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**MONTHLY  
MICROCLIMATIC SUMMARY**

**December 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

December 1966

Prepared by

Michael A. Fradel, Project Officer  
and  
Dr. Wilfried H. Portig, Meteorologist

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, micro-biological, 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 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.

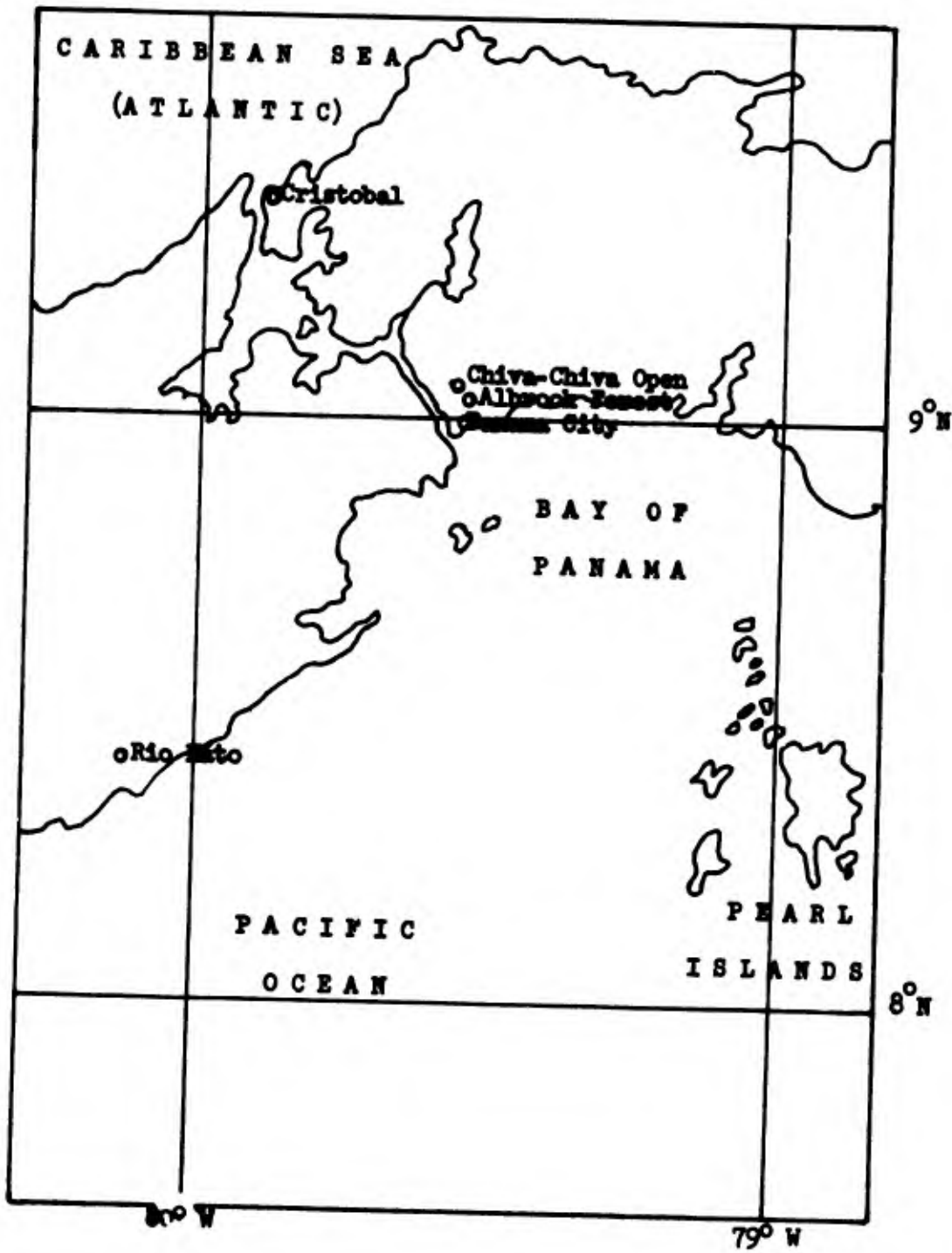


FIGURE 1. LOCATION MAP, ISTHMUS OF PANAMA

FIGURE 2. FREQUENCY OF OBSERVATIONS

# Element	Height (meters)										Frequency	
	Sfc	0.5	1.0	2.0	4.0	8.0	13.5	26.5	28.5	46.0		
Temperature:												
Dry Bulb	-	1	1	1	1	2	1	1	2	1	1	Hourly*/Continuously
Wet Bulb	-	1	-	1	1	-	-	-	-	-	-	Hourly*/Continuously
Grass Minimum	3	-	-	-	-	-	-	-	-	-	-	Once Daily
WBGT Index	-	-	1	-	-	-	-	-	-	-	-	Hourly (0600-1900 EST)
Relative Humidity	-	1	1	1	1	-	1	1	-	1	1	Hourly*/Continuously
Barometric Pressure	-	-	1	-	-	-	-	-	-	-	-	Continuously
Evaporation	-	1	-	-	-	-	2	2	-	2	2	Once Daily
Precipitation:												
Recording Gage	-	-	1	-	-	-	-	-	-	-	-	Continuously
Manual Gage	-	-	2	-	-	-	-	-	-	-	-	4 Times Daily
Stem Flow	-	-	2	-	-	-	-	-	-	-	-	4 Times Daily
Wind:												
Direction	-	-	-	-	1	-	-	1	-	1	-	Continuously
Speed	-	-	-	3**	1	-	3**	1**	-	1	1	Hourly**/Continuously

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

\* Observations made with sling psychrometer when recorders are inoperative.

