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MONTHLY
MICROCLIMATIC SUMMARY

OCTOBER 1966

ENVIRONMENTAL DATA BASE
FOR REGIONAL STUDIES IN THE HUMID TROPICS

USATECOM Project No. 9-4-0013-01

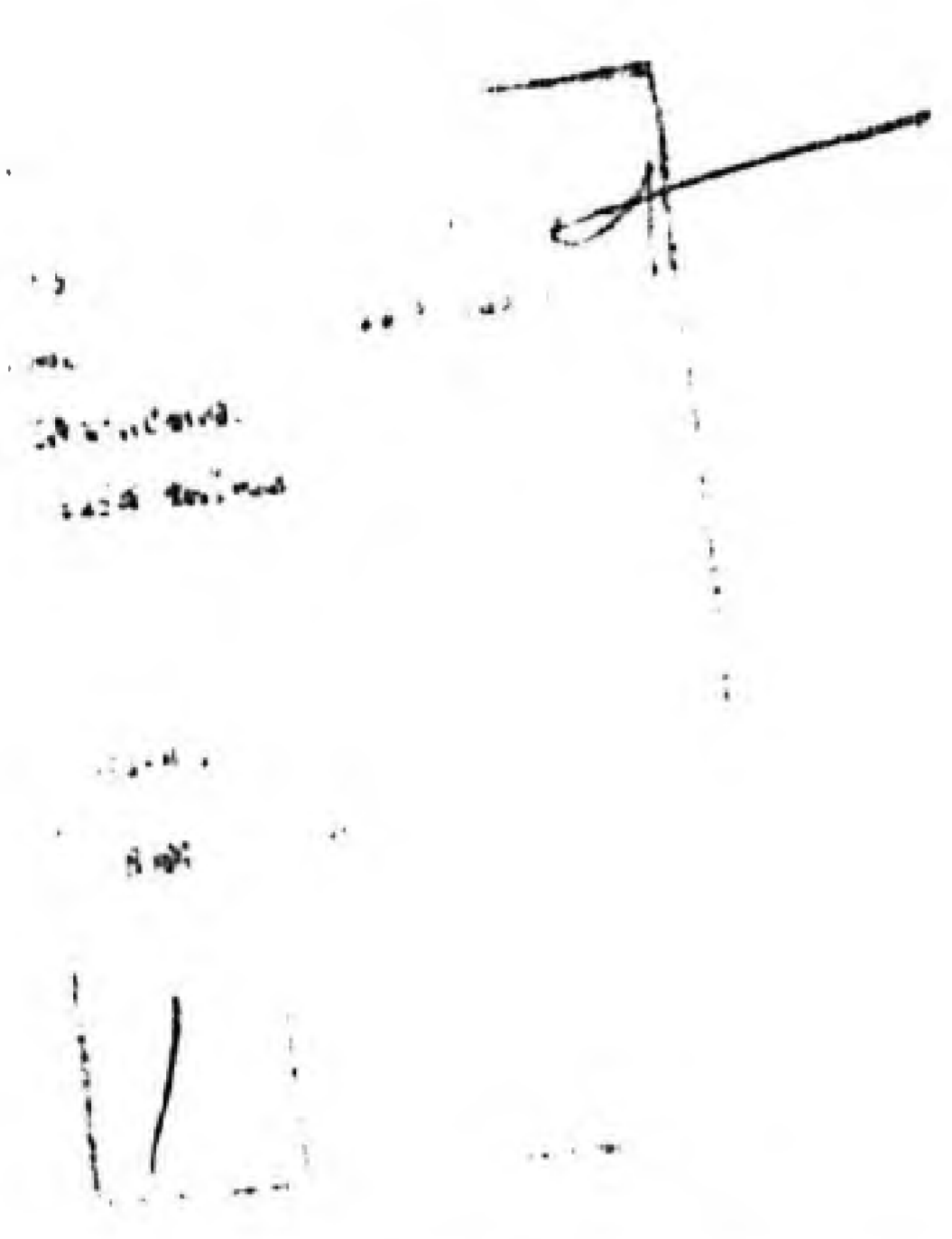
US ARMY
TROPIC TEST CENTER
Fort Clayton, Canal Zone

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FOR REGIONAL STUDIES IN THE HUMID TROPICS

MONTHLY
MICROCLIMATIC SUMMARY

OCTOBER 1966

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USATECOM Project No. 9-4-0013-01

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MONTHLY MICROCLIMATIC SUMMARY

Introduction

Monthly microclimatic data summarized in this series of reports were collected by the US Army Tropic Test Center and the Weather Engineers of Panama Corporation under the project, Environmental Data Base for Regional Studies in the Humid Tropics. The project is sponsored by the Advanced Research Projects Agency of the Department of Defense and by the Army Research Office, Office of the Chief of Research and Development. It is an investigation of microclimatic, air chemistry, vegetation, soils, microbiological, and macrofaunal conditions at selected sites in the principal tropical environments of the Panama Canal Zone and the Rio Hato Military Reservation. The objective of the project is to assemble quantitative environmental data for RDT&E purposes.

Sites. Data summarized in this report were collected at the Albrook Forest and Chiva Chiva sites. Figure 1 shows the site locations within the Isthmus of Panama. Geographic coordinates are shown below:

Albrook Forest	09° 01'N, 79° 33'W
Chiva Chiva	09° 01'N, 79° 35'W

The Chiva Chiva open site and the Albrook Forest site are paired for comparative study of environmental conditions in a tropical semideciduous forest and in a large clearing. Both are located in a region where the annual precipitation is approximately 80 inches and there is a pronounced dry season. The other satellite sites were located primarily for soil studies purposes. Albrook and Fort Kobbe have climatic regimes similar to the principal sites.

The Albrook and Chiva Chiva main sites are approximately four kilometers apart. Each has a 46 meter walk-up tower and an air-conditioned building to house the recording equipment and observers. Both sites are approximately 30 meters above sea level. The top of the forest canopy at the Albrook site is about 26.5 meters above the ground.

Instrumentation. A wide range of climatic elements are measured at the Albrook and Chiva Chiva sites. Types of observations and frequencies are shown on Figure 2. The towers at the Albrook and Chiva Chiva sites are similarly oriented. Sensing equipment is mounted at several levels on the towers to provide measurements through the vertical profile. Additional instruments are emplaced in the immediate vicinity on or near the ground. All instrument exposures are duplicated at each site. Figures 3, 4, and 5 show the instrument array at these sites.

Data Reduction and Storage. All data, as applicable, are recorded at or reduced to each full hour and transposed to punch cards. These punch cards, together with all raw data, are stored in the Tropic Test Center Technical Library Annex.

The relative humidity data contained in this report required some adjustment due to the difficult problems in maintaining hair hygrometers in the humid tropics. The hygrometers show saturation at a time when the psychrometer shows a relative humidity well below 100%. For this reason the hourly measurements made by means of a hair hygrometer have been modified on the basis of simultaneous psychrometer readings of other levels. Details will be given in the fourth Semiannual Report. It can be assumed that the means of relative humidity presented in this volume are very close to the true means.

