THE UNIVERSITY OF WISCONSIN

DEPARTMENT OF METEOROLOGY

MADISON, WISCONSIN

1954

Presentation of Standby Data

Taken at O'Neill, Nebraska

August-September 1953

Contract AF19(122)-461

INTRODUCTION

This report includes all the heat budget, temperature and vapor pressure data taken by the University of Wisconsin on standby days. The description of the instrumentation, the exposure of the instruments and the method of recording were discussed in a previous report entitled "Presentation of Data for Official Run Days". In the following pages are to be found a brief description of the evaluation used when the data was not complete, particularly the soil temperature data.

On September 3, a Deacon heat meter was installed at 5 cm depth, and the recorded values obtained were used to calculate the heat conduction through the 5 cm level.

Beginning on August 22, the temperature change of the 0-5 cm soil layer was recorded automatically. This method of measuring the heat absorbed above the 5 cm in conjunction with the Deacon heat meter which gave the heat flow below the 5 cm level was used to calculate the entire soil heat budget on September 3,4 and September 5-7 (except for 1235-1635 on September 6 when the recorder went off scale).

Prior to installing the Deacon heat meter the heat conduction through the 5 cm layer was obtained by means of manually read soil resistance thermometers, c.f. University of Wisconsin "Presentation of Data for Official Run Days". These manual readings in conjunction with the recorded mean temperatures for 0-5 cm were used on August 28,29, and Aug. 30, with the following exceptions:

August 30 1435, 1535 when recorder was off scale
and 1635-2335 when there were only 2 manual temperature measurements, August 29, 0035-1235. On

days when there was no recorded data for 0-5 cm and no recorded Deacon heat meter data, the entire soil heat budget was obtained by reading the resistance thermometers manually. This was done on Aug. 25, 30 at 1435,1535, and Agu. 29, 0635-1235.

There were some days where no heat conduction data was available from our own measurements. For the most part, these days had similar insolation and moisture conditions to the preceding and subsequent official run days. Therefore, on interpolation between the runs was made by use of the formula

$$C_t = \frac{m\, C_{t-n} + n\, C_{t+m}}{n + m}$$

where

C = Interpolated value of conduction

C -n = Conduction for a n run days previous to interpolated day

C m = Conduction for a run m days after interpolated day t

n = Number of days between interpolated day and preceding run day used

m = Number of days between interpolated day and subsequent run day Wed.

This method was used on:

Aug. 21, 22 using Run #3 and Run #5.

Aug. 22, 23 using Run #3 and Run #5.

Aug. 24 using Run #3 and Run #5.

Aug. 25-27 using Run #5 and Run #6.

Sept. 5-7 1235-1635 using Run #5 and Run #7.

For the period 1635-2335 on Aug. 30, only 2 measurements of soil temperature were available. Since the observed soil temperature -- time profiles were all of similar shape, the shape of the missing profile was estimated from average curve of other similar days. Soil temperatures were then fitted to the known points.

HOURLY MEAN NET RADIATION VALUES FOR STANDBY DAYS

August-September 1953

(cal. cm.$^{-2}$ min.$^{-1}$)

O'Neill, Nebraska

Time	Aug.21	Aug.22	Aug.23	Aug.24	Aug.25	Aug.26	Aug.27	Aug.28	Aug.29	Aug.30	Sept.3	Sept.4
0035		-.113	-.111	-.031		-.114	-.124	-.102	-.101			-.106
0135		-.106	-.106	-.033		-.106	-.112	-.092	-.097			-.110
0235		-.095	-.097	-.023		-.110	-.110	-.088	-.092			-.103
0335		-.094	-.096	-.078		-.113	-.114	-.085	-.074			-.101
0435			-.062	-.050		-.112	-.112	-.103	-.094			-.105
0535			-.049	-.065		-.102	-.110	-.102	-.069			-.102
0635			.048	-.029		-.028	-.037	-.054	-.018			-.051
0735			.116	.237		.153	.133	.124	.193			.093
0835			.189	.373		.345	.348	.397	.264			.274
0935			.413	.608		.559	.560	.521	.404			.435
1035			.706	.770		.738	.739	.556	.587	.576		.618
1135			.862	.872		.840		.535	.807	.689		.722
1235	.920		.655			.878	.816	.763	.744	.723		.780
1335	.846		.524			.834	.800	.719	.393	.694		.599
1435	.689		.511			.713	.729	.657		.602		.413
1535	.402		.252			.547	.511	.302		.450		.285
1635	.292		.244		.491	.304	.311	.263		.246		.057
1735	.044	.058	.167		.273	.082	.090	.044		.055		
1835	-.076	.048	-.079		.058	-.063	-.076	-.048		-.072		
1935	-.111	-.108	-.092		-.083	-.134	-.120	-.099		-.090		
2035	-.118	-.095	-.083		-.119	-.129	-.117	-.098		-.088		
2135	-.120	-.117	-.090		-.118	-.120	-.125	-.103		-.092		
2235	-.115	-.116	-.083		-.114	-.124	-.124	-.100		-.095	-.100	
2335	-.115	-.115	-.081		-.108	-.127	-.127	-.099			-.109	
					-.113							

HOURLY MEAN NET RADIATION VALUES FOR STANDBY DAYS

August-September 1953 (cal. cm.$^{-2}$ min.$^{-1}$) O'Neill, Nebraska

Time	Sept.5	Sept.6	Sept.7
0035			
0135		-.047	-.070
0235		-.058	-.081
0335		-.034	-.079
0435		-.036	
0535		-.064	
0635		-.061	
0735		-.055	
0835		.081	
0935		.304	
1035		.479	
1135		.576	
1235		.651	
1335		.676	
1435		.649	
1535		.565	
1635		.416	
1735		.223	
1835	.063	.044	
1935	no	-.091	
2035	reading	-.082	
2135	-.076	-.091	
2235	-.072	-.083	
2335	-.073	-.080	
		-.074	

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Standby Heat Budget and Gradient Data for O'Neill, Nebraska August 21-22, 1953

Time	R	C	E	L	Δ T	Δ e
1205-1305	.920	.079	.427	.414	-.563	-.351
1305-1405	.846	.108	.352	.386	-.561	-.310
1405-1505	.689	.106	.269	.314	-.464	-.242
1505-1605	.402	.060	.174	.168	-.291	-.182
1605-1705	.292	.036	.090	.166	-.192	-.063
1705-1805	.044	-.115	.060	.099*	.075	-.024
1805-1905	-.076	-.018	.029	-.087	.219	-.040
1905-2005	-.111	-.042	-.005	-.068	.346	.016
2005-2105	-.118	-.063	-.049	-.006	.282	.138
2105-2205	-.120	-.050	-.026	-.044	.224	.078
2205-2305	-.115	-.041	-.047	-.027	.247	.263
2305-2405	-.115	-.061	-.006	-.040	.194	.015
0005-0105	-.113	-.041	-.054	-.018	.235	.042
0105-0205	-.106	-.034	-.043	-.029	.240	.214
0205-0305	-.095	-.031	-.036	-.028	.264	.222
0305-0405	-.094	-.031	-.018	-.050	.251	.040

*Since the observed values of Δ e and Δ T for 1705-1805 do not permit a reasonable calculation of E & L, E was Interpolated.

