TABLE 2.—*Rainfall departures at Denver, Colo.*

Year.	January.	February.	March.	April.	May.	June.
	Inches.	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*
1872	0.01	-0.31	-0.02	0.19	0.98	0.71
1873	-0.41	-0.29	-0.71	0.53	-2.01	0.88
1874	0.80	0.00	-0.44	-0.20	-0.33	-0.15
1875	-0.16	0.07	-0.54	0.34	-0.82	-0.93
1876	-0.33	-0.42	0.87	-0.68	5.81	-0.26
1877	1.36	-0.13	0.47	0.87	-0.46	0.57
1878	-0.44	-0.05	0.89	-1.85	0.14	1.42
1879	-0.14	-0.14	0.07	0.72	0.60	-1.04
1880	-0.16	-0.21	-0.72	-1.59	-1.65	-0.14
1881	-0.04	0.69	-0.06	-1.40	-0.55	-1.27
1882	0.03	-0.83	-0.73	-0.43	0.22	3.60
1883	1.81	-0.08	-0.72	1.20	1.54	-0.51
1884	-0.82	0.33	0.00	1.43	1.85	0.11
1885	-0.13	0.22	0.04	3.04	-0.63	-0.70
1886	0.08	0.19	1.43	0.89	-2.67	0.90
1887	0.13	-0.23	-0.70	0.26	-1.63	-0.83
1888	-0.43	-0.16	0.22	-0.19	-0.10	-1.07
1889	-0.04	0.17	-0.53	-0.56	0.68	0.52
1890	-0.36	-0.07	-0.58	0.60	-0.75	-1.36
1891	1.06	-0.26	2.17	0.59	1.39	1.57
1892	-0.14	0.22	0.27	-0.15	-0.62	-0.03
1893	-0.49	0.30	-0.70	-1.03	0.33	-1.23
1894	-0.36	0.37	-0.23	1.40	0.24	-0.97
1895	-0.22	-0.05	0.26	-0.71	0.10	1.29
1896	-0.29	-0.29	0.50	-0.97	-1.49	-0.47
1897	0.04	0.29	-0.03	-0.59	0.39	0.80
1898	-0.34	0.15	-0.65	-0.70	2.12	-0.42
1899	0.11	0.05	0.17	-1.15	-2.61	-0.89
Normal	0.54	0.53	0.93	1.90	2.76	1.36

Year.	July.	August.	September.	October.	November.	December.	Annual.
	Inches.	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*
1872	0.96	0.29	0.81	-0.26	0.11	-0.37	3.10
1873	0.27	-0.05	0.13	-0.21	-0.42	-0.05	-2.34
1874	1.62	-0.78	0.58	-0.30	-0.50	-0.49	-0.69
1875	2.44	0.51	2.13	-0.72	0.70	-0.07	2.95
1876	-0.57	0.57	-0.16	-0.82	0.92	1.04	5.97
1877	-1.40	-0.16	-0.38	1.21	0.15	0.11	2.21
1878	-0.40	0.79	0.47	-0.14	0.09	0.39	1.31
1879	-1.09	-0.08	-0.74	-0.75	-0.37	-0.33	-3.29
1880	-0.35	0.00	0.13	0.43	0.25	-0.56	-4.57
1881	0.77	0.87	-0.19	-0.62	1.10	-0.66	-1.36
1882	-1.07	-0.26	-0.70	-0.19	0.13	0.07	0.34
1883	0.54	-0.71	0.32	0.55	-0.26	1.66	5.34
1884	-1.08	0.25	-0.63	-0.73	-0.39	0.10	0.92
1885	-0.40	-0.28	0.46	-0.21	-0.03	0.42	1.80
1886	-1.23	0.16	0.22	-0.61	1.35	0.21	0.92
1887	0.76	1.22	0.21	0.03	-0.36	-0.52	-1.66
1888	-1.32	0.05	-0.65	-0.17	-0.25	-0.57	-4.64
1889	1.21	-1.18	-0.48	1.17	-0.05	-0.36	0.60
1890	-0.94	0.43	-0.59	-0.30	-0.28	-0.62	-4.82
1891	-1.14	1.38	-0.03	-0.46	0.11	0.90	7.28
1892	-0.54	-0.88	-0.76	2.98	-0.14	0.66	0.87
1893	-0.59	-1.11	-0.71	-0.10	-0.03	-0.31	-5.67
1894	0.38	0.40	0.79	-0.75	-0.36	0.03	0.94
1895	2.55	-0.70	0.22	0.13	-0.31	-0.65	1.97
1896	1.07	-0.49	1.05	-0.10	-0.48	-0.35	-2.31
1897	0.33	-0.02	-0.32	0.70	-0.34	-0.03	1.22
1898	-1.06	-0.50	-0.48	0.11	0.27	0.33	-1.17
1899	0.19	0.32	-0.56	0.07	-0.58	0.06	-4.82
Normal	1.73	1.46	0.76	0.94	0.58	0.66	14.15

In general, it is evident that the study of statistics for a single station is wholly inadequate to the prediction of seasonal conditions. We not only need observations over a broad area, such as the whole of the Northern Hemisphere, but also a correct view of the mechanics of the earth's atmosphere in order to guide our study.

