# SOLAR RADIATION AND SUNSPOT DATA FOR FEBRUARY 1941

## SOLAR RADIATION OBSERVATIONS

By HELEN CULLINANE

Measurements of solar radiant energy received at the surface of the earth are made at 9 stations maintained by the Weather Bureau and at 10 cooperating stations maintained by other institutions. The intensity of the total radiation from sun and sky on a horizontal surface is continuously recorded (from sunrise to sunset) at all these stations by self-registering instruments; pyrheliometric measurements of the intensity of direct solar radiation at normal incidence are made at frequent intervals on clear days at two Weather Bureau stations (Madison, Wis.; Lincoln, Nebr.) and at the Blue Hill Observatory at Harvard University. Occasional observations of sky polarization are taken at the Weather Bureau station at Madison and at Blue Hill Observatory.

The geographic coordinates of the stations, and descriptions of the instrumental equipment, station exposures, and methods of observation, together with summaries of the data obtained, up to the end of 1936, will be found in the MONTHLY WEATHER REVIEW, December 1937, pp. 415 to 441; further descriptions of instruments and methods are given in Weather Bureau Circular Q.

Table 1 contains the measurements of the intensity of direct solar radiation at normal incidence, with means and their departures from normal (means based on less than 3 values are in parentheses). At Lincoln the observations are made with the Marvin pyrheliometer; at Madison and Blue Hill they are obtained with a recording thermopile, checked by observations with a Smithsonian silver-disk pyrheliometer at Blue Hill. The table also gives vapor pressures at 7:30 a. m. and at 1:30 p. m. (75th meridian time).

Table 2 contains the average amounts of radiation received daily on a horizontal surface from both sun and sky during each week, their departures from normal and the accumulated departures since the beginning of the year. The values at most of the stations are obtained from the records of the Eppley pyrheliometer recording on either a microammeter or a potentiometer.

Recalibration work is at present being conducted at all the stations measuring total solar and sky radiation, and from time to time there will appear in the MONTHLY WEATHER REVIEW information regarding any changes made necessary in the normals for the different stations. Recalibration has already been completed at the Massachusetts Institute of Technology, Cambridge, Mass., and corrected figures for that station for January will be found below under "Late Data."

Total solar and sky radiation was considerably deficient at Lincoln, Fresno, Twin Falls, La Jolla, and Riverside, and somewhat above normal at Washington, Madison, Chicago, New York, and Friday Harbor.

Normal incidence measurements at Blue Hill Observatory showed a considerable excess in radiation during both January and February.

TABLE 1.—*Solar radiation intensities during January 1941*

[Gram-calories per minute per square centimeter of normal surface]