C Values Interpolated Between Run #3 and Run #5.

The vapor pressure and temperature differences and the heat fluxes were calculated for a layer extending from the heights of z = 44 to 88 cm.

R = Net radiation

C = Conduction into the ground

E = Evaporation

L = Eddy conduction

All terms of the heat budget are in the units of calories/sq.cm./min.

Δ e is in millibars
Δ T is in degrees centigrade

All the above terms are averages for the hour from sixty observations per hour, one observation per minute.

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Standby Heat Budget and Gradient Data for O'Neill, Nebraska August 23-24, 1953

Time	R	C	E	L	Δ e	Δ T
1805-1905	-.079				.133	.438
1905-2005	-.092				.028	.463
2005-2105	-.083				-.113	.399
2105-2205	-.090				.035	.316
2205-2305	-.083				.051	.256
2305-0005	-.081				-.150	.134
0005-0105	-.031				-.172	.055
0105-0205	-.033				-.145	.013
0205-0305	-.023	-.042	.016	.003	-.150	-.043
0305-0405	-.078	-.044	.011	-.045	-.127	.085
0405-0505	-.050	-.044	.007	-.001	-.161	.063
0505-0605	-.065	-.035	.002	-.032	-.093	.097
0605-0705	-.029	-.024	-.003	-.002	-.092	-.122
0705-0805	.237	.001	.146	.090	-.195	-.199
0805-1005	.373	.051	.195	.127	-.211	-.227
1005-1105	.608	.110	.309	.189	-.481	-.486
1105-1205	.770	.111	.412	.247	-.644	-.635
1205-1305	.872	.124	.464	.284	-.621	-.626

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Standby Heat Budget and Gradient Data for O'Neill, Nebraska August 25, 1953

Time	R	C	E	L	Δ T	Δ e
1505-1605	.491	.006			-.386	.003
1605-1705	.273	-.015			-.225	.070
1705-1805	.058	-.028			-.060	.066
1805-1905	-.083	-.058			.172	.299
1905-2005	-.119	no rdg			.230	.061
2005-2035	-.117	no rdg			.212	.026

The values of Δ T and Δ e do not lend themselves readily to calculations of E and L.

All values of Δ e are doubtful.

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Standby Heat Budget and Gradient Data For O'Neill, Nebraska August 25,26,27, 1953

Time	R	C	E	L	△ T	△ e
2040-2105	-.120	no rdg	no rdg	no rdg	.072	-.284
2105-2205	-.114	-.036	.492	-.570	.107	-.058
2205-2305	-.108	-.307	-.054	0.017	.174	.327#
2305-0005	-.113	-.042	-.017	-.054	.139	.029
0005-0105	-.114	-.040	-.043*	-.030	.097	-.071
0105-0205	-.106	-.040	-.070	.004	.010	-.098
0205-0305	-.110	-.040	-.026	-.044	.154	.054
0305-0405	-.113	-.042	-.020	-.051	.152	.036
0405-0505	-.112	-.041	-.012*	-.059	.092	-.042
0505-0605	-.102	-.034	-.004	-.064	.138	.053
0605-0705	-.028	-.024	-.002	-.002	.155	.134
0705-0805	.153	-.001	no rdg	no rdg	-.140	no rdg
0805-0905	.345	.051	.008	.286	-.292	-.005
0905-1005	.559	.077	.123	.359	-.449	-.093
1005-1105	.738	.110	.190	.438	-.548	-.144
1105-1205	.840	.122	.171	,547	-.598	-.262
1205-1305	.878	.130	.312	.436	-.653	-.283
1305-1405	.834	.117	.187	.530	-.544	-.117
1405-1505	.713	.094	.242	.377	-.546	-.212
1505-1605	.547	.052	.083	.412	-.461	-.056
1605-1705	.304	.020	.015	.269	-.234	.008#
1705-1805	.082	-.033	.096	,019	-.180	-.565#
1805-1905	-.063	-.034	-.003	-.026	-.010	-.123
1905-2005	-.134	-.044	.024	-.114	.080	-.102
2005-2105	-.129	-.042	.024*	-.111	.105	-.068
2105-2205	-.120	-.040	.025*	-.105	.124	-.084
2205-2305	-.124	-.042	.025*	-.107	.084	-.058
2305-0005	-.127	-.046	.025*	-.106	.100	.149#
0005-0105	-.124	-.042	.025	-.107	.114	-.016
0105-0205	-.112	-.042	-.154	.084	.090	-.10
0205-0305	-.110	-.042	no rdg	no rdg	.110	no rdg
0305-0405	-.114	-.043	no rdg	no rdg	.119	no rdg
0405-0505	-.112	-.044	no rdg	no rdg	.119	no rdg
0505-0605	-.110	-.036	no rdg	no rdg	.099	no rdg
0605-0705	-.037	-.026	-.014	.003	.040	-.123
0705-0805	.133	-.013	.068	.078	-.154	-.082
0805-0905	.348	.051	.172	,125	-.311	-.260
0905-1005	.560	.079	.465	.016	-.411	-.731#
1005-1045	.739	no rdg	no rdg	no rdg	-.613	.179#

*Values of E are Interpolated because the observed △ e and △ T do not permit calculation of a reasonable value for E.

Doubtful values of △ e

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Standby Heat Budget and Gradient Data For O'Neill, Nebraska August 28, 29, 1953

Time	R	C	E	L	△ T	△ e
0905-1005	.521	.062			-.474	-.175
1005-1105	.556	.078			-.588	-.023
1105-1205	.535	.079			-.671	.023*
1205-1305	.763	.128			-.678	.032*
1305-1405	.719	.107			-.703	-.017
1405-1505	.657	.116			-.638	-.018*
1505-1605	.302	-.024			-.291	-.047
1605-1705	.263	-.028			-.259	-.086
1705-1805	.044	-.007			-.010	.016
1805-1905	-.048	-.037			.040	-.069
1905-2005	-.099	-.049			.020	-.098
2005-2105	-.098	-.046			.140	.035
2105-2205	-.103	-.048			.142	.054
2205-2305	-.100	-.049			.152	.053
2305-0005	-.099	-.053			.137	.048
0005-0105	-.101	-.053			.120	.005
0105-0205	-.097	-.047			.137	.051
0205-0305	-.092	-.046			.145	.030
0305-0405	-.074	-.055			.109	.023
0405-0505	-.094	-.041			.114	-.007
0505-0605	-.069	-.053			.092	-.015
0605-0705	-.018	-.042			-.103	.029
0705-0805	.193	.004			-.159	.110
0805-0905	.264	.041			-.316	.012*
0905-1005	.404	.034			-.411	-.030
1005-1105	.587	.084			-.605	-.071
1105-1205	.807	.104			-.970	-.112
1205-1305	.744	no rdg.			-.970	-.105
1305-1405	.393	.132			-.419	-.207

* Doubtful Values of △ e.

The observed values of △ T, and △ e do not lend themselves readily to calculation of L. & E.

