Frequency Distribution of Hourly Sums of Direct Solar Radiation at Potsdam

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The frequency distribution of direct solar radiation can be of importance in problems related to the building of apartment houses and in city planning. However, extended series of measurements of this radiation component are as yet available from only a few places. At the Potsdam Observatory (latitude 52° 23′ N, longitude 13° 04′ E, height 106m) direct solar radiation has been registered since 1930 with a Moll-Gorczynski pyrheliograph. The results have been published in the "Deutschen Meteorologischen Jahrbuch", Part IV, and should be typical for the flat countries of Central Europe.

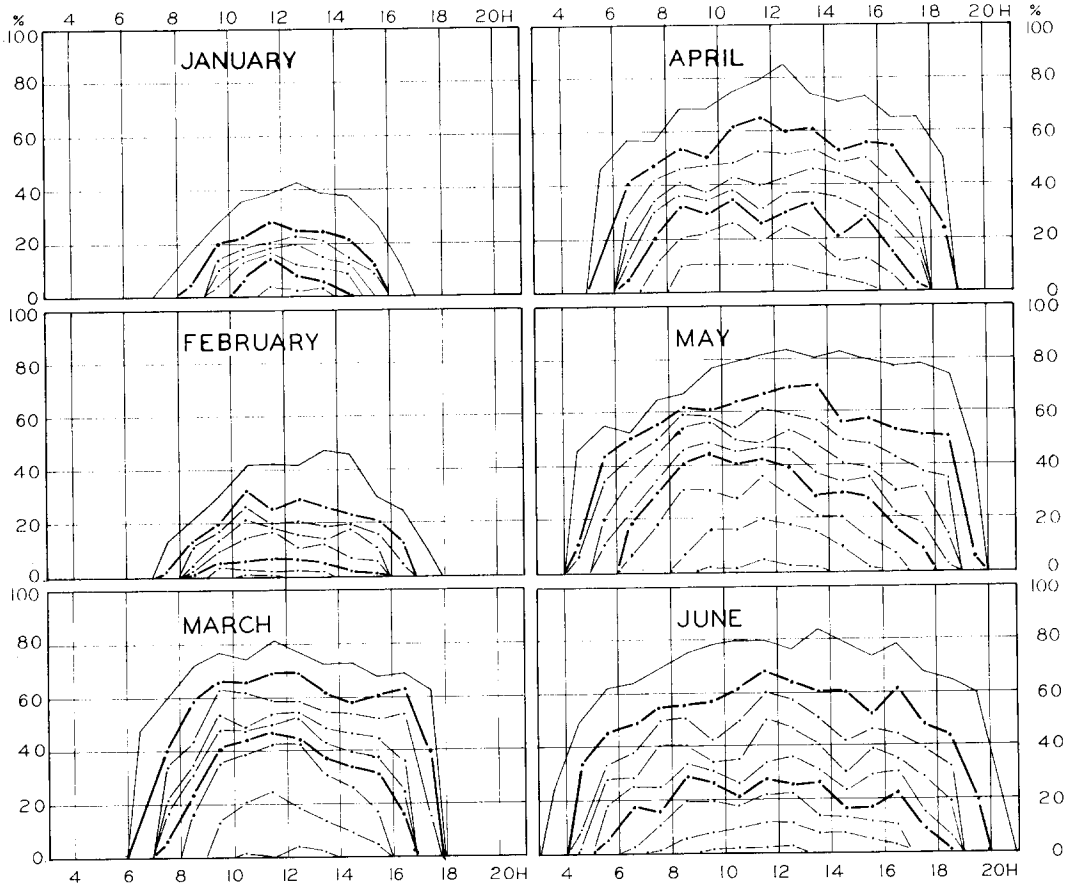

FIG. 1(a)—Frequency distribution of hourly sums of direct solar radiation, at normal incidence, at Potsdam (ϕ52° 23′ N, λ13° 04′ E, h 106m); January–June.