**Blue Hill Observatory**

| Date | Sun's zenith distance | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 7:30 a. m. | 78.7° | 75.7° | 70.7° | 60.0° | 0.0° | 60.0° | 70.7° | 75.7° | 78.7° | 1:30 p. m. |
| | 75th mer. time | Air mass | | | | | | | | | Local mean solar time |
| | | A. M. | | | | | P. M. | | | | |
| | e | 5.0 | 4.0 | 3.0 | 2.0 | *1.0 | 2.0 | 3.0 | 4.0 | 5.0 | e |
| | *mm.* | *cal.* | *cal.* | *cal.* | *cal.* | *cal.* | *cal.* | *cal.* | *cal.* | *cal.* | *mm.* |
| Jan. 1 | 3.0 | ------ | ------ | ------ | ------ | ------ | 1.35 | 1.24 | 1.13 | 1.03 | 3.2 |
| Jan. 6 | 2.1 | ------ | ------ | ------ | ------ | ------ | ------ | 1.30 | 1.19 | 1.10 | 2.0 |
| Jan. 7 | 1.0 | ------ | ------ | ------ | ------ | ------ | 1.43 | 1.30 | 1.18 | 1.08 | 1.3 |
| Jan. 8 | 0.9 | 1.15 | 1.23 | 1.32 | ------ | ------ | 1.46 | 1.30 | 1.17 | 1.10 | 1.4 |
| Jan. 13 | 1.8 | 0.98 | 1.02 | 1.18 | ------ | ------ | ------ | 1.26 | 1.15 | 1.07 | 2.1 |
| Jan. 14 | 0.6 | 1.06 | 1.19 | 1.30 | ------ | ------ | 1.45 | 1.31 | 1.19 | 1.08 | 0.7 |
| Jan. 20 | 1.0 | 0.75 | 0.87 | 0.96 | 1.37 | ------ | ------ | 1.00 | 0.88 | 0.79 | 1.4 |
| Jan. 21 | 0.8 | ------ | 1.22 | 1.32 | 1.45 | ------ | ------ | 1.30 | 1.18 | 1.10 | 1.0 |
| Jan. 31 | 1.9 | ------ | ------ | ------ | ------ | ------ | ------ | 1.20 | 1.04 | 0.94 | 2.1 |
| Means | ------ | **0.98** | **1.11** | **1.22** | **1.41** | ------ | **1.42** | **1.25** | **1.12** | **1.03** | ------ |
| Departures | ------ | **+.02** | **+.07** | **+.07** | **+.10** | ------ | **+.10** | **+.08** | **+.08** | **+.09** | ------ |
| *Solar radiation intensities during February 1941* | | | | | | | | | | | |
| Feb. 1 | 1.5 | 1.05 | 1.15 | 1.25 | 1.37 | ------ | ------ | ------ | ------ | ------ | 2.1 |
| Feb. 4 | 2.2 | ------ | ------ | ------ | ------ | ------ | 1.29 | 1.16 | 1.04 | 0.92 | 2.3 |
| Feb. 5 | 1.6 | 1.10 | 1.19 | 1.32 | 1.44 | ------ | 1.38 | 1.23 | 1.11 | .99 | 1.8 |
| Feb. 6 | 2.0 | 1.06 | 1.14 | 1.25 | ------ | ------ | ------ | ------ | ------ | ------ | 2.4 |
| Feb. 8 | 4.0 | ------ | ------ | ------ | ------ | ------ | ------ | ------ | ------ | .62 | 2.1 |
| Feb. 10 | 0.8 | 1.08 | 1.18 | 1.30 | 1.41 | ------ | 1.38 | 1.21 | 1.07 | .97 | 1.0 |
| Feb. 11 | 2.1 | 0.93 | 1.05 | 1.13 | 1.38 | ------ | 1.19 | 1.00 | 0.88 | .69 | 1.9 |
| Feb. 16 | 1.2 | 1.07 | 1.18 | 1.30 | 1.46 | ------ | 1.45 | 1.29 | 1.16 | 1.04 | 1.4 |
| Feb. 19 | 1.6 | 0.74 | 0.88 | 1.03 | ------ | ------ | ------ | ------ | ------ | ------ | 1.6 |
| Feb. 20 | 1.5 | 0.86 | ------ | ------ | 1.30 | ------ | ------ | ------ | ------ | ------ | 2.0 |
| Feb. 23 | 2.5 | .92 | 1.03 | 1.13 | 1.29 | ------ | 1.30 | 1.18 | 1.06 | 0.95 | 2.6 |
| Feb. 24 | 1.4 | 1.04 | 1.13 | 1.24 | 1.40 | ------ | 1.39 | 1.27 | 1.14 | 1.05 | 1.5 |
| Feb. 26 | 1.1 | 0.95 | 1.07 | 1.20 | 1.36 | ------ | 1.34 | 1.15 | 1.00 | 0.91 | 1.3 |
| Feb. 27 | 1.1 | .93 | 1.04 | ------ | ------ | ------ | 1.38 | 1.13 | 0.98 | .88 | 1.4 |
| Means | ------ | **0.98** | **1.09** | **1.22** | **1.38** | ------ | **1.34** | **1.18** | **1.05** | **0.90** | ------ |
| Departures | ------ | **+.04** | **+.03** | **+.12** | **+.08** | ------ | **+.06** | **+.03** | **+.02** | **−.03** | ------ |

*Extrapolated.

TABLE 2.—*Average daily totals of solar radiation (direct+diffuse) received on a horizontal surface*

[Gram-calories per square centimeter]

