at the distance 0.707 radius from the surface becomes 8264°, and at this rate, an increase of 612° in 0.293 radius, the total increase from the surface to the center is 2089°, making the central temperature 9741°. This gives an average gradient of —0.0030072° per 1000 meters from the center to the surface. We find, also, the gradient from the photosphere to the top of the inner corona to be —0.012563° per 1000 meters. The gradient of the temperature is about four times as great in the atmosphere of the sun as inside the photosphere. The cooling is, therefore, more rapid outside than it is inside the photosphere.

The mass of sun, the weight of 1 gram on the surface of the sun, and the transformation factor.

The mass of the sun is 2.0091×10^{33} by Nipher's formula, agreeing closely with that adopted from Newcomb, 2.0132×10^{33}, the former being computed through the product RT, and thus checking all the quantities. The weight of 1 gram at the surface of the sun is 27428 by Nipher's formula, through the product RT, and this agrees with the simple product $g = 980.6 \times 28.028 = 27484$, thus checking again. The transition factor from a perfect gaseous system to that actually existing at the surface, where the density is 0.37255, is found as indicated. We find the pressure corresponding to 0.37255 instead of that for which the computation was made in a hydrogen atmosphere of density 0.000089996, and obtain $P_2 = 7.0065 \times 10^{10}$ through Nipher's formula, as if the atmosphere were of the greater density. For the actual hydrogen atmosphere we computed (Table 13) $P_1 = 7.95967 \times 10^{8}$. Hence, $P_2 = 88.025\ P_1$, so that 88.025 is the required factor. Similarly, the gas constant from Nipher's formula is $R_2 = 1.0175 \times 10^{11}$. It was computed for the actual hydrogen atmosphere (Table 13) to be $R_1 = 1.1559 \times 10^{9}$. Again, $R_2 = 88.025\ R_1$, so that there is mutual agreement. Some such factor as 88 is required to pass from the law for perfect gases, $P_1 v = R_1 T$, to that for solar liquids, $P_2 v = R_2 T$.

It will not be advantageous to speculate as to what this factor 88 signifies, but it is not so large as to be improbable in passing from a gaseous to a fluid state, as it may stand for the internal forces of viscosity or friction and molecular cohesion, and possibly for some unknown forces of electricity and magnetism.

Specific heats, energy of radiation, and contraction.

Carrying the values of the several quantities through the various formulæ we find that they conform to the prescribed conditions, as follows:

Specific heat of contraction	$-\left(\frac{dQ}{dT}\right)_n$	=	18138.8
Exponent and coefficient	n	=	1.1 closely.
Heat energy of radiation	Q	=	0.9192×10^{48}
Work energy of contraction	W	=	1.2225×10^{48}
Ratio $\frac{\text{heat radiated}}{\text{work of gravitation}}$	$= c = \frac{Q}{W}$	=	0.75 closely.
Ratio $\frac{\text{heat radiated}}{\text{excess}}$	$= \frac{Q}{W-Q}$	=	3.00 closely.
Ratio $\frac{\text{work of compression}}{\text{excess}}$	$= \frac{W}{W-Q}$	=	4.00 closely.
Specific heat at constant pressure	c_p	=	8414.8
Specific heat at constant volume	c_v	=	7977.2
$\kappa = \frac{c_p}{c_v}$ ratio of the specific heats at the temperature 7652°		=	1.0548

We note that this ratio $\kappa = \frac{c_p}{c_v} = 1.4065$ in terrestrial conditions; in solar conditions inside the photosphere $\kappa = 1.0548$; and in the hydrogen envelope $\kappa = 1.000052$ according to the preceding discussion.

Surveying this set of interrelated thermodynamic values, and especially in view of the fact that they seem to conform so well with the known astrophysical conditions derived from observation, and with the astronomical data obtained by the general laws of motion, we conclude that they afford ground for further research. If they form the approximate basis for a sound solar physics they will become important in further meteorological studies.

THE TEMPERATURE ELEMENT OF THE CLIMATE OF BINGHAMTON, N. Y.

By W. E. DONALDSON, Observer, Weather Bureau.

[Condensed from a paper read before the Binghamton Academy of Science on March 1, 1904.

The climate of Binghamton is continental; the climate of Iceland is oceanic; the climate of Omaha, Nebr., is continental. As a result the January climate of the coast of Iceland is 11° warmer than the January climate of Omaha, and 7° warmer than the January climate of Binghamton. The July climate of the coast of Iceland is 26° cooler than the July climate of Omaha, and 21° cooler than the July climate of Binghamton. Thus the Binghamton climate occupies an intermediate position between the climate of Omaha and that of Iceland; though differing very slightly from the climate of Omaha, it differs decidedly from that of Iceland.

The normal mean temperature, by decades, has its minimum, 21°, in the first decade of February and its maximum, 72°, in the first decade of July.