The volumes for 1930 to 1953 present the following frequency distributions of hourly summations:

1. Direct solar radiation received by a surface area perpendicular to the solar beam for each month;
2. Direct solar radiation on a vertical wall facing north for the fifteenth of each month;

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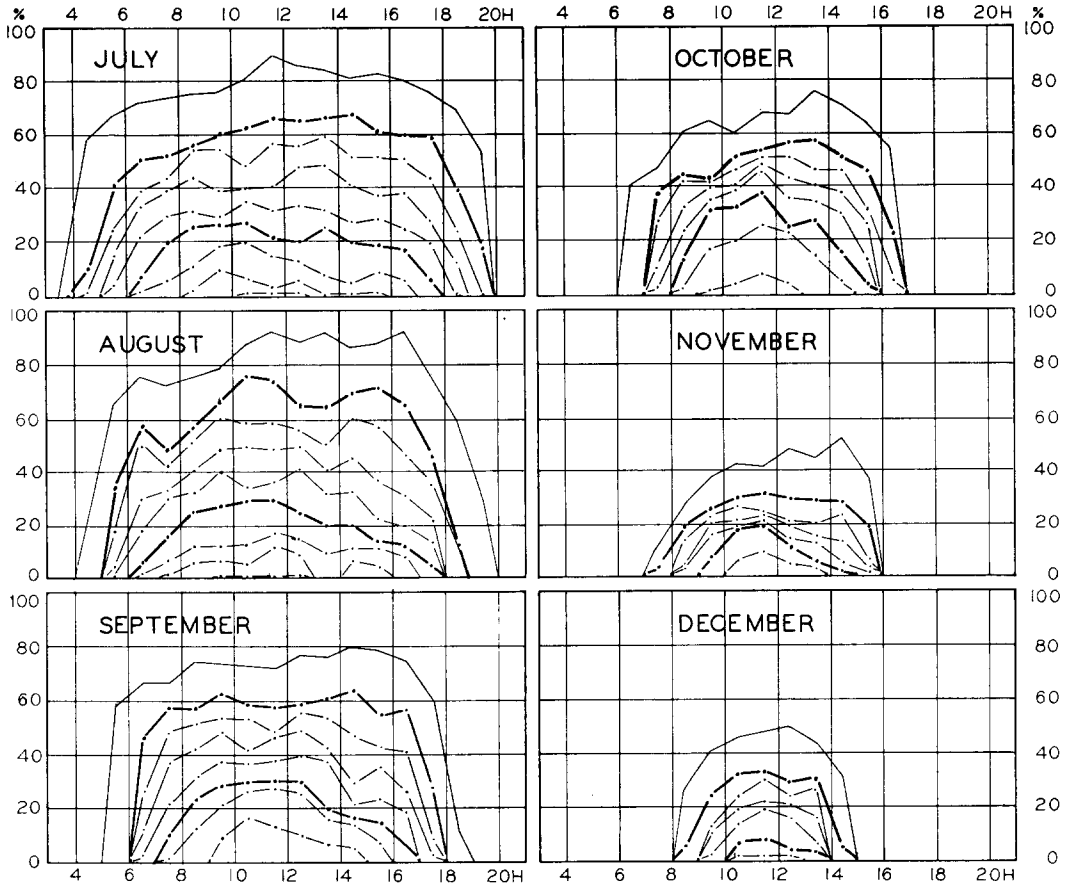

FIG. 1(b)—Frequency distribution of hourly sums of direct solar radiation, at normal incidence, at Potsdam (ϕ52° 23′ N, λ13° 04′ E, h 106m); July–December.

