

nearer than 10 parsecs ultimately become known, the velocities will follow a distribution similar to the one found here.

The evidence from nearby stars, therefore, favors distinctly the assumption that the distribution of the stellar velocities can be represented by a single logarithmic error curve instead of by a combination of two Maxwellian curves or two logarithmic error curves.

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### THE SOLAR PRELUDE OF AN UNUSUAL WINTER

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Does the sun's variation influence the weather? If so, the year 1922 and following months ought to show it.

Referring to the accompanying illustrations, the lower curves give, respectively, the monthly mean "solar constant" values determined by my colleagues and myself at the two Smithsonian Institution observing stations Mount Harqua Hala, Arizona, and Mount Montezuma, Chile, and also the general mean of both stations. These observations cover all months from October, 1920, to September, 1922. The extraordinary drop of solar values during 1922 at once strikes the eye. It is confirmed at both stations.

At the top of the figure we give the mean monthly values for the past four years as determined at Calama, alone, to July, 1920, and thereafter at Montezuma and Harqua Hala. The reader will note prevalingly high solar constant values until 1922, usually exceeding the normal solar constant value of about 1.94 calories, as we have determined it. The curve shows that nothing so outstanding as the change of 1922 to low values has occurred in all that interval. Indeed, nothing so marked has occurred since we began these observations in 1905, so far as our Mount Wilson work can show. That work, however, was fragmentary.

Low solar radiation values continued to prevail in later months of 1922 and early months of 1923, as results yet unpublished will show. A full account of the individual values here summarized may be found in Volume IV of the Annals of the Astrophysical Observatory of the Smithsonian Institution, supplemented by a forthcoming detailed publication to appear as a Supplement of the U. S. Weather Bureau's "Monthly Weather Review." We give the monthly mean values in the accompanying table.

All this being so, has anything unusual occurred in weather conditions which may have been connected with solar changes? We are not to look for anything so simple as a general drop of temperatures all over the world.

Oceans, deserts, mountains, clouds and winds make up too complex a system for such simple reactions. Pronounced departures of some sort from normal conditions, however, we might expect.

It will be recalled that the prevailing characteristic of the weather of the United States for the last couple of years or more is a condition generally

