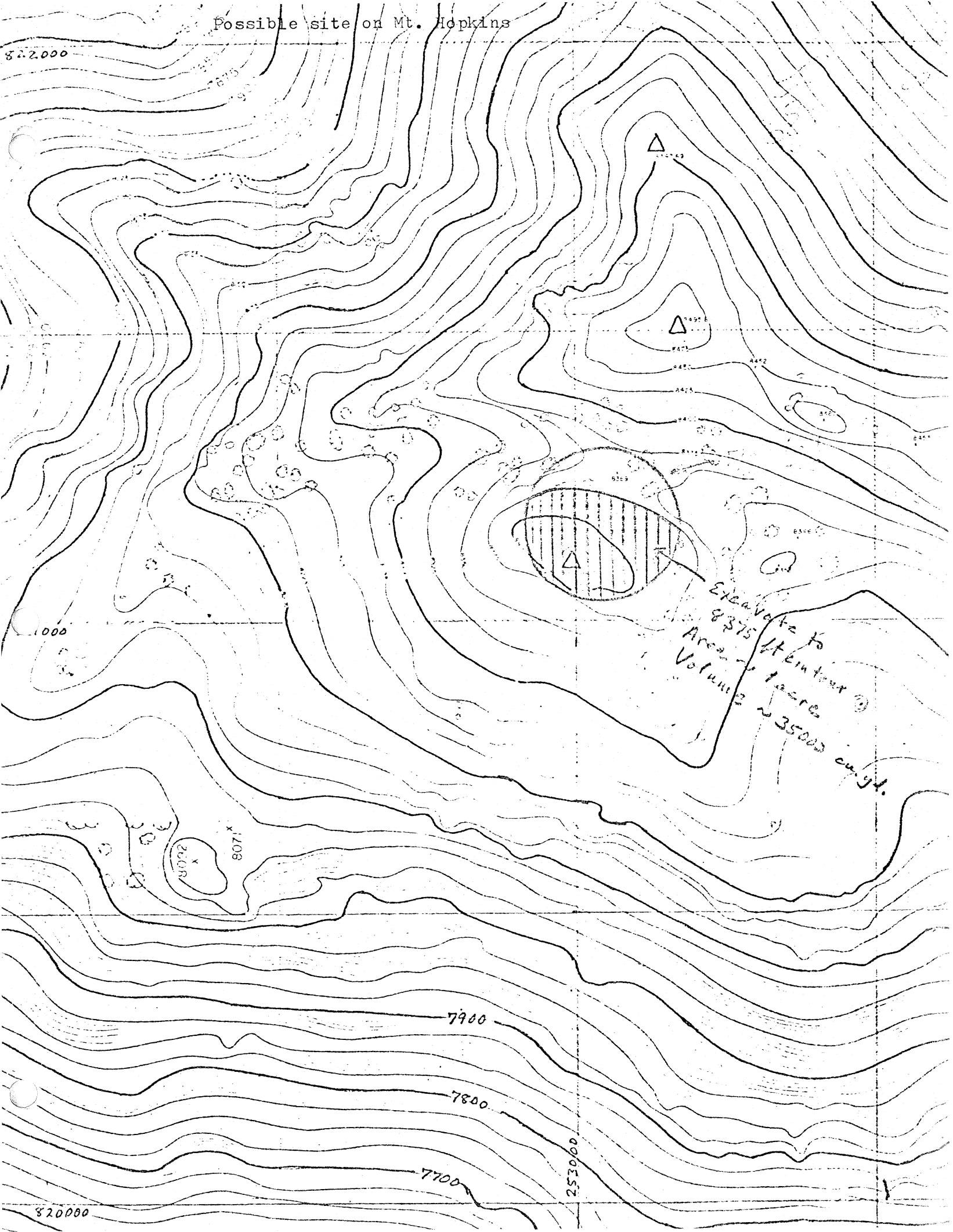


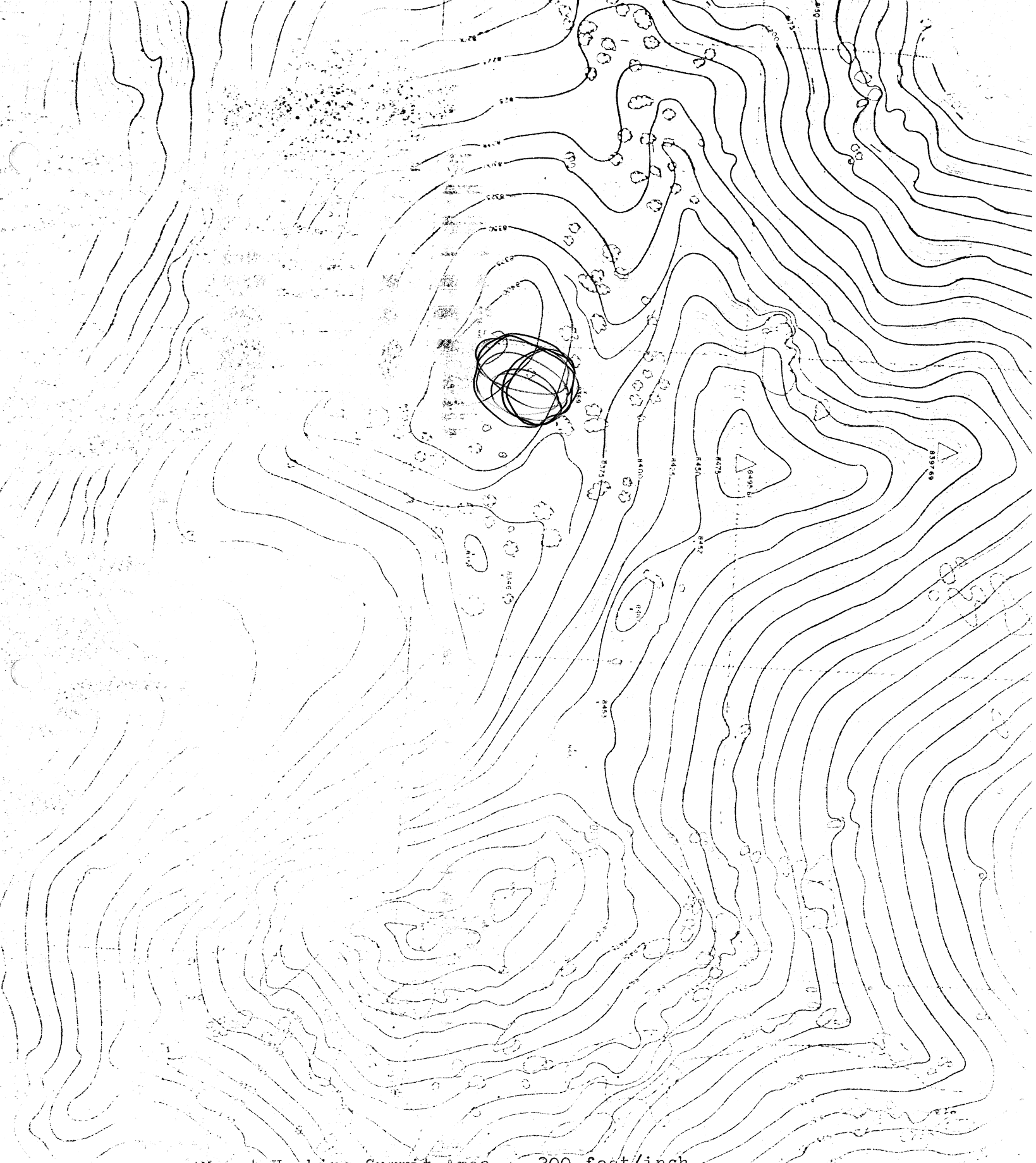
80 feet contours

Mount Hopkins Scale 1:62500



Possible site on Mt. Hopkins





Mount Hopkins Summit Area 200 feet/inch

Samples of weather data found available for some sites

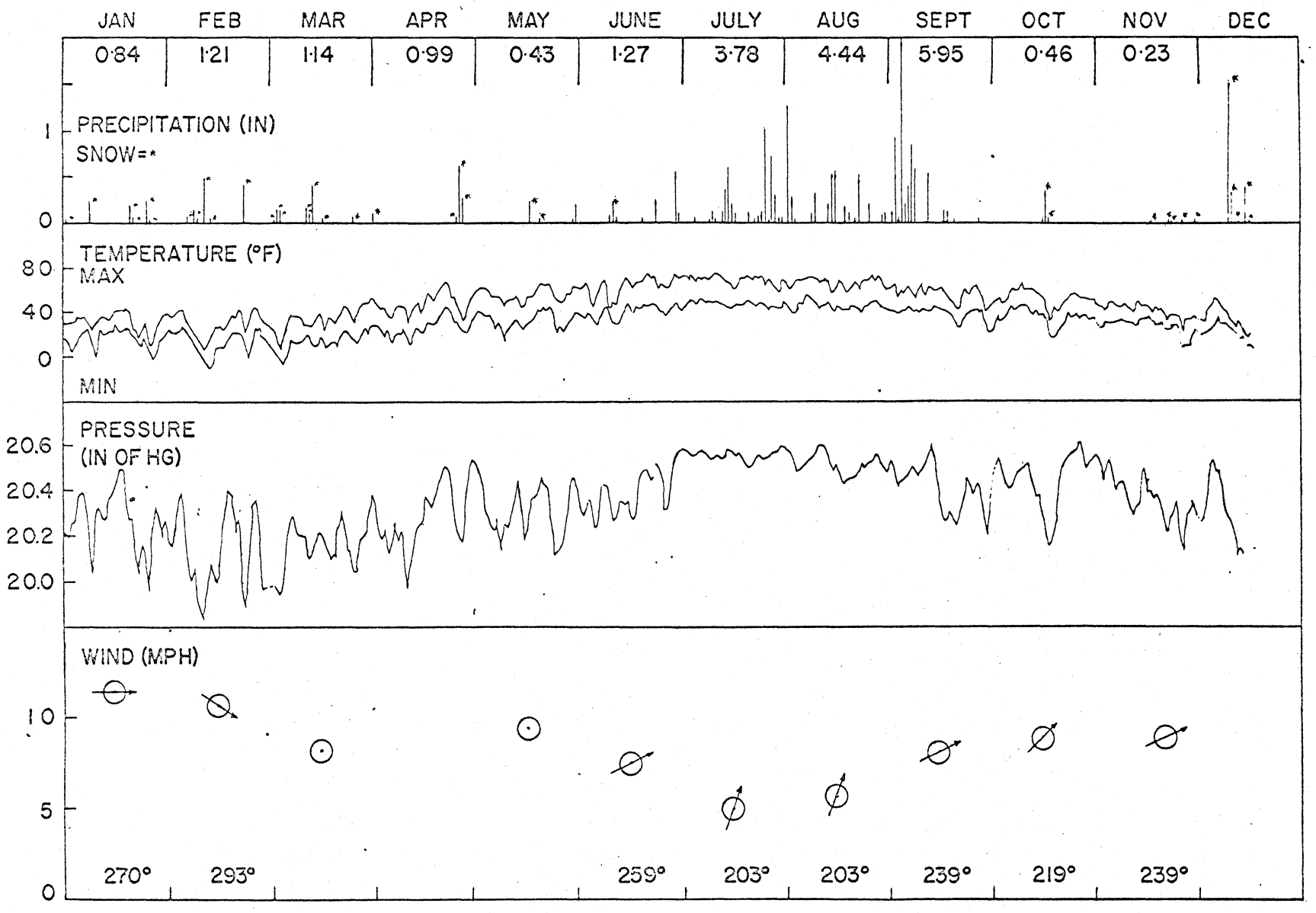
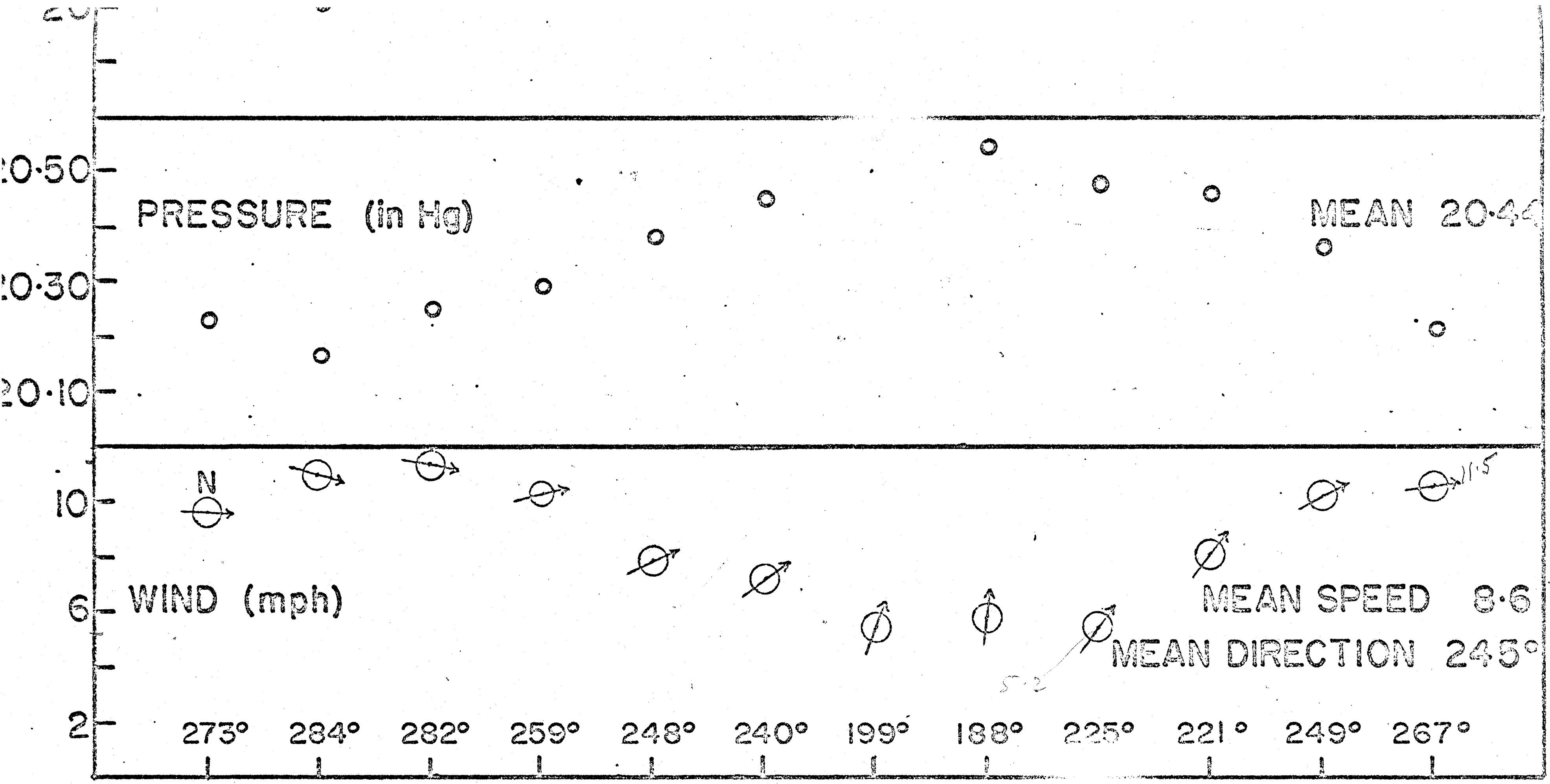