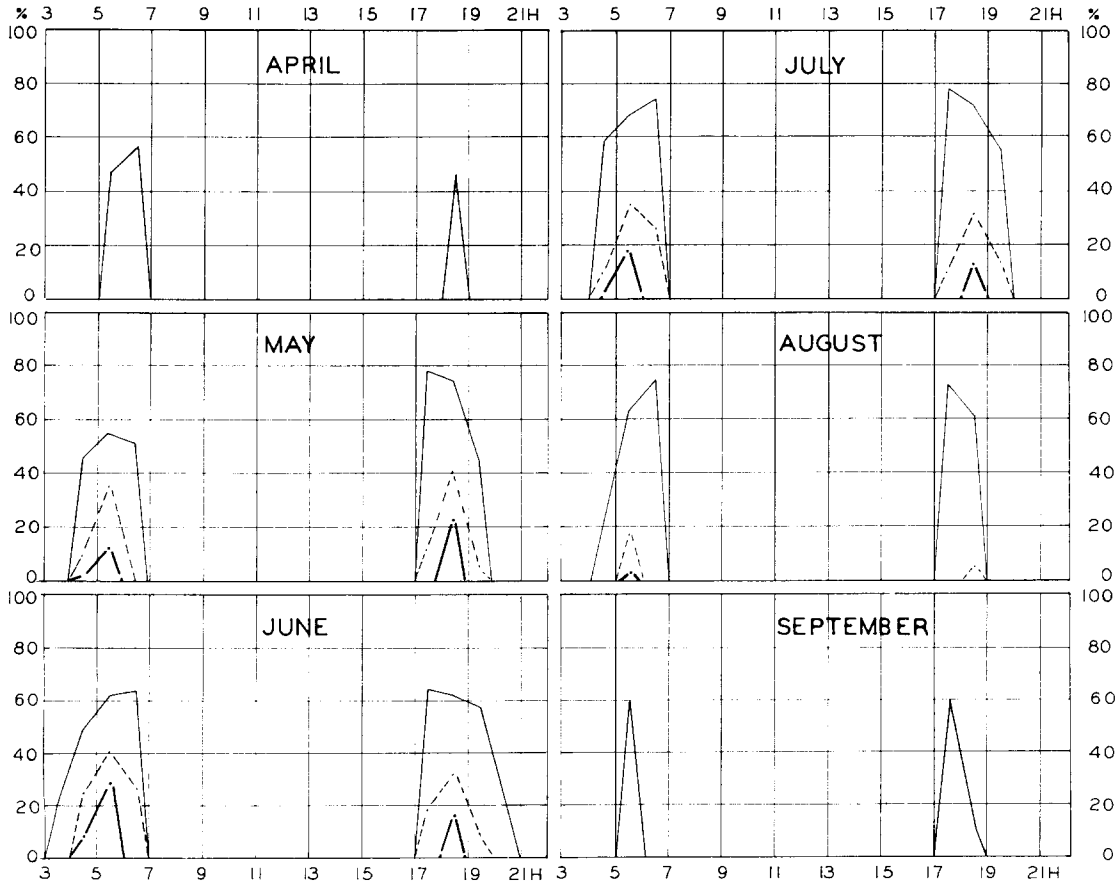

FIG. 2—Frequency distribution of hourly sums of direct solar radiation on a North-facing wall at Potsdam; April–September.