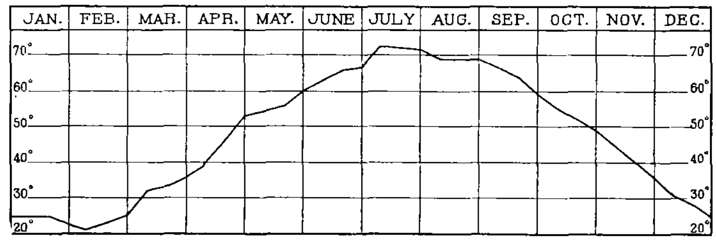

FIG. 1.—Normal annual temperature curve at Binghamton, N. Y., determined from seven years' record, October 1, 1896–September 30, 1903.

The change from winter to summer in this section is decidedly more rapid than the change from summer to winter. The normal annual temperature curve, fig. 1, is ascending 150 days and descending 215 days. This curve has a marked resemblance to the normal diurnal temperature curve in summer, fig. 2. The rapid rise from February 10 to July 10 resembles very closely the rapid rise from sunrise until about 2 p. m.; the slight change from July 10 to September 10 resembles the slight change from about 2 p. m. to 5 p. m.; the rapid fall from September 10 to December 31 resembles the rapid fall from about 5 p. m. to about 3 a. m., and the slight change from December 31 to February 10 resembles the slight change from about 3 a. m. to sunrise.

In the summer the diurnal temperature changes are in accordance with the diurnal variation in the intensity of insolation. The minimum temperature usually occurs at sunrise and the maximum about 3 p. m. The mean temperatures for individual summers closely approximate the normal for the summer. The regularity of the diurnal temperature curve day after day in summer and the close approximation of the mean temperatures of each summer to the normal summer temperature, result from the nonimportation of large masses of air from distant points.

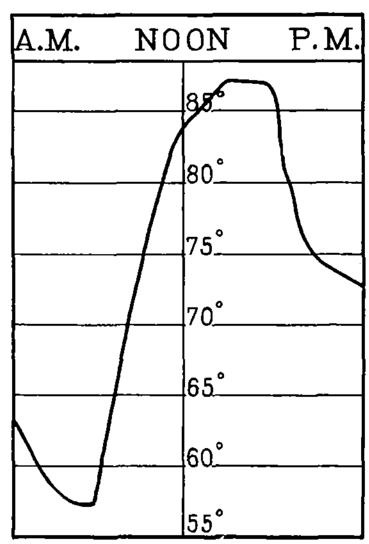

FIG. 2.—Summer type. Diurnal temperature curve on June 25, 1901.

In the winter the diurnal temperature curve, figs. 3, 4, and 5, frequently has no similarity to the diurnal variation in inso-

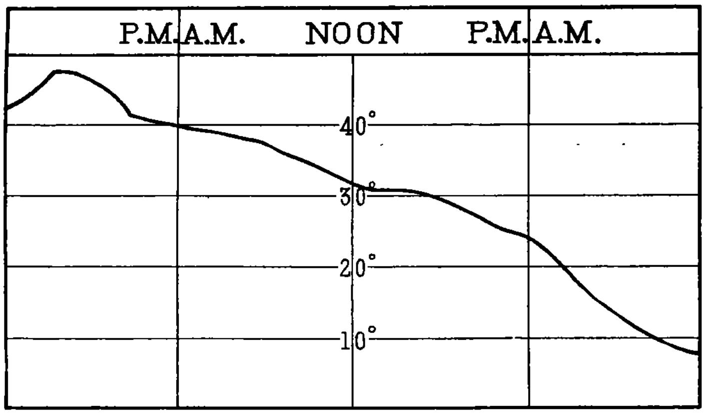

FIG. 3.—Winter type. Diurnal temperature curve; result of brisk northerly winds. Noon, January 16, to noon, January 18, 1901.

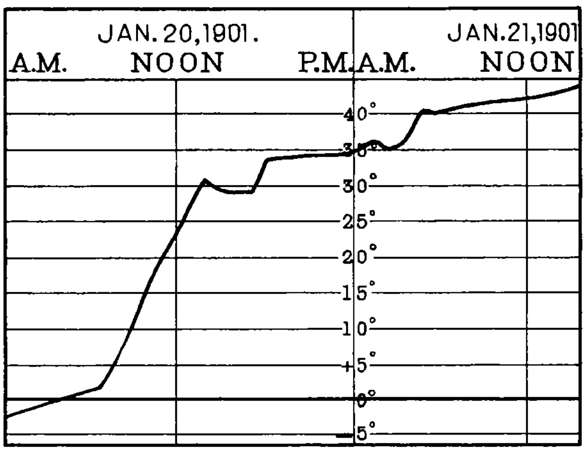

FIG. 4.—Winter type. Diurnal temperature curve; result of brisk southerly winds. January 20 and 21, 1901.

lation. The mean temperatures for individual winters depart decidedly from the normal winter temperature. The irregularity of the diurnal temperature curve in winter and the radical departure of the mean temperatures of individual winters from the normal winter temperature, result from the importation of large masses of air from far distant points.

In spring the temperature conditions recede from the winter types and gradually merge into the summer type. In autumn the temperature conditions recede from the summer type and gradually merge into the winter type.