\*\* Hourly

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

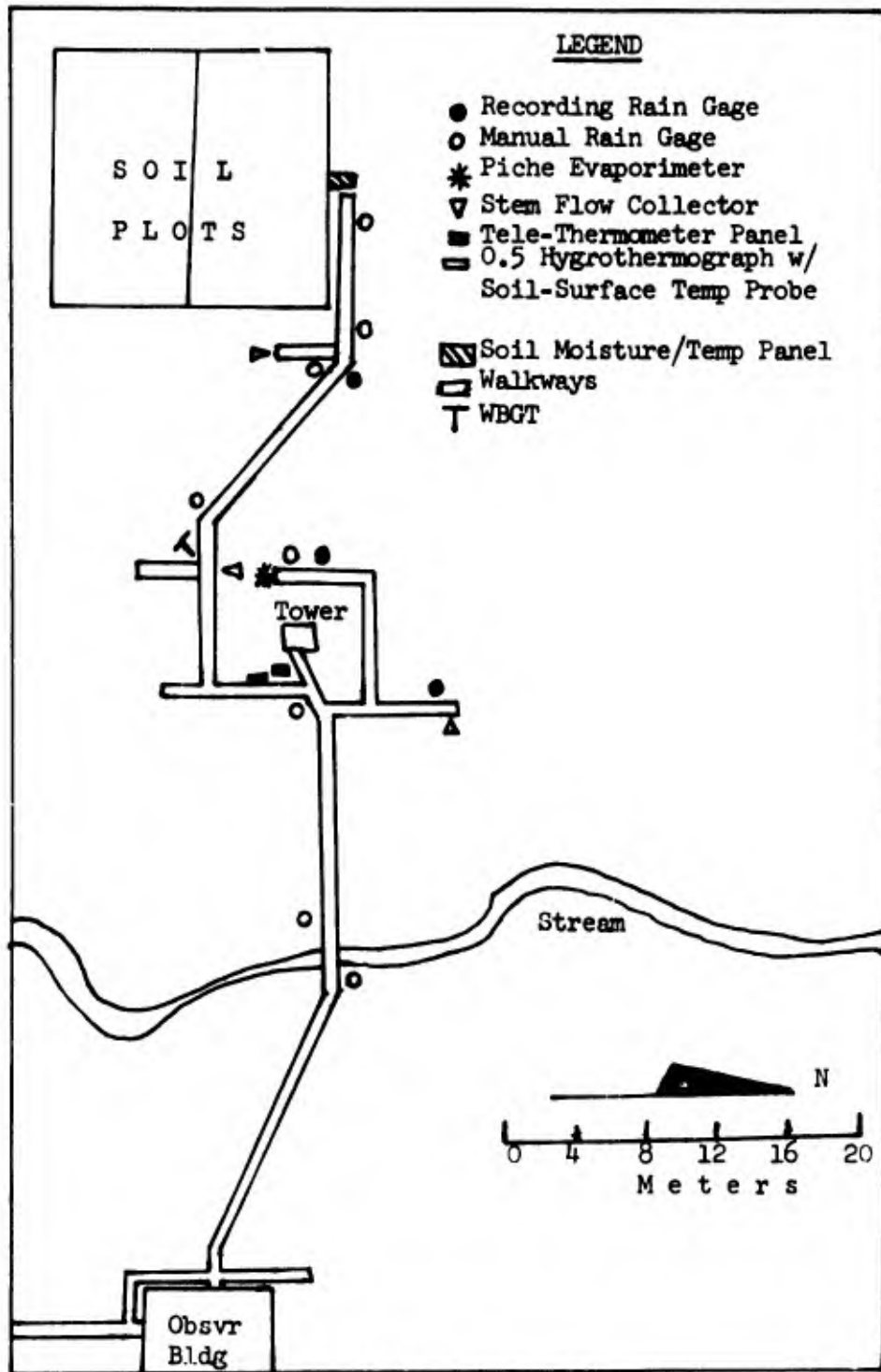


FIGURE 3. ALBROOK FOREST SITE, GENERALIZED PLOT

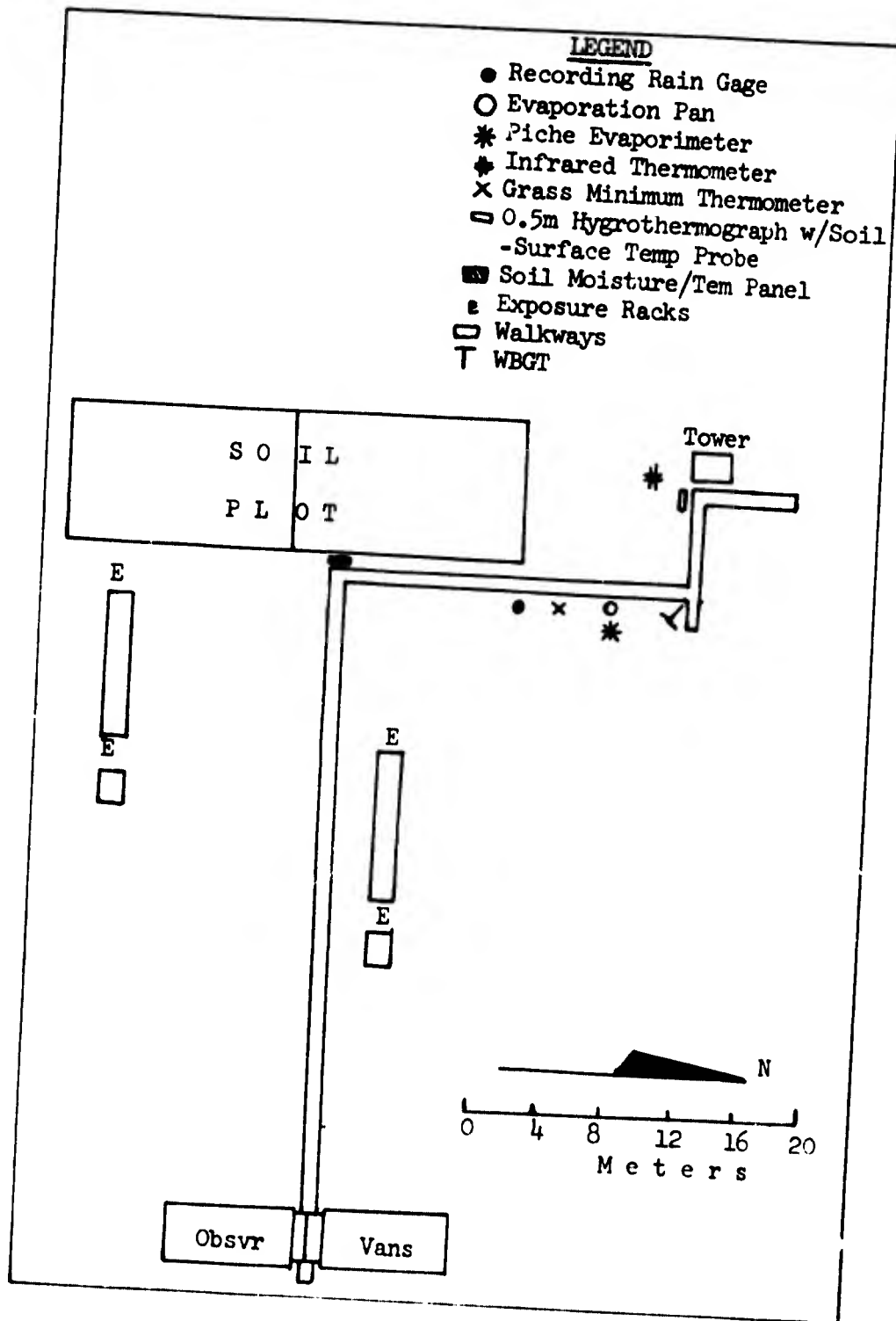


FIGURE 4. CHIVA CHIVA OPEN, GENERALIZED PLOT

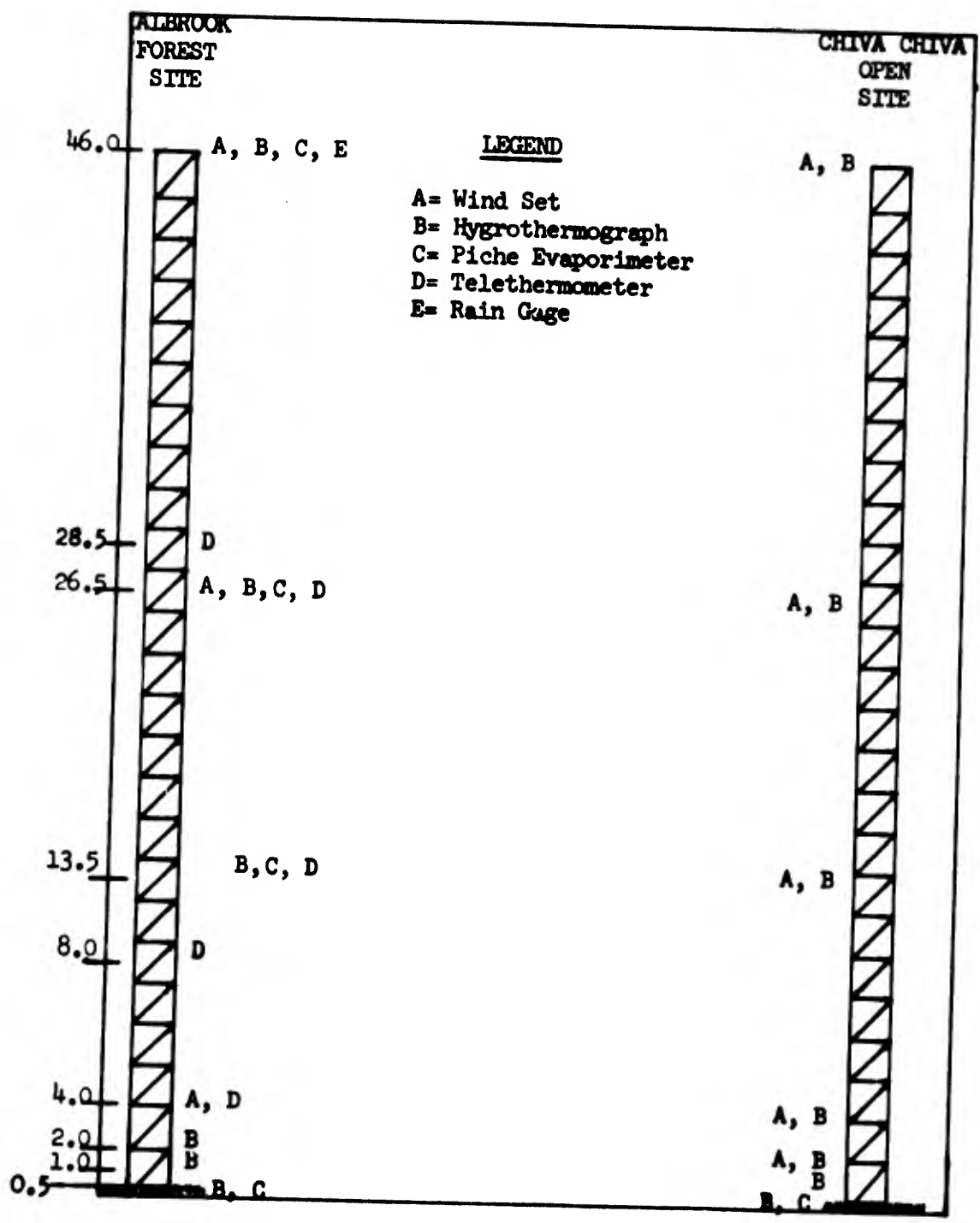


FIGURE 5. INSTRUMENT LOCATION ON TOWERS

**SUMMARY OF METEOROLOGICAL OBSERVATIONS**  
**HOURLY DATA**  
 DECEMBER 1966

Exposure	Site	Monthly Means of Air Temperature by Hour (°F)																								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	Max.
Albrook (Forest site)	46.0 m	73.8	73.7	73.5	73.2	73.2	73.1	73.4	75.3	78.5	80.4	82.1	82.1	81.5	81.0	80.3	79.0	77.9	76.5	75.4	74.9	74.5	74.3	74.1	74.1	718	70.2	76.5	87.6
	28.5 m								This level was not instrumented for air temperature at this time																				
	26.5 m	73.2	73.2	73.0	72.9	72.8	72.6	73.0	75.2	78.6	80.5	82.2	82.3	82.2	81.4	80.9	79.4	78.1	76.3	75.1	74.6	73.9	73.8	73.6	73.5	737	70.3	76.3	88.5