THE THUNDERSTORM OF MAY 16 IN IDAHO.

In connection with the thunderstorm on the above date at Boise, the barogram and thermogram at that station showed remarkable changes. The temperature fell about 25° in two hours and a half, while the pressure rose 0.30 inch in the same interval of time. It bespeaks a commendable enterprise and appreciation of the meteorological interests involved when an observer and section director combine to publish the special diagrams in the monthly section reports It would, however, be worth while to always reproduce the two curves on the same plate or block, so as to facilitate a more minute comparison between the simultaneous temperatures and pressures.

As to the reason why such corresponding changes of temperature and pressure occur in a thunderstorm it is worth noting that at least two different causes are operative. In the first place, a thunderstorm generally occurs when a wind from an area of cool, dry air underruns or pushes aside an area of warm, moist southerly winds. The very fact that the former pushes the latter aside shows that presumably a greater pressure exists within it and that, therefore, the barometer must rise when this area has established itself. In the second place, a thunderstorm is essentially due to a simple vertical interchange of warm air below and cool air overhead. The two layers of air are in unstable equilibrium and exchange places. The upper air (A) is drawn down by the force of gravity (g) prevailing at that altitude more powerfully than is the lower air (a) acted upon by its force of gravity (G). Before the overturning the joint pressure due to the weight of the atmosphere may be represented by $a\ G + A\ g$, but after the overturning the weight of the column is $A\ G + a\ g$, and the latter is greater than the former. This necessity of taking into consideration the varying products of the density by the gravity has been particularly felt of late years in the efforts that have been made to reduce barometric pressures upward or downward to other levels, and especially in the computations of the altitudes of the sounding balloons that have been used to explore the upper atmosphere. Practical formulæ for the computation of barometric pressures for each separate strata of air have been developed by Rykatcheff and by Hergesell, but most elaborately by Angot in a recent volume of the memoirs of the Central Meteorological Bureau of France.

THE HAWAIIAN STANDARD OF TIME.

In the notes accompanying the observations at Honolulu, on pages Nos. 508, 545, 8, 65, and 150 of the MONTHLY WEATHER REVIEWS for November and December, 1899, and January, February, and April, 1900, respectively, for "temperatures observed at 7:29 p. m., Greenwich time," read "4.31 p. m., Greenwich time, which is simultaneous with 6 a. m. of the local standard."

Similarly, for "the rainfall has been measured at 10:29 p. m., Greenwich time," read "7:31 p. m., which is simultaneous with 9 a. m. local standard."

Mr. Lyons says:

> The rainfall began to be reported at 9 a. m., local, instead of 6 a. m., local, a year or two since, partly on account of my health and partly for the report made daily to the local newspapers.

Mr. Lyons writes that:

> The Hawaiian standard time is that of the meridian of 157° 30′ W., or 10*h.* 30*m.* slow of Greenwich time, being central to the group and better for our purpose than an even hour division, and is so near the local time of Honolulu that for meteorological purposes the difference is not worth noticing.

HEAVY RAINFALL IN LOCAL STORMS.

We are sometimes asked where all the rain comes from that falls during a short time in a thunderstorm or cloudburst. Three inches of rain in an hour makes a very heavy local rain. Rainfalls from 3 inches in half an hour, up to 12 or 15 inches in an hour are spoken of as cloudbursts. The heaviest rains are those recorded at Cherrapunji, amounting to 30 or 40 inches in a day. It is very rare that rain falls from absolutely still air; in general, there is a horizontal movement which we detect by the motions of the clouds, and an ascending movement which is easily seen if we study the phenomena going on within the clouds. This ascending movement is very violent in thunderstorms and tornadoes; is always present in waterspouts, and in the general heavy rains attending areas of low pressure. In studying the thunderheads or great cumulus clouds of a thunderstorm we see a rapid ascension going on at the top of the cloud nearly over the region where hail and the heaviest rain occurs. Evidently the quantity of rain that falls upon any given area represents, not merely the vapor precipitated from the air over that area at any moment, but from the successive masses of air that flow over it during any given time. Thus at Cherrapunji, India, the heavy rains drop from a rapidly-moving southwest monsoon current flowing over the Khasia Hills. It is not improper to assume that the heavy rainfalls that we call local rains, are also due to the supply of moisture brought by rapid currents flowing over any given spot. Thus, in the hailstorm, and in the center of a large cumulus cloud the currents of air ascend rapidly, while in the general widely extended rains they ascend slowly. One can easily calculate the total depth of rainfall in the column of air extending from the ground to the upper limit of the atmosphere, with results as shown in the accompanying table, prepared in 1883, but published in the Smithsonian Report for 1888, page 410. These figures apply only to still air, and are to be modified to an indefinite extent if horizontal or vertical movements are taking place.