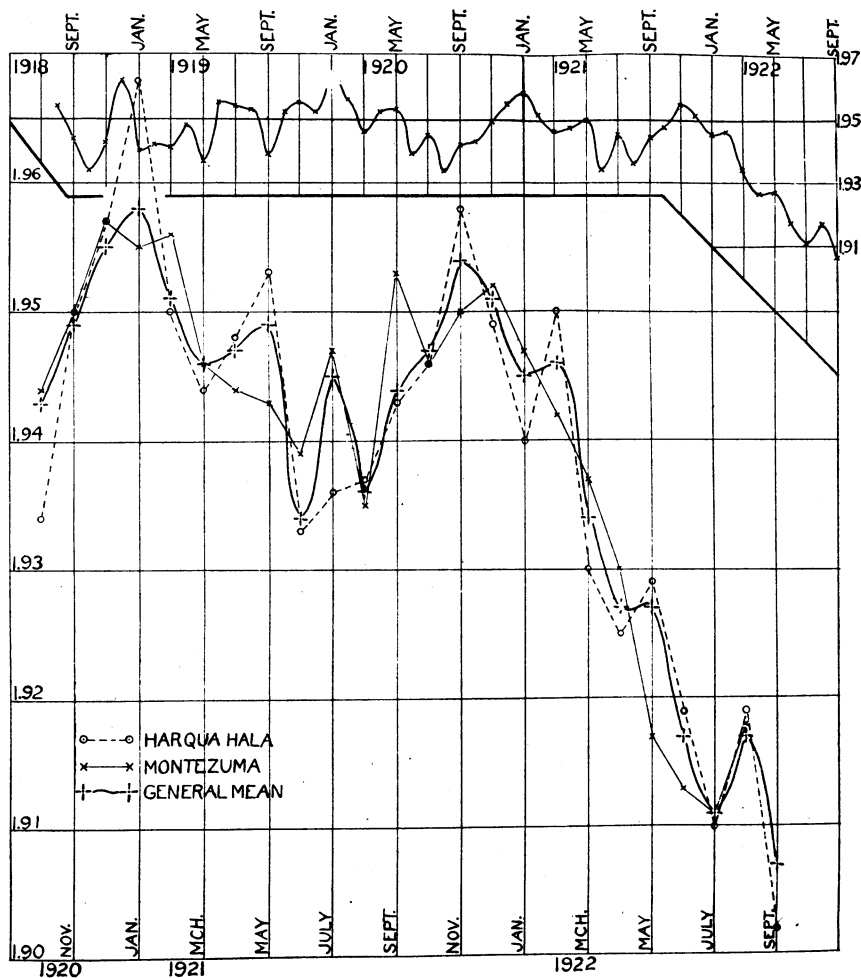


FIGURE 1  
Monthly mean values compared

warmer than normal. Thus, from the summary for 1921, U. S. Weather Bureau, Climatological Data, "The outstanding feature of the year was the unusually warm weather in nearly every month. The annual mean temperature was 66.3°, or 2.7° above the normal, making it the warmest

TABLE—MONTHLY MEAN VALUES COMPARED  
 (“Unsatisfactory” values omitted, “Unsatisfactory plus” retained)

Month.....	1920											
	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
No. Harqua Hala.....	11	10	3	9	17	9	15	13	20	5	12	25
No. Montezuma.....	20	25	21	9	7	13	16	12	17	17	1	5
No. in mean.....	25	25	22	14	20	18	26	22	23	21	11	27
Mean, Harqua Hala..	1.934	1.950	1.957	1.968	1.950	1.944	1.948	1.953	1.983	1.936	1.937	1.943
Mean, Montezuma...	1.944	1.950	1.957	1.955	1.956	1.946	1.944	1.943	1.939	1.947	1.935	1.953
Harqua Hala—Montezuma.....	-0.010	0.000	0.000	0.013	-0.006	-0.002	0.004	0.010	-0.006	-0.011	0.002	-0.010
General mean.....	1.943	1.949	1.955	1.958	1.951	1.946	1.947	1.949	1.934	1.945	1.936	1.944
Month.....	1921											
	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept. <sup>1</sup>
No. Harqua Hala.....	19	17	10	13	8	12	17	20	23	18	9	13
No. Montezuma.....	11	14	12	18	9	11	11	5	10	8	10	2
No. in mean.....	23	24	15	21	16	20	24	24	24	19	15	13
Mean, Harqua Hala..	1.946	1.958	1.949	1.940	1.950	1.930	1.925	1.929	1.919	1.910	1.919	1.902
Mean, Montezuma...	1.946	1.950	1.952	1.947	1.942	1.937	1.930	1.917	1.913	1.911	1.918	1.930
Harqua Hala—Montezuma.....	0.000	0.008	-0.003	-0.007	0.008	-0.007	-0.005	0.012	0.006	-0.001	0.001	-0.028
General mean.....	1.947	1.954	1.951	1.945	1.946	1.934	1.927	1.927	1.917	1.911	1.917	1.907

Average monthly deviation (Harqua Hala-Montezuma) without regard to sign, 0.0057, or 0.3 per cent. Range of solar variation in monthly means, 2.5 per cent.

General means (Montezuma alone) { August, 1920 Number, 27 Value, 1.930  
 { September, 1920 Number, 25 Value, 1.942

<sup>1</sup> This month is incomplete. A change in apparatus was made at Harqua Hala after September 20, so that the table closes with that day. Only two satisfactory observations being reported from Montezuma, and these quite out of the general trend, the large difference between the stations should be discounted.

year since the beginning of State-wide records." The monthly reports for 1922, while less pronounced in this sense, indicate warmer than normal conditions on the whole. We start, then, with an excess of heat.