	13.5 m	73.2	73.2	73.1	73.0	72.7	72.6	72.6	74.6	77.0	79.1	80.6	80.9	81.0	80.2	80.1	79.0	77.9	76.1	75.1	74.7	74.3	73.9	73.7	73.5	719	69.6	75.0	88.1
	8.0 m	73.1	73.0	72.9	72.8	72.5	72.5	72.4	74.3	76.7	78.8	80.3	80.4	80.6	80.0	79.9	78.8	77.7	75.9	75.0	74.5	74.0	73.8	73.6	73.4	719	69.7	75.7	88.2
	4.0 m	72.8	72.6	72.4	72.3	72.1	72.0	72.2	74.6	76.9	79.0	80.4	80.6	80.9	79.8	79.5	78.3	77.1	75.6	74.6	74.2	73.7	73.4	73.2	73.0	742	69.0	75.5	86.0
	2.0 m	72.9	72.6	72.5	72.3	72.1	72.0	72.1	74.4	76.6	78.5	79.9	80.3	80.5	79.5	79.3	78.3	77.1	75.6	74.6	74.2	73.7	73.4	73.3	73.0	743	69.0	75.3	86.0
	1.0 m	72.8	72.7	72.6	72.4	72.2	72.2	72.3	74.2	76.5	78.2	79.8	80.0	80.1	79.8	79.4	78.4	77.3	75.8	74.8	74.2	73.8	73.5	73.3	73.1	744	69.4	75.4	86.3
0.5 m	73.3	73.1	73.0	72.8	72.7	72.5	72.5	73.7	75.7	77.4	78.9	79.4	79.6	79.3	79.5	78.5	77.5	76.3	75.2	74.7	74.2	73.9	73.7	73.5	732	70.0	75.4	85.8	