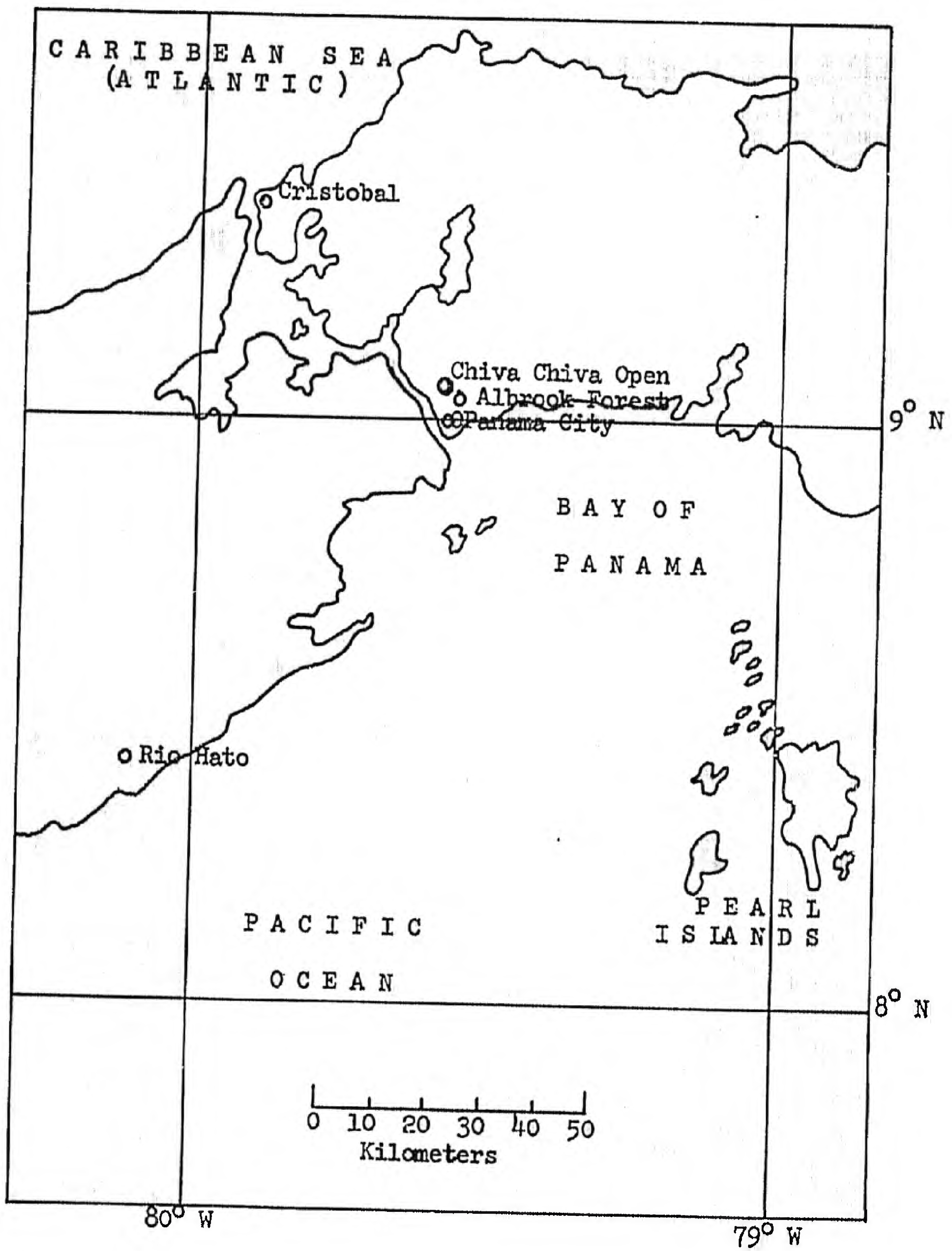


FIGURE 1. LOCATION MAP, ISTHMUS OF PANAMA

FIGURE 2. FREQUENCY OF OBSERVATIONS

Height (meters)

# Element	<u>Height (meters)</u>								<u>Frequency</u>	
	<u>Sfc</u>	<u>0.5</u>	<u>1.0</u>	<u>2.0</u>	<u>4.0</u>	<u>8.0</u>	<u>13.5</u>	<u>26.5</u>		<u>28.5</u>
<u>Temperature:</u>										
Dry Bulb	1	1	1	1	1	2	1	1	2	1
Wet Bulb	-	1	1	1	1	-	-	-	-	-
Grass Minimum	3	-	-	-	-	-	-	-	-	-
<u>WBGT Index</u>	-	-	1	-	-	-	-	-	-	-
<u>Relative Humidity</u>	-	1	1	1	1	1	1	1	-	1
<u>Barometric Pressure</u>	-	-	1	-	-	-	-	-	-	-
<u>Evaporation</u>	1	-	-	-	-	-	-	2	-	2
<u>Precipitation:</u>										
Recording Gage	-	-	1	-	-	-	-	-	-	2
Manual Gage	-	-	2	-	-	-	-	-	-	-
Stem Flow	-	-	2	-	-	-	-	-	-	-
<u>Wind:</u>										
Direction	-	-	-	-	1	-	-	1	-	1
Speed	-	-	-	1**	1	-	1**	1**	-	1

- 1. Albrook and Chiva Chiva
- 2. Albrook only
- 3. Chiva Chiva only

* Observations made with sling psychrometer when recorders are inoperative.

** Hourly

Instrument descriptions are contained in the Environmental Data Base semiannual reports.