| Week beginning— | Washington | Madison | Lincoln | Chicago | New York | Fresno | Cambridge | Fairbanks | Twin Falls | La Jolla | Newport | New Orleans | Riverside | Blue Hill | Albuquerque | Friday Harbor |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *cal.* | *cal.* | *cal.* | *cal.* | *cal.* | *cal.* | *cal.* | *cal.* | *cal.* | *cal.* | *cal.* | *cal.* | *cal.* | *cal.* | *cal.* | *cal.* |
| Jan. 29 | 204 | 247 | 183 | 125 | 195 | 152 | 182 | 27 | 249 | 334 | 203 | 241 | 317 | 188 | 285 | 105 |
| Feb. 5 | 275 | 224 | 276 | 138 | 221 | 166 | 246 | 72 | 140 | 290 | 278 | 263 | 221 | 274 | 361 | 121 |
| Feb. 12 | 241 | 208 | 221 | 146 | 194 | 242 | 188 | 69 | 218 | 233 | 216 | 383 | 223 | 199 | 361 | 279 |
| Feb. 19 | 371 | 351 | 218 | 273 | 332 | 252 | 296 | 110 | 254 | 304 | 311 | 222 | 253 | 300 | 308 | 196 |
| DEPARTURES FROM WEEKLY NORMALS | | | | | | | | | | | | | | | | |
| Jan. 29 | +2 | +60 | −37 | +8 | +38 | −33 | −9 | −16 | +55 | +63 | −9 | +10 | +78 | −27 | −11 | 0 |
| Feb. 5 | +6 | +21 | +16 | +2 | +57 | −90 | +30 | +9 | −56 | −14 | +34 | +35 | −58 | +40 | +19 | +9 |
| Feb. 12 | +15 | −16 | −45 | −1 | +16 | −44 | −42 | −12 | −38 | −58 | −39 | +28 | −80 | −34 | +12 | +124 |
| Feb. 19 | +112 | +96 | −64 | +91 | +125 | 0 | +28 | +6 | 0 | −51 | +26 | −55 | −82 | +34 | −34 | +36 |
| ACCUMULATED DEPARTURES ON FEBRUARY 25, 1941 | | | | | | | | | | | | | | | | |
| | +1,148 | +364 | −2,085 | +392 | +2,310 | −1,659 | +91 | +112 | −70 | −1,239 | +98 | +1,232 | −2,898 | −455 | −70 | +1,344 |

**LATE DATA AND CORRECTIONS TO TABLE 2**

| | Fairbanks | | Cambridge* | |
|---|---|---|---|---|
| | Gram-calories | Departures | Gram-calories | Departures |
| Jan. 1 | 9 | +8 | 139 | +7 |
| Jan. 8 | 17 | +11 | 165 | +18 |
| Jan. 15 | 27 | +16 | 119 | −21 |
| Jan. 22 | 38 | +27 | 153 | +1 |
| Accumulated departures on January 28 | +303 | | +42 | |

* The figures for Cambridge are 94.6% of the original figures.

## POSITIONS, AREAS, AND COUNTS OF SUN SPOTS

[Communicated by Capt. J. F. Hellweg, U. S. Navy (Ret.), Superintendent, U. S. Naval Observatory.] All measurements and spot counts were made at the Naval Observatory from plates taken at the observatories indicated. Difference in longitude is measured from the central meridian, positive toward the west. Latitude is positive toward the north. Areas are corrected for foreshortening and expressed in millionths of Sun's hemisphere. For each day, under longitude, latitude, area of spot or group, and spot count, are included assumed longitude of center of the disk, assumed latitude of center of the disk, total area of spots and groups, and total spot count.