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Standby Heat Budget and Gradient Data for O'Neill, Nebraska August 30, 1953

Time	R	C	E	L	Δ T	Δ e
1005-1105	.576	.029	.215	.332	-.832	-.326
1105-1205	.689	no rdg	no rdg	no rdg	-.913	-.178
1205-1305	.723	.108	.000	.615	-1.026	-.005
1305-1405	.694	.115	.000	.579	-.967	.001
1405-1505	.602	.119	.030	.453	-.868	-.040
1505-1605	.450	.057	.175	.218	-.640	-.311
1605-1705	.276	.057*	.161*	.017*	-.434	.186
1705-1805	.055	.017*	.148*	.110*	-.184	.116
1805-1905	-.072	-.003*	.134	-.203	.070	-.028
1905-2005	-.090	-.023*	-.017	-.050	.157	.032
2005-2105	-.088	-.022*	.021	-.045	.167	.047
2105-2205	-.092	-.024	.197	-.265	.164	-.152
2205-2305	-.095	-.030	-.029	-.036	.152	.076

*Indicates interpolated value

The values of Δ e @ 1005-1705 & 1705-1805. Do not permit A plausible calculation of E & L & these valued are therefore, interpolated for these hours.

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Standby Heat Budget and Gradient Data For O'Neill, Nebraska Sept. 3-4, 1953

Time	R	C	E	L	$\triangle$ T	$\triangle$ e
2205-2305	-.100				.261	.326
2305-0005	-.109	-.079	-.015	-.015	.267	.149
0005-0105	-.106	-.077	-.006	-.023	.194	.028
0105-0205	-.110	-.076	-.005	-.029	.244	.069
0205-0305	-.103	-.077	-.011	-.015	.329	.150
0305-0405	-.101	-.073	-.013	-.015	.302	.149
0405-0505	-.105	-.069	-.015	-.021	.256	.112
0505-0605	-.102	-.072	-.015	-.015	.246	.148
0605-0705	-.051	-.058	.004	.003	.264	.164
0705-0805	.093	-.027	.061	.059	-.005	-.031
0805-0905	.274	.000	.138	.136	-.197	-.122
0905-1005	.435	.033	.205	.197	-.312	-.198
1005-1105	.618	.081	.293	.244	-.401	-.292
1105-1205	.722	.092	.346	.284	-.496	-.369
1205-1305	.780	.033	.406	.341	-.444	-.319
1305-1405	.599	.066	.279	.254	-.341	-.227
1405-1505	.413	.097	.135	.181	-.314	-.142
1505-1605	.285	-.027	.165	.147	-.259	-.176
1605-1705	.057	-.091	.022	.126	-.037	-.019