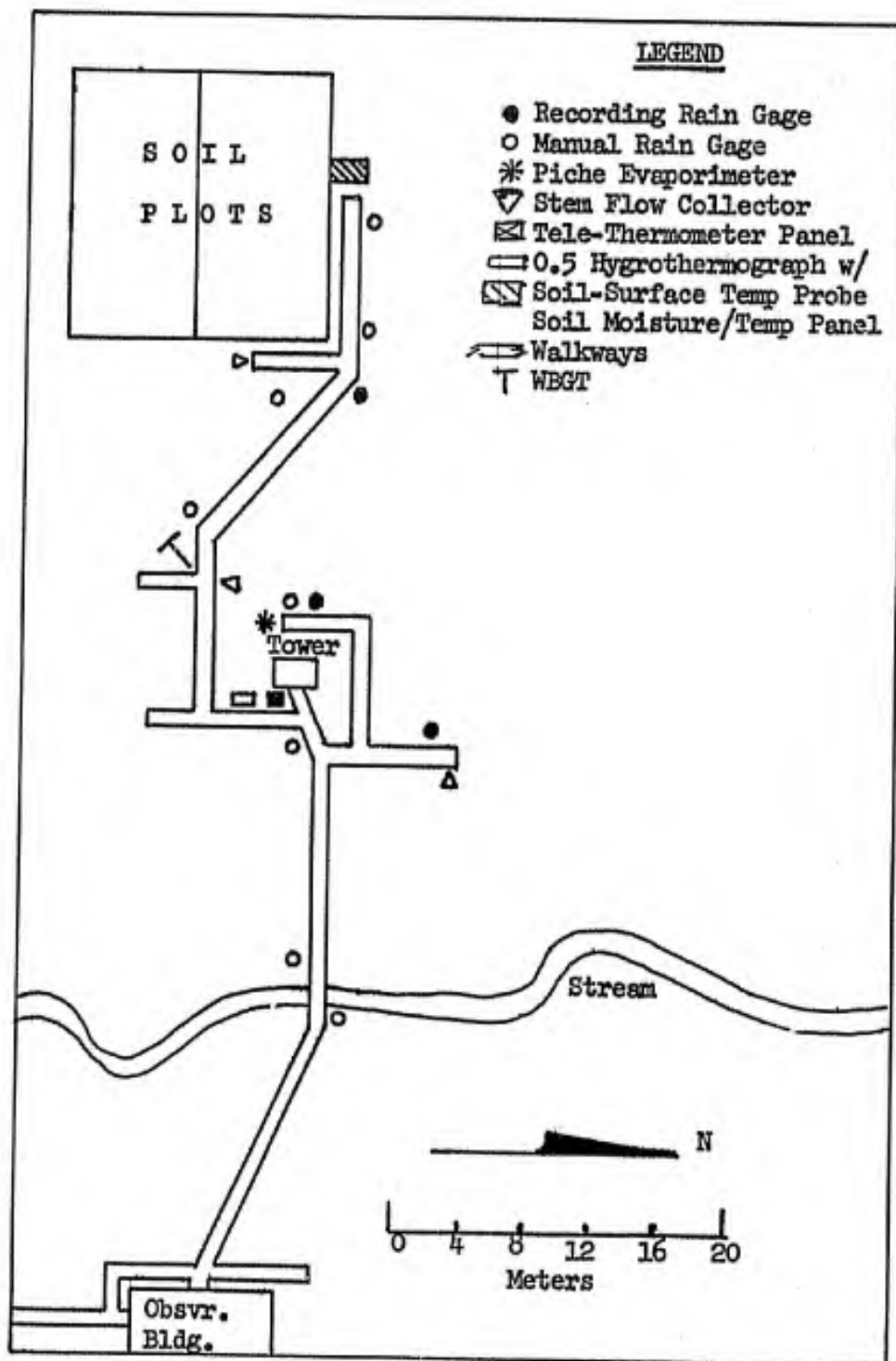


FIGURE 3. ALBROOK FOREST SITE, GENERALIZED PLOT

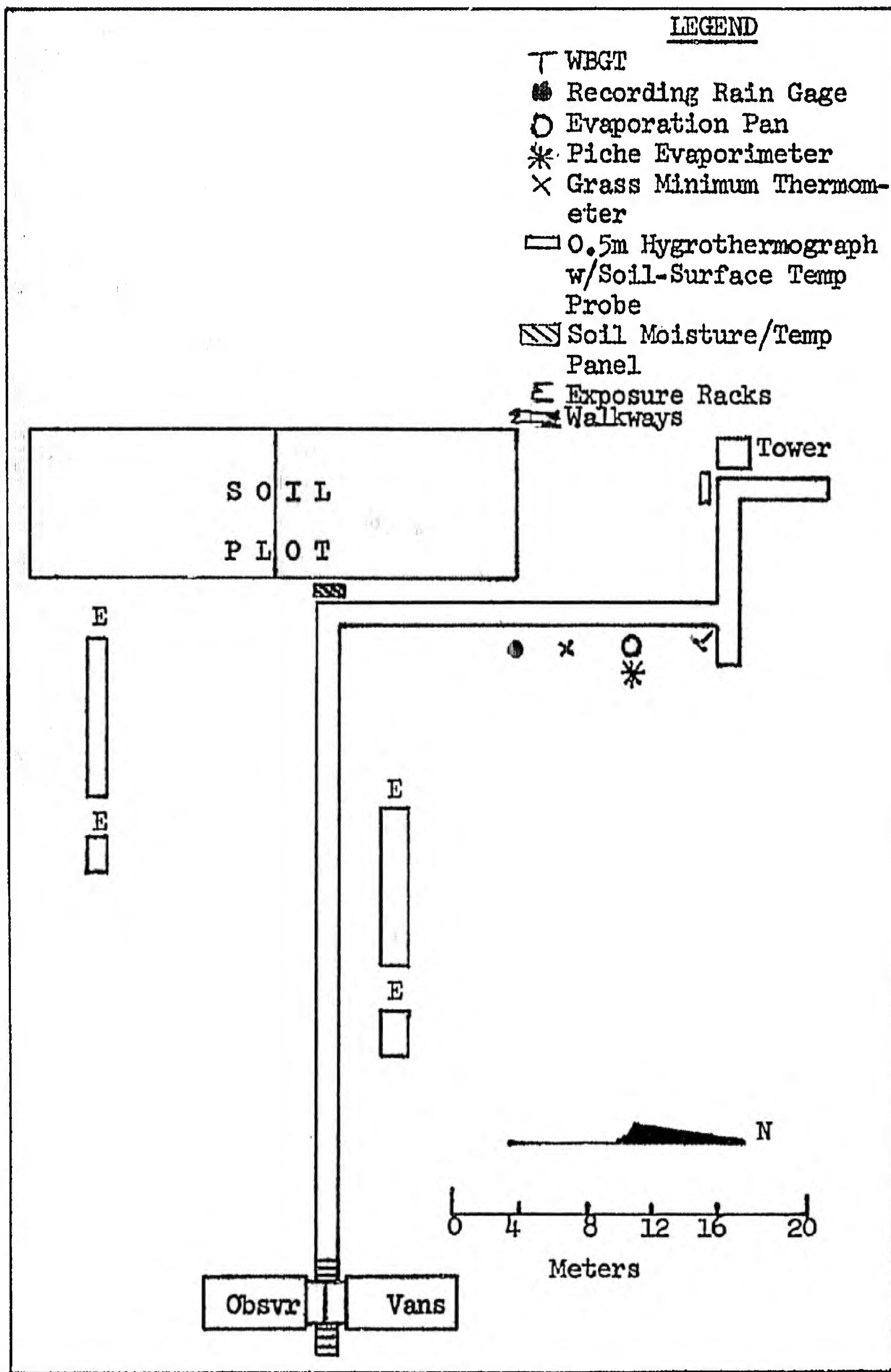


FIGURE 4. CHIVA CHIVA OPEN, GENERALIZED PLOT

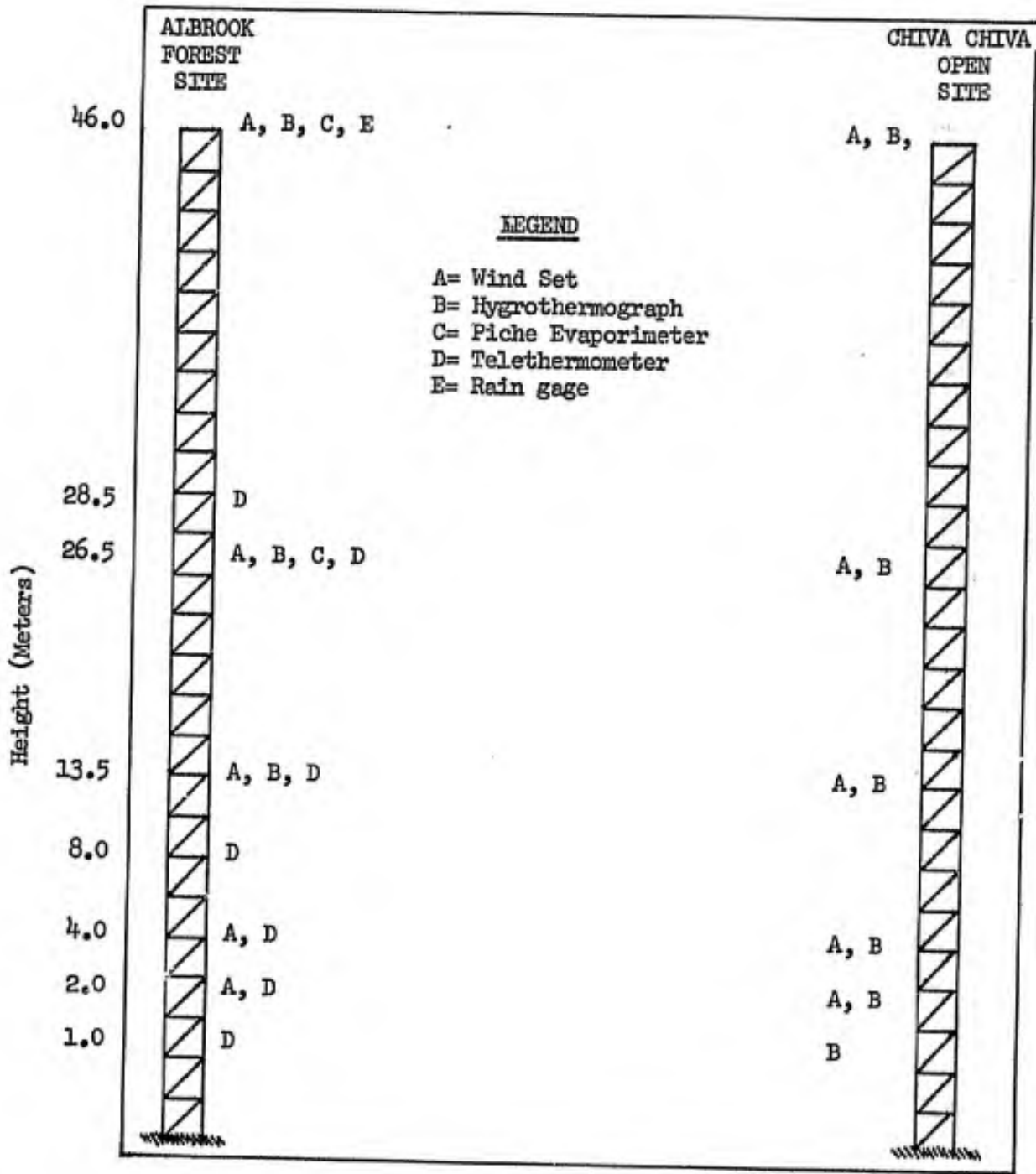


FIGURE 5. INSTRUMENT LOCATION ON TOWERS

SUMMARY OF METEOROLOGICAL OBSERVATIONS
HOURLY DATA
OCTOBER 1966

Exposure	Monthly Means of Air Temperature by Hour (°F)																								Monthly Summary					
	Site	Level	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	No. of Obs.	Min.	Mean	Max.
Albrook (Forest site)	46.0 m		74.6	74.3	74.3	74.1	74.0	73.9	75.0	77.1	79.2	80.4	80.6	80.4	80.0	79.7	79.2	78.8	77.7	76.7	75.9	75.5	75.3	75.1	74.9	74.7	741	71.1	76.7	89.1
	28.5 m		74.1	74.0	73.9	73.6	73.5	73.3	74.7	77.7	80.0	81.2	81.2	81.4	80.9	80.2	79.5	79.1	78.1	76.6	75.7	75.1	75.0	74.8	74.5	74.2	744	70.8	76.8	90.1
	26.5 m		73.9	73.6	73.8	73.5	73.5	73.2	74.7	77.9	80.1	81.4	81.4	81.6	81.0	80.4	79.7	79.2	78.2	76.6	75.6	75.0	75.0	74.7	74.3	74.1	744	70.4	76.8	91.4
	13.5 m		74.1	74.0	74.0	73.7	73.6	73.5	74.1	76.6	77.9	79.2	79.9	80.3	80.2	79.6	78.8	78.5	77.7	76.7	75.8	75.3	75.0	74.8	74.4	74.2	740	70.9	76.3	86.5
	8.0 m		74.1	73.9	74.0	73.7	73.6	73.4	74.0	76.0	77.7	79.2	79.7	80.0	80.1	79.4	78.7	78.5	77.7	76.7	75.7	75.3	75.0	74.7	74.4	74.1	744	71.0	76.2	85.4
	4.0 m		73.8	73.6	73.8	73.4	73.2	73.1	74.0	76.0	78.0	79.4	79.8	80.0	79.7	79.2	78.7	78.3	77.1	76.1	75.3	74.8	74.5	74.3	74.0	73.9	739	70.0	76.0	85.5
	2.0 m		73.8	73.7	73.8	73.4	73.3	73.2	74.0	75.9	77.9	79.1	79.6	79.7	79.5	79.1	78.6	78.2	77.1	76.1	75.3	74.8	74.5	74.3	74.0	73.9	739	70.2	75.9	85.3
1.0 m		74.1	73.9	73.9	73.8	73.7	73.2	73.9	75.7	77.3	78.6	79.2	79.3	79.3	78.9	78.4	78.0	77.1	76.1	75.4	75.2	74.8	74.6	74.4	74.2	744	70.5	76.0	89.0	
0.5 m		74.4	74.1	74.1	74.0	73.8	73.7	74.0	75.5	77.2	78.7	79.1	79.4	79.4	79.1	78.5	78.2	77.6	76.8	76.0	75.5	75.2	74.9	74.6	74.4	744	70.8	76.2	83.5	

46.0 m	74.8	74.6	74.5	74.4	74.3	74.3	74.7	77.0	79.2	80.5	80.7	81.2	80.0	79.5	79.0	78.8	78.0	76.9	76.3	75.7	75.4	75.3	75.1	75.0	738	72.2	76.9	87.2										
28.5 m								This level was not instrumented for air temperature at this time																														
26.5 m	74.7	74.4	74.4	74.2	74.1	74.1	74.9	77.4	79.7	81.0	81.4	81.7	80.4	80.0	79.5	79.2	78.5	77.4	76.3	75.8	75.5	75.2	75.0	74.9	740	72.3	77.0	87.1										
13.5 m	74.5	74.2	74.1	73.9	73.7	73.7	74.7	77.2	79.6	80.9	81.7	81.8	80.7	80.1	79.5	79.3	78.4	77.4	76.1	75.7	75.3	75.1	74.9	74.7	744	71.0	77.0	87.5										
8.0 m								This level was not instrumented for air temperature at this time																														
4.0 m	73.9	73.7	73.6	73.4	73.3	73.3	73.2	75.2	77.9	80.4	82.3	82.8	82.5	82.0	81.1	80.2	79.8	78.5	77.0	76.0	75.4	75.0	74.8	74.2	738	70.4	77.1	89.7										