Quoting, now, from Climatological Data: "The record of December, 1922, shows unusual contrasts as to the temperature and precipitation in different parts of the country. In the Southeast it was the warmest or almost the warmest December for 30 years or more, while in the far Northwest it was the coldest December in a like period. The precipitation over Tennessee, Mississippi, and considerable parts of the states adjoining was about as great as ever yet recorded there in December, while an area centering in Kansas had no precipitation, or practically none."

Prof. P. C. Day has kindly sent me in advance of publication summary statements for January and February, 1923, as follows:

"Like the preceding December, January, 1923, was notable for the disturbed atmospheric conditions. Cyclones and anticyclones, mostly well to the northward of their usual tracks, moved in rapid succession across the country. . . . The absence of important anticyclones that usually move into the United States during winter from the far Canadian Northwest was one of the marked features controlling the weather of the month, and the chief factor leading to its moderate character over much of the country. As a result . . . the average sea-level pressure was far below normal over the greater part of the country, and notably so in the far Northwest.

"The outstanding feature of the weather . . . was the almost continuously high temperature . . . over much of the country. At the same time, however, severe winter weather was the rule over New England and much of New York.

"Precipitation occurred with unusual frequency . . . in northern districts west of the Continental Divide and from the Upper Lakes eastward. . . . The snowfall . . . was about average in most higher districts of the far West, save to east and south of the Colorado river, and was heavy in the northern portions of the Lakes region, and especially in the Northeast . . . The average for all the New England States was the greatest in the 35-year period of comparative records.

"The disturbed atmospheric conditions, so persistent during the first two months of the present winter, continued into February . . . The pressure distribution for the month as a whole showed marked variations from the conditions usually expected in February. In the Canadian Northwest Provinces and the adjoining portions of the United States, the averages for the month were far above normal, in fact all sections of the United States and Canada, as far as reports disclose, had averages above normal, a condition rarely experienced.

“The unseasonable warmth which had continued during most of the two preceding months of the winter save over the Northeastern States, terminated with the first few days of February, and the remainder of the month was distinctly cold. . . . The month as a whole was colder than normal in nearly all parts of the country. . . . The month’s precipitation was less than normal over much more than half of the country.”

— While it is far too early in the study of the relations of solar radiation and weather to state that the extraordinary solar change caused the unusual winter weather, it does no harm to draw attention to both, in the hope of attracting investigation.

— A few remarks on the degree of accordance of our results on the measurement of solar radiation will be of interest.

A comparison has been made between the individual daily values at the two stations. After making a systematic horizontal increase of all Harqua Hala values of approximately 1 per cent to bring the two series onto the same scale, the average accidental difference remaining for 105 days in which satisfactory, or moderately satisfactory, results were had at both stations is only 0.68 per cent. This implies an accidental probable error of 0.41 per cent for a fairly good day’s determination at one station. The average deviation of the monthly mean values, 0.3 per cent, would doubtless be smaller than it is if the days observed were always identical at the two stations.

While these values indicate a rather satisfactory degree of accuracy, improvements just made at both stations will probably lead to better work and closer accord beginning January, 1923. Arrangements have been made to carry on the “solar constant” observations daily, when possible, at both stations until July, 1925. It is hoped that by that time it will be possible to make a just estimate of the value of the work for meteorology.

<sup>1</sup> My colleagues, F. E. Fowle, L. B. Aldrich, A. F. Moore, L. H. Abbot, and J. A. Roebling, have each and all contributed so largely in different ways to these results that their names are entitled to co-authorship. It is only to avoid cumbrous citations that they are omitted in the heading.

Only less valuable and indispensable for the research has been the conscientious, painstaking, and enthusiastic work of Messrs. A. Kramer, P. E. Greeley, F. A. Greeley, Mrs. G. M. Bond and Miss M. A. Neill.

We owe, besides, much to the help of the weather bureaus of the United States, Chile, and Argentina, the Chile Exploration Company, and to many citizens of Wenden, Arizona, especially Mr. W. B. Ellison, and Mr. J. E. Matteson.