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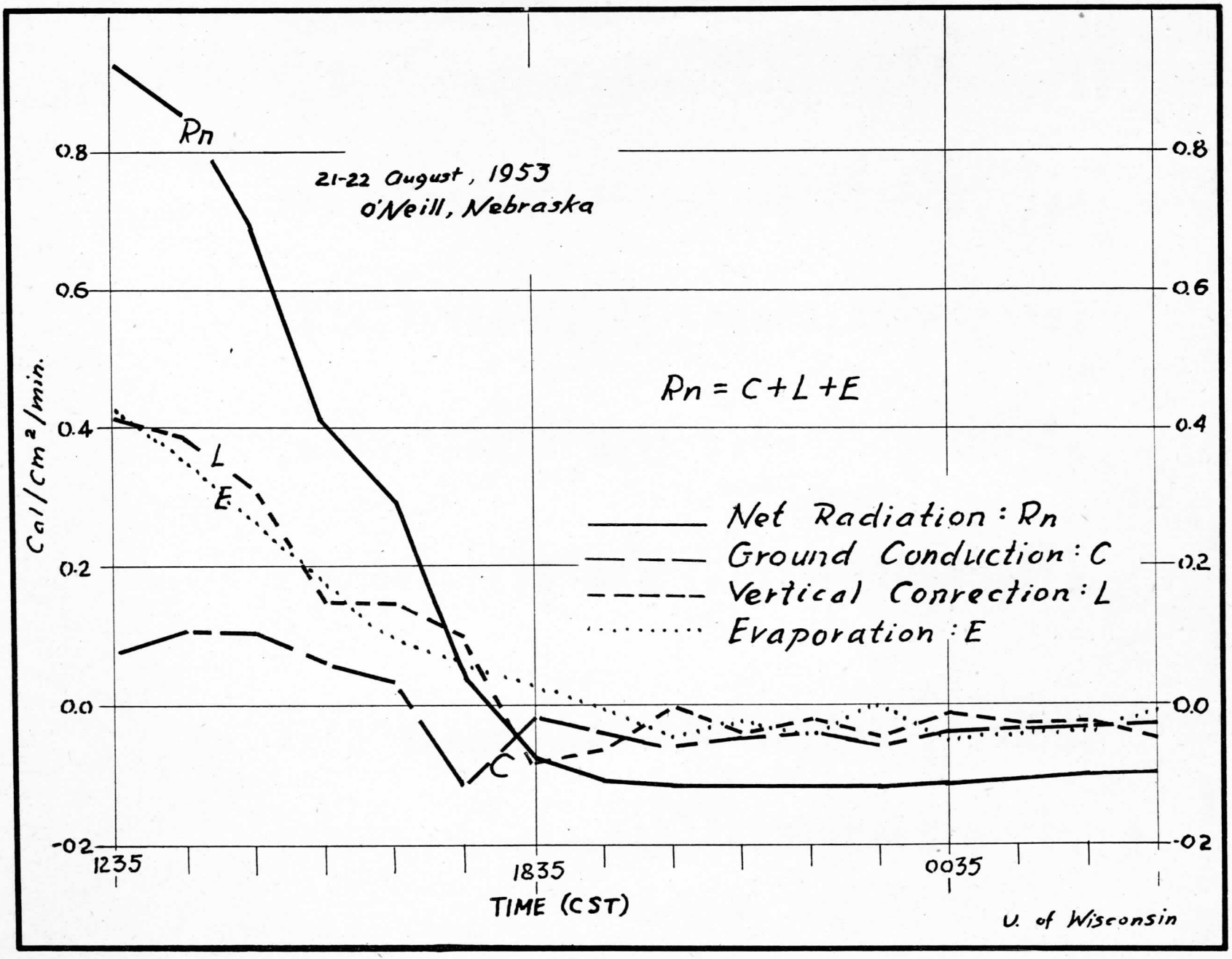
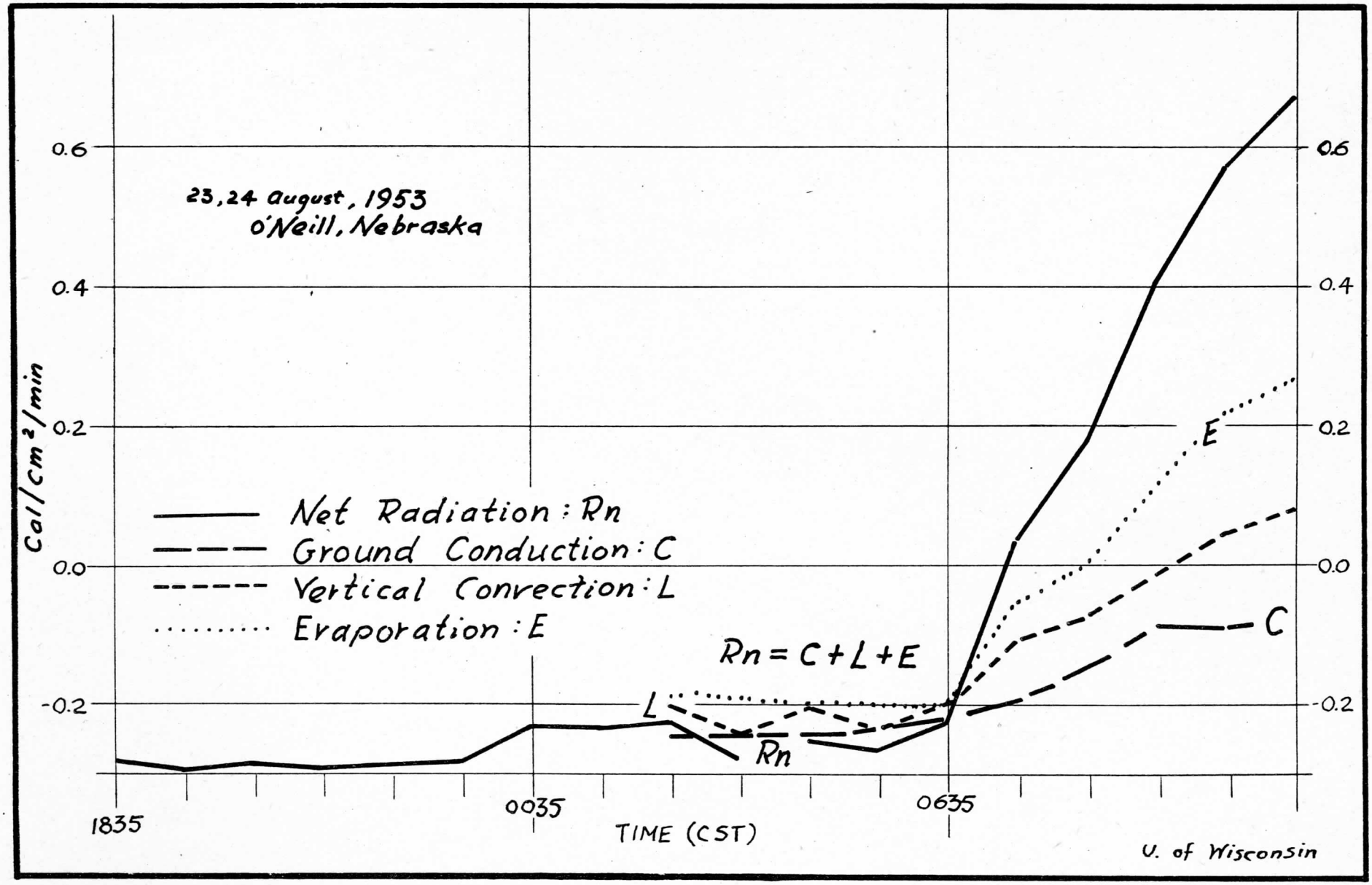
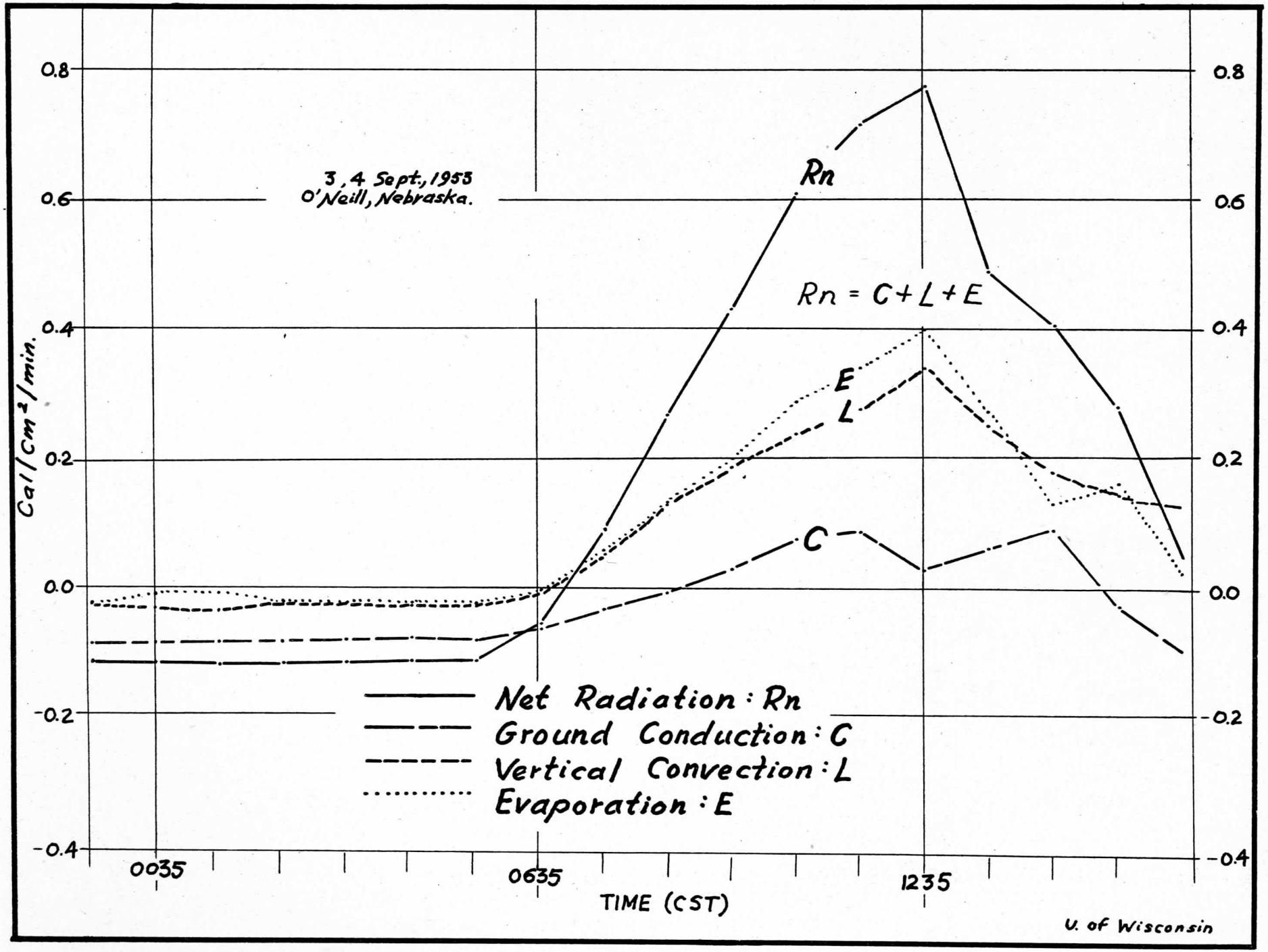
Standby Heat Budget and Gradient Data for O'Neill, Nebraska Sept. 5-7, 1953