FIGURE 3 - ANNUAL SUMMARY 1965

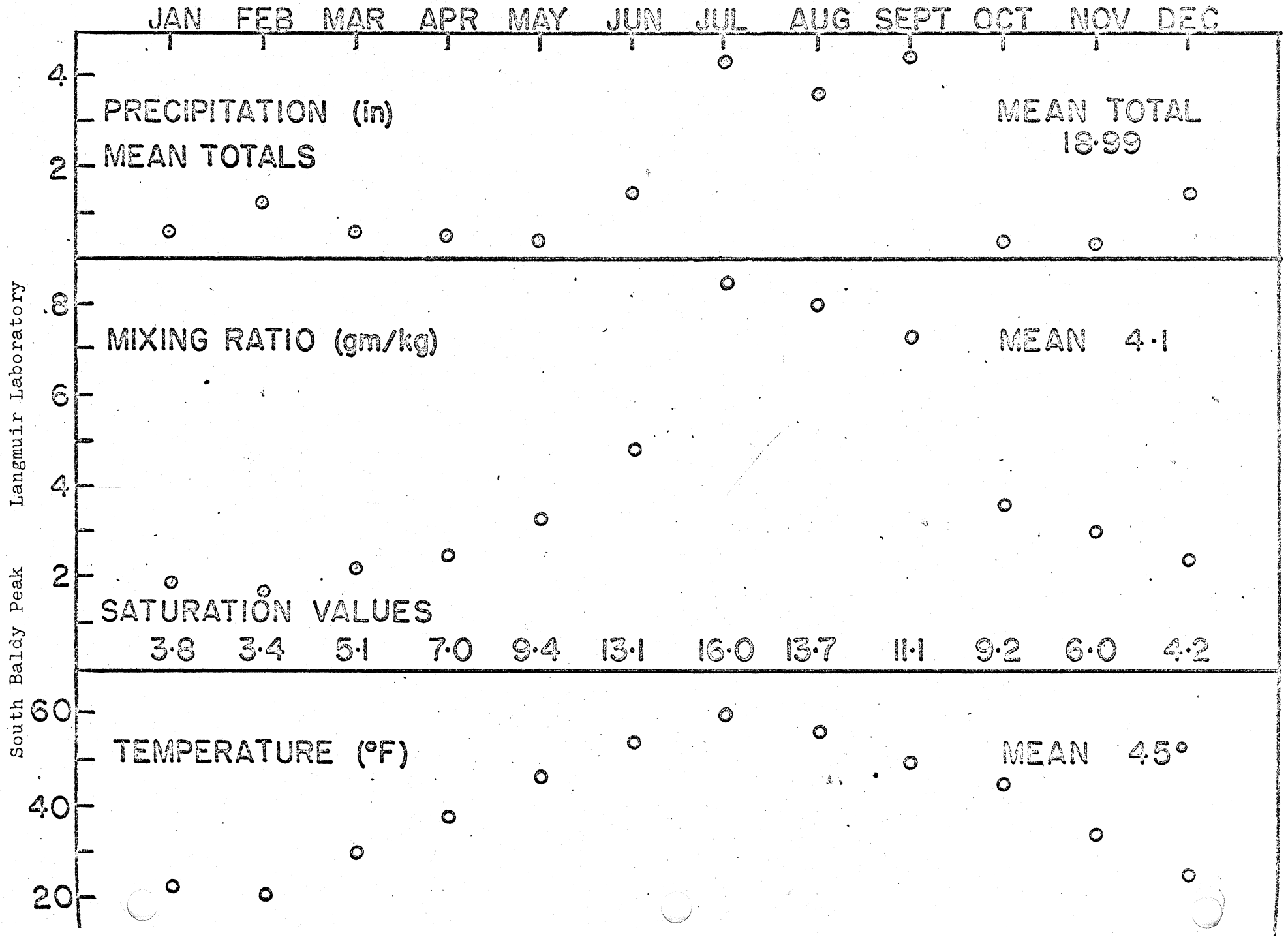
South Baldy Peak weather summary

Langmuir Laboratory, New Mexico Institute of Mining and Technology



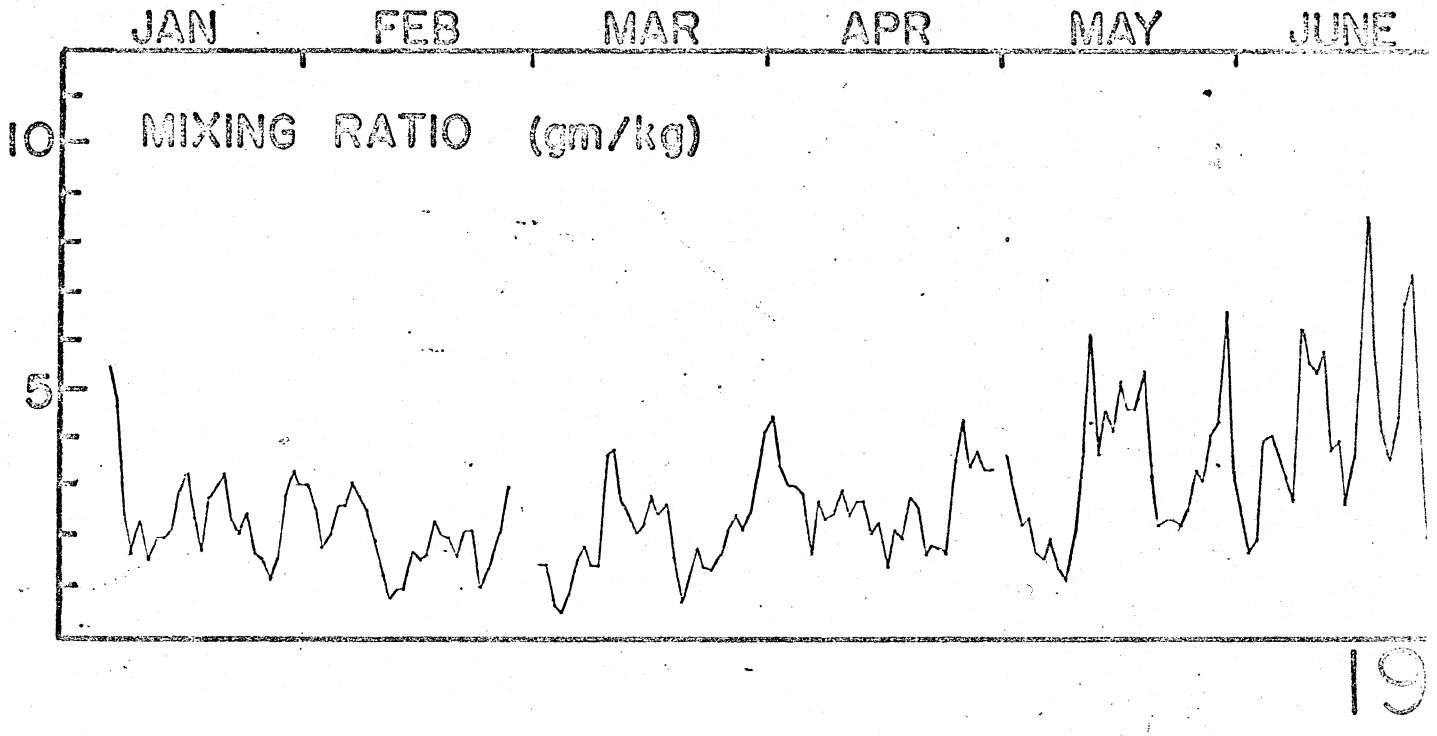
MONTHLY MEANS
1964-1967

South Baldy Peak
Langmuir Laboratory
(continued)

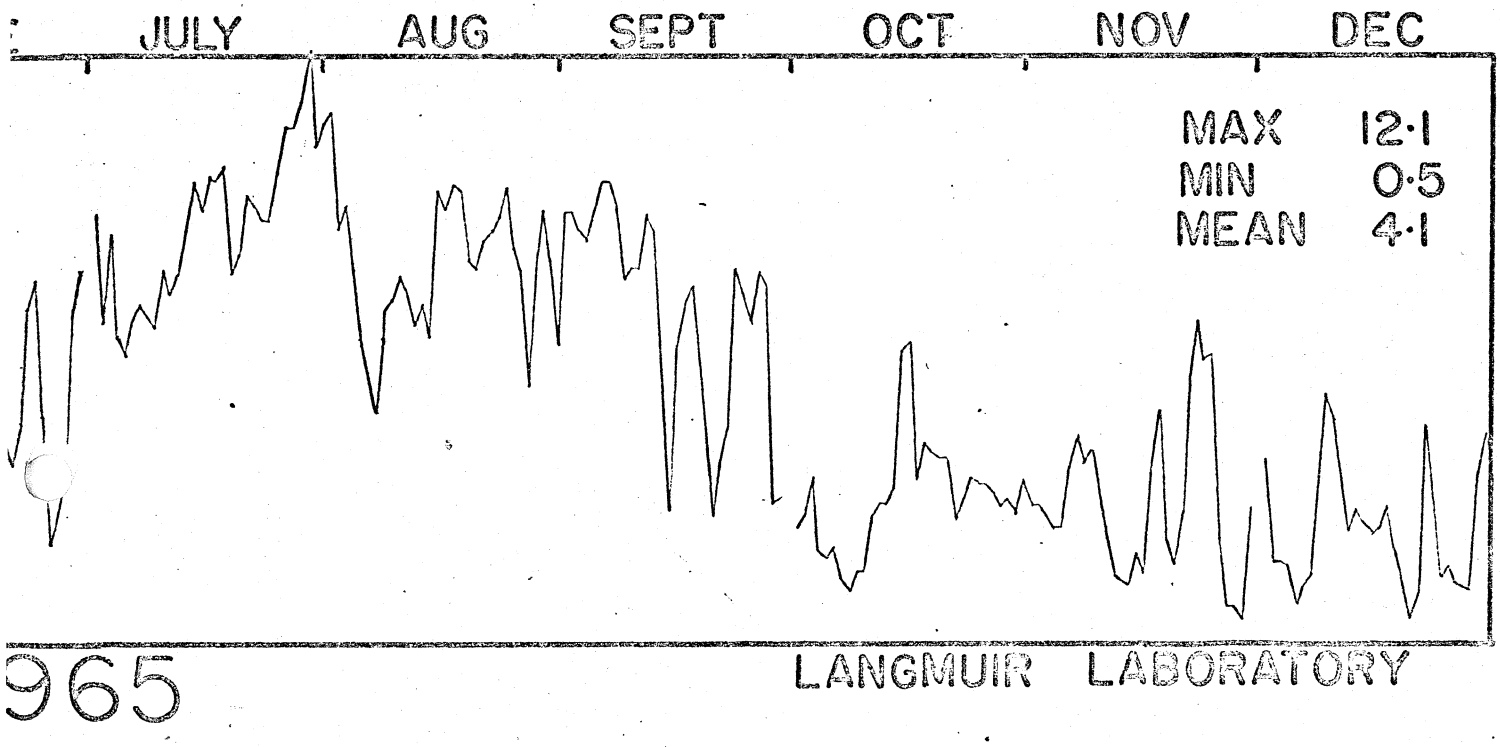

JAN FEB MAR APR MAY JUN JUL AUG SEPT OCT NOV DEC
4
2
PRECIPITATION (in)
MEAN TOTALS
MEAN TOTAL
18·99
8
6
4
2
MIXING RATIO (gm/kg)
MEAN 4·1
SATURATION VALUES
3·8 3·4 5·1 7·0 9·4 13·1 16·0 13·7 11·1 9·2 6·0 4·2
60
40
20
TEMPERATURE (°F)
MEAN 45°
South Baldy Peak Langmuir Laboratory