Chiva Chiva (Open site)	46.0 m	74.3	74.2	73.9	73.7	73.5	73.3	73.6	75.3	78.0	80.1	81.8	81.7	82.0	80.6	80.4	79.6	78.3	76.9	75.9	75.3	75.0	74.7	74.6	74.4	725	71.0	76.7	86.6
	28.5 m								This level was not instrumented for air temperature at this time																				
	26.5 m	74.0	73.9	73.6	73.3	73.2	73.0	73.3	75.4	78.3	80.3	81.9	81.8	80.7	80.4	79.8	78.4	77.1	75.9	75.3	74.8	74.5	74.4	74.2	74.2	744	70.2	76.6	86.7
	13.5 m	73.8	73.7	73.4	73.2	73.0	72.9	73.2	75.6	78.8	80.9	82.5	82.4	81.1	81.0	80.2	78.6	77.2	75.9	75.3	74.7	74.4	74.2	74.0	74.0	744	69.9	76.8	87.6
	8.0 m								This level was not instrumented for air temperature at this time																				
	4.0 m	73.6	73.2	72.9	72.9	72.5	72.4	73.4	76.8	79.4	81.5	82.9	82.7	82.8	81.3	81.2	80.2	78.5	76.8	75.6	75.1	74.6	74.4	73.9	73.9	720	68.8	76.8	89.7
	2.0 m	73.4	73.3	72.9	72.8	72.5	72.4	73.4	77.0	79.9	81.8	83.4	83.1	83.2	81.7	81.5	80.5	78.7	76.8	75.7	75.0	74.5	74.4	73.9	73.8	719	69.2	76.9	89.9
	1.0 m	73.3	73.2	72.7	72.7	72.3	72.0	73.5	78.0	80.8	82.8	84.4	84.2	84.4	82.7	81.6	80.8	78.7	76.6	75.3	74.8	74.2	73.8	73.5	73.3	744	66.2	77.1	92.6
0.5 m	73.5	73.3	72.9	72.8	72.6	72.4	73.1	76.8	80.6	83.3	84.9	84.6	84.8	83.3	82.6	81.5	79.3	76.8	75.4	74.7	74.1	73.8	73.7	73.6	744	68.5	77.3	92.5	

**SUMMARY OF METEOROLOGICAL OBSERVATIONS**  
**HOURLY DATA**  
**DECEMBER 1966**

Exposure	Site	Monthly Ranges of Air Temperature by Hour (°F)																								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)	4.5	5.6	5.2	5.4	5.0	5.4	5.4	7.2	10.8	11.3	12.8	10.8	12.4	12.6	13.0	13.8	11.5	9.8	8.3	7.6	7.4	6.2	5.5	4.1	
28.5 m		This level was not instrumented for air temperature at this time																								
26.5 m		4.8	5.1	5.5	5.2	4.8	4.7	4.8	8.2	11.8	11.9	13.2	11.4	13.3	14.5	14.8	12.7	9.9	8.1	6.6	6.5	6.1	5.2	5.0		
13.5 m		5.1	4.5	5.1	5.3	5.1	4.5	5.0	6.1	8.9	10.7	12.4	12.1	11.1	13.7	13.7	12.4	9.9	6.9	6.0	6.7	6.0	5.2	5.3	4.8	
8.0 m		4.7	4.6	5.1	5.0	4.8	4.6	5.0	5.3	8.7	11.2	12.6	13.6	11.5	13.9	13.5	12.0	9.4	7.2	6.0	6.9	6.2	5.2	5.1	4.7	
4.0 m		5.1	5.1	4.9	5.2	4.9	5.8	6.1	5.6	7.8	9.5	10.6	11.3	9.7	12.0	12.5	12.0	8.5	6.7	6.5	5.3	6.5	6.1	5.5	5.2	
2.0 m		5.0	5.4	4.8	5.2	4.8	5.6	6.0	4.9	7.4	9.4	9.8	10.2	9.0	11.8	12.7	11.3	8.8	7.2	6.0	5.5	6.5	6.0	6.8	4.9	
1.0 m		4.2	4.2	4.0	4.8	4.8	5.3	5.6	4.5	7.3	9.2	10.1	9.9	10.3	11.9	13.0	11.0	8.8	6.3	5.8	5.7	6.1	5.9	5.7	5.0	
0.5 m		4.7	4.3	4.0	4.2	4.4	4.3	4.8	4.4	6.6	8.1	8.5	8.6	8.8	9.6	12.2	10.9	9.1	6.8	6.3	6.0	5.6	5.9	5.3	4.7	

\* No monthly summary was computed for the ranges.

46.0 m	Chiva Chiva (Open site)	4.8	4.9	4.4	4.3	4.3	4.5	4.4	7.0	10.0	10.7	12.7	8.8	12.4	12.3	11.6	11.8	11.1	9.9	8.6	6.3	6.1	5.6	5.1	5.0	
28.5 m		This level was not instrumented for air temperature at this time																								
26.5 m		4.6	5.5	1.6	5.1	5.3	6.1	5.6	7.2	10.8	11.5	13.0	9.7	12.2	12.7	12.1	12.2	11.5	8.8	7.8	6.9	6.9	5.6	5.4	4.9	
13.5 m		4.9	5.2	4.9	5.0	5.4	6.0	5.1	8.2	10.9	11.8	13.2	9.5	12.3	12.7	12.0	11.6	11.6	8.5	7.2	5.8	6.1	5.0	4.7	4.6	
8.0 m		This level was not instrumented for air temperature at this time																								
4.0 m		5.9	6.3	5.4	5.8	6.0	8.1	6.3	9.6	11.2	15.2	15.7	11.8	13.8	15.1	13.5	12.6	10.4	8.1	7.2	6.3	5.8	4.5	5.2	5.9	
2.0 m		6.3	6.4	5.8	5.9	5.8	7.3	5.8	8.9	11.1	14.5	16.0	11.4	14.6	15.1	13.6	12.0	10.9	8.0	7.6	6.7	6.0	4.4	5.3	5.3	
1.0 m		5.0	5.4	6.7	6.8	7.0	8.0	7.7	14.1	15.0	15.9	18.6	15.5	14.8	16.7	15.7	15.5	12.2	9.1	8.0	7.4	6.3	5.4	4.8	5.7	
0.5 m		5.1	5.5	5.5	5.7	6.9	7.4	6.8	10.6	14.5	14.6	17.2	15.9	15.8	17.5	17.5	15.4	12.8	7.7	6.4	5.6	4.9	4.0	5.0	5.0	

# SUMMARY OF METEOROLOGICAL OBSERVATIONS

## HOURLY DATA

DECEMBER 1966

Exposure Site	Monthly Means of Relative Humidity 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. Obs.	Min.	Max.
Albrook (Forest site)	46.0 m	93	93	94	93	93	92	89	79	74	70	72	74	76	79	83	86	89	91	92	93	93	93	93	705	51	86
	28.5 m																										
	26.5 m	94	94	94	94	94	93	89	81	74	71	72	73	76	77	81	84	88	91	92	93	94	94	94	737	52	87
	13.5 m	96	96	95	96	96	96	93	87	81	77	77	77	79	80	83	86	90	92	93	93	94	94	94	744	53	89
	8.0 m																										
	4.0 m	97	98	98	97	98	98	95	90	84	80	80	79	83	84	87	90	93	94	95	96	96	97	97	743	58	92
2.0 m	97	98	98	97	98	98	96	92	87	83	83	82	85	86	88	91	93	95	95	96	96	97	98	743	62	93	
1.0 m	97	97	97	97	97	97	98	97	94	90	86	86	85	87	87	90	92	95	95	96	96	97	97	739	68	94	
0.5 m	96	97	97	97	97	97	96	93	91	88	87	87	86	87	89	91	92	94	94	95	95	96	96	732	70	93	