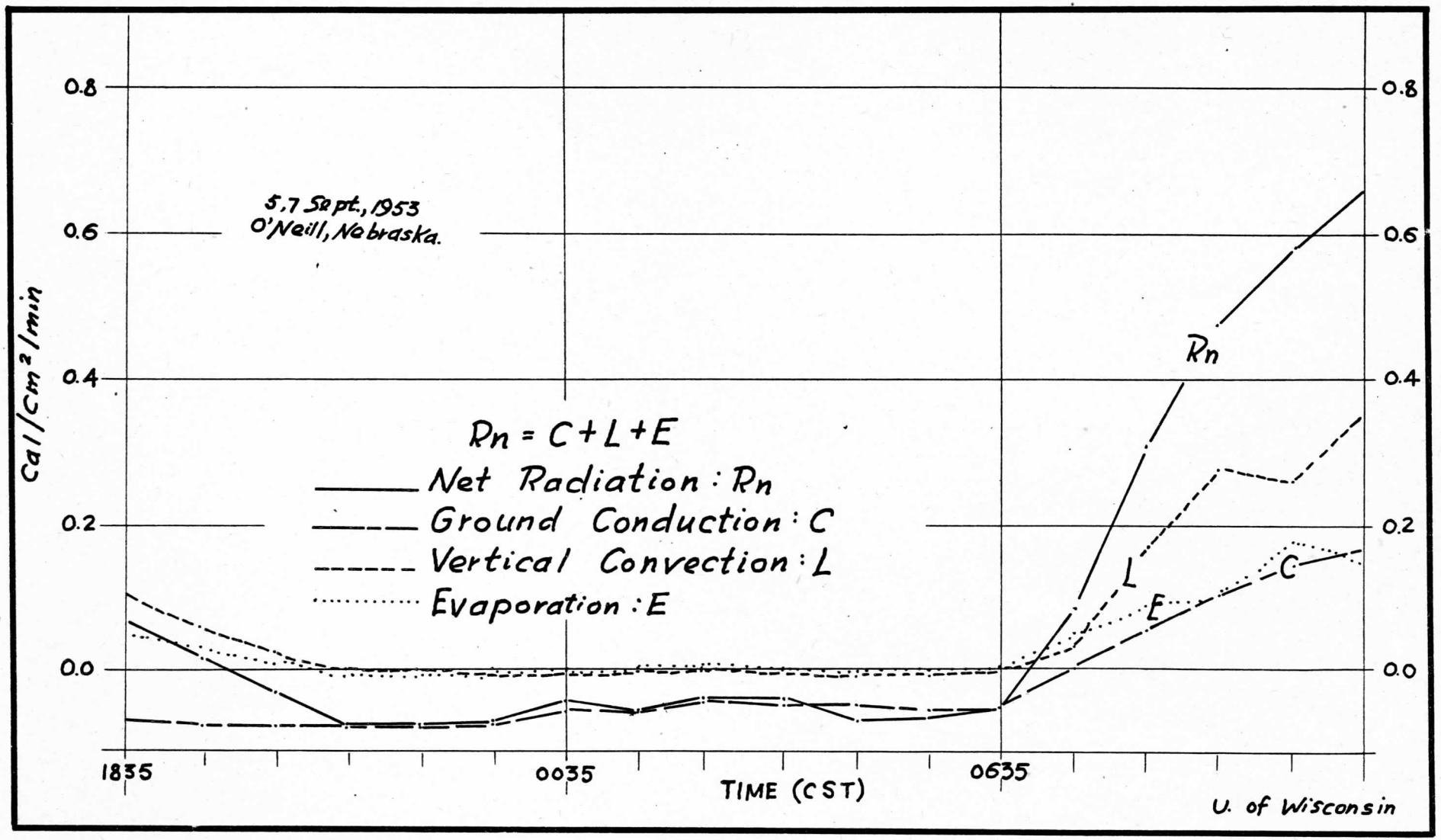
Time	R	C	E	L	Δ T	Δ e
1720-1805	No rdg.				.023	-.230
1805-1809	.063	-.072	.045	.090	1.254	-.376
1905-2005	No rdg.	-.079	msg.	msg.	1.490	-.600
2005-2105	No rdg.	-.078	msg.	msg.	1.762	-.595
2105-2205	-.076	-.077	.000	.001	1.100	-.214
2205-2305	-.072	-.073	.000	.001	.804	.059
2305-0005	-.072	-.071	-.000	-.001	.945	.257
0005-0105	-.047	-.053	.001	.005	.678	.086
0105-0205	-.058	-.056	.000	-.002	.363	-.024
0205-0305	-.034	-.045	.002	.009	.408	.063
0305-0405	-.036	-.041	.001	.004	.457	.043
0405-0505	-.064	-.048	.005	-.011	.431	.117
0505-0605	-.061	-.054	-.001	-.006	.274	.032
0605-0705	-.055	-.042	-.006	-.007	.854	.500
0705-0805	.081	.007	.043	.031	-.099	-.082
0805-0905	.304	.053	.087	.164	-.266	-.086
0905-1005	.479	.104	.097	.278	-.448	-.095
1005-1105	.576	.145	.171	.260	-.691	-.275
1105-1205	.651	.163	.143	.345	-.809	-.204
1205-1305	.676	.159*	.230	.287	-.578	-.208
1305-1405	.649	.138*	.178	.333	-.816	-.265
1405-1505	.565	.102*	.107	-.356	-.704	-.154
1505-1605	.416	.058*	.117	.241	-.498	-.147
1605-1705	.223	.004*	.088	.131	-.420	-.172
1705-1805	.044	-.061	.069	.036	-.041	-.048
1805-1905	-.091	-.086	-.001	-.004	.272	-.051
1905-2005	-.082	-.028	-.042	-.012	.665	-.407
2005-2105	-.091	-.032	-.042	-.017	.926	.400
2105-2205	-.083	-.038	-.033	-.012	1.198	.539
2205-2305	-.080	-.051	-.023	-.006	1.850	.906
2305-0005	-.074	-.079	.002	.003	1.410	.753
0005-0105	-.070	-.076	.003	.003	1.202	.731
0105-0205	-.070	-.070	.000	.000	.821	.525
0205-0305	-.081	-.068	-.006	-.007	.605	.362
0305-0405	-.079	-.057	-.010	-.012	.415	.196