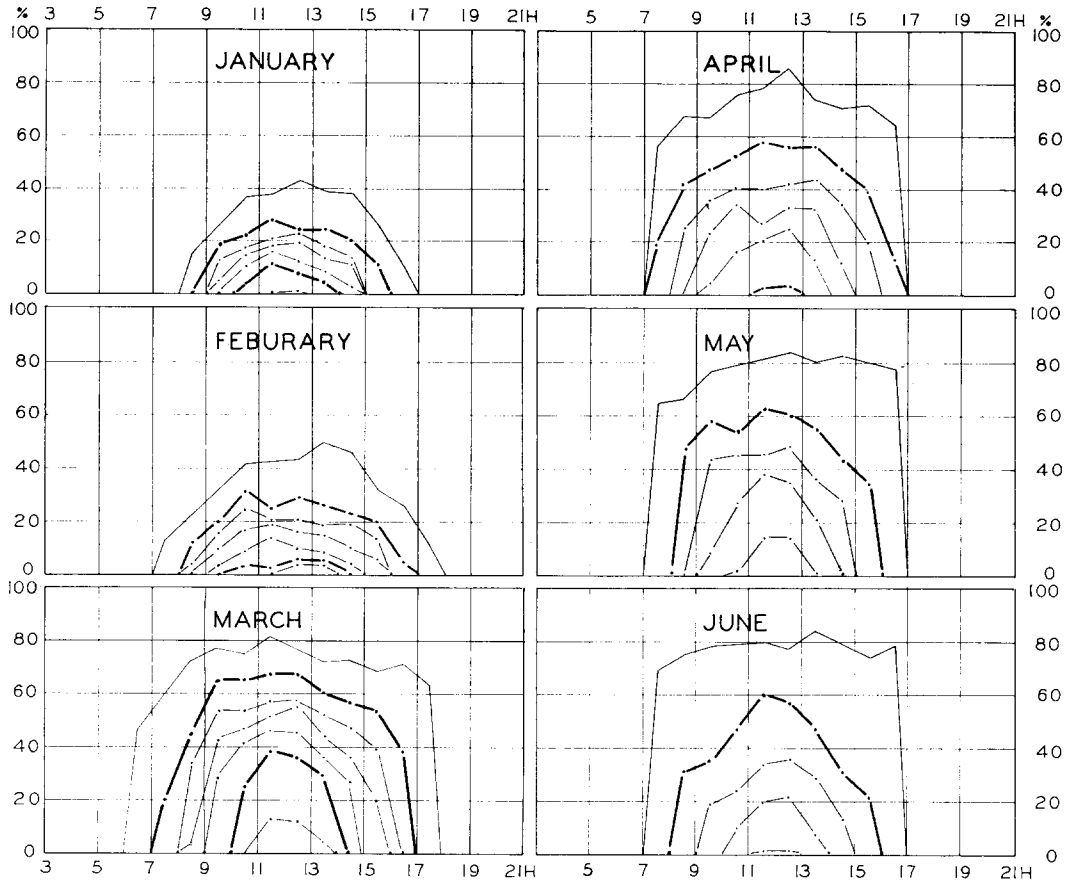

FIG. 3(a)—Frequency distribution of hourly sums of direct solar radiation on a south-facing wall at Potsdam; January–June