46.0 m	90	91	91	91	92	91	91	87	81	76	72	72	72	76	76	79	82	85	88	89	89	90	90	90	744	52	85
28.5 m																											
26.5 m	91	91	92	92	92	92	91	88	82	76	72	72	73	76	77	79	82	86	89	90	90	91	91	91	744	54	85
13.5 m	91	92	92	92	93	93	92	87	81	75	71	72	72	76	76	79	82	86	89	90	91	91	91	91	744	53	85
8.0 m																											
4.0 m	92	93	93	93	94	94	93	87	80	74	71	71	72	76	75	79	82	86	89	90	91	92	92	720	55	85	
2.0 m	94	94	95	94	95	94	87	80	74	71	71	72	75	76	78	82	87	90	92	93	93	94	94	719	55	86	
1.0 m	94	94	95	94	95	94	88	81	75	71	72	72	76	77	79	83	88	91	92	93	93	94	94	744	55	87	
0.5 m	94	94	94	94	94	94	94	88	80	73	70	71	70	75	75	78	82	87	91	92	93	93	94	744	51	86	

**SUMMARY OF METEOROLOGICAL OBSERVATIONS**  
**HOURLY DATA**  
 DECEMBER 1966

Exposure	Monthly Ranges of Relative Humidity by Hour																								Monthly Summary*
	Site	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	
46.0 m	20	20	21	19	18	21	21	21	21	32	31	46	40	45	47	48	43	36	28	21	18	16	17	12	18
28.5 m						This level was not instrumented for relative humidity at this time																			
26.5 m	15	15	15	15	15	15	16	16	33	34	42	34	45	48	48	42	34	24	15	15	15	15	15	14	
13.5 m	10	13	13	12	13	9	10	18	26	33	39	43	43	47	43	36	28	23	22	18	18	17	16	14	
8.0 m						This level was not instrumented for relative humidity at this time																			
4.0 m	12	9	7	9	8	8	8	13	21	31	38	39	38	41	37	33	26	21	16	14	14	13	14	8	
2.0 m	12	10	7	7	8	7	5	10	15	29	31	34	35	38	33	33	28	21	14	14	14	13	12	6	
1.0 m	5	6	7	6	5	6	8	18	23	21	25	24	29	31	28	25	21	16	12	11	9	7	7	6	
0.5 m	8	8	7	9	9	9	11	10	12	16	20	22	26	29	28	24	19	15	12	16	10	11	9	6	

\* No monthly summary was computed for the ranges.

46.0 m	14	17	13	12	11	11	9	12	21	25	38	36	35	41	44	36	36	24	14	11	10	11	9	11
28.5 m						This level was not instrumented for relative humidity at this time																		
26.5 m	14	18	10	13	12	10	7	12	21	26	35	37	36	39	41	34	34	25	13	10	8	8	6	12
13.5 m	12	16	11	12	10	10	8	18	25	28	38	38	37	40	43	36	34	25	12	9	10	7	8	10
8.0 m						This level was not instrumented for relative humidity at this time																		
4.0 m	15	20	13	15	13	14	12	21	27	29	38	38	40	42	42	36	34	26	17	16	14	12	12	12
2.0 m	13	17	14	13	8	11	9	21	25	31	39	37	42	40	39	39	34	26	18	15	15	10	15	11
1.0 m	10	12	11	10	8	8	10	19	28	33	39	37	42	41	43	36	34	22	12	9	10	9	5	9
0.5 m	11	11	13	9	10	8	11	26	34	37	41	41	46	47	48	37	39	25	18	11	15	10	10	9

**SUMMARY OF METEOROLOGICAL OBSERVATIONS**  
**HOURLY DATA**  
 DECEMBER 1966

Exposure	Site Code <sup>1</sup>	Monthly Means <sup>2</sup> 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	Max.
Albrook (Forest site)	WB (4.0 m)	72.3	72.1	72.0	71.8	71.7	71.6	71.8	73.6	74.7	75.2	75.6	75.8	75.6	75.4	75.7	75.2	74.9	74.0	73.4	73.1	72.8	72.6	72.6	72.5	743	68.7	73.6	80.0
	WB (2.0 m)	72.4	72.2	72.0	71.8	71.7	71.6	71.8	73.6	74.9	75.4	75.8	76.2	75.7	75.8	75.5	75.0	74.1	73.4	73.2	72.8	72.7	72.7	72.7	72.5	743	68.6	73.7	80.0
	WB (0.5 m)	72.6	72.4	72.3	72.1	72.0	71.9	71.9	72.8	74.3	75.3	76.0	76.3	76.5	76.0	76.2	75.8	75.5	74.7	73.9	73.5	73.2	73.1	72.8	72.7	732	69.3	73.9	79.5
	BP	.730	.716	.701	.695	.700	.711	.733	.751	.765	.768	.759	.740	.710	.691	.670	.666	.670	.683	.697	.717	.736	.747	.748	.745	744	.630	.719	.810
P1	0.72	0.03	0.02	0.01	0.02	0.03	0.10	0.08	0.04	0.03	0.06	0.07	0.22	0.15	0.18	0.21	0.18	0.02	0.01	0.01	0.01	0.04	0.02	0.21	93	0.00	6.36	0.73	
P2	0.52	0.04	0.00	0.00	0.02	0.07	0.35	0.10	0.03	0.02	0.05	0.09	0.10	0.28	0.35	0.40	0.14	0.03	0.00	0.00	0.00	0.00	0.00	0.03	68	0.00	4.54	0.73	
P3	0.50	0.00	0.02	0.01	0.00	0.05	0.20	0.16	0.04	0.01	0.10	0.07	0.01	0.37	0.52	0.34	0.18	0.04	0.00	0.00	0.00	0.00	0.00	0.35	59	0.00	5.18	0.70	
P4	0.81	0.03	0.00	0.00	0.00	0.05	0.09	0.07	0.06	0.03	0.03	0.13	0.00	0.46	0.85	0.43	0.17	0.06	0.01	0.01	0.00	0.00	0.00	0.15	63	0.00	6.16	0.89	

Chiva Chiva (Open site)	WB (4.0 m)	72.0	71.8	71.5	71.4	71.3	71.1	71.9	73.8	74.7	75.1	75.4	75.5	75.1	74.9	74.8	74.2	73.6	73.2	72.9	72.7	72.6	72.2	72.2	720	68.4	73.3	79.3
	WB (2.0 m)	72.3	72.4	71.7	71.6	71.5	72.3	74.2	75.1	75.4	75.9	75.7	75.8	75.4	75.2	75.1	74.5	73.8	73.6	73.3	73.0	72.9	72.6	72.6	720	68.4	73.6	79.1
	WB (0.5 m)	72.2	71.7	71.7	71.4	71.3	71.9	74.2	75.6	76.4	76.8	76.7	76.8	76.6	76.1	75.8	74.9	73.9	73.5	73.1	72.7	72.5	72.4	72.4	744	67.2	73.9	79.6
	BP	.817	.795	.778	.785	.794	.813	.836	.850	.854	.844	.821	.797	.773	.757	.750	.756	.766	.782	.802	.822	.831	.832	.823	744	.715	.803	.890
PS	0.07	0.01	0.00	0.01	0.02	0.09	0.31	0.09	0.04	0.04	0.26	0.04	0.38	0.21	0.09	0.19	0.03	0.02	0.00	0.00	0.01	0.02	0.00	0.00	43	0.00	5.45	0.70

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

P3 - 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.)