South Baldy Peak Langmuir Laboratory

(continued)



South Baldy Peak Langmuir Laboratory



965

LANGMUIR LABORATORY

Kitt Peak

Sample of wind speed data summary

year	mo., day	$\bar{V}$	$\bar{\theta}$	remarks	Av. $\bar{V}$
1962	12-17/18	1800-0100..20 0100-0600..32	✓ S	Gusty	26
	18/19	15	✓SSW	Gusty	
—	19/20	5	--		
	20/21	16	✓ NE	Gusty	
	21/22	18	✓ ENE	Fitful	
	22/23	1800-0100. 10 0100-0600 10	✓ S		
	23/24	30	✓ SSW	Gusty	30
	24/25	1800-0100..20 0100-0600..15	✓ W	Gusty	17
	25/26	8	✓ SSW		
	26/27	8	✓ SSW		
XX			✓		
	28/29	19 1800-0300..18	✓ NNE	Gusty by 0005	19
	29/30	0300-0600.. 6	✓ SSE		12
	30/31	14	✓ SSE		
	31/1	1800-2300..18 2300-0400..12	✓ SSE ✓ S	Wheel stuck at 0004	16
1963	1- 1/2	10	✓ SE		
	2/3	1800-0400..22 0400-0600..15	✓ S	Gusty	19
	3/4	1800-2300..10	✓ S	Chart stopped at 2300	
—	4/5	13	✓ SE		
	5/6	13	✓ SE		
	6/7	5	✓ NE	Calm from 2100--0003	
	7/8	8	✓ S	Gusty after 0002	
	8/9	8	✓ W	Fitful	
	9/10	25	✓ S	Gusty	25
	10/11	35	✓ SSW	Very gusty	35
	11/12	15	✓ NW		

Legend: — end of roll

$\bar{x}$ mechanical failure or break in record

Kitt Peak

Sample of wind speed data summary

Year	Mo. Day	Time	$\overline{V}$	$\overline{\theta}$	Comments	
1970	4/ 19-20	2000-0020	35	W	Brisk, gust of 48 at 2117	
		0020-0400	20	WNW	Fretful, undulating	28
	20-21	2000-0140	35	WSW	Brisk	
		0140-0400	40	SSW	Becoming gusty; gust of 60 at 0327	37
	21-22	2000-2300	25	W	Fretful after being gusty	
		2300-0400	12	NW to C600, then SW	Undulating, quiet	
	22-23	2000-0300	11av	NW to 2130, then SW; erratic (23- to ½)		
		0300-0400	5	W	Periods of calm after 0317	
	23-24	2000-0050	8	NNW	Irregular, fretful	
		0050-0400	12	W (if working)	Steady	
	24-25	2000-2330	21	Not working	Fretful	
		2330-0400	8	" "	Barely fretful, irregular (15 to ½)	
	25-26	2000-2210	16	WSW	Fretful, irregular	
		2210-0010	10av	W	Irreg.	
		0010-0400	15	W	Fretful	
	26-27	2000-2100	30	SW	Busy, steady	
		2100-0400	35	SW	Busy, fairly steady	34
	27-28	2000-0020	45	WSW	Gusty, dying to breezy, gust of 72 at 2021	
		0020-0210	25	WSW, shifted to SW at 0130/ Busy		
		0210-0400	17	SW, shifted to SSW at 0250. Irregular, busy		34
	28-29	2000-2340	18	NW (mostly)	Irreg., busy	
		2340-0400	22	NNE	Fretful, steady	20
	29-30	2000-0040	14	N	Irreg.	
		0400-0400	17	N	More nearly steady	
	5/ 30- 1	2000-2345	17	N	Busy	
		2345-0200	13	N	Fretful	
		0200-0400	17	N	Fretful	
	5/ 1 - 2	2000-0020	17	ENE to 2302 then E.	Brisk	
		0020-0200	20	E	Brisk	
		0200-0400	17	E	Busy	
	2 - 3	2000-2308	25	SSE	Brisk	
		2308-0150	30	SSE	Gusty to 0256	
		0150-0400	35	SSE	Gusty then brisk after 0256	29
	3-4	2000-2050	14	S	Fretful	
		2050-2310	20	S	Irreg.	
		2310-0235	22	SSE	Fretful	
		0235-0400	18	S	Barely fretful	
	4-5	2000-0305	18	WSW to 2308, then SE to 0100, then SSW.	Brisk, busy by 0008	
		0305-0400	14	SSW	Barely fretful	
	5-6	2000-2230	25	SW	Busy	
		2230-0130	31	SW, SSW by 0100.	Undulating, brisk	27
		0130-0400	27	SSW	Brisk	
	6-7	2000-2305	40	SW	Breezy	
		2305-0400	35	SW	Brisk or busy to breezy	37
	7-8	2000-2310	16	WNW, W by 2100, WSW by 2200	Erratic	
		2310-0200	10av	SW	Erratic (14 to calm to 8)	
		0200-0400	5av	SW, NE by 0300; calm at times		
	8-9	2000-2310	12	NNE	Somewhat erratic	
		2310-0400	5	NE, SW by 0000		
	9-10	2000-2345	21	WSW, fretful, somewhat irreg.		
		2345-0350	26	WSW, dropping slightly by 0350, shifting to WNW		2
	10-11	2000-0200	24	WSW	Busy	
		0200-0400	20	WSW	Busy, more breezy in action	2
OUT OF	OPERATION;	INSTALLATION OF CABLE FROM TRANSMITTER				
	25-26	2000-2130	20av	SSW	Busy	
		2130-0150	26av	SSW to 2308, then no record.	Brisk	23
		0150-0400	17	No record, fretful, undulating		
	26-27	2000-2050	16	NW	Busy	
		2050-0400	10	SSE by 2140.	Barely fretful, somewhat irregular	
	27-28	2000-0400	20	W to 2130; WSW thereafter.	Brisk	20
	28-29	2000-1310	14av	W to 2120, then SW.	Busy, dying to fretful by 0030	
		1311-0400	8	SSW (Is this working?)	Quiet	

Record of winds of 40-or-more during scanning hours
8-8-65 to 3-25-67

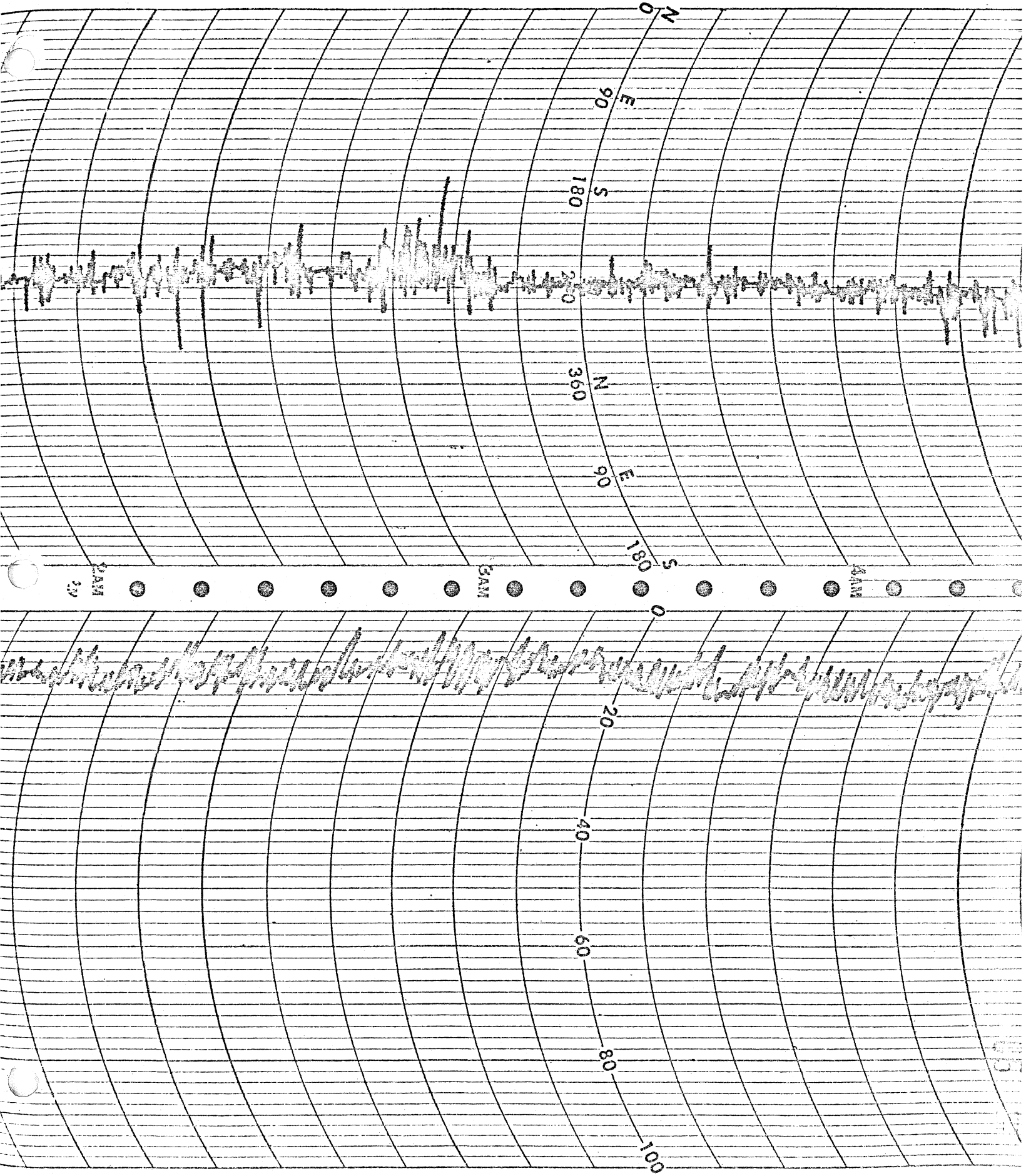
Kitt Peak

Year	Mo., Day	Time	$\bar{V}$	$\bar{\theta}$	Sample
1965					
	8/ 8-9	2110-2210	40-44	ESE	4 gusts
	13-14 **	2000-2110	40-50	SSE	16 gusts, 1 of 50
	9/16-17	2040-0600	40 (av.)	SSE	77 gusts over 50, 5 over 60 (1 of 68)
	17-18	1830-0600	40 (av.)	SSE	60 gusts over 50; 5 of 60 and +
	18-19	1800-0120	40-46	S	46 gusts, 1 of 48
	27-28	0330-0600	44-44	S	35 gusts
	10/13-14	2200-2300	40-42	SSW	6 gusts
	15-16	2320-0600	40-50	SSW	75 gusts, 1 of 63
	11/14-15	0450-0530	40-42	S	3 gusts
	16-17	0130-0230	40-41	SSW	5 gusts
	12/22-23	0240-0600	40-48	SSW	56 gusts
	25-26	1800-2140	40-50	SSW	60 gusts, 3 over 50
	12/ 9-10	1800-0600	50+	SSE-S-SSW	44 gusts, 1 of 69
	10-11	1800-2100	40-49	SSW	13 gusts
	"TOWER AND MACHINE ICED"		12/14-27		
	28-29	1850-2015	40-44	NE	20 gusts
		0150-0300	40-47	NE	15 gusts
1966	2/6-7	2340	40	SW	1 gust
	7-8	2350	42	SW	1 gust
	"INSTRUMENT FROZEN"		2/8-18		
	3/1-2 ***	1930-0005	40-42	N until 2000, switched to S	12 gusts (Records are suspec right here)
	4/14-15	2000-0005	40-46	SW	8 gusts
	18-19	2000-0400	48 (av)	S	19 gusts over 60
	28-29	0302	40	SE	1 gust
	5/11-12	0030	42	NW	1 gust
	15-16	0018-0425	40-49	S	48 gusts (θ pen trustworthy?)
	28-29	2340-0030	40	NNE	2 gusts
	8/ 8-9	2300-0110		N	6 gusts (rose abruptly from 20 at 2300 t
		0300	40-48	E	1 gust (rose abruptly from 30 to 47)
	10-11	2230	41	ENE	1 gust
		0030	51	N	1 gust (rose abruptly from 10, dropped to
	18-19	0342	40	SE	1 gust (rose from calm at 0120, shifted f
	29-30 ***	2040-2140	40-43	NW	9 gusts
	*** 9/12-13	0455-0600	40-43	SSE	7 gusts
	26-27	2120-0035	40-45	SSW	4 gusts
	27-28	2350-0600	40-48	ESE	14 gusts
	10/2-3	2355	48	S	1 gust (rose abruptly from 30, then dropp
	11/5-6	0455-0600	40-42	SSW(?)	3 gusts
	6-7	1800-0600	40 (av)	S	93 gusts over 50, 1 of 63
		1800-2400	37 (av.)	NNE	118 gusts over 40
	7-8	0000-0600	50 (av.)	N	7 gusts of 70-72

** Scanning hours changed to 2000-0400

*** Scanning hours changed to 1800-0600

Sample of a Kitt Peak wind speed and direction record



WIND SPEED AND DIRECTION

PRINTED IN U.S.A.