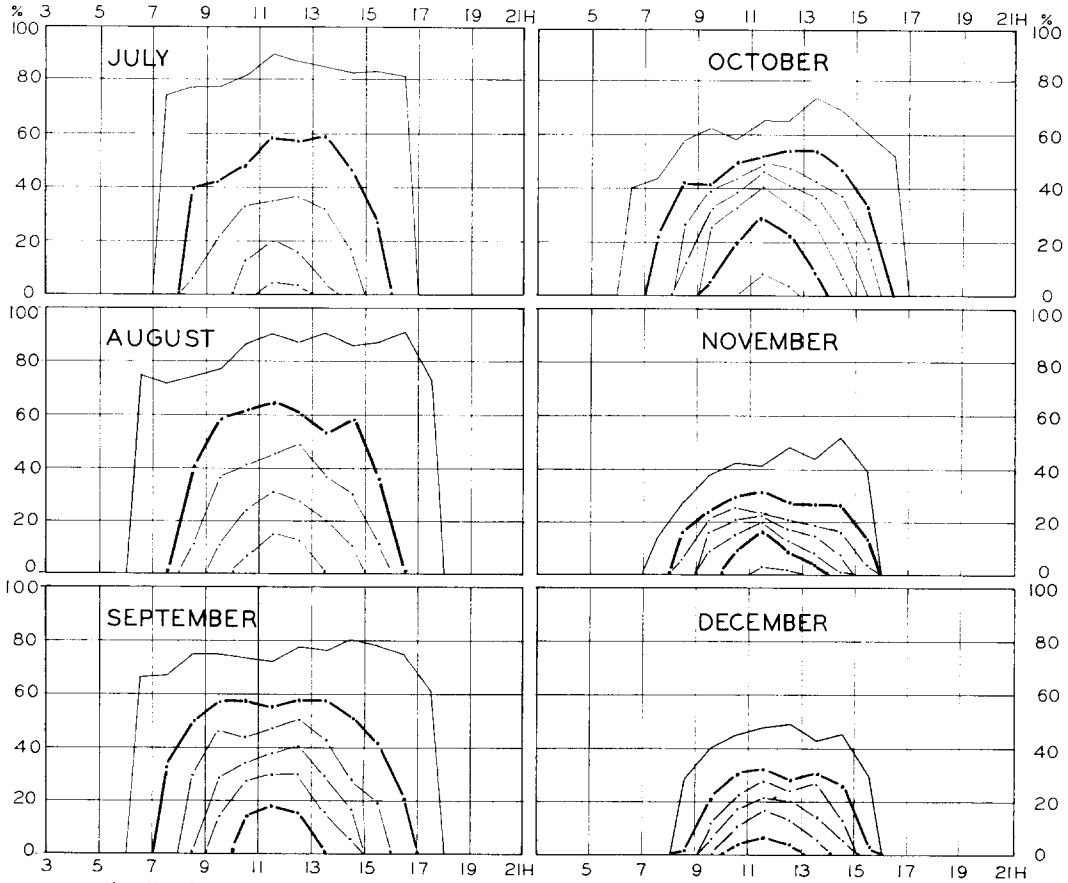

FIG. 3(b)—Frequency distribution of hourly sums of direct solar radiation on a south-facing wall at Potsdam; July–December

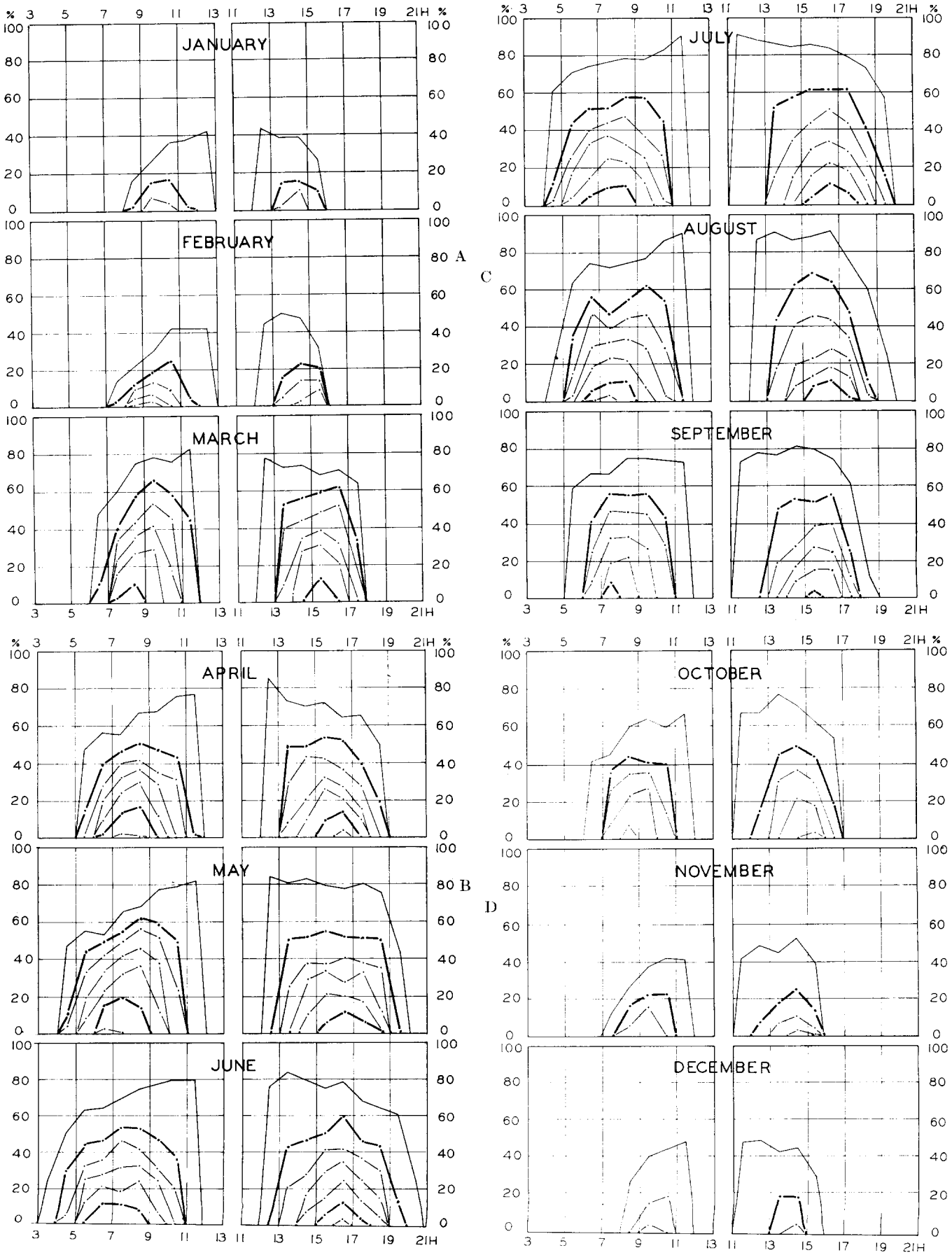
JANUARY
FEBRUARY
MARCH
APRIL
MAY
JUNE
JULY
AUGUST
SEPTEMBER
OCTOBER
NOVEMBER
DECEMBER
A
B
C
D