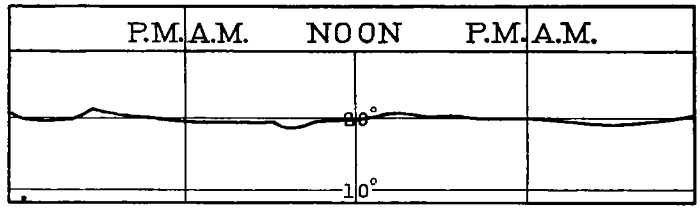

FIG. 5.—Winter type. Diurnal temperature curve; result of calm, cloudy weather. Noon, January 29, to noon, January 31, 1901.

SAMUEL M. BLANDFORD.

Section Director Samuel M. Blandford died February 9, 1904, at Boise, Idaho. Mr. Blandford was born June 15, 1866, in Prince George County, Md. His early education was obtained in the common schools and this was supplemented by the teaching of his father, Dr. J. H. Blandford. He enlisted in the meteorological service of the Army, October 15, 1887, and continued in that service until the organization of the Weather Bureau in 1891, when he was transferred to the civil establishment, in which he continued until his death. During his connection with the weather service Mr. Blandford served at various important stations, and by his integrity, fidelity, and ability won for himself the regard and commendation of those who knew him. His excellent work as an official was recognized by his assignment on September 19, 1898, to the charge of the important station at Boise.

NOTES AND EXTRACTS.

DESIRABILITY OF COMPLETE RAINFALL RECORDS.

The great importance of the study of rainfall and of the proper presentation of rainfall on our monthly and annual charts suggests that many will be pleased to examine the following table, which shows the number of regular and voluntary stations for which either complete or incomplete records were published in the respective monthly and annual section reports during the years 1901 and 1902. A complete record covers every day of the year, and is essential in making up normal values and departures from normals. Records of regu-

Total number of complete and incomplete records of precipitation at regular and voluntary stations of the Weather Bureau, as published in the monthly and annual section reports.

State or Territory.	Area in units of 1000 square miles.	Population per square mile.	Number of published records of precipitation.			
			1901.		1902.	
			Complete.	Incomplete.	Complete.	Incomplete.
Alabama	51.5	35.5	50	20	47	24
Arizona	112.9	1.1	44	20	40	21
Arkansas	53.0	24.7	46	17	42	24
California	155.7	9.5	176	25	185	15
Colorado	103.6	5.2	64	22	61	18
Connecticut	4.8	187.5	14	0	14	2
Delaware	2.0	94.3	3	2	4	0
District of Columbia	....	....	1	0	3	0
Florida	54.2	9.7	63	9	50	22
Georgia	59.0	37.6	66	28	57	39
Idaho	84.3	1.9	25	17	26	18
Illinois	56.0	86.1	84	3	79	24
Indiana	35.9	70.1	46	15	46	15
Indian Territory	31.0	12.6	*	*	*	*
Iowa	55.5	40.2	103	17	99	26
Kansas	81.7	18.0	65	19	66	28
Kentucky	40.0	53.7	41	12	38	22
Louisiana	45.4	30.4	43	14	33	19

Total number of complete and incomplete records, etc.—Continued.

State or Territory.	Area in units of 1000 square miles.	Population per square mile.	Number of published records of precipitation.			
			1901.		1902.	
			Complete.	Incomplete.	Complete.	Incomplete.
Maine	29.9	23.2	17	0	14	7
Maryland	10.0	120.5	37	20	36	13
Massachusetts	8.0	348.9	22	0	21	3
Michigan	57.4	42.2	106	21	109	23
Minnesota	79.2	22.1	54	17	55	13
Mississippi	46.3	33.5	36	19	43	14
Missouri	68.7	45.2	77	13	76	14
Montana	145.3	1.7	31	28	26	30
Nebraska	76.8	13.9	80	11	108	36
Nevada	109.7	0.4	35	4	17	27
New Hampshire	9.0	45.7	16	0	15	1
New Jersey	7.5	250.3	45	10	50	9
New Mexico	122.5	1.6	26	23	23	21
New York	47.6	152.6	75	22	93	15
North Carolina	48.6	39.0	49	13	49	16
North Dakota	70.2	4.5	43	4	26	12
Ohio	40.8	102.0	78	7	93	40
Oklahoma	38.8	10.3	....	....	....	....
Oklahoma and Indian Territory	69.8	11.4	34	22	31	34
Oregon	94.6	4.4	63	31	64	23
Pennsylvania	45.0	140.1	69	23	69	18
Rhode Island	1.1	407.0	6	0	6	0
South Carolina	30.1	44.4	48	9	50	11
South Dakota	76.8	5.2	46	19	45	23
Tennessee	41.8	48.4	52	20	49	29
Texas	262.3	11.6	68	25	85	15
Utah	82.2	3.4	41	23	41	27
Vermont	9.1	37.6	13	1	12	2
Virginia	40.1	46.2	32	14	28	27
Washington	66.9	7.7	48	26	52	22
West Virginia	24.6	38.9	45	10	43	15
Wisconsin	54.4	38.0	41	28	49	17
Wyoming	97.6	0.9	28	20	31	17
Total	....	....	2,398	726	2,499	873

*See Oklahoma.