[RECORDING CHARTS]

W. B. FORM 612-14 U.S. DEPARTMENT OF COMMERCE—ENVIRONMENTAL SCIENCE SERVICES ADMINISTRATION

Station Tucson Int'l Ad.

RECORD OF CLIMATOLOGICAL OBSERVATIONS

County Pima

Time of observation (local time) if once daily 0800;

Month July, 1970

State Arizona

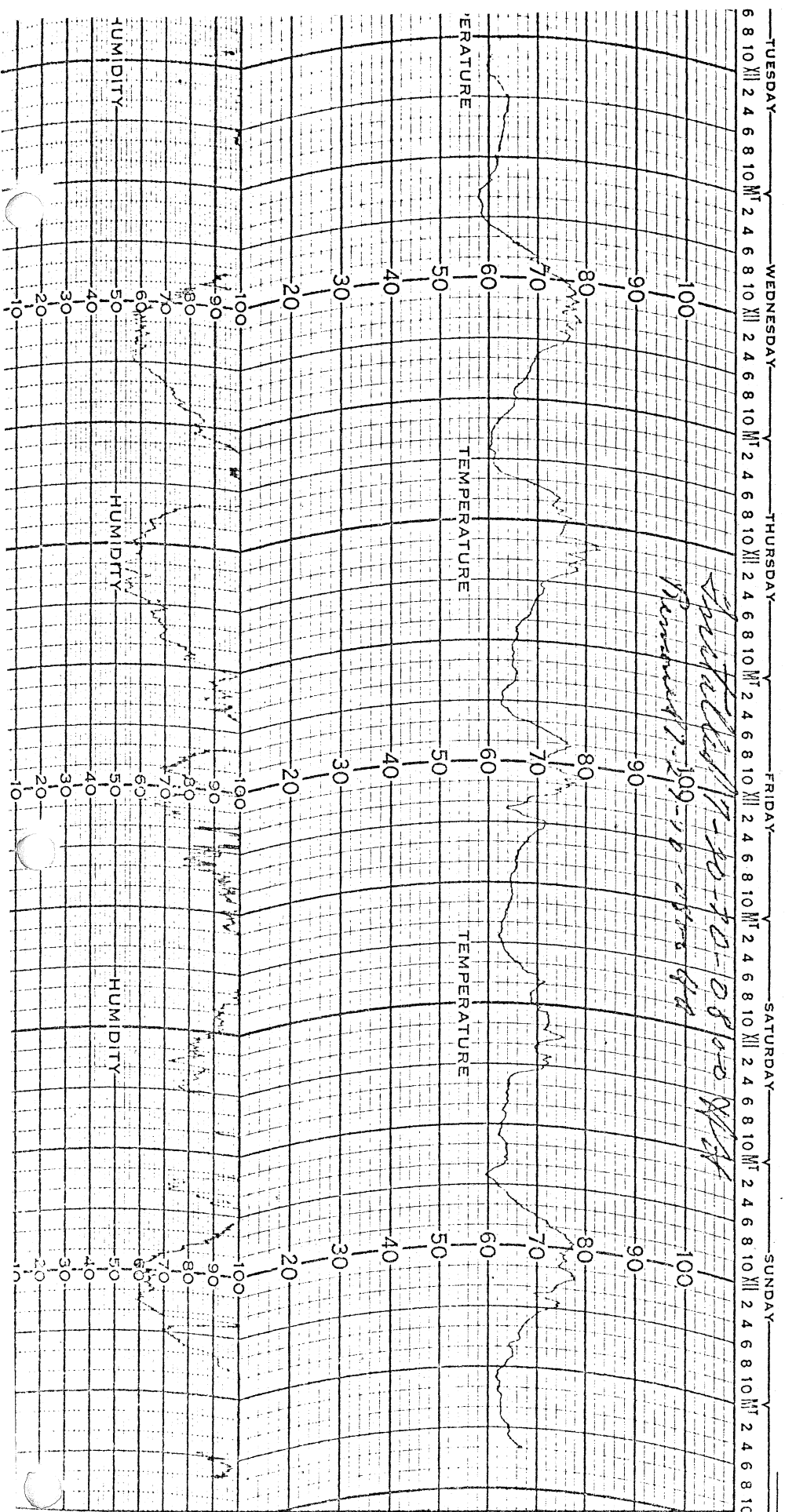
If at different times, temperature _____, precipitation _____

Standard time in use Mtn.

Date	TEMPERATURE °F: 24 hrs. ending at observation — Max	Min	At obsn.	PRECIPITATION: 24-hr. amounts — Rain, Melted snow, etc. (ins. & hund'ths)	Snow, Sleet, Hail (ins. & tenths)	At obsn. — Snow, Sleet, Hail, Ice on grd (inches)	WEATHER (CALENDAR DAY) Mark 'X' for all types occurring each day — Fog	Sleet	Glaze	Thunder	Hail	Damaging Wind	Time of Obsn. If different from the above	Important weather conditions not included in 'Weather' block; remarks, etc.
1	80	60	65											Wind 29 - H 3
2	72	57	66											" 29 - H 3
3	79	62	72											" 27 - clear
4	87	60	61											" 25 - L 2
5	89	64	72											" 43 - L 1
6	85	67	72											" 34 - H 5
7	94	58	70											" 50 - L 2
8	81	60	68	TR										" Broken
9	79	59	74	.05										Broken
10	80	58	64	.05										Broken
11	80	61	70											Wind 21 - M 2
12	87	67	73											" 26 - H 2
13	89	66	78											" 13 - L 2
14	89	68	75											" 29 - M 9
15	79	67	75											" 26 - H 3
16	78	67	73											" 24 - L 2
17	78	65	73											" 31 - M 2
18	80	62	71											" 32 - H 2
19	85	64	71											" 29 - H 5
20	85	63	63	.TR										" 31 - L 8
21	72	61	63	.35										" 24 - clear
22	72	57	67	.72										" 32 - M 3
23	77	58	71											" 25 - H 5
24	82	61	65											" 42 - H 3
25	88	61	65	.33										" 27 - M 3
26	74	58	65	.03										" 14 - L 9
27	76	60	66	.TR										" 26 - H 6
28	72	62	67	.05										" 27 - H 4
29	78	60	70											" 32 - H 6
30	81	61	70											" 26 - H 2
31	84	59	68											" 26 H 4

Sample of a Kitt Peak record of climatological observations

Sample of a Kitt Peak record of temperature and humidity



These summaries start [illegible]

Year, Mo., Day	Outside Met. Sta. Temps Max. (t)		Outside Met. Sta. Temps Min. (t)		Inside 84-in. Plat. Temps. Max. (t)		Inside 84-in. Plat. Temps. Min. (t)		Seeing	Remarks	Observing Hours
1970 6 16	86+	1330, 1345, 1430	60+	0515	68-	1900 -2000	57+	0430 -0715	1.5-3	Variable clouds	2000-0445
17	90-	1415, 1430 -1445	59+	0530 -0545	70	1945 -2015	58	0530 -0700	0.8-3	Much variable cloudiness	2000-0445
18	93	1245*	62	0515 -0530	74+	1915 -2000	62+	0545 -0630	1	Clear	2000-0430
19	94+	1215	66	0215	76-	1730 -2000	66	0430 -0445, 0645 -0745	1-4	Clear until near end	2000-0430
20	94+	1430	67-	0530	75	1800	66+	0415 -0430	1-1.5	Extremely cloudy	2030-0445
21	94	1215, 1230 -1300	68	0545	76+	1900 -1915	68-	0545	1-3	Clear	2000-0445
22	85-	1330	64+	2315 -2330	78+	1815 -1945	67	0430 -0545	1-3	Cloudy	2000-0500
23	86	0215, 0245	64	0545 -0615	79-	1815 -1845	69+	0515 -0545	1-2	Cloudy till 0100	0100-0500
24	91-	1315, 1430	68	0515 -0530	80+	1900 -2000	70	0400 -0730	3-7	Clouds on horizon till 2200	1900-0500
25	96-	1515	73+	0430 -0600	86-	1830 -1945	75+	0400 -0845	2	Clear to overcast	1930-2200
26	92-	1300, 1315	70-	0600	85-	1500 -1515	76	0400 -0445, 2400	2-3	Scattered overcast at 0400	1930-0400
27	88+	1215 -1230	68+	0550	81+	1600 -1630	74	0415 -0515, 2400	2-3	Var.overcast to scattered clouds	2015-0415
28	85	1300	59-	2015	77+	1800 -1900	68	2400	- -	Overcast to clear	- - - -
29	87-	1415	60	0500 -0615	71	1715 -1730	68+	2400	4-6	Overcast to scattered clouds	0000-0415

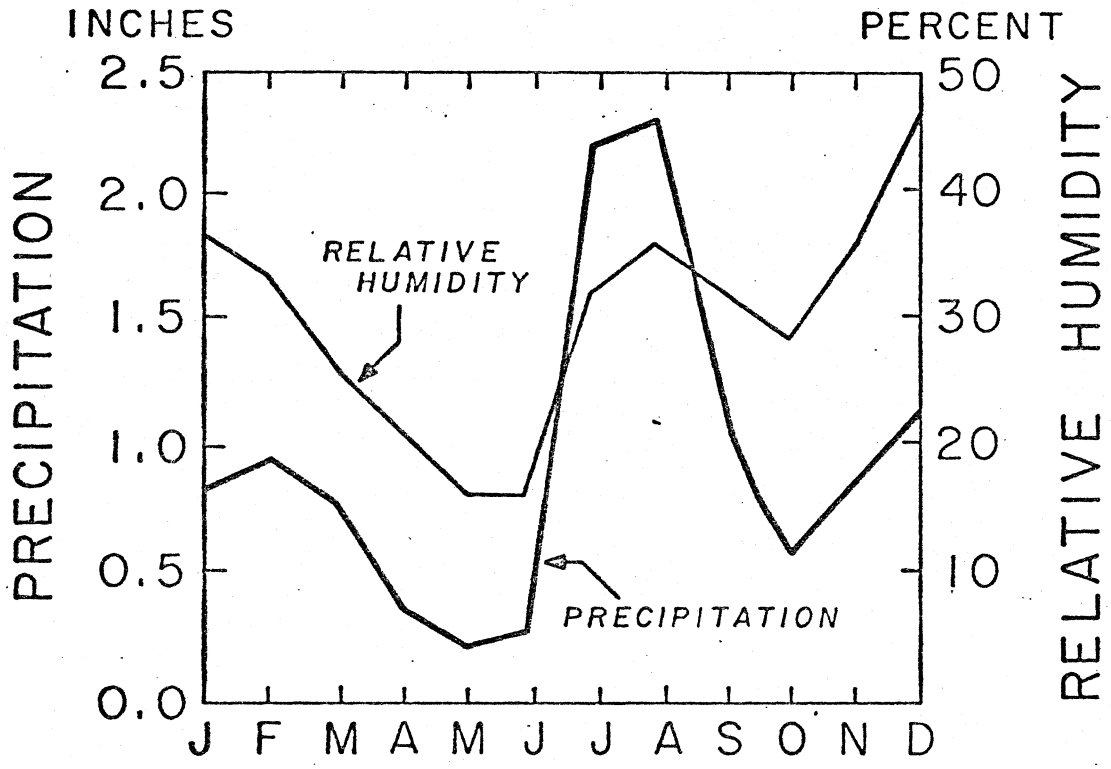
hoops! * May have been at other times, too; but cage was open to direct sun during repair, and records are not reliable again until 1645.