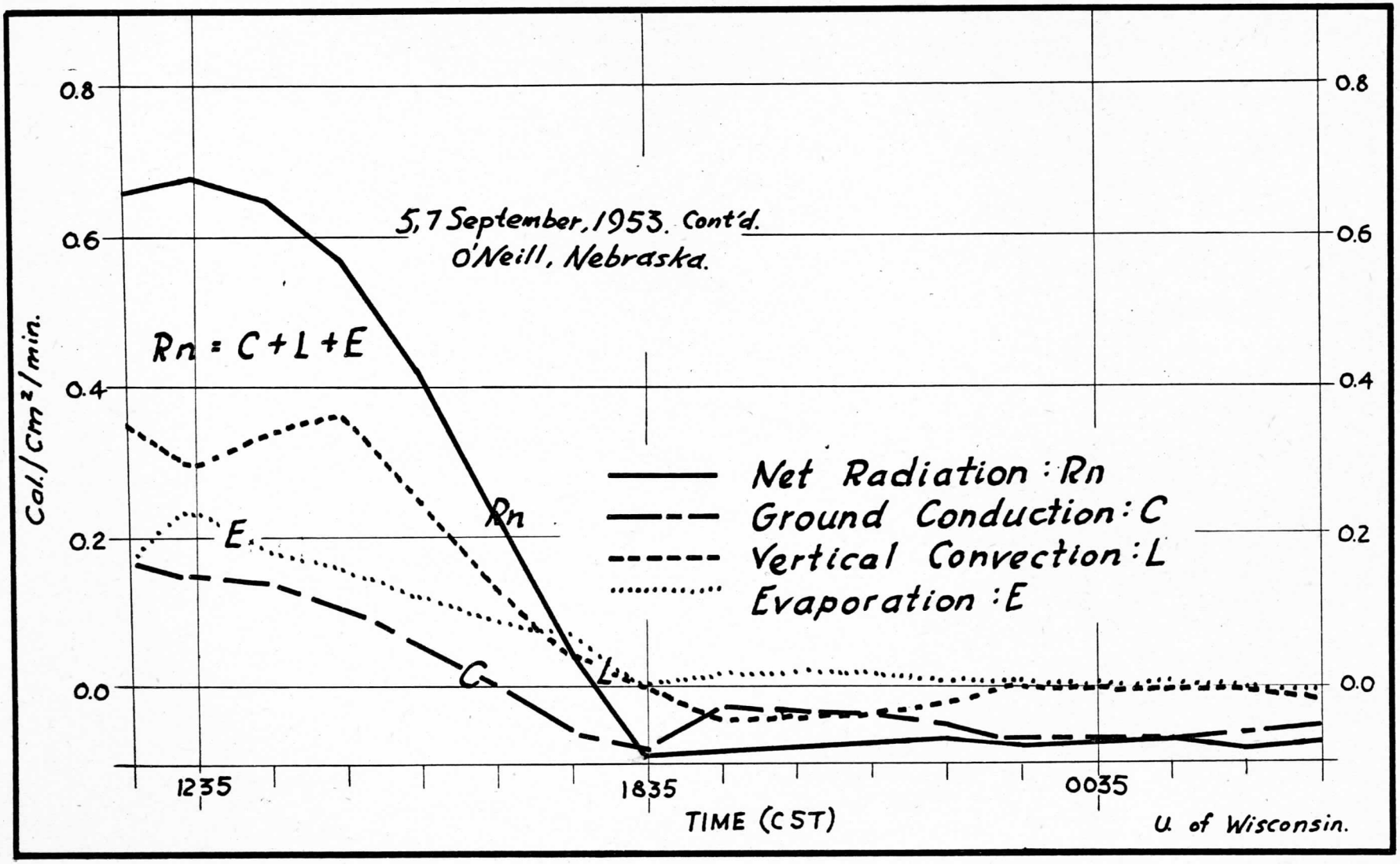
* Indicates interpolation

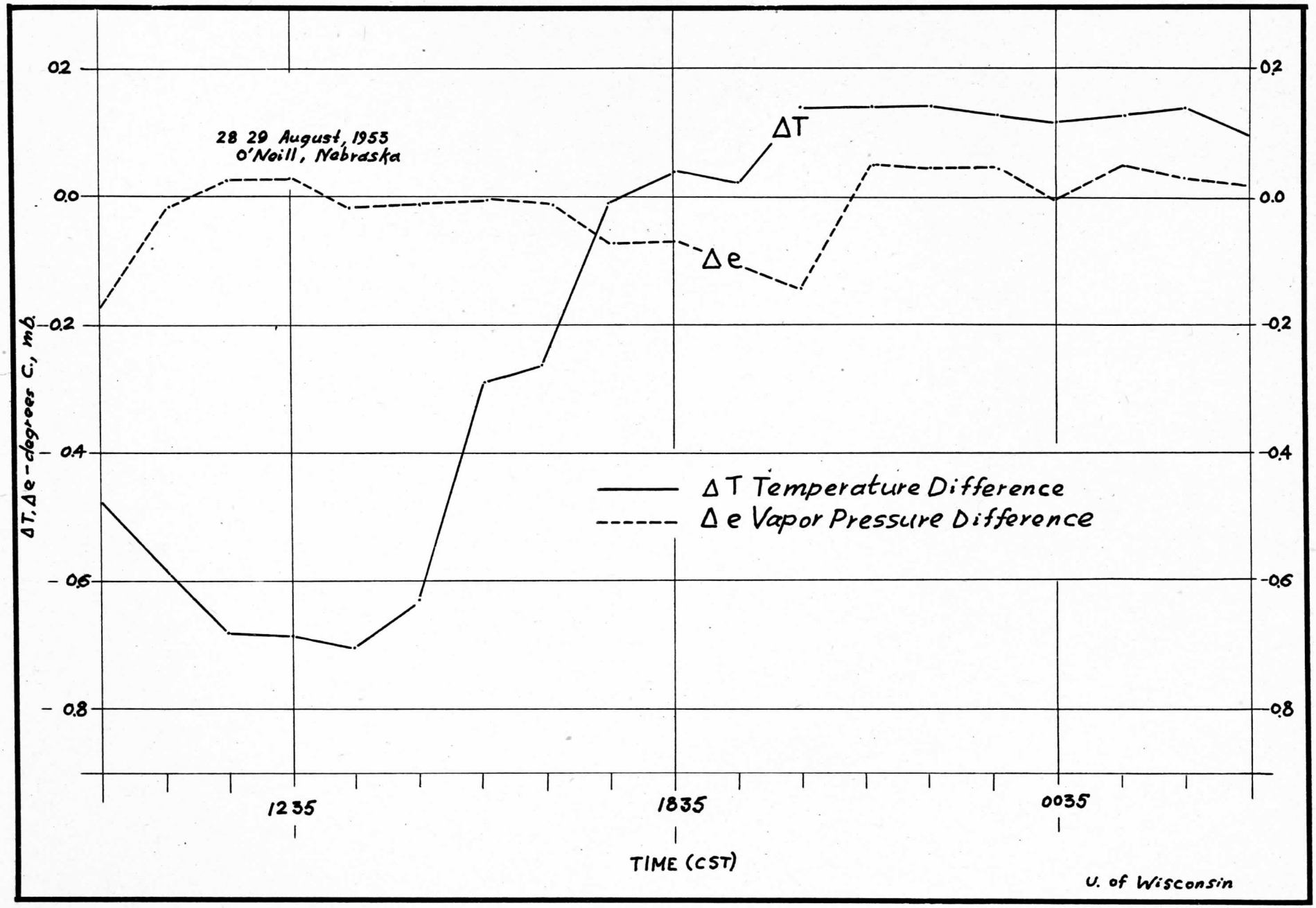

Rn
21-22 August, 1953
O'Neill, Nebraska
Rn = C+L+E
L
E
C
Net Radiation : Rn
Ground Conduction : C
Vertical Connection : L
Evaporation : E
0.8
0.6
0.4
0.2
0.0
-02
Cal/Cm²/min.
1235
1835
0035
TIME (CST)
U. of Wisconsin