2.0 m	73.7	73.5	73.4	73.2	73.0	72.9	75.2	78.2	80.8	82.7	83.1	82.8	82.1	81.4	80.2	79.7	78.4	76.8	75.8	75.2	74.7	74.5	74.0	74.0	739	70.3	77.0	89.9										
1.0 m	74.1	73.9	73.7	73.4	73.3	72.3	74.6	76.3	80.9	83.2	83.9	83.2	82.0	81.1	80.2	79.7	78.5	76.5	75.3	75.5	75.0	74.6	74.4	74.3	744	69.0	77.2	94.3										
0.5 m	74.5	74.2	74.0	73.8	73.7	73.6	74.7	77.5	80.3	82.0	82.9	83.2	82.3	81.6	80.7	80.2	79.0	77.3	76.3	75.7	75.4	75.0	74.8	74.7	744	70.7	77.4	90.3										

SUMMARY OF METEOROLOGICAL OBSERVATIONS
HOURLY DATA
OCTOBER 1966

Exposure	Monthly Ranges of Air Temperature by Hour (°F)																								Monthly Summary*	
	Site	Level	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22		23
Albrook (Forest site)	46.0 m	5.1	5.1	5.2	4.9	4.9	3.6	5.9	6.1	10.0	11.5	11.6	10.6	11.0	10.9	11.9	17.0	10.0	6.8	6.7	5.2	4.9	4.9	4.9	5.3	4.8
	28.5 m	5.1	4.6	5.5	5.0	5.3	4.2	5.5	9.0	11.5	13.0	12.2	11.3	12.1	12.2	15.8	16.1	10.1	8.1	6.4	6.2	7.0	7.6	6.1	5.7	
	26.5 m	5.3	4.7	5.3	5.2	5.7	4.2	5.3	9.6	12.0	13.0	12.3	11.0	12.5	12.6	15.7	19.4	10.3	8.7	6.6	6.0	6.2	7.2	6.4	5.8	
	13.5 m	5.3	4.7	5.3	4.7	4.5	4.1	4.2	6.0	6.7	8.8	9.8	8.7	10.2	10.7	13.0	11.0	7.6	6.7	6.0	5.9	6.1	5.7	5.7	5.6	
	8.0 m	5.0	4.6	4.9	4.8	4.5	4.3	4.5	3.8	5.1	8.8	8.5	8.9	9.6	10.7	12.8	10.9	9.0	7.3	5.8	5.7	5.7	6.6	5.8	5.5	
	4.0 m	4.6	5.2	5.7	5.3	4.5	5.5	4.0	3.8	6.3	9.6	10.0	9.1	9.9	11.2	10.7	10.8	7.3	6.2	6.0	5.8	5.8	6.1	5.7	5.1	
	2.0 m	4.6	5.0	5.5	5.3	4.5	5.3	4.7	3.7	6.4	7.6	9.1	8.5	9.9	9.8	11.0	10.6	6.8	6.1	5.6	5.6	6.0	6.5	6.0	5.1	
	1.0 m	5.1	4.1	5.1	5.2	5.1	5.0	4.4	3.1	6.0	8.0	9.0	9.4	10.7	10.5	16.0	11.1	9.0	6.2	5.7	5.1	5.3	6.0	6.1	5.2	
	0.5 m	4.3	4.8	4.2	4.2	4.2	4.0	4.6	3.7	4.8	8.0	7.8	7.7	8.4	8.4	11.2	11.5	7.6	7.0	6.0	5.4	4.8	5.4	5.4	5.8	5.2

* No monthly summary was computed for the ranges.

46.0 m	4.3	4.0	4.0	3.7	3.2	3.2	4.0	6.9	8.2	10.2	12.3	11.6	12.6	9.4	11.1	14.1	8.5	8.8	5.7	5.3	4.6	4.7	4.6	4.6	4.6
28.5 m																									
26.5 m	5.1	4.6	4.2	4.0	4.2	4.2	5.0	7.1	9.7	11.3	12.5	12.3	13.2	9.8	11.9	13.6	9.7	8.8	5.6	5.6	4.5	5.5	5.5	5.0	
13.5 m	4.6	4.5	4.6	4.6	4.1	4.6	4.4	6.8	8.5	11.2	12.6	12.4	12.3	10.7	12.4	13.4	9.3	8.2	4.8	4.7	4.9	6.9	5.7	5.4	
8.0 m																									
4.0 m	6.3	5.4	5.0	5.3	4.9	4.9	7.6	8.1	10.8	15.3	15.7	13.5	11.7	13.9	15.7	14.8	9.9	6.7	5.4	4.9	5.4	5.9	5.8	5.0	
2.0 m	6.2	5.4	5.4	5.4	5.4	5.4	5.8	7.5	10.5	15.1	15.6	14.2	12.9	13.8	15.6	15.6	9.8	6.7	5.3	4.9	6.6	6.2	5.3	5.3	
1.0 m	4.5	4.9	4.8	4.9	5.2	6.2	9.5	11.1	15.0	15.5	20.3	18.5	16.8	16.0	19.0	15.5	11.8	8.0	6.0	4.9	4.7	6.2	6.4	5.5	
0.5 m	5.0	5.4	5.2	5.4	5.4	5.4	7.9	7.2	9.7	13.9	15.9	15.7	12.7	12.8	14.8	15.0	11.3	7.8	5.5	5.8	6.0	6.5	6.5	5.9	