FIG. 4.

3. Direct solar radiation on a vertical wall facing east for the fifteenth of each month;

4. Direct solar radiation on a vertical wall facing south for the fifteenth of each month;

5. Direct solar radiation on a vertical wall facing west for the fifteenth of each month.

All frequency distributions refer to local mean time. Because of the time equation, incidence of radiation on the wall facing west commences before 12 noon during several months and terminates for the wall facing east sometimes after 12 noon.

In the graphical summaries presented in this contribution, Fig. 1 depicts the basic values of direct solar radiation at normal incidence; Fig. 2, the derived data for a north-facing wall; Fig. 3, the data for a south-facing wall; and Fig. 4, the data for east- and west-facing walls. Percentage distribution is shown on the ordinate scale and the time intervals (local mean time) on the abscissa.

In order to avoid unnecessary detail in the presentation, numerical values have been omitted. There should, however, be no difficulty in understanding the graphs. In all presentations the following categories have been used: 0, 0 to 10, 10 to 20 cal/cm^2, etc., the 0 category being the uppermost area. The intervals are connected by thin lines. To facilitate use of the diagrams, categories <10 cal/cm^2 and <50 cal/cm^2 have been separated from the categories $>$ 10 cal/cm^2 and >50 cal/cm^2 by thick lines. Only in the distributions for the wall facing north have the sums <5 cal/cm^2 also been separated from those >5 cal/cm^2 by a broken line. These connecting lines have no physical meaning; they serve purely for illustration, only the points for given time intervals being significant. In the evaluations for the vertical walls it was assumed that there was a random distribution of cloudy periods. The influence of turbidity was taken into consideration.

During the period of investigation (1930 to 1953) the 1913 revised Smithsonian scale was used to express intensities. A reevaluation to the new pyrheliometric scale, proposed in 1956, has not been attempted, since the reduction of all values by about 2 per cent is rather small and probably lies within the limits of error of all the frequency distributions.

FIG. 4(a)—Frequency distribution of hourly sums of direct solar radiation on east- and on west-facing walls at Potsdam; January–March.

FIG. 4(b)—Frequency distribution of hourly sums of direct solar radiation on east- and on west-facing walls at Potsdam; April–June.

FIG. 4(c)—Frequency distribution of hourly sums of direct solar radiation on east- and on west-facing walls at Potsdam; July–September.

FIG. 4(d)—Frequency distribution of hourly sums of direct solar radiation on east- and on west-facing walls at Potsdam; October–December.