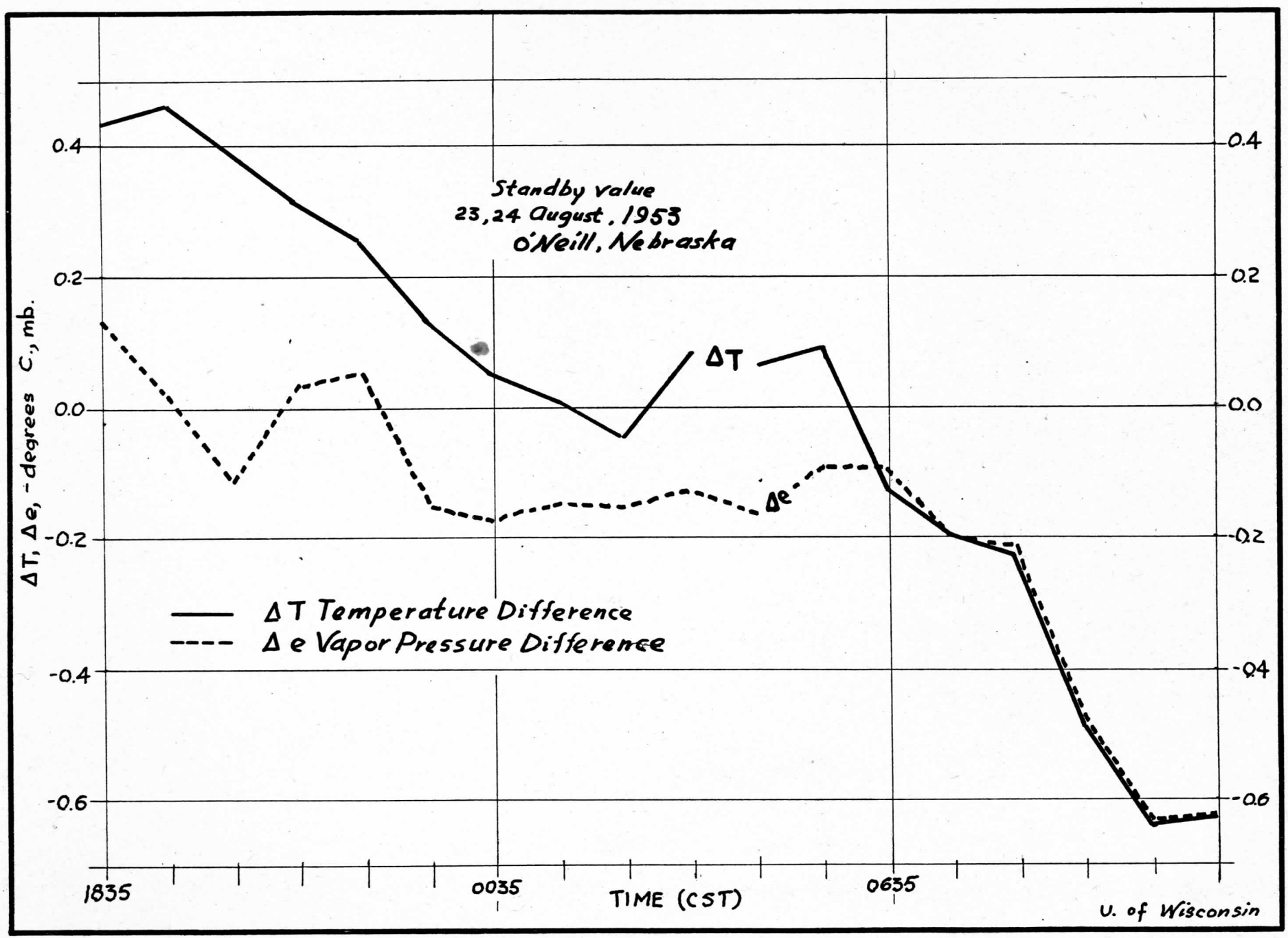

23, 24 August, 1953
O'Neill, Nebraska
0.6
0.4
0.2
0.0
-0.2
Cal/cm²/min
Net Radiation : Rn
Ground Conduction : C
Vertical Convection : L
Evaporation : E
Rn = C + L + E
L
Rn
E
C
1835
0035
0635
TIME (CST)
U. of Wisconsin