<sup>2</sup> 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**  
**DECEMBER 1966**

Deposure Site	Monthly Ranges <sup>2</sup> 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		
Albrook (Forest site)	WB (4.0 m)	4.5	4.6	4.6	5.0	5.0	5.5	6.1	3.9	4.8	5.2	5.3	7.0	5.5	7.2	6.7	6.7	6.7	5.2	5.3	4.8	5.3	4.9	5.4	4.7	
	WB (2.0 m)	4.5	4.6	4.7	4.9	5.0	5.4	6.3	3.9	4.9	6.0	5.8	6.3	6.1	7.0	6.7	6.7	6.7	5.5	5.0	4.8	5.2	5.0	5.6	4.8	
	WB (0.5 m)	4.5	3.8	3.7	3.7	4.2	4.2	4.2	3.8	4.6	5.2	5.5	5.0	4.9	5.1	6.5	6.0	6.5	5.4	5.2	4.5	4.5	4.2	4.3	4.5	
	BP	.105	.100	.085	.095	.095	.085	.080	.075	.070	.080	.090	.080	.085	.080	.080	.075	.070	.080	.080	.080	.080	.070	.090	.090	
Chive Chive (open site)	WB (4.0 m)	5.0	4.6	5.0	4.8	5.9	4.6	4.5	5.5	6.9	5.5	5.8	5.9	5.0	4.6	7.2	5.4	4.7	4.8	4.6	4.6	4.6	4.3	4.1	4.1	
	WB (2.0 m)	4.6	4.5	4.7	5.2	5.1	5.6	4.2	5.3	6.3	5.5	5.3	5.5	4.8	4.2	6.3	5.0	4.2	4.2	4.5	4.1	4.0	3.8	3.8		
	WB (0.5 m)	5.1	5.7	5.4	6.2	6.5	7.0	5.3	4.6	5.6	5.8	5.5	5.1	5.3	5.7	5.9	7.0	5.6	5.0	4.6	4.7	4.2	4.6	5.1	5.4	
	BP	.085	.080	.095	.090	.080	.075	.080	.075	.075	.075	.085	.090	.075	.080	.080	.070	.070	.075	.080	.080	.085	.065	.085	.080	
P5	0.00	0.00	0.00	0.00	0.00	0.11	0.00	0.09	0.05	0.00	0.68	0.02	0.10	0.46	0.16	0.52	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00		

\* No monthly summary was computed for the ranges.

5

Deposure Site	Monthly Ranges <sup>2</sup> 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		
Albrook (Forest site)	WB (4.0 m)	4.5	4.6	4.6	5.0	5.0	5.5	6.1	3.9	4.8	5.2	5.3	7.0	5.5	7.2	6.7	6.7	6.7	5.2	5.3	4.8	5.3	4.9	5.4	4.7	
	WB (2.0 m)	4.5	4.6	4.7	4.9	5.0	5.4	6.3	3.9	4.9	6.0	5.8	6.3	6.1	7.0	6.7	6.7	6.7	5.5	5.0	4.8	5.2	5.0	5.6	4.8	
	WB (0.5 m)	4.5	3.8	3.7	3.7	4.2	4.2	4.2	3.8	4.6	5.2	5.5	5.0	4.9	5.1	6.5	6.0	6.5	5.4	5.2	4.5	4.5	4.2	4.3	4.5	
	BP	.105	.100	.085	.095	.095	.085	.080	.075	.070	.080	.090	.080	.085	.080	.080	.075	.070	.080	.080	.080	.070	.090	.090		
Chive Chive (open site)	WB (4.0 m)	5.0	4.6	5.0	4.8	5.9	4.6	4.5	5.5	6.9	5.5	5.8	5.9	5.0	4.6	7.2	5.4	4.7	4.8	4.6	4.6	4.6	4.3	4.1	4.1	
	WB (2.0 m)	4.6	4.5	4.7	5.2	5.1	5.6	4.2	5.3	6.3	5.5	5.3	5.5	4.8	4.2	6.3	5.0	4.2	4.2	4.5	4.1	4.0	3.8	3.8		
	WB (0.5 m)	5.1	5.7	5.4	6.2	6.5	7.0	5.3	4.6	5.6	5.8	5.5	5.1	5.3	5.7	5.9	7.0	5.6	5.0	4.6	4.7	4.2	4.6	5.1	5.4	
	BP	.085	.080	.095	.090	.080	.075	.080	.075	.075	.075	.085	.090	.075	.080	.080	.070	.070	.075	.080	.080	.085	.065	.085	.080	
P5	0.00	0.00	0.00	0.00	0.00	0.11	0.00	0.09	0.05	0.00	0.68	0.02	0.10	0.46	0.16	0.52	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00		

\* No monthly summary was computed for the ranges.

5

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

P5 - 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.)

<sup>2</sup> Monthly ranges of precipitation are computed for precipitation days.



**SUMMARY OF METEOROLOGICAL OBSERVATIONS**  
**HOURLY DATA**  
 DECEMBER 1966

Exposure	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					
Site	12	12	13	13	15	10	11	14	14	16	18	17	17	17	18	18	18	14	15	10	11	11	10	14					
Level	46.0 m	3	3	4	3	5	2	4	4	5	8	15	10	9	14	5	4	5	6	7	3	5	4	3	3				
								This level was not instrumented for wind speed at this time																					
								This level was not instrumented for wind speed at this time																					
								This level was not instrumented for wind speed at this time																					
								This level was not instrumented for wind speed at this time																					
								This level was not instrumented for wind speed at this time																					
								This level was not instrumented for wind speed at this time																					
								This level was not instrumented for wind speed at this time																					

\* No monthly summary was computed for the ranges.