30	88+	1345, 1400	62-	2345	71	1800	60-	0445	1.5-3	Clear	2030-0415

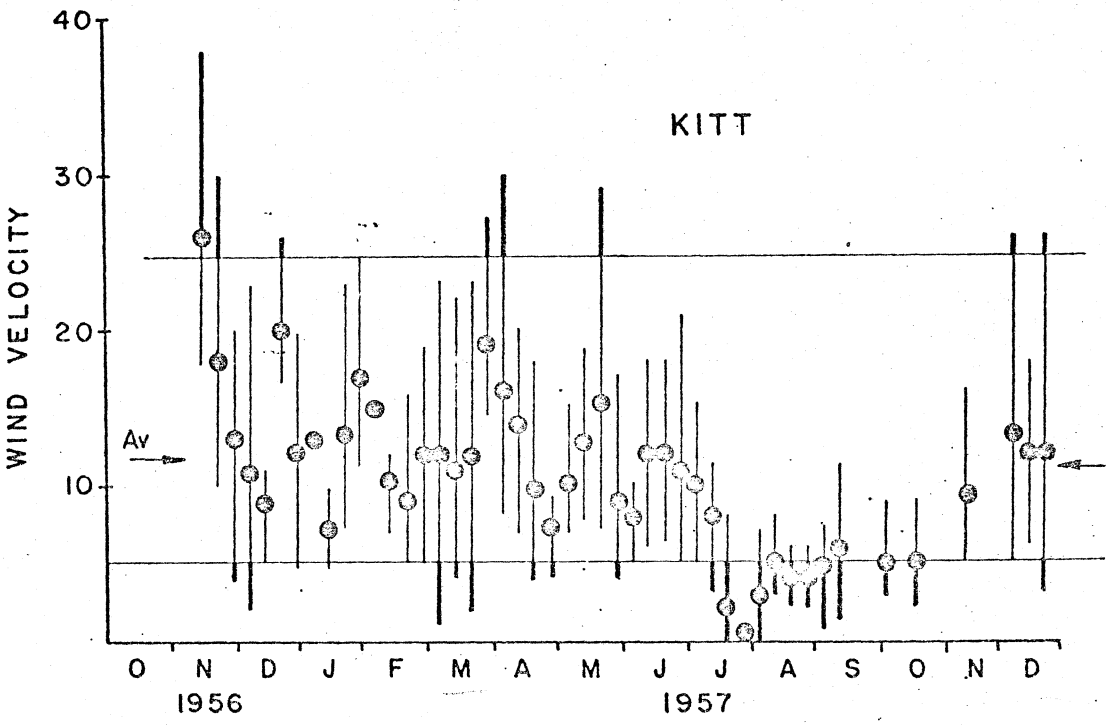
Sample of a Kitt Peak record of cloudiness, seeing, and temperature

J Schaaf

AVERAGE MONTHLY PRECIPITATION AND RELATIVE HUMIDITY UNIVERSITY OF ARIZONA, TUCSON



The following 9 samples are taken from A.B. Meinel's report on the site selection survey for Kitt Peak National Observatory



WEEKLY AVERAGE WIND VELOCITY AND DAILY-AVERAGE RANGE

FIG. 14

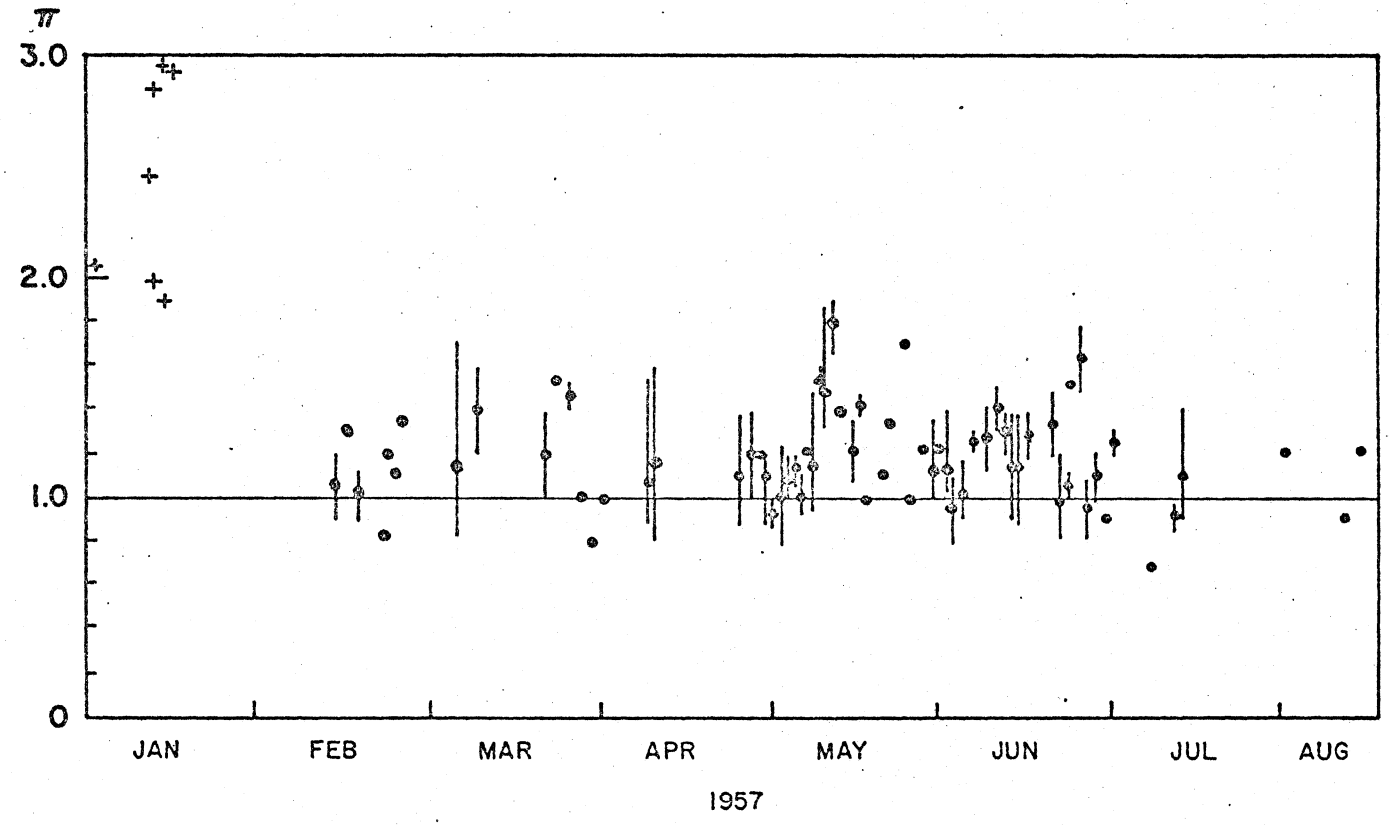
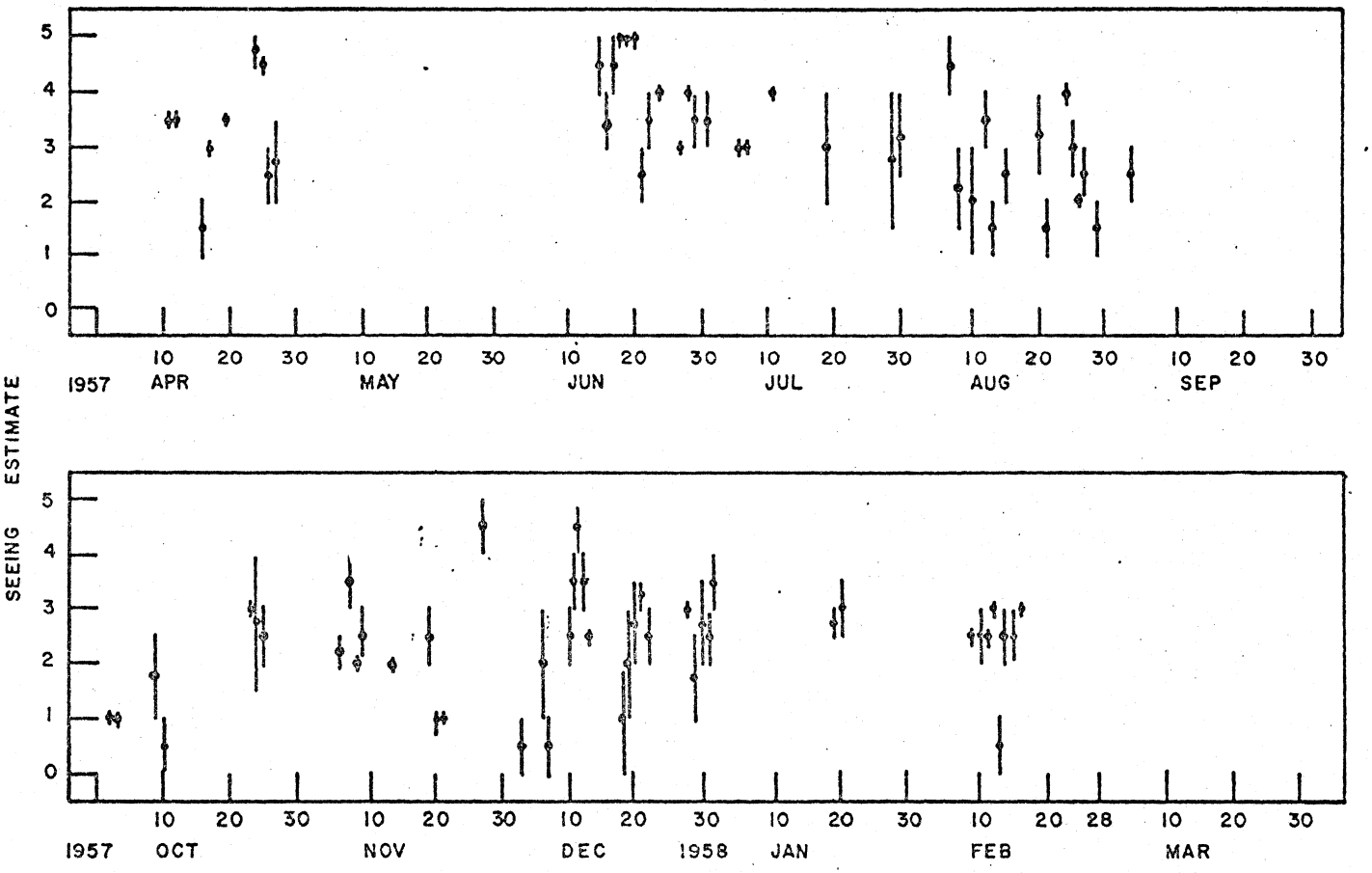


FIG. 48

AVERAGE NIGHTLY SEEING AND RANGE OF DISC DIAMETER FOR KITT PEAK

KITT PEAK



KITT

FIG. 42.

