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CLEAR WEATHER OVER NASHVILLE

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ABSTRACT

An analysis of the "sky-cover" data from the records of the U. S. Weather Bureau station in Nashville, Tennessee has been made in order to obtain an estimate of the amount of clear skies occurring over the Dyer Observatory. It has been found that an average of 32% of the possible night-time hours per year have been clear during the 21 year interval for which the "sky-cover" data was available.

Since the Dyer Observatory was dedicated in 1953, it has been the impression of the staff that the amount of clear weather and the photometric quality of the sky over Nashville, Tennessee were both quite good relative to these conditions at many of the observatories east of the Mississippi Valley. During these years the size of the staff, even when supplemented by students, was not adequate to permit continuous recording of the amount of astronomically clear weather experienced in Nashville. In order to examine as objectively as possible the impressions of the staff, as well as to secure possible substantiation to justify the acquisition of an additional and larger telescope in the future, an analysis was undertaken of the cloud cover as recorded by the U. S. Weather Bureau at the Nashville Airport (Berry Field), 8 air miles from the observatory.

Our aims were to determine the total number of clear night-time hours for as long a period as the Weather Bureau had records, and to derive yearly and monthly statistics. The records of the Weather Bureau, obtained from the National Weather Records Center in Asheville, North Carolina, give the amount of sky-cover, (from zero to ten where ten represents completely overcast sky conditions), over Nashville for every hour of every day from the time these observations were initiated at Berry Field, (January 1, 1948), to the present. At this point we wish to emphasize that

the quantity which we will be calling clear night-time hours is what the Weather Bureau records as "zero sky-cover".

The number of "zero sky-cover" hours to be counted was taken from those intervals of possible night-time hours when useful astronomical observations could be made. Our working definition of times of useful astronomical observation made use of two relatively simple criteria. The first was to include those intervals of time after onset or before the ending of civil twilight so as to make the total number of hours per night to be an integral multiple of hours or half-hours. (It is to be noted that certain kinds of astronomical observations can be undertaken before the total darkness of astronomical twilight begins or ends.) The second criterion was to include only those nights when at least one interval of three or more consecutive hours of "zero sky-cover" appeared on the weather records. This resulted in the elimination of all the nights where only one or two consecutive hour intervals of "zero sky-cover" occurred. Our results, then, are a reasonable lower limit to the total number of clear night-time hours, but the addition of those few extra one or two hour intervals would probably not raise the yearly average by more than 1%. On the other hand, these short intervals of "zero sky-cover" were added to the counts on nights satisfying the three-hour criterion.

The results for the twenty-one year period from 1948 through 1968 are presented in the accompanying figures. Figure 1 shows the percentage of clear night-time hours for each year of the entire period that records from the Weather Bureau were available. Our total number of available night-time hours for astronomical observation averages 3900 hours per year. The average annual number of clear hours over the whole twenty-one year interval is 1230 hours or 31.6% of the total

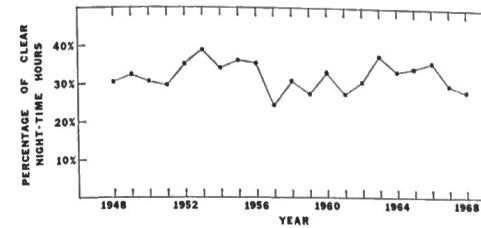


Fig. 1. Percentage of clear night-time hours over Nashville, Tenn., 1948-1968.

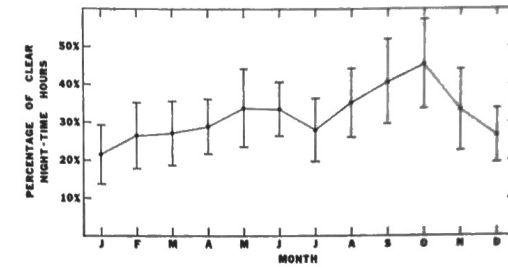


Fig. 2. Average percentage of clear night-time hours over Nashville, Tenn. per month for the years, 1948-1968. The length of the vertical bars represents the magnitude of the mean error.

dark time. The short time interval of twenty-one years does not really permit any discussion of possible long term trends in the clear weather patterns, if any exist at all, but it does seem long enough to help in planning future observing programs.

The results shown in Figure 2 give the average percentage of clear night-time hours for each month of the year. The error bars give some indication of the large year-to-year variations in different months. The fall months represent the best observing weather, usually reaching a peak in late October, while the deep winter months from December to March are the poorest time of the year. The large-scale seasonal variations are quite similar to those experienced by the majority of the midwest observatories and are very helpful for the planning of observing projects.

An alternate way of viewing the results of our analysis is from the point of view of available nights for astronomical observations. We have found that over the whole twenty-one year interval, the average number of nights per year that have at least three consecutive hours of "zero sky-cover" is 172. In addition, the average number of nights per year where at least 50% of the available night-time hours have "zero sky-cover" is 119. Finally, the average number of nights per year

where at least 90% of the night has "zero sky-cover" is 68.

In conclusion, the study of our local cloud cover has substantiated our initial feelings that almost a third of our available time is clear and probably suitable for significant astronomical research. No information concerning the qualities of the sky (such as seeing and scintillation) over Nashville can be obtained from the Weather Bureau data in our possession, but again we feel that possibly 75% of the clear weather is suitable for accurate photometry, and that a significant fraction of these hours has good seeing. The possibility also exists that spectrographic observations could be made under conditions of "non-zero sky-cover" such as haze or thin cirrus clouds. All in all, the sky conditions over Nashville, Tennessee provide an amount of suitable weather very favorable to the making of valuable, accurate and rewarding astronomical observations.

We would sincerely like to thank the officials of the Nashville station of the United States Weather Bureau for their data and advice. We would also like to express our thanks to the Natural Science Committee of Vanderbilt University for their help in the acquisition of most of the necessary weather records.