This level was not instrumented for air temperature at this time

This level was not instrumented for air temperature at this time

SUMMARY OF METEOROLOGICAL OBSERVATIONS

HOURLY DATA

OCTOBER 1966

Exposure	Monthly Means of Relative Humidity by Hour																								Monthly Summary								
	Site	Level	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	No. of Obs.	Min.	Mean	Max.			
Albrook (Forest site)	46.0 m		94	94	95	95	95	96	93	88	83	79	79	81	82	83	84	86	89	93	94	94	94	94	94	95	739	64	90	98			
	28.5 m								This level was not instrumented for relative humidity at this time																								
	26.5 m		96	96	96	96	96	97	94	88	83	79	80	81	83	84	85	87	91	94	96	96	96	95	96	96	740	65	91	100			
	13.5 m		97	97	97	97	97	98	97	94	88	85	83	84	86	86	88	89	89	92	95	96	96	97	97	97	738	67	93	100			
	8.0 m									This level was not instrumented for relative humidity at this time																							
	4.0 m		98	99	98	99	99	99	98	96	92	88	87	86	88	88	89	91	91	95	96	97	98	98	98	98	738	72	95	100			
	2.0 m		98	99	98	98	99	98	98	97	94	90	88	88	89	90	90	92	92	95	97	97	98	98	98	98	739	71	95	100			
1.0 m		98	98	98	98	98	98	98	97	95	92	91	90	91	91	91	92	93	95	95	96	97	97	97	98	740	77	95	100				
0.5 m		97	97	97	98	98	97	97	96	94	92	91	91	91	91	91	92	93	94	95	96	97	97	97	97	744	76	95	100				

Chiva Chiva (Open site)	46.0 m		94	95	95	95	95	96	93	88	83	79	78	78	81	83	84	85	87	91	92	93	94	93	94	94	742	64	89	98			
	28.5 m								This level was not instrumented for relative humidity at this time																								
	26.5 m		95	95	96	96	96	96	94	88	82	78	77	77	80	83	84	85	87	92	93	94	94	94	95	95	741	63	89	98			
	13.5 m		96	96	96	96	96	97	94	88	82	78	76	77	80	82	83	84	87	92	94	95	95	95	95	95	742	61	90	99			
	8.0 m									This level was not instrumented for relative humidity at this time																							
	4.0 m		97	97	97	97	97	98	94	89	82	76	75	76	78	80	82	83	86	90	93	95	95	95	96	96	740	60	89	100			
	2.0 m		97	97	98	97	97	98	94	89	83	77	76	77	79	81	82	84	88	92	95	96	96	96	97	97	717	62	90	100			
1.0 m		97	97	97	97	97	97	95	90	83	77	76	77	81	82	83	85	88	93	95	95	96	96	96	96	742	62	90	100				
0.5 m		96	96	96	97	96	97	95	91	85	81	78	79	81	82	83	85	87	91	93	94	94	95	95	95	744	63	90	100				

SUMMARY OF METEOROLOGICAL OBSERVATIONS
HOURLY DATA
OCTOBER 1966

Exposure	Monthly Ranges of Relative Humidity by Hour (%)																								Monthly Summary*		
	Site	Level	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22		23	24
Albrook (Forest site)	46.0 m	14	11	7	8	7	5	9	20	26	30	31	32	33	28	26	29	19	10	12	13	9	12	15	10		
	28.5 m								This level was not instrumented for relative humidity at this time																		
	26.5 m	15	8	6	7	7	3	17	23	29	33	32	29	32	26	27	28	24	15	10	12	8	13	10	8		
	13.5 m	13	9	6	8	8	6	10	14	19	22	29	31	32	24	23	22	17	13	9	10	9	10	12	7		
	8.0 m									This level was not instrumented for relative humidity at this time																	
4.0 m	5	5	5	5	5	5	5	5	11	16	23	25	26	27	28	24	24	17	13	11	9	9	9	8	6		
2.0 m	5	5	5	5	5	6	4	6	10	15	21	24	28	29	27	24	23	15	12	10	9	9	9	8	6		
1.0 m	5	6	5	4	5	5	5	6	10	13	16	17	21	22	20	21	20	15	10	9	8	6	8	6	6		
0.5 m	8	8	8	8	8	10	8	10	8	10	14	16	17	20	21	20	24	18	16	14	12	11	10	8	10	8	

* No monthly summary was computed for the ranges.

Chive Clave (Open site)	46.0 m	13	12	9	8	9	7	10	20	22	33	29	33	26	26	28	27	26	12	8	7	11	8	19	13	
	28.5 m								This level was not instrumented for relative humidity at this time																	
	26.5 m	14	10	6	7	7	6	11	19	23	34	34	34	28	26	28	29	24	9	6	5	7	8	18	12	
	13.5 m	15	14	8	10	9	7	11	20	26	35	35	37	28	29	29	30	26	12	8	7	7	10	18	14	
	8.0 m									This level was not instrumented for relative humidity at this time																
4.0 m	15	13	8	8	9	8	18	18	29	38	39	37	34	33	33	35	26	17	10	10	12	9	16	15		
2.0 m	13	11	6	11	9	8	10	16	27	35	36	35	33	34	30	34	24	14	10	9	9	9	15	14		
1.0 m	13	11	6	6	5	6	10	15	30	36	37	37	31	30	30	32	26	11	11	11	11	10	14	11		
0.5 m	12	12	12	12	10	10	10	14	19	26	30	34	37	32	30	32	36	28	18	14	14	14	13	14	12	

SUMMARY OF METEOROLOGICAL OBSERVATIONS
HOURLY DATA
OCTOBER 1966

Exposure	Site	Code ¹	Monthly Means ² of other Elements by Hour																								Monthly Summary		
			01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	NO. OF OBS.	Min.	Mean
Albrook (Forest site)	WB	(4.0 m)	73.5	73.4	73.4	73.2	73.0	72.9	73.6	75.2	76.3	76.5	76.6	76.7	76.4	76.2	76.2	75.9	75.3	74.7	74.4	74.1	73.9	73.6	73.6	740	70.0	74.8	79.7
	WB	(2.0 m)	73.5	73.4	73.4	73.1	73.0	72.9	73.7	75.2	76.4	76.7	76.8	76.8	76.9	76.7	76.4	76.0	75.4	74.7	74.3	74.1	73.9	73.7	73.6	740	70.2	74.9	79.9
	WB	(0.5 m)	73.8	73.6	73.6	73.5	73.4	73.2	73.5	74.7	76.0	76.8	77.1	77.2	77.2	77.0	76.5	76.6	76.3	75.2	74.8	74.5	74.3	74.0	73.8	744	70.8	75.1	79.3
	BP		.741	.722	.710	.705	.709	.722	.746	.760	.780	.788	.779	.759	.730	.682	.678	.681	.694	.709	.731	.750	.755	.762	.756	744	.605	.732	.870
	P1		0.08	0.02	0.02	0.34	0.02	0.12	0.10	0.41	0.23	0.25	0.15	0.05	0.12	0.36	0.09	0.12	0.03	0.21	0.19	0.11	0.04	0.05	127	0.00	18.21	1.61	
	P2		0.04	0.02	0.02	0.27	0.04	0.08	0.10	0.20	0.30	0.24	0.24	0.12	0.19	0.32	0.17	0.26	0.08	0.13	0.38	0.29	0.04	0.05	92	0.00	13.49	1.15	
	P3		0.04	0.01	0.02	0.46	0.02	0.04	0.14	0.33	0.26	0.13	0.03	0.04	0.09	0.31	0.17	0.13	0.04	0.36	0.18	0.12	0.03	0.09	96	0.00	13.78	1.45	
	P4		0.09	0.02	0.02	0.54	0.03	0.07	0.12	0.49	0.39	0.35	0.15	0.07	0.14	0.46	0.25	0.04	0.19	0.06	0.25	0.19	0.06	0.13	89	0.00	17.74	2.10	