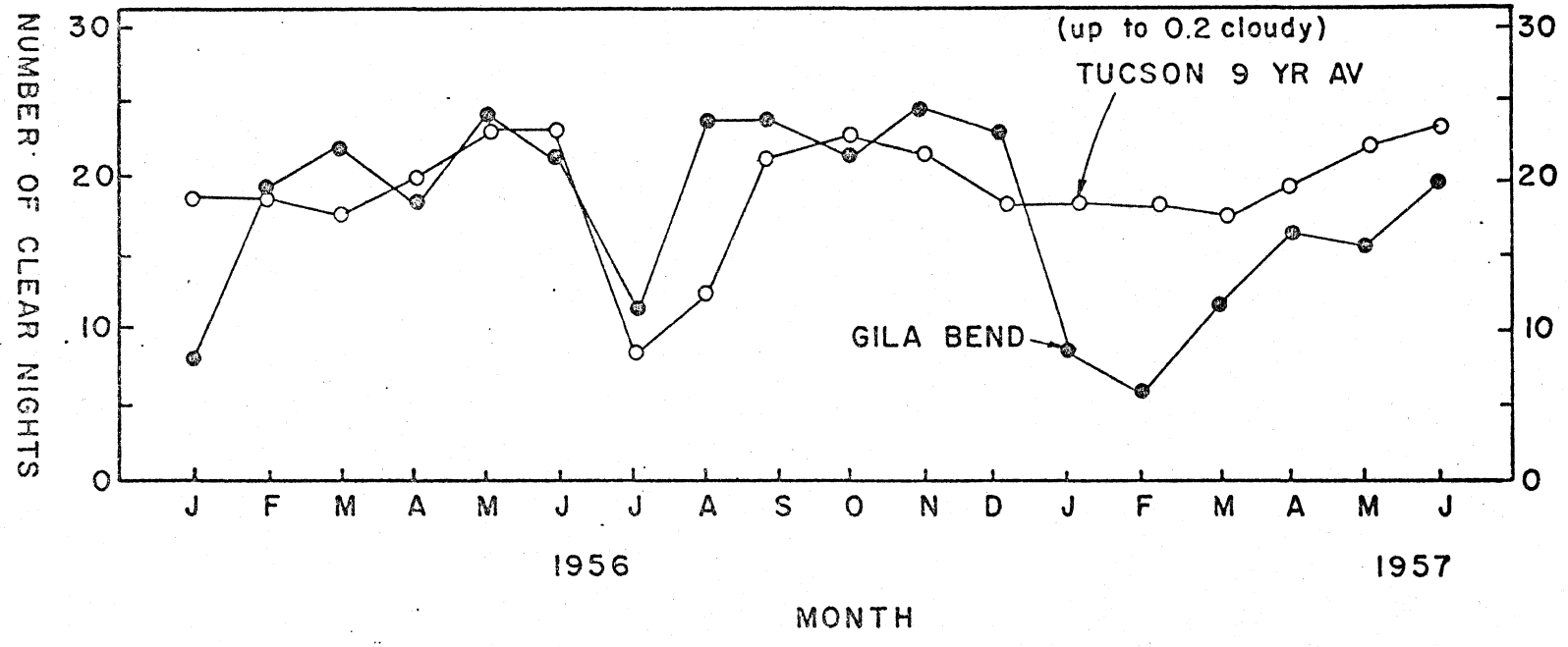
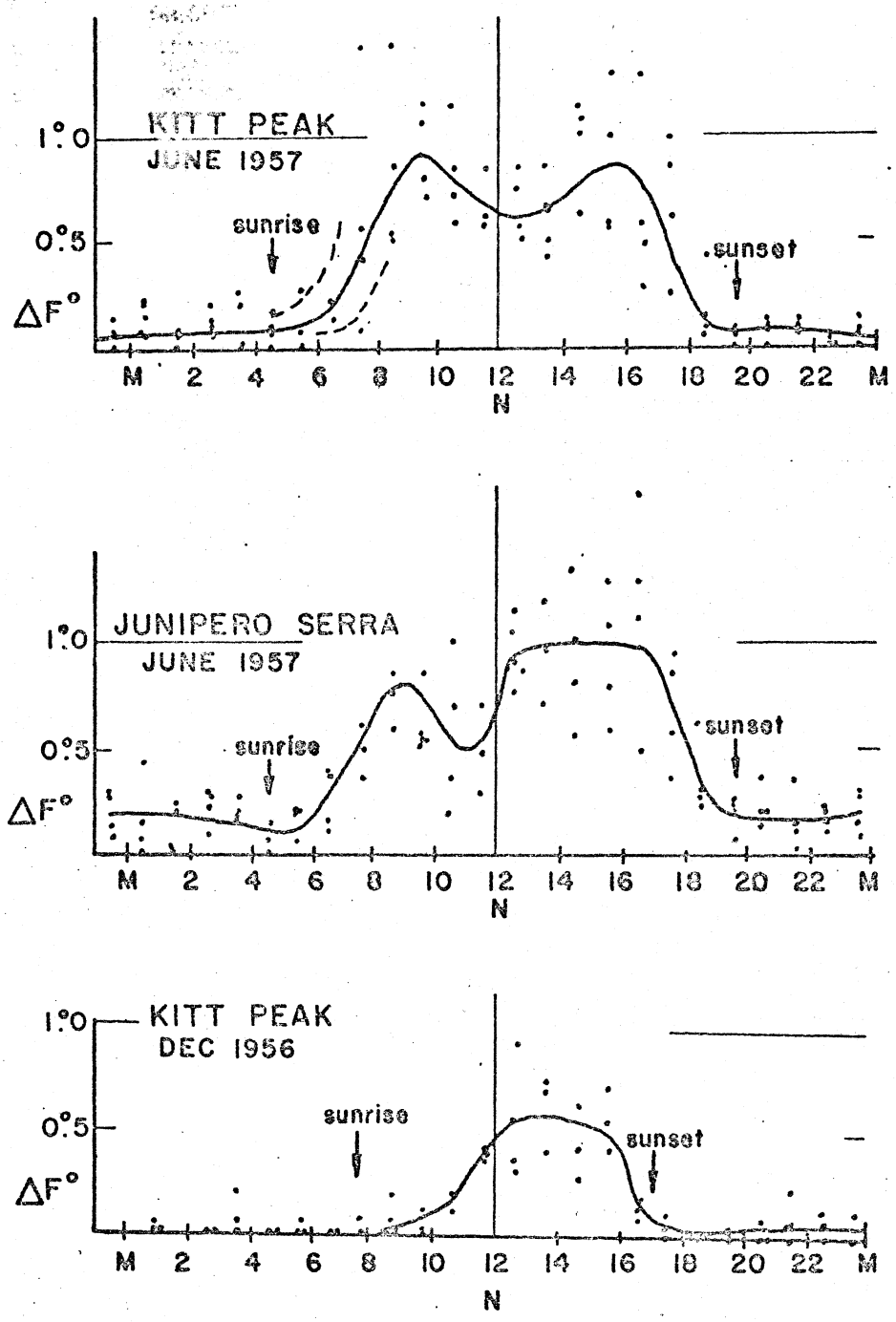

NUMBER OF CLEAR NIGHTS
30
20
10
0
(up to 0.2 cloudy)
TUCSON 9 YR AV
GILA BEND
J F M A M J J A S O N D J F M A M J
1956
1957
MONTH