Site	13	16	12	17	10	9	10	10	11	17	15	15	16	16	16	17	13	11	13	11	13	10	14	12				
Level	46.0 m	11	15	11	12	8	8	10	10	18	17	16	16	17	8	14	12	9	15	10	12	9	10	9				
								This level was not instrumented for wind speed at this time																				
								This level was not instrumented for wind speed at this time																				
								This level was not instrumented for wind speed at this time																				
								This level was not instrumented for wind speed at this time																				
								This level was not instrumented for wind speed at this time																				
								This level was not instrumented for wind speed at this time																				
								This level was not instrumented for wind speed at this time																				

ALBROOK (Forest site) DECEMBER 1966

Relative Frequencies\* of Wind Directions by Hour at 46.0 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	3.2	3.2	6.4	22.6	12.9	16.6	20.0	20.0	16.1	16.1	3.2				3.2	3.2	3.2	
NNE			3.2							9.7	9.7	3.3	6.6	6.6	9.7	3.2				3.2	3.2	3.2	3.2	6.4
NE			3.2	3.2				6.4	3.2	12.9	6.4	3.3				9.7								
ENE						3.2		6.4		3.2	9.7		3.3		3.2			3.2				3.2	3.2	
E						3.2		3.2			3.2	3.3	6.6	3.3	3.2									
ESE									9.7	6.4			3.3	3.3	3.2									
SE											6.6	3.3	6.6	6.6			3.2							
SSE											3.2	6.6	6.6	3.3	3.2			3.2						
S														3.3	3.2		3.2							
SSW		3.2											3.3	3.3										
SW	3.2	6.4								3.2	3.2	6.6	6.6		3.2	6.4								
WSW	3.2		3.2		3.2	6.4	3.2		3.2						3.2	3.2	6.4				3.2	3.2	6.4	6.4
W	29.0	32.2	41.9	38.7	38.7	19.4	29.0	41.9	25.8	19.4	22.6	16.6	13.3	20.0	16.1		22.6	22.6	35.5	32.2	29.0	32.2	38.7	45.2
WNW	29.0	29.0	29.0	32.2	32.2	32.2	32.2	22.6	3.2	6.4	6.4	6.6		3.3	9.7	6.4	12.9	25.8	25.8	19.4	38.7	19.4	32.2	25.8
NW	9.7	6.4	3.2	9.7	6.4	16.1	3.2	9.7	19.4	6.4	6.4	6.6	6.6	6.6	3.2	29.0	35.5	25.8	12.9	16.1	3.2	19.4	6.4	6.4
NNW	3.2	3.2				9.7			3.2	3.2	9.7	10.0	13.3	6.6	12.9	6.4		9.7	6.4	12.9		3.2		
CALM	22.6	19.4	12.9	12.9	16.1	6.4	29.0	6.4	25.8	6.4	6.4	13.3	6.6	13.3	16.1	12.9	12.9	9.7	19.4	12.9	19.4	12.9	9.7	9.7

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

ALBROOK (Forest site) DECEMBER 1966

Relative Frequencies\* of Wind Directions by Hour at 26.5 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	6.4	6.4	3.2	12.9	6.4	3.2			3.2	6.4	6.4	3.3	3.3	13.3	9.7	6.4	3.2	6.4	3.2	3.2	9.7	6.4	6.4	6.4
NNE												6.6												
NE									3.2			3.3	3.3	3.3										
ENE											3.2		6.6											
E																								
SE										3.2	3.2					3.2								3.2
SSE																								
S												6.6	3.3											
SSW																								
SW														3.3										
WSW	6.4																							
W																								
WNW																								
NW	6.4	6.4	12.9	3.2	6.4	3.2	3.2	3.2	9.7	3.2	3.2	3.3	3.3	3.3			9.7	3.2	3.2		3.2			3.2
NNW	9.7	3.2	6.4	9.7	3.2	3.2	6.4	6.4	3.2	3.2	12.9	6.6	6.6	6.6	9.7	6.4	3.2	6.4	9.7	6.4	9.7	6.4	6.4	3.2
CALM	71.0	83.9	77.4	74.2	83.9	90.3	83.9	77.4	77.4	77.4	48.4	56.4	59.8	53.1	64.5	77.4	80.6	87.4	87.4	87.1	71.0	83.9	77.4	77.4

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

ALBROOK (Forest site) DECEMBER 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												3.3												
NNE									3.2								3.2							
NE																								
ENE																								
E																								
ESE													3.3											
SE																								
SSE										3.2														
S										3.2														
SSW																								
SW									6.4	3.2				3.3										
WSW									3.2									3.2						
W																6.4								
WNW											3.2													
NW														3.3										
NNW											3.2													
CAIM	100.0	100.0	100.0	100.0	100.0	96.8	100.0	100.0	90.3	96.8	83.9	96.3	96.3	93.0	90.3	100.0	96.8	96.8	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) DECEMBER 1966

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

Hr	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	9.7	6.4	9.7	16.1	9.7	12.9	6.4	16.1	16.1	25.8	22.6	19.4	22.6	32.2	22.6	25.8	22.6	16.1	13.3	6.6	13.3	19.4	9.7
NNE	3.2	6.4	6.4	6.4	6.4	3.2	6.4	3.2	9.7	9.7	9.7	12.9	9.7	12.9	6.4	6.4	3.2	3.2						3.2
NE		6.4						3.2		6.4			3.2	3.2	3.2	6.4				3.3		3.3		
ENE		6.4					3.2		3.2		3.2				3.2				6.4		3.3	3.3		
E	3.2					3.2			12.9	3.2	3.2	3.2	6.4	3.2		3.2	3.2	3.2	3.2	3.3	3.3			
ESE									3.2	3.2			3.2										3.2	
SE				3.2					3.2	3.2			3.2											3.2
SSE								3.2			3.2		6.4	3.2	6.4	3.2		3.2						3.2
S		6.4	3.2						3.2	3.2	3.2			6.4		3.2	3.2		3.2	3.3	3.3			
SSW										3.2	6.4	3.2	3.2		3.2	3.2				3.3	3.2			
SW	3.2	3.2				3.2	3.2						3.2	6.4			3.2							
WSW	3.2							3.2								3.2	3.2	3.2			3.3	6.6	3.2	
W		12.9	25.1	3.2	6.4	9.7	6.4	9.7	3.2	3.2	12.9	6.4									3.3			6.4
WNW	9.7	6.4	12.9	16.1	6.4	16.1	12.9	12.9	3.2	6.4			3.2	3.2	6.4	12.9	12.9	19.4				3.3	3.2	6.4
NW	29.0	19.4	25.8	32.2	29.0	32.2	25.8	25.8	29.0	29.0	9.7	12.9	12.9	16.1	16.1	12.9	19.4	19.4	51.6	39.9	29.9	36.6	35.5	25.8
NNW	41.9	22.6	19.4	19.4	29.0	22.6	22.6	16.1	22.6	16.1	19.4	22.6	22.6	19.4	9.7	19.4	19.4	25.8	12.9	26.6	36.6	26.6	22.6	22.6
CALM	3.2			9.7			6.4																	3.2