Chiva Chiva (Open site)	WB	(4.0 m)	73.2	73.1	73.0	72.8	72.8	72.7	73.9	75.2	75.9	76.3	76.4	76.5	76.6	76.2	75.6	75.7	75.4	74.9	74.6	74.3	74.1	73.8	73.5	73.4	743	69.9	74.6	79.1
	WB	(2.0 m)	73.1	72.9	72.9	72.6	72.5	72.4	73.9	75.4	76.3	76.8	76.9	76.9	77.0	76.6	75.9	75.9	75.6	75.1	74.6	74.3	74.0	73.7	73.3	73.3	744	70.1	74.7	80.1
	WB	(0.5 m)	73.6	73.4	73.2	73.0	72.9	72.8	73.7	75.5	76.6	77.4	77.5	77.8	77.5	77.2	76.5	76.4	75.9	75.3	74.8	74.4	74.0	73.7	73.7	73.7	744	70.3	75.0	82.0
	BP		.805	.784	.773	.767	.773	.786	.805	.825	.840	.854	.844	.819	.794	.767	.750	.745	.748	.758	.773	.794	.813	.822	.827	.819	744	.675	.795	.940
	PS		0.04	0.01	0.02	0.24	0.03	0.30	0.05	0.17	0.81	0.42	0.12	0.06	0.20	0.16	0.08	0.17	0.11	0.02	0.16	0.10	0.07	0.05	0.17	105	0.00	16.41	2.17	

WB - Wet bulb temperature (°F)
 BP - Barometric pressure (in. of Hg minus 29.0)
 PS - Precipitation at 1.0 m. in open area (in.)
 P1 - Precipitation at 46.0 m. above canopy (in.)
 P2 - Precipitation under full canopy (in.)
 P3 - Precipitation under drip canopy (in.)
 P4 - Precipitation under open canopy (in.)

² Monthly means of precipitation are computed for precipitation days. Precipitation totals are substituted for the mean in the monthly summary.

SUMMARY OF METEOROLOGICAL OBSERVATIONS
HOURLY DATA
OCTOBER 1966

Exposure	Monthly Ranges ² of other Elements by Hour																								Monthly Summary*		
	Site	Code ¹	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22		23	24
Albrook (Forest site)	WB (4.0 m)		4.0	4.2	4.5	4.8	4.6	5.0	3.6	3.5	5.0	5.1	4.7	5.0	6.0	5.0	5.8	6.8	6.0	5.0	4.5	4.0	5.0	5.0	5.0	4.5	4.9
	WB (2.0 m)		4.0	4.2	4.5	4.5	4.7	4.8	3.7	3.8	5.4	4.5	4.3	5.1	6.3	4.6	5.8	7.3	6.0	5.0	4.5	4.0	5.0	5.0	5.0	4.5	4.9
	WB (0.5 m)		3.8	3.8	3.8	3.8	3.3	3.6	3.5	2.8	3.6	4.5	4.3	4.7	4.0	4.4	6.9	8.3	5.9	5.3	4.3	3.5	3.0	3.6	4.0	4.2	
	BP		.130	.140	.155	.145	.145	.160	.155	.160	.160	.165	.160	.140	.150	.125	.150	.135	.155	.155	.130	.135	.140	.135	.125	.130	
	P1		0.33	0.04	0.02	1.60	0.07	0.15	0.16	0.95	0.51	0.49	0.22	0.10	0.46	1.58	1.35	0.67	0.34	0.52	0.11	0.83	0.78	0.49	0.08	0.14	
P2		0.08	0.01	0.02	0.99	0.10	0.11	0.24	0.53	0.55	0.61	0.00	0.01	0.57	1.14	1.09	0.49	0.38	0.34	0.44	0.89	0.14	0.04	0.08	0.18		
P3		0.07	0.00	0.01	1.33	0.02	0.15	0.35	0.80	0.63	0.20	0.06	0.03	0.50	1.44	1.13	0.26	0.51	0.47	0.09	0.72	0.43	0.39	0.08	0.29		
P4		0.14	0.02	0.02	2.09	0.03	0.11	0.21	1.14	0.30	0.89	0.29	0.13	0.54	1.72	1.85	0.45	0.06	0.57	0.07	0.00	0.00	0.58	0.11	0.38		

* No monthly summary was computed for the ranges.

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Chiva Chiva (Open site)	WB (4.0 m)		5.1	3.9	3.7	4.2	4.0	3.7	4.1	3.6	5.2	4.5	5.0	4.0	3.3	5.2	7.0	6.9	4.3	3.9	3.0	2.8	3.4	4.1	3.7	3.7	
	WB (2.0 m)		4.8	4.2	4.2	4.6	4.6	4.6	4.8	4.0	5.7	5.5	6.3	4.6	4.6	6.3	7.6	7.5	4.8	4.4	3.5	3.2	3.8	4.6	4.2	4.2	
	WB (0.5 m)		3.1	3.9	4.3	4.3	4.7	4.7	4.7	3.9	5.1	7.1	6.7	6.6	8.2	6.3	7.4	6.6	4.6	4.3	3.1	3.1	3.1	3.5	3.9	4.3	
	BP		.115	.120	.150	.165	.175	.170	.165	.170	.170	.180	.140	.120	.125	.135	.125	.140	.165	.150	.140	.145	.140	.140	.140	.130	.140
	PS		0.07	0.01	0.03	0.84	0.04	0.45	0.16	0.23	2.12	1.50	0.40	0.06	1.34	0.77	0.65	0.24	0.53	0.24	0.03	0.34	0.31	0.12	0.14	0.43	

WB - Wet bulb temperature (°F)
BP - Barometric pressure (in. of Hg minus 29.0)

PS - Precipitation at 1.0 m. in open area (in.)
P1 - Precipitation at 46.0 m. above canopy (in.)
P2 - Precipitation under full canopy (in.)

P3 - Precipitation under drip canopy (in.)
P4 - Precipitation under open canopy (in.)

² Monthly ranges of precipitation are computed for precipitation days.

SUMMARY OF METEOROLOGICAL OBSERVATIONS

HOURLY DATA

OCTOBER 1966

Exposure	Monthly Means of Wind Speed by Hour (miles/hr.)																								Monthly Summary							
	Site	Level	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	No. of Obs.	Min.	Mean	Max.		
Albrook (Forest site)	46.0 m	3	3	4	4	4	4	5	5	7	7	7	7	8	7	6	6	5	4	4	4	3	3	4	4	4	4	669	0	5	17	
	28.5 m																															
	26.5 m	0	1	1	1	1	1	1	1	1	3	2	2	3	3	2	2	1	1	1	1	0	1	1	1	1	1	654	0	1	12	
	13.5 m	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	416	0	0	5	
	8.0 m																															
	4.0 m	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	741	0	0	5	
2.0 m	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	416	0	0	0		
1.0 m																																
0.5 m																																

Note: Observations of wind speed at levels 2.0m. and 13.5 m. were discontinued after 0800 on 18 October 1966.

46.0 m	3	4	3	4	3	4	4	5	5	7	7	7	8	9	10	9	8	7	6	5	5	4	4	4	4	4	4	725	0	5	20
28.5 m																															
26.5 m	1	1	0	1	1	1	1	2	3	4	5	5	6	6	6	5	4	3	2	2	1	1	1	1	1	1	725	0	2	18	
13.5 m	0	0	0	0	1	1	0	1	2	3	3	4	5	4	5	3	3	2	1	1	1	0	0	0	0	0	737	0	1	16	
8.0 m																															
4.0 m	2	2	2	2	2	2	1	3	4	4	5	6	6	6	6	5	4	4	3	2	2	2	2	2	2	2	724	0	3	18	
2.0 m	0	0	0	0	1	1	0	1	1	2	2	3	4	3	4	3	3	2	2	1	0	0	0	0	0	0	734	0	1	12	
1.0 m																															
0.5 m																															

SUMMARY OF METEOROLOGICAL OBSERVATIONS
HOURLY DATA
OCTOBER 1966

Exposure	Site	Monthly Ranges of Wind Speed by Hour (miles/hr.)																								Monthly Summary*	
		01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24		
46.0 m	Albrook (Forest site)	12	10	12	11	10	12	10	13	12	15	15	17	16	16	15	17	15	16	15	12	12	17	15	17		
28.5 m										This level was not instrumented for wind speed at this time																	
26.5 m		5	6	5	7	4	8	5	7	6	12	7	9	9	12	6	11	6	5	7	7	7	7	8	11		
13.5 m		0	0	0	0	0	3	1	2	1	2	2	3	4	4	1	2	0	1	0	0	0	1	3	0	5	
8.0 m										This level was not instrumented for wind speed at this time																	
4.0 m		1	0	0	0	0	1	2	1	1	2	5	3	2	4	5	2	1	1	0	0	0	0	0	0		
2.0 m		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
1.0 m									This level was not instrumented for wind speed at this time																		
0.5 m									This level was not instrumented for wind speed at this time																		

Note: Observations of wind speed at levels 2.0 m. and 13.5 m. were discontinued after 0800 on 18 October 1966.