Height of column.	Depth of water in the atmosphere corresponding to the respective dew points at the earth's surface.			
	80°	70°	60°	50°
Feet.	*Inches.*	*Inches.*	*Inches.*	*Inches.*
6,000	1.3	1.0	0.7	0.5
12,000	2.1	1.5	1.1	0.3
18,000	2.5	1.8	1.3	0.9
24,000	2.7	2.0	1.4	1.0
30,000	2.8	2.1	1.5	1.1

THE JUNE RISE OF THE MISSOURI AND MISSISSIPPI RIVERS.

For many years it was a popular saying that the rising waters of the Missouri and Mississippi rivers during June are due to the melting snows in the Rocky Mountain region, but the regular reports and predictions of the river conditions that have been published by the Signal Service and Weather Bureau since 1872 have long since banished this error from the minds of those familiar with the weather map. Even before regular river work began, in January 1872, the present Editor, who did the "probabilities" or indications during the preceding year, frequently had occasion to point out the fact that the rains which occurred everywhere in the watershed of the Upper Mississippi and Lower Missouri rivers contributed far more to the June rise than any possible melting of snows in the mountains. The latter serves mostly to supply water for irrigation along the beds of the smaller tributaries of the eastern Rocky Mountain slope, whereas the floods of the Lower Missouri and Mississippi rivers depend almost wholly on the rain that falls on that portion of the watershed that is below the 2,000-foot contour line.

A METEOROLOGICAL LIBRARY.

The Editor takes pleasure in calling the attention of regular and voluntary observers to the fact that the extensive collection of text-books, periodicals, and treatises on meteorology belonging to the late Prof. H. A. Hazen, is now in the hands of his sister, Miss Mary S. Hazen, 1234 Tenth street, N.W., Washington, D. C., and those who desire to obtain any of them should correspond with her. It is very much to be hoped that some college or experiment station will obtain the whole of this collection. It is very difficult to complete broken files of rare works on meteorology, and the importance of a special library is always felt during the prosecution of any scientific investigation.

The development of agricultural libraries is admirably sketched in an article by Mr. Charles H. Greathouse, in the Yearbook of the Department of Agriculture for 1899, and his opening paragraph should be the motto of librarians in every department of science:

> To furnish the right book to the right man at the right time is a problem that faces every student of agricultural affairs who would help men to better ways of farming.

A well arranged library with a good index catalogue is not only a help but an incentive to study. The progress of meteorology is impeded by the absence of a comprehensive bibliography or subject index. Many a student wastes his time solving problems that have long since been solved by others and overlooks the questions that still demand investigation. A complete index to the literature of meteorology would remedy all this.

MONUMENT TO CANTONI.

The faculty of sciences of the University of Pavia, Italy, has taken the initiative in a subscription toward the erection of a memorial monument in the University Building, in honor of Signor Professor Giovanni Cantoni. The great work that Cantoni has done in Italy for meteorology and climatology considered as branches of exact physical science insure that the subscription lists will include the names of many meteorologists.

LECTURES ON METEOROLOGY.

On May 9 the Editor had occasion to lecture before one of the private schools of Washington, D. C., and took for his theme "The clouds." No more interesting topic could be suggested, and perhaps the following synopsis may be useful to other members of the service who may have occasion to lecture on this subject.

The clouds may be studied from various points of view, artistic, poetic, or scientific. In the latter study we must begin by giving them names so as to make sure of a definite record that can be understood by others. We naturally inquire, first of all, as to their general appearances, colors, shapes, and movements. Then we find methods of measuring their altitude and absolute velocity in miles per hour. We soon observe that the upper layers of clouds move in a different direction from those of the lower layers or the lowest wind. A short study brings out the fact that internal changes of structure are going on. Then we perceive that some kinds of clouds precede fair weather, others precede rain, or snow, or wind. We notice that some kinds diminish and disappear toward sunset, others begin to appear at that time. Some kinds of distant cloud banks indicate the approach of thunderstorms, others snowstorms, and still others belong to distant hurricanes. The colors of the clouds especially at sunset are the most gorgous displays ever witnessed by man. These colors may be caused either by absorption, dispersion, or diffraction of the sunlight, and their study offers many important problems in physical optics. Generally speaking the highest clouds are white while the lower clouds begin to be colored, but as the sun descends lower and lower the highest clouds become colored. Sometimes when minute particles of moist-