FIG. 31

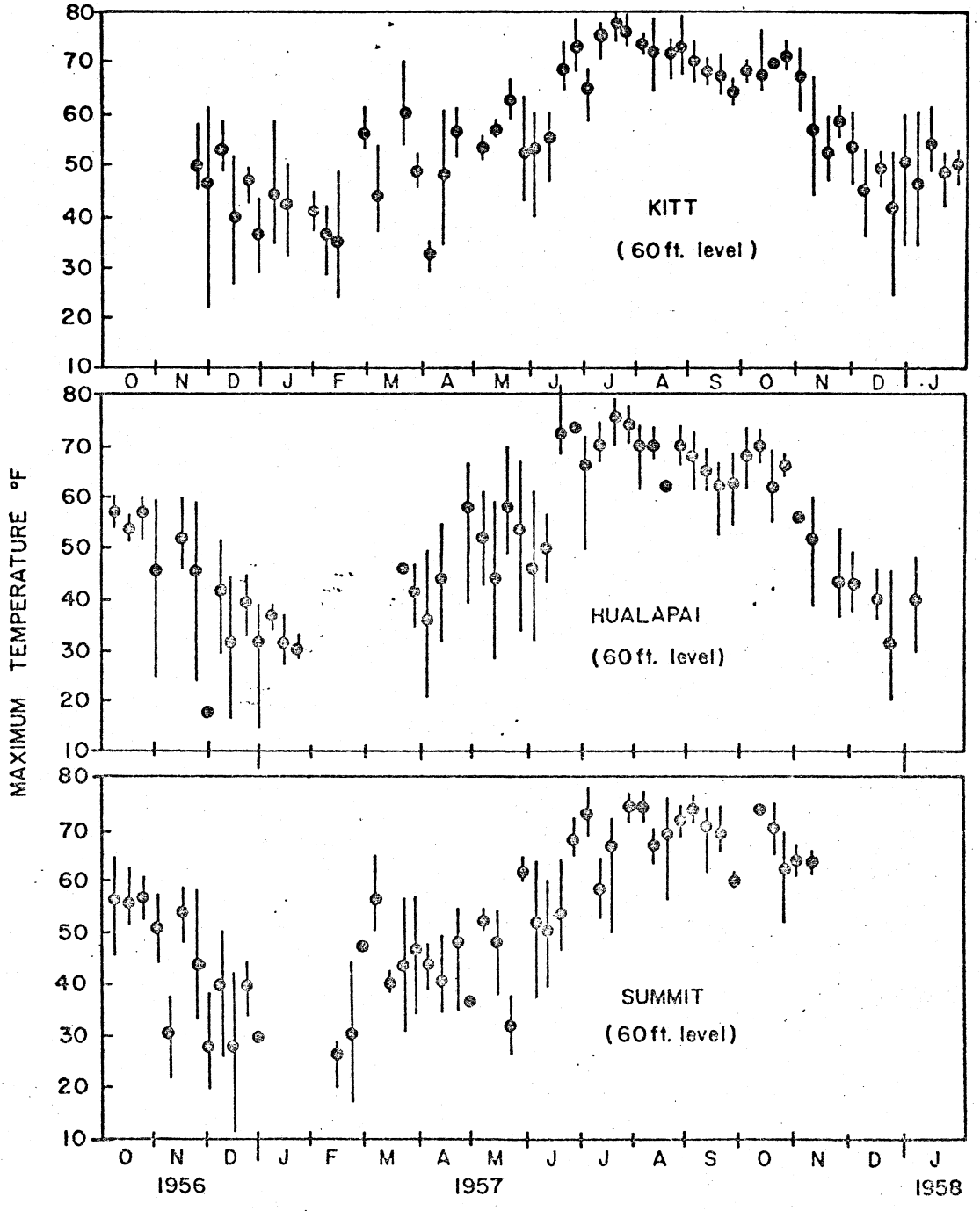


DIURNAL MICROTHERMAL FLUCTUATIONS

$T_{max} - T_{min}$ (°F) for 3^m intervals

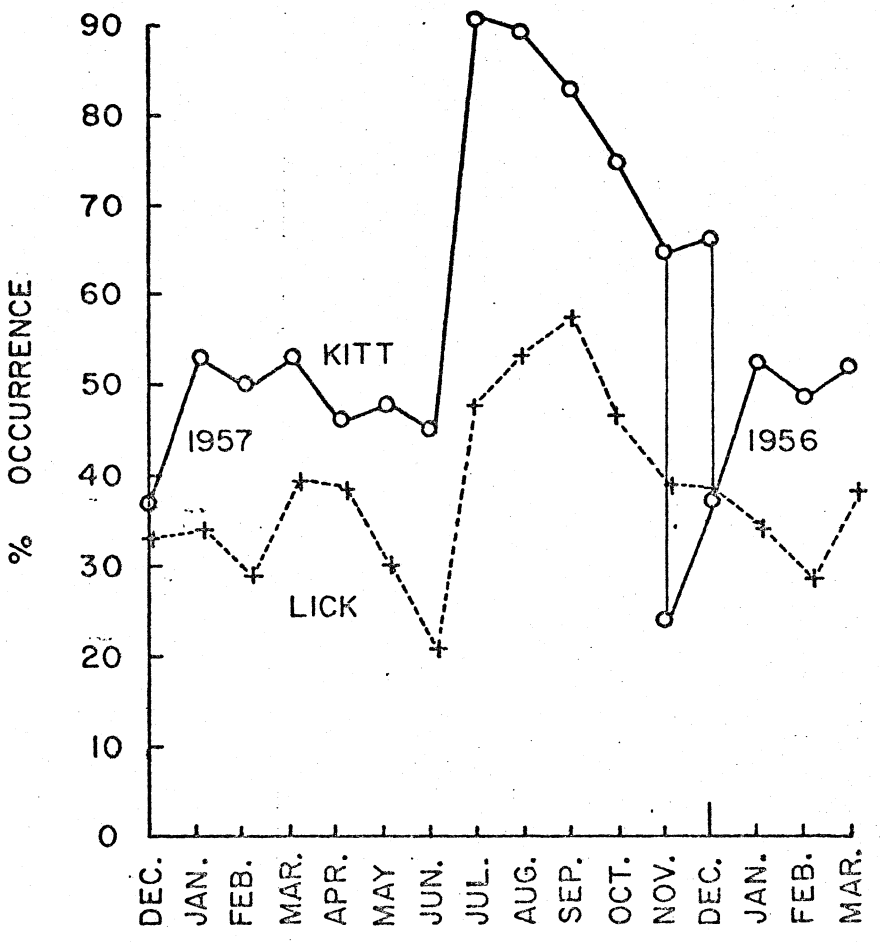
60 ft. above ground

FIG. 25



WEEKLY AVERAGE TEMPERATURE & DAILY-AVERAGE RANGE

FIG. 23



PERCENTAGE OF WINDS WITHIN 0-10mph GROUP

FIG. 22

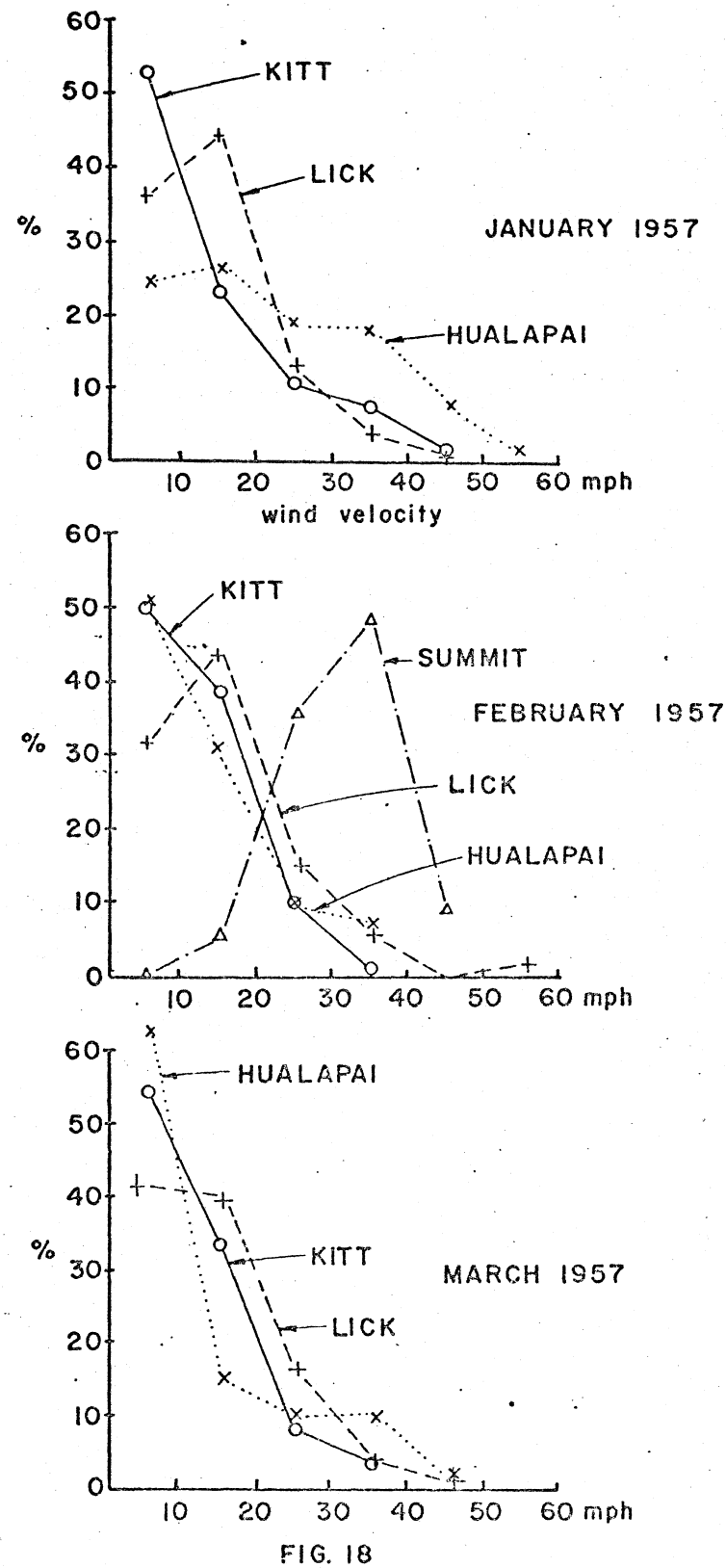
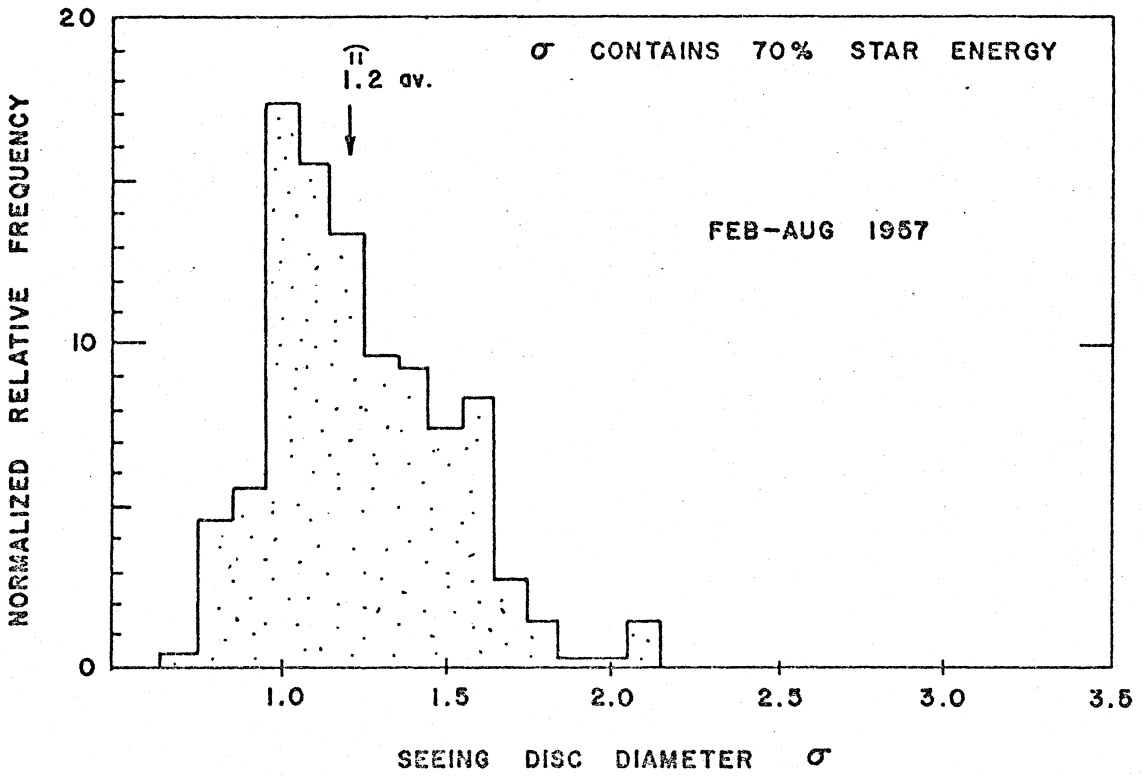

KITT
LICK
HUALAPAI
JANUARY 1957
%
wind velocity
SUMMIT
FEBRUARY 1957
MARCH 1957
10 20 30 40 50 60 mph

FIG. 18



KITT PEAK IMAGE SIZE DISTRIBUTION FOR 75 NIGHTS
FROM FEB 25 TO AUG 5,1957 (229 OBSERVATIONS)

FIG 50

Next three pages from 36' site survey file

LOS ALAMOS SCIENTIFIC LABORATORY
UNIVERSITY OF CALIFORNIA
LOS ALAMOS, NEW MEXICO

OFFICE MEMORANDUM

TO : Norris E. Bradbury, Director DATE: November 19, 1964

FROM : Orin W. Stopinski, Alternate Group Leader, H-6

SUBJECT: PRECIPITABLE WATER CONTENT OF THE ATMOSPHERE

SYMBOL : H-6

Estimates of the amounts of precipitable water in the atmosphere have been computed for two locations at Los Alamos: (1) South Mesa, and (2) the saddle just north of Pajarito Mountain. These estimates have been compared with similar estimates for Climax, Colorado. Climax was selected for comparison since this was the most favorable location cited in the Second Progress Report by the National Radio Astronomy Observatory.

The estimates for the Los Alamos sites were based on monthly averages of the radiosonde data obtained by the US Weather Bureau in Albuquerque for 1963. The estimates for Climax were based on the monthly averages from Denver for the same period. All values are given in millimeters of water.

Site	Climax, Colo.	North Saddle Pajarito Mtn.	South Mesa Los Alamos
Elevation	3350 m	3040 m	2250 m
January	1.6	1.3	2.6
February	2.0	2.6	4.2
March	1.6	2.7	4.3
April	2.1	1.6	3.4
May	3.7	4.2	6.6
June	4.6	5.2	8.1
July	9.2	11.9	17.5
August	11.1	13.4	19.8
September	5.0	7.8	12.9
October	4.1	4.8	8.4
November	2.0	0.1	2.6
December	1.7	0.7	1.9

The referenced document lists three criteria for the telescope enclosure: (1) wind speeds of 90 mph, (2) snow or ice loads of 20 pounds per square foot, and (3) ambient temperature range of -30°F to +120°F.

LOS ALAMOS SCIENTIFIC LABORATORY
UNIVERSITY OF CALIFORNIA
LOS ALAMOS, NEW MEXICO

TO: Norris E. Bradbury 2 DATE: November 19, 1964

The maximum wind speed ever recorded in Los Alamos was a gust of 87 miles per hour and is believed to be about what could be expected on the mountain. Sustained wind speeds of 55 mph have been observed in the town site and it is estimated that sustained winds of 70-75 mph would probably be observed on the mountain.

The maximum snowfall from a single storm in Los Alamos is 18 inches. The limited comparison between SM-43 and the ski slope indicates the slope will experience 1½ - 2 times as much snow as the town site. Taking the upper limit of 2 and our maximum storm snowfall of 18 inches, the snow loading on the horizontal surface at the mountain would be about 18.75 pounds per square foot.

Extreme temperatures at Los Alamos have ranged from -18°F to 95°F. With the assumption that the mountain temperatures are some 10° lower than those at SM-43 the range on the mountain would be within the specified range.

Since weather conditions near Pajarito Mountain are within the ranges specified for the telescope enclosure and the atmospheric water content quite significantly lower than on the plateau, I would recommend that emphasis be placed on the mountain location.

Orin W. Stopinski

OWS:mtj

CC: John H. Manley, RAJM
H-6 File

Los Alamos Site - 36-foot

1. Mean Sky Cover

The following compares the sky cover (clouds) in tenths at Albuquerque (N.M.) and Tucson (Ariz.) for sunrise to sunset.

Station	Years of record	J	F	M	A	M	Jn	Jy	A	S	O	N	D	Annual
Albuquerque	25	4.3	4.5	4.6	4.5	4.3	3.4	4.4	4.5	3.2	2.9	3.1	4.0	4.0
Tucson	16	5.0	4.5	4.6	3.7	2.8	2.2	5.5	4.7	2.7	3.1	3.0	4.4	3.9

2. Mean Precipitable Water (inches)

See appendix for curves from pages 7 and 26 of the Weather Bureau Technical Paper No. 10 (1949). The following table gives the mean precipitable water in inches contained between heights above sea level of 2-8 km in the atmosphere over Albuquerque and Phoenix (nearest available recording station to Tucson).

Station and height	J	F	M	A	M	Jn	Jy	A	S	O	N	D	Mean
Albuquerque 1620 m	.238	.210	.248	.350	.380	.549	.778	.893	.680	.416	.289	.281	.443
Phoenix 339 m	.267	.253	.242	.291	.309	.375	.685	.856	.602	.373	.276	.262	.399

3. Conclusions

Tucson and Albuquerque are equal insofar as cloud cover is concerned.

Phoenix is at least as good as Albuquerque as far as water content in the range 2-8 km above sea level is concerned.