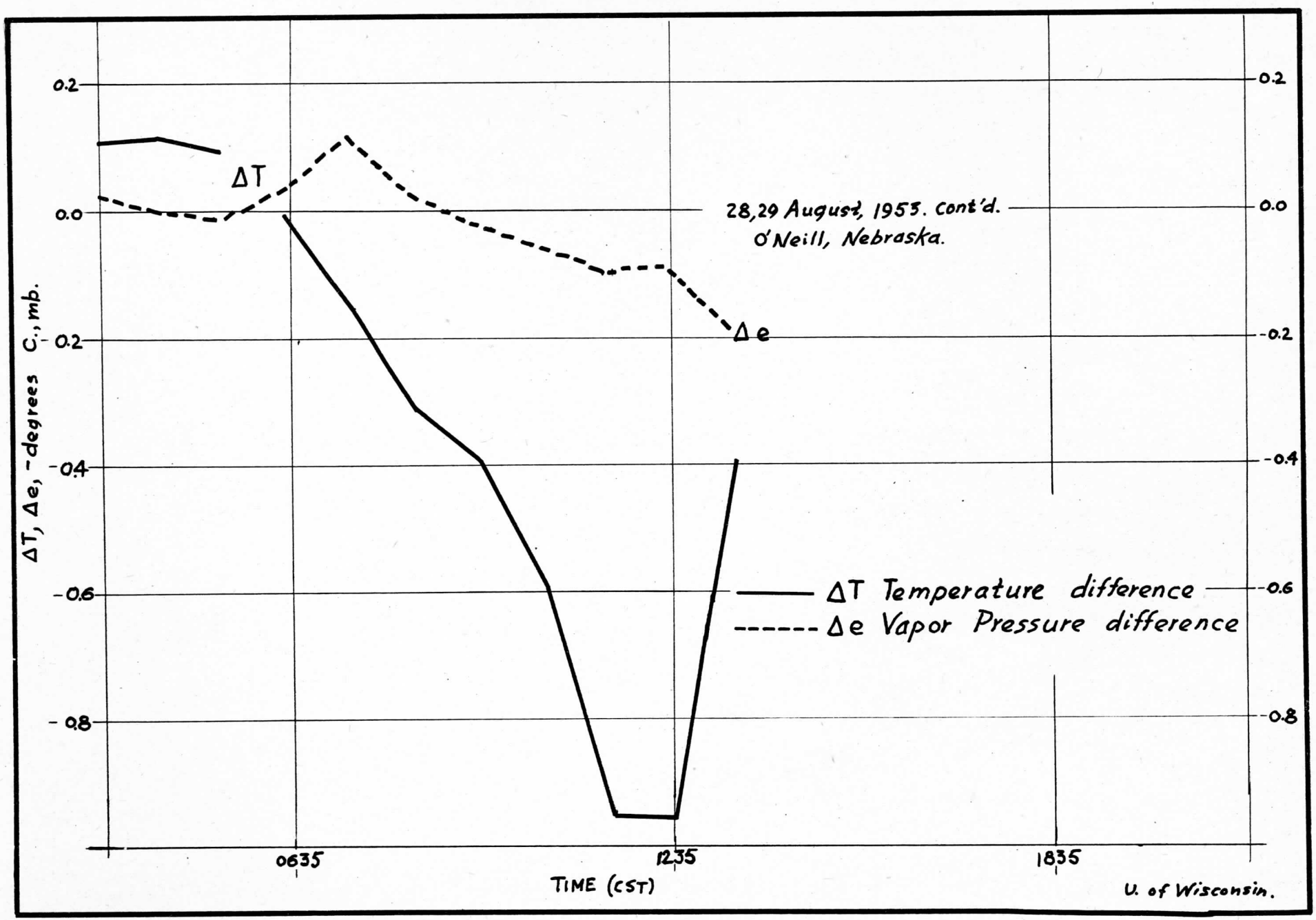

3, 4 Sept., 1953
O'Neill, Nebraska.
Rn
Rn = C+L+E
E
L
C
Net Radiation : Rn
Ground Conduction : C
Vertical Convection : L
Evaporation : E
Cal/cm²/min.
0.8
0.6
0.4
0.2
0.0
-0.2
-0.4
0035
0635
1235
TIME (CST)
U. of Wisconsin

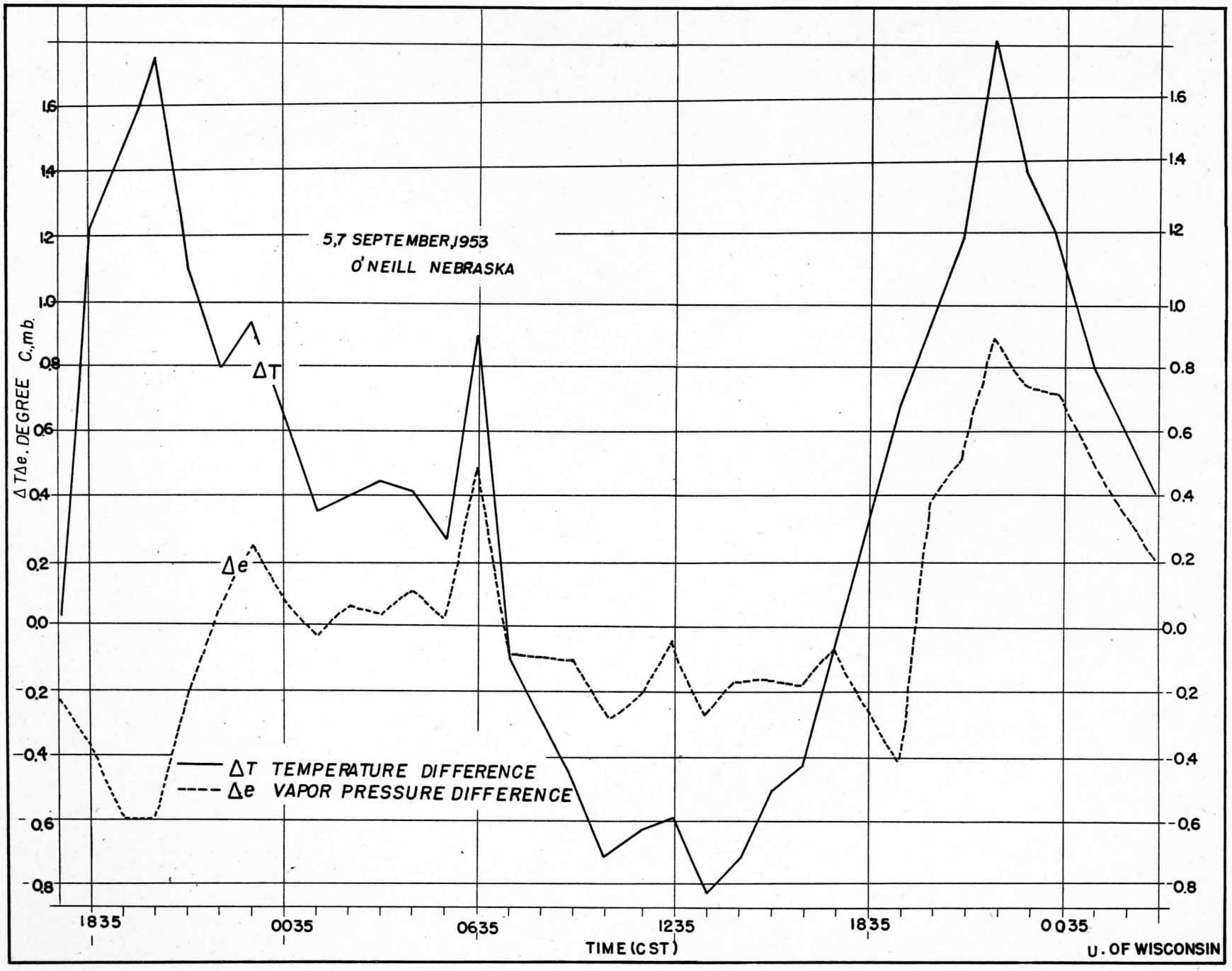

0.8
0.6
0.4
0.2
0.0
Cal/Cm²/min
5,7 Sept., 1953
O'Neill, Nebraska.
Rn = C+L+E
Net Radiation : Rn
Ground Conduction : C
Vertical Convection : L
Evaporation : E
Rn
L
E
C
1835
0035
0635
TIME (CST)
U. of Wisconsin


5, 7 September, 1953. Cont'd.
O'Neill, Nebraska.
Rn = C + L + E
Net Radiation : Rn
Ground Conduction : C
Vertical Convection : L
Evaporation : E
Rn
E
C
L
0.8
0.6
0.4
0.2
0.0
Cal./Cm²/min.
1235
1835
0035
TIME (CST)
U. of Wisconsin.


28 29 August, 1953
O'Neill, Nebraska
ΔT
Δe
ΔT Temperature Difference
Δe Vapor Pressure Difference
ΔT, Δe - degrees C., mb.
0.2
0.0
-0.2
-0.4
-0.6
-0.8
1235
1835
0035
TIME (CST)
U. of Wisconsin


Standby value
23,24 August, 1953
O'Neill, Nebraska
ΔT
Δe
ΔT Temperature Difference
Δ e Vapor Pressure Difference
ΔT, Δe, - degrees C., mb.
0.4
0.2
0.0
-0.2
-0.4
-0.6
1835
0035
0635
TIME (CST)
U. of Wisconsin


28,29 August, 1953. cont'd.
O'Neill, Nebraska.
ΔT
Δe
ΔT Temperature difference
Δe Vapor Pressure difference
ΔT, Δe, -degrees C., mb.
0.2
0.0
-0.2
-0.4
-0.6
-0.8
0635
1235
1835
TIME (CST)
U. of Wisconsin.


5,7 SEPTEMBER, 1953
O'NEILL NEBRASKA
ΔT
Δe
ΔT TEMPERATURE DIFFERENCE
Δe VAPOR PRESSURE DIFFERENCE
ΔT Δe, DEGREE C., mb.
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
-0.2
-0.4
-0.6
-0.8
1835
0035
0635
1235
1835
0035
TIME (CST)
U. OF WISCONSIN