* No monthly summary was computed for the ranges.

46.0 m	10	8	10	11	8	14	6	12	9	15	12	14	13	18	14	17	14	12	10	9	10	10	10	9	
28.5 m								This level was not instrumented for wind speed at this time																	
26.5 m	7	6	3	7	5	12	4	7	8	13	12	18	15	15	18	16	13	9	8	7	8	7	7	5	
13.5 m	2	2	2	5	3	10	4	5	7	9	8	13	10	10	16	11	9	8	6	4	3	2	3	2	
8.0 m								This level was not instrumented for wind speed at this time																	
4.0 m	7	4	5	6	4	6	4	10	7	10	8	12	11	10	17	14	9	7	6	6	6	5	8	5	
2.0 m	5	1	1	4	1	5	3	3	6	9	7	10	12	8	12	12	10	7	2	2	3	2	4	2	
1.0 m								This level was not instrumented for wind speed at this time																	
0.5 m								This level was not instrumented for wind speed at this time																	

Relative Frequencies* of Wind Directions by Hour at 46.0 m.
(%)

Dir.	01	02	03	04	05	06	07	03	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
N		3.3			6.6						3.5		3.5	3.6	6.6	6.5	3.2		3.2	3.2	3.3	3.3		3.2
NNE	6.6		6.6	6.6			3.3								3.3		3.2			10.0	3.3	3.3	3.2	6.4
NE	10.0	16.6	6.6	3.3	20.0	6.6	16.6	6.6				3.5			6.6	3.3	3.2		3.2	16.1	3.3	23.3	12.9	6.4
ENE	13.3	6.6	6.6	20.0	10.0	16.6	10.0	10.0	3.4							10.0		3.2	6.4			6.6	3.2	3.2
E	3.3	3.3	6.6	6.6	6.6	10.0	10.0	3.3	17.1	7.0	7.0	3.5								3.2				3.2
ESE			3.3					16.6	6.8	14.0	7.0	10.7	3.5	3.6	6.6		6.4	3.2					3.2	
SE	6.6			3.3		3.3	3.3	10.0	6.8	10.7	14.2	21.3	24.9	18.4	10.0	6.6	12.9	6.4		3.2			3.2	3.2
SSE						6.6		3.3	3.4	3.5	17.7	10.7	10.7	3.6	3.3	6.6	6.4		9.7			3.3		
S	10.0	6.6	3.3	3.3	6.6	3.3	3.3	10.0	10.3	17.7	17.7	28.4	21.3	33.1	26.6	36.6	22.6	12.9	6.4	6.4	13.3	6.6	9.7	3.2
SSW										3.5			7.0	3.6			3.2	6.4						
SW											7.0		3.5	9.7	6.6	3.3	3.2	6.4	3.2	3.2		6.6		3.2
WSW		6.6	3.3				6.6			3.5		7.0		3.6	3.3	3.3			6.4		3.3		3.2	3.2
W					3.3	10.0	3.3	10.0	6.8	7.0	10.7	3.5	10.7	3.6		3.3	16.1	6.4	6.4	3.2	3.3		3.2	
WNW	6.6	6.6	6.6	6.6	13.3	6.6	10.0		6.8	7.0	7.0	3.5	3.5		10.0	10.0	6.4	19.4	19.4	9.7	6.6	3.3		9.7
NW	13.3	13.3	20.6	23.3	10.0	16.6	10.0	10.0	17.1	7.0	3.5	3.5	3.5	11.0	10.0		6.4	12.9	12.9	19.4	23.3	23.3	19.4	9.7
NNW			6.6	3.3	3.3	3.3		10.0	3.4	7.0				3.6		6.6	3.2	3.2	3.2	3.2	6.6	3.3	9.7	12.9
CALM	29.9	36.6	29.9	23.3	20.0	16.6	23.3	10.0	17.1	10.7	3.5	3.5	7.0	3.6	6.6	3.3	9.7	16.1	16.1	29.0	26.6	16.6	29.0	32.2

* Note: Due to rounding, percentage totals do not equal 100%.

ALBROOK (Forest site) OCTOBER 1966

Relative Frequencies* of Wind Directions by Hour at 26.5 m.
(%)

Dir.	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	
N							10.0	10.0	10.0	20.0			16.6					8.3	16.6	8.3				8.3	8.3
NNE					9.0																				
NE			9.0	9.0		9.0			10.0													9.1			8.3
ENE		9.0														8.3									
E					9.0		10.0	10.0	10.0	20.0	27.2	18.2	8.3												
ESE							10.0				9.0	9.0		16.6	8.3										
SE						9.0	10.0	10.0			9.0	18.2	49.9	16.6	8.3		8.3								8.3
SSE	9.0								10.0																
S									10.0			9.0		8.3		16.6	8.3	8.3							
SSW																						9.1			
SW	9.0						20.0			10.0	9.0				8.3										
WSW																8.3					9.1				
W		9.0	9.0		18.2	9.0	10.0			10.0	20.0				16.6	8.3	8.3	8.3		8.3					
WNW	9.0	9.0			9.0		10.0	10.0	10.0		36.3	18.2		8.3	8.3		8.3	8.3	16.6	8.3	9.1	9.1	16.6	8.3	8.3
NW	9.0	9.0	18.2	27.2	9.0	9.0	10.0	30.0	20.0	10.0				8.3	16.6	16.6	16.6	8.3	8.3	24.9	27.2	18.2	8.3	16.6	8.3
NNW	9.0	18.2	9.0	9.0	9.0	9.0				20.0		9.0	8.3	8.3	8.3	8.3	8.3	8.3				27.2	8.3		
CALM	54.5	45.4	45.4	45.4	36.3	36.3	30.0	20.0	10.0		9.0	19.2	8.3	24.9	24.9	16.6	33.3	41.5	58.1		54.5	27.2	41.5	49.9	49.9

* Note: Due to rounding, percentage totals do not equal 100%.

ALBROOK (Forest site) OCTOBER 1966

ALBROOK (Forest site) OCTOBER 1956

Relative Frequencies* of Wind Directions by Hour at 4.0 m.
(%)

Hr. Dir.	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	
N											3.2	3.2	3.2	3.2					3.2						
NNE																									
NE									3.2		3.2														
ENE	3.2								6.4		6.4			6.4				3.2							
E												3.2	3.2	6.4											
ESE													3.2												
SE																									
SSE											3.2	3.2				3.2									
S									3.2																
SSW							3.2		3.2	3.2	3.2	3.2	3.2		3.2										
SW								3.2			3.2			3.2											
WSW															3.2										
W									3.2	3.2			3.2	3.2	3.2										
WNW														3.2					3.2						
NW						3.2							6.4												
NNW																									
CALM	96.8	100.0	100.0	100.0	100.0	96.8	96.8	96.8	90.3	96.8	83.9	96.8	77.4	74.2	87.1	96.8	100.0	96.8	93.5	100.0	100.0	100.0	100.0	100.0	100.0

* Note: Due to rounding, percentage totals do not equal 100%.

CHIVA CHIVA (Open site) OCTOBER 1966

Relative Frequencies* of Wind Directions by Hour at 46.0 m.