JWF - Nov. 10, 1964

cc: DSH - FJL

From High Altitude Sites and IR Astronomy by G.P. Kuiper
Communications of the Lunar and Planetary Laboratory N° 142

TABLE I

PRECIP. H_2O IN VERTICAL COLUMN (mm)

SITE	LAT. (N)	LONG	ELEVATION FT.	ELEVATION M	p (mb)	ACCESS *	PRECIP.	SNOW †	JANUARY 5%	JANUARY 50%	APRIL 5%	APRIL 50%	JULY 5%	JULY 50%	OCTOBER 5%	OCTOBER 50%	25% ± (9 MO.)
Palomar Obs. (Calif.)	33°21′	116°52′	5600	1706	825	A	24	36	1.8	3.4	1.9	4.4	3.5	9.5	2.6	6.1	2.1
National Radio Obs.	38°26′	79°50	2700	823	920	A	44	80	1.2	4.3	2.6	8.0	12.	20.	3.4	10.	2.4
Kitt Peak Nat'l Obs.	31°58′	111°36′	6750	2064	789	A	12	4	1.7	4.4	1.8	3.7	5.5	10.9	2.3	7.1	1.9
Catalina Obs. (Ariz.)	32°25′	110°44′	8450	2580	740	A	12	5	1.1	2.9	1.4	3.0	5.1	9.7	1.9	5.5	1.5
Mt. Lemmon (Ariz.)	32°26′	110°47′	9190	2800	720	A	12	5	1.0	2.7	1.3	2.8	5.0	9.1	1.8	5.0	1.4
Humphreys Pk. (Ariz.)	35°21′	111°41′	12633	3852	629	O	24	60	0.57	1.4	0.7	1.6	1.7	4.8	0.94	2.1	0.74
Mt. Agassiz (Ariz.)	35°20′	111°41′	12356	3770	636	A *	24	60	.62	1.5	.8	1.7	2.0	5.2	1.0	2.3	0.81
Charleston Pk., Nev.	36°16′	115°42′	11920	3635	647	O *	12	10:	.56	1.5	.57	1.85	1.85	3.1	1.1	2.6	0.74
White Mt., Calif.	37°38′	118°15′	14242	4340	590	O *	12	30	.44	1.1	.49	1.2	1.1	1.9	0.7	1.3	0.54
Barcroft Lab. (White Mt.)	37°35′	118°15′	12500	3510	632	A	12	30	.59	1.4	.66	1.6	1.4	2.4	.8	1.6	0.68
Wheeler Pk., Nev.	38°59′	114°19′	13058	3980	618	T *	12	60+	.47	1.2	.65	1.5	1.35	3.1	.8	1.9	0.64
Delano Peak, Utah	38°22′	112°22′	12173	3712	640	T *	16	60+	.57	1.4	.83	1.7	1.6	4.3	.95	2.4	0.78
Mt. Peale, Utah	38°4	109°2	12721	3880	626	O *	24	60+	.48	1.3	.90	1.6	1.6	4.5	.93	2.3	0.77
Mt. Nebo, Utah	39°49′	111°45′	11871	3620	648	T *	16	50	.57	1.5	1.0	1.9	1.7	4.4	1.0	2.5	0.86
Mt. Timpanogos, Utah	40°23′	111°39′	11750	3580	652	T *	32	100	.54	1.5	1.0	2.0	1.7	4.5	.96	2.6	0.83
Kings Pk., Utah	40°47′	110°22′	13528	4130	606	O	40	150:	.40	1.1	0.67	1.4	1.3	3.6	0.75	1.8	0.61
Pikes Pk., Colo.	38°50′	105°2′	14110	4300	593	(A)*	24	100	.40	1.0	.7	1.3	1.6	4.2	.81	1.9	0.64
Mt. Shasta, Calif.	41°25′	122°12′	14162	4317	592	O *	80	100+	.35	1.0	.47	1.2	0.93	1.7	.64	1.35	0.49
Mt. Rainier, Wash.[1]	46°51′	121°46′	14150	4313	592	O *	96	400+	.38	0.95	.39	1.2	.88	1.6	.54	1.4	0.44
Mt. Fairweather, Alsk.	58°54′	137°31′	15320	4670	566	O *	32	200:	.16	0.6	.23	0.6	.7	1.6	.25	0.8	0.21
Mt. McKinley, Alaska	63°05′	150°59′	20320	6200	459	O *	16	100	0.07	0.15	0.09	0.20	0.24	0.6	0.09	0.24	0.08
Mauna Kea, Hawaii	19°8	155°5	13800	4215	600	A	16	+	1.2	1.5	1.0	1.8	1.3	2.0	1.2	2.3	1.1
Baja California, Mex.	31°0	115°6	9280	2830	717	(A)	—	—	1.2	2.6	1.35	2.8	3.5	8.2	1.9	4.7	1.5
Popocatepetl, Mex.	19°0	98°6	17887	5450	509	O	—	—	0.61	1.0	0.79	1.4	1.9	2.8	0.81	2.7	0.74
Road terminus [2]	19°0	98°6	15500	4730	560	A	—	—	.9	1.7	1.1	2.1	2.9	4.1	1.25	4.1	1.1
Mt. Bolivar, Venez.	8°6	71°1W	16427	5000	540	A	—	—	.6	1.6	1.1	1.7	1.5	2.8	1.6	3.5	1.1
Jungfraujoch, Swit.	46°5	8°E	11500	3500	658	A	—	—	.52	1.5	0.6	2.0	1.4	4.1	1.1	2.7	0.74
Mt. Blanc, France	45°52′	7°E	15782	4810	554	O	—	—	0.25	0.9	0.28	0.9	0.6	1.8	0.42	1.3	0.32
Tenerife, Canary Is.	28°3	16°7W	12000	3660	645	(A)	—	—	1.1	3.4	1.2	2.2	2.3	3.7	1.9	3.7	1.4
Zelenchukskaya[3]	43°50′	41°36′E	6830	2080	788	A	—	—	1.9	4.1	2.3	4.2	5.3	9.6	2.2	5.8	2.1
Mt. Ararat, Turkey	39°7	44°3 E	16945	5165	529	O	—	—	0.42	1.0	0.59	1.3	0.9	2.3	0.7	1.6	0.57
Mt. Everest	28°0	87°0 E	29002	8840	315	O	—	—	0.09	0.13	0.09	0.16	0.6	1.7	0.17	0.24	0.12

* Accessible by road (A), trail (T), not (O).

† These interpolated chart figures must apply to *wider* areas than the summits. (E.g., Catalina Obs: summit figures are around 40″; cf. Appendices for some other sites.)

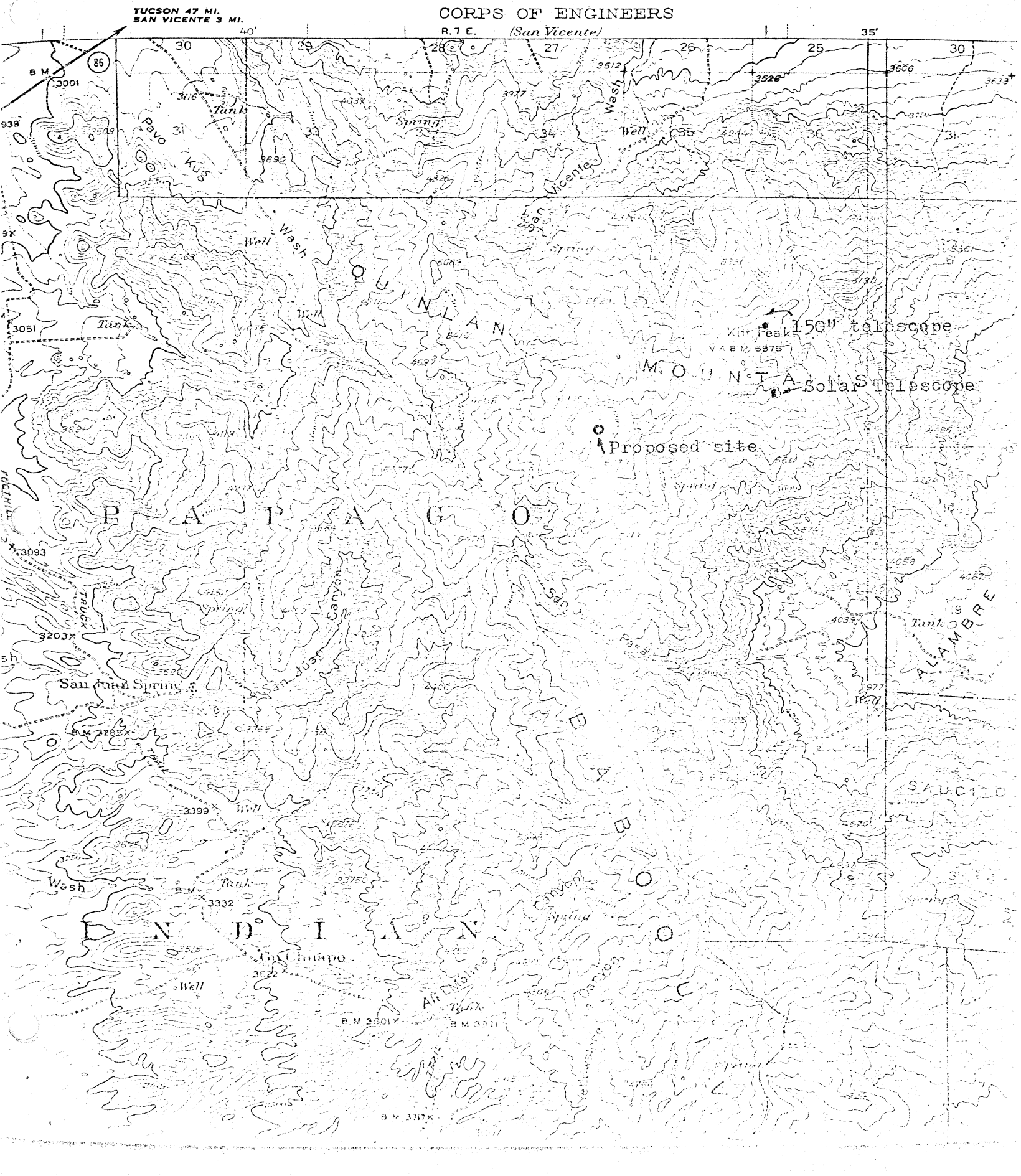
1) Point Success: summit crater unsuited.

2) Road to 15,500′ = 4730 m, where snow-covered deep cinders begin.

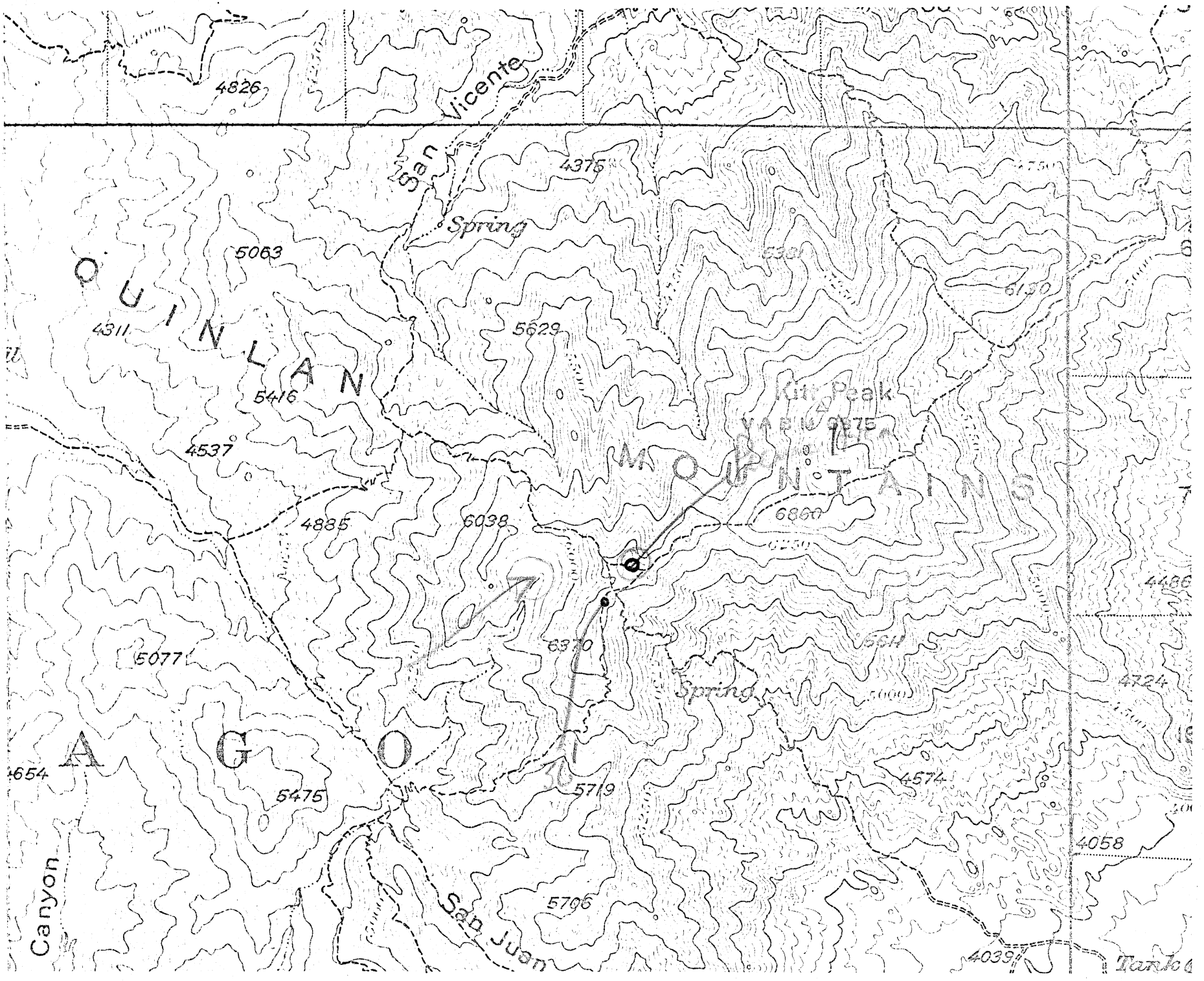
3) Future site of 6-meter telescope.

Kitt Peak Scale 1:62500

UNITED STATES
DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS



1: 33621 1.21 1/16 inch = diff diameter



Valle Seco, Jemez Mountains Scale 1:46000