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

CHIVA CHIVA (Open site) DECEMBER 1966

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

Hr	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	16.6	10.0	16.6	16.6	10.0	16.6	20.0	10.0	20.0	17.1	29.9	20.0	29.9	20.0	22.6	25.8	16.1	25.8	19.4	23.3	16.6	20.0	16.6	23.3
NNE	3.3	6.6	6.6	6.6	13.3			3.3	6.6	6.8	10.0	16.6	6.6	10.0	12.9	6.4	9.7		3.2	6.6	3.3			3.3
NE		6.6		10.0	3.3		6.6	3.3	6.6	10.3		6.6	3.3	6.6	3.2	6.4	3.2	3.2		3.3	3.3	3.3		
ENE		3.3	3.3					3.3			3.3			3.3	3.2	3.2			3.2					
E	3.3		3.3					6.6	10.0		3.3		3.3	3.3	3.2				3.2			3.3		
ESE												6.6	3.3							3.3				
SE		3.3							3.3	3.4	3.3	6.6	3.3		3.2	3.2		3.2	3.2	3.2	3.3	3.3		6.6
SSE										10.3	3.3	3.3	10.0	3.2	3.2	3.2	3.2							
S		3.3									6.6	6.6	6.6	3.2	3.2	3.2	3.2							
SSW													6.6		3.2									
SW	3.3		6.6				3.3		3.3					3.3		3.2	3.2	3.2		3.3				
WSW		3.3	3.3										3.3			6.4	3.2							6.6
W	3.3	6.6	13.3	3.3	3.3	10.0	13.3	10.0	3.3		6.6	3.3	3.3		3.2		9.7	3.2		3.3	3.3	3.3	3.3	3.3
WNW	13.3	6.6	10.0	6.6	6.6	13.3	3.3	20.0	3.3	3.4	3.3			3.3	6.4	3.2	6.4	12.9	6.4	3.3	3.3	3.3	10.0	13.3
NW	26.6	13.3	13.3	23.3	23.3	13.3	13.3	16.6	20.0	20.6	6.6	13.3	3.3	16.6	22.6	12.9	12.9	29.0	29.0	16.6	20.0	23.3	26.6	10.0
NNW	26.6	26.6	23.3	33.2	36.6	13.3	16.6	13.3	24.0	16.6	23.3	24.0	16.6	20.0	23.3	9.0	19.4	29.0	19.4	29.0	26.6	23.3	23.3	23.3
CALM	3.3	10.0	3.3	10.0	3.3	3.3	26.6	10.0		3.4	3.3								6.4	3.3	3.3	3.3	3.3	10.0

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

CHIVA CHIVA (Open site) DECEMBER 1966

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

Hr	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	12.9	3.2	6.4	22.6	6.4	12.9	12.9	9.7	22.6	6.4	29.0	19.4	22.6	22.6	19.4	22.6	29.0	22.6	16.1	16.6	3.3	20.0	6.4	12.9
NNE	6.4	3.2	3.2		3.2	6.4	3.2	3.2	3.2	6.4	12.9	16.1	6.4	6.4	19.4	22.6	9.7	6.4	9.7	10.0	13.3		3.2	6.4
NE	6.4	6.4	6.4	16.1	12.9		6.4		3.2	12.9	3.2	6.4	3.2	9.7		3.2			3.2	6.6	3.3	10.0	6.4	6.4
ENE	3.2	3.2		6.4			3.2	9.7	6.4				3.2		3.2			3.2		3.3		3.3	9.7	
E	3.2	3.2	6.4	3.7	3.2	3.2		3.2	3.2		3.2	6.4	3.2		3.2	6.4	3.2	6.4			3.3	3.3		3.2
ESE		3.2																						
SE		3.2				3.2					6.4	3.2	6.4			3.2		3.2		6.6	3.3	6.6		
SSE										3.2	3.2	3.2	6.4			3.2				6.6	3.3			
S		3.2			3.2		3.2		3.2	3.2	12.9	9.7	9.7	9.7	9.7	6.4	3.2				6.6			3.2
SSW					3.2				3.2	6.4			3.2				6.4	3.2		3.3			3.2	3.2
SW	3.2			3.2	3.2			6.4	3.2	3.2			3.2	3.2	3.2	9.7	3.2					6.6		3.2
WSW		6.4	3.2	3.2			3.2	6.4			3.2			3.2				3.2			3.3		6.4	
W	6.4	3.2	9.7	6.4	3.2	6.4	3.2	6.4			6.4	3.2		3.2	6.4		6.4		3.2	3.3	3.3	6.6	6.4	3.2
WNW	3.2	6.4	6.4	6.4	3.2	6.4	12.9	9.7	6.4	6.4	6.4	3.2		3.2		6.4	3.2	12.9				3.3	3.2	9.7
NW	12.9	9.7	3.2	6.4	22.6	19.4		16.1	19.4	25.8	6.4	22.6	16.1	19.7	19.4	9.7	22.6	29.0	19.4	20.0	20.0	20.0	9.7	12.9
NNW	25.8	25.8	29.0	16.1	22.6	22.6	19.4	12.9	22.6	22.6	9.7	9.7	19.4	25.8	12.9	9.7	12.9	16.1	19.4	20.0	29.0	16.6	19.4	19.4
CALM	16.1	19.4	25.8	9.7	12.9	19.4	32.2	16.1	3.2	3.2									9.7	10.0	6.6	3.3	22.6	19.4

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

## SUMMARY OF NON HOURLY DATA

DECEMBER 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)	WBG Index <sup>1</sup> (at 1.0 meters)	Index value	434	69.2	75.8	81.8
		Dry bulb temp.	434	69.4	77.1	86.3
		Wet bulb temp.	434	69.0	75.1	86.3
		Black bulb temp.	434	69.7	77.5	87.0
	Evaporation <sup>3</sup> (in. at 4 levels)	Piche (46.0 m)	31	0.012	7.951*	0.793
		Piche (26.5 m)	30	0.012	5.351*	0.464
		Piche (13.5 m)	17	0.012	1.806*	0.214
		Piche ( 0.5 m)	24	0.006	1.190*	0.171
	Precipitation from Raingauge Network <sup>2</sup> (in. at 1.0 meters)	Gauge # 1	52	0.01	5.88*	2.00
		Gauge # 2	53	0.01	6.24*	1.48
Gauge # 3		54	0.01	6.02*	1.18	
Gauge # 4		52	0.01	4.70*	0.82	
Gauge # 5		52	0.01	5.26*	1.08	
Gauge # 6		56	0.01	6.06*	1.18	
Gauge # 7		55	0.01	5.81*	1.14	
Gauge # 8		50	0.01	5.27*	1.15	
Stem Flow <sup>2</sup> (in. at 2.0 meters)	Small tree	22	0.01	6.61*	1.65	
	Medium tree	20	0.01	5.85*	1.20	
	Large tree	11	0.02	231.37*	75.59	
Chiva Chiva (Open site)	WBG Index <sup>1</sup> (at 1.0 meters)	Index value	434	67.2	78.5	91.1
		Dry bulb temp.	434	66.2	79.7	92.6
		Wet bulb temp.	434	67.2	75.4	92.6
		Black bulb temp.	432	66.8	88.3	124.0
	Evaporation <sup>3</sup> (in. at 0.5 meters)	Piche	31	0.006	4.807*	0.342
		Pan	28	0.006	3.488*	0.220
Minimum Grass temp <sup>3</sup> (°F at grass tips)	None	28	66.0	70.1	81.5	

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 Dec 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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