Dir.	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	
N	3.2		3.3		6.6		10.0	3.3					3.3	3.3	3.3		3.3	3.3	6.4	3.2	6.4	3.2	6.4	3.2	6.6
NNE			3.3		3.3	3.3													3.2	6.4	6.4	3.2			10.0
NE			3.3	3.3	6.6	6.6	3.3	3.3					3.3			3.3			3.2	6.4	6.4	3.2			3.3
ENE	6.4	6.6	3.3	23.3	6.6	6.6	13.3		3.3							6.6	3.3	3.3			6.4	3.2	3.3		
E	16.1	6.6	16.6	16.6	13.3	10.0	16.6	23.3	16.6	6.6	3.3	13.3	3.3					3.3	9.7	9.7	3.2	6.4	3.3	3.3	6.6
ESE	3.2	10.0	6.6			6.6		10.0	3.3	13.3	10.0	16.6		10.0	3.3	10.0	6.6	10.0	9.7	3.2	6.4	6.4	6.6	3.3	3.3
SE	9.7	10.0	3.3	10.0	10.0	10.0	6.6		10.0	13.3	13.3	10.0	3.3	16.6	20.0	16.6	16.6	16.6	12.9	6.4	6.4	6.4	10.0	6.6	6.6
SSE	3.2	3.3	3.3		3.3		3.3		10.0	16.6	23.3	10.0	26.6	10.0	6.6	3.3	13.3	3.3	6.4	6.4	9.7	6.4	6.6	3.3	3.3
S							6.6	16.6	20.0	16.6	20.0	29.9	36.6	26.6	23.3	23.3	16.6	6.6	3.2		6.4	3.2	3.3	6.6	6.6
SSW		3.3					3.3							3.3	6.6	3.3	3.3	3.3	6.4	6.4					3.3
SW	3.2	3.3						3.3			3.3		3.3			3.3			6.4		3.2	3.3			3.3
WSW	3.2	3.3	3.3		3.3		6.6			3.3					3.3				3.2	3.2					
W			3.3	13.3		10.0		6.6	6.6	3.3	3.3	3.3		3.3	6.6	6.6	6.6	6.6	6.4	6.4			6.4	6.6	3.3
WNW	6.4	10.0	3.3	6.6	10.0	13.3	3.3	6.6	13.3	10.0	10.0		10.0	13.3	10.0	6.6	10.0	16.6	6.4	3.2	9.7	3.2			6.6
NW	12.9	10.0	16.6	23.3	6.6	6.6	13.3	16.6	10.0	13.3	13.3	16.6	3.3	6.6	6.6	13.3	10.0	10.0	9.7	12.9	19.4	12.9	16.6	23.3	6.6
NNW	9.7	6.6	3.3	10.0	10.0	10.0	6.6	3.3	3.3	3.3			6.6	6.6	6.6	3.3	6.6	13.3	12.9	12.9	9.7	19.4	13.3	6.6	6.6
CALM	22.6	20.0	13.3	6.6	13.3	10.0	6.6	6.6		3.3			6.6	6.6	6.6	3.3	6.6	3.3	6.4	6.4	3.2	16.1	13.3	16.6	6.6

* Note: Due to rounding, percentage totals do not equal 100%.

CHIVA CHIVA (Open site) OCTOBER 1966

Relative Frequencies* of Wind Directions by Hour at 26.5 m.
(%)

Dir.	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
N																								
NNE																								
NE																	33.3							
ENE																								
E																33.3								
ESE																								
SE									33.3		33.3	33.3	33.3	33.3	33.3									
SSE										33.3														
S																				25.0	25.0	25.0		33.3
SSW																				25.0	25.0			
SW							50.0																	
WSW			50.0																					
W					50.0	100.0	50.0																	
WNTW			50.0	100.0									33.3	33.3		33.3	66.7			25.0	25.0	25.0	33.3	66.7
NW	66.7	50.0						50.0		33.3	66.7	66.7	33.3	33.3	66.7	33.3		66.7	50.0		25.0	25.0	33.3	
NNW		50.0						50.0	100.0	33.3								33.3	25.0	25.0	25.0	25.0		
CALM																								

* Note: Due to rounding, percentage totals do not equal 100%.

CHIVA CHIVA (Open site) OCTOBER 1966

Relative Frequencies* of Wind Directions by Hour at 4.0 m.
(%)

Dir.	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
N	13.3	3.4	3.4	10.3	3.3	13.7	3.4		6.8					10.0	6.5		3.3		6.4	12.9	9.7	3.2		3.3
NNE	6.6		13.7		3.3	10.3	6.8										3.3			6.4	6.4	6.4	6.6	10.0
NE	16.6	13.7	3.4	10.3	6.6	3.4			3.4	6.8		3.3				10.0		3.3	6.4	12.9	6.4	9.7	3.3	10.0
ENE					6.6	3.4	3.4		3.4	3.4				3.3				10.0			3.2		3.3	3.3
E	6.6	3.4	3.4	3.4		3.4	6.8	20.6	10.3	6.8	3.4	3.3	3.3	3.3	3.3		3.3	10.0	3.2	3.2	3.2	6.4	3.3	6.6
ESE		3.4		3.4	6.6					6.8		6.6		3.3	3.3	3.3		3.3	3.2		6.4		10.0	
SE	6.6			3.4		3.4		3.4	13.7	6.8	10.3	20.0	10.0	6.6	10.0	13.3	10.0	3.3	3.2		3.2		3.3	6.6
SSE			3.4		3.3	3.4	6.8		6.8	10.3	13.7	13.3	10.0	3.3	6.6	3.3	10.0		3.2	3.2	3.2	3.2		3.3
S	3.3				6.6		10.3	10.3	24.0	24.0	34.1	33.2	43.2	46.6	36.6	33.2	26.6	16.6	6.4	6.4	6.4	6.4	3.3	3.3
SSW		3.4		6.8		3.4		3.4			6.8				3.3		6.6		3.2	6.4	6.4	3.2		
SW	6.6	17.1	3.4			3.4	3.4									3.3	3.3		6.4	6.4	3.2	9.7		
WSW	6.6	3.4	6.8	3.4	3.3	3.4	3.4	10.3	3.4	3.4		3.3	3.3	3.3	3.3				3.2				3.3	
W				3.4	3.4	6.6	3.4	6.8	10.3	6.8	6.8	3.4	3.3	3.3	3.3	10.0	3.3	3.3	3.2		6.4	3.2		3.3
WNW	3.3	6.8			3.4	6.6	3.4	3.4																
NW	3.3	13.7	10.3	6.8	16.6	10.3	6.8	10.3	3.4	17.1	13.7	10.0	10.0	13.3	10.0		13.3	16.6	9.7	19.4	12.9	6.4	23.3	10.0
NNW	3.3	6.8	17.1	10.3		3.4	3.4	3.4	6.8				6.6	3.3	3.3	6.6	3.3	3.3	6.4		12.9	6.4	6.6	10.0
CALM	23.3	24.0	30.7	34.1	30.7	27.3	34.1	27.3		6.8		3.3	3.3			6.6		13.3	22.6	9.7	12.9	32.2	29.9	10.0

* Note: Due to rounding, percentage totals do not equal 100%.

SUMMARY OF NON HOURLY DATA

OCTOBER 1966

Summary of Elements with Non-hourly Frequencies of Observation						
Site	Element, Units and Exposure	Description	Number of obs.	Minimum Value	Mean or Total Value	Maximum Value
Albrook (Forest site)	WBGT Index ¹ (at 1.5 meters)	Index value	434	70.4	76.5	84.8
		Dry bulb temp.	434	70.5	77.2	89.0
		Wet bulb temp.	434	70.2	76.0	89.0
		Black bulb temp.	434	70.5	77.7	89.0
	Evaporation ³ (in. at 3 levels)	Piche (46.0 m)	28	0.049	4.505*	0.317
		Piche (26.5 m)	29	0.006	3.323*	0.238
		Piche (0.5 m)	20	0.006	0.498*	0.061
	Precipitation from Raingauge Network ² (in. at 1.0 meters)	Gauge # 1	62	0.01	21.99*	3.56
		Gauge # 2	63	0.01	19.09*	2.58
Gauge # 3		64	0.01	16.78*	2.23	
Gauge # 4		64	0.01	19.34*	2.54	
Gauge # 5		61	0.01	16.55*	2.58	
Gauge # 6		64	0.01	19.72*	2.91	
Gauge # 7		64	0.01	20.32*	2.88	
Gauge # 8		63	0.01	18.66*	2.87	
Stem Flow ² (in. at 2.0 meters)	Small tree	37	0.01	20.11*	5.51	
	medium tree	38	0.01	62.20*	16.40	
	Large tree	29	0.01	1099.10*	277.40	
Chiva Chiva (Open site)	WBGT Index ¹ (at 1.5 meters)	Index value	448	69.0	79.1	91.0
		Dry bulb temp.	434	69.0	79.3	94.3
		Wet bulb temp.	434	69.0	76.5	94.3
		Black bulb temp.	429	69.0	87.8	126.3
	Evaporation ³ (in. at 0.5 meters)	Piche	29	0.006	3.167*	0.256
		Pan	31	0.017	4.359*	0.360
	Minimum Grass temp ³ (°F at grass tips)	None	30	67.5	71.7	86.6

- 1 - Hourly observations between 0600 and 1900 hours inclusive
 2 - Six hourly observations
 3 - Daily observations

* Total Values

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13. ABSTRACT
This report contains detailed microclimatic data for October 1966 from specific sites in the Panama Canal Zone and vicinity. The data are presented in tabular form, summarized for hourly and/or daily observations from surface to 46-meter levels. Elements listed are: temperature, pressure, precipitation, wind speed and direction, relative humidity, and evaporation.

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