| Date | Eastern standard time | | Mount Wilson group No. | Heliographic: Difference in longitude | Heliographic: Longitude | Heliographic: Latitude | Heliographic: Distance from center of disk | Area of spot or group | Spot count | Plate quality | Observatory |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1941 | h | m | | ° | ° | ° | ° | | | | |
| Feb. 1 | 11 | 7 | 8018 | −39 | 293 | −12 | 39 | 97 | 11 | VG | U. S. Naval. |
| | | | 8019 | −31 | 301 | +9 | 35 | 48 | 2 | | |
| | | | 8018 | −27 | 305 | −12 | 27 | 218 | 5 | | |
| | | | 8016 | +2 | 334 | −1 | 6 | 145 | 1 | | |
| | | | 8015 | +8 | 340 | −10 | 9 | 6 | 3 | | |
| | | | 8014 | +21 | 353 | +12 | 28 | 436 | 24 | | |
| | | | 8020 | +28 | 0 | −10 | 28 | 24 | 3 | | |
| | | | 8017 | +76 | 48 | −1 | 77 | 48 | 4 | | |
| | | | | | (332) | (−6) | | 1022 | 53 | | |
| Feb. 2 | 10 | 55 | 8021 | −75 | 244 | −15 | 75 | 12 | 2 | G | Mt. Wilson. |
| | | | 8018 | −26 | 293 | −12 | 27 | 97 | 11 | | |
| | | | 8019 | −19 | 300 | +9 | 24 | 36 | 1 | | |
| | | | 8018 | −16 | 303 | −11 | 16 | 218 | 6 | | |
| | | | 8016 | +8 | 327 | −3 | 10 | 24 | 3 | | |
| | | | 8016 | +15 | 334 | −1 | 16 | 121 | 1 | | |
| | | | 8014 | +34 | 353 | +12 | 40 | 436 | 18 | | |
| | | | 8020 | +41 | 0 | −11 | 41 | 48 | 6 | | |
| | | | | | (319) | (−6) | | 992 | 48 | | |
| Feb. 3 | 12 | 3 | 8022 | −80 | 225 | −9 | 80 | 194 | 1 | VG | U. S. Naval. |
| | | | 8021 | −62 | 243 | −15 | 63 | 12 | 1 | | |
| | | | 8018 | −12 | 293 | −12 | 13 | 97 | 10 | | |
| | | | 8019 | −4 | 301 | +10 | 16 | 36 | 2 | | |
| | | | 8018 | −1 | 304 | −11 | 5 | 218 | 5 | | |
| | | | 8016 | +29 | 334 | −1 | 30 | 97 | 1 | | |
| | | | 8014 | +49 | 354 | +12 | 53 | 242 | 15 | | |
| | | | 8020 | +53 | 358 | −12 | 53 | 24 | 3 | | |
| | | | | | (305) | (−6) | | 920 | 38 | | |
| Feb. 4 | 11 | 23 | 8022 | −68 | 224 | −9 | 68 | 121 | 1 | F | Do. |
| | | | 8025 | −29 | 263 | −10 | 29 | 24 | 3 | | |
| | | | 8018 | −1 | 291 | −11 | 5 | 48 | 3 | | |
| | | | 8019 | +8 | 300 | +10 | 18 | 24 | 2 | | |
| | | | 8018 | +12 | 304 | −10 | 13 | 242 | 13 | | |
| | | | 8024 | +16 | 308 | −4 | 16 | 6 | 1 | | |
| | | | 8023 | +23 | 315 | +5 | 26 | 24 | 1 | | |
| | | | 8016 | +42 | 334 | −1 | 43 | 73 | 1 | | |
| | | | 8014 | +64 | 356 | +12 | 69 | 194 | 6 | | |
| | | | 8020 | +65 | 357 | −12 | 65 | 48 | 2 | | |
| | | | | | (292) | (−6) | | 804 | 33 | | |
| Feb. 5 | 11 | 33 | 8026 | −79 | 200 | +14 | 80 | 145 | 4 | G | Do. |
| | | | 8022 | −54 | 225 | −10 | 54 | 73 | 3 | | |
| | | | 8025 | −14 | 265 | −8 | 14 | 73 | 14 | | |
| | | | 8018 | +12 | 291 | −11 | 13 | 48 | 3 | | |
| | | | 8019 | +20 | 299 | +10 | 26 | 12 | 4 | | |
| | | | 8018 | +26 | 305 | −11 | 27 | 145 | 11 | | |
| | | | 8023 | +38 | 317 | +4 | 40 | 48 | 13 | | |
| | | | 8016 | +56 | 335 | −1 | 57 | 24 | 2 | | |
| | | | 8014 | +78 | 357 | +12 | 80 | 145 | 4 | | |
| | | | 8020 | +78 | 357 | −12 | 78 | 12 | 1 | | |
| | | | | | (279) | (−6) | | 725 | 59 | | |
| Feb. 6 | 11 | 39 | 8026 | −65 | 201 | +14 | 70 | 121 | 2 | F | Do. |
| | | | 8026 | −60 | 206 | +14 | 65 | 121 | 4 | | |
| | | | 8022 | −40 | 226 | −9 | 40 | 73 | 1 | | |
| | | | 8025 | 0 | 266 | −8 | 2 | 48 | 5 | | |
| | | | 8018 | +26 | 292 | −10 | 26 | 48 | 1 | | |
| | | | 8018 | +40 | 306 | −10 | 40 | 145 | 6 | | |
| | | | 8023 | +53 | 319 | +4 | 56 | 24 | 4 | | |
| | | | | | (266) | (−6) | | 580 | 23 | | |

## POSITIONS, AREAS, AND COUNTS OF SUN SPOTS—Con.

| Date | Eastern standard time | | Mount Wilson group No. | Heliographic: Difference in longitude | Heliographic: Longitude | Heliographic: Latitude | Heliographic: Distance from center of disk | Area of spot or group | Spot count | Plate quality | Observatory |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1940 | h | m | | ° | ° | ° | ° | ° | | | |
| Feb. 7 | 11 | 2 | 8026 | −51 | 202 | +15 | 56 | 73 | 3 | G | Mt. Wilson. |
| | | | 8026 | −43 | 210 | +15 | 49 | 12 | 2 | | |
| | | | 8022 | −27 | 226 | −9 | 27 | 24 | 4 | | |
| | | | 8025 | +13 | 266 | −9 | 13 | 48 | 4 | | |
| | | | 8018 | +40 | 293 | −10 | 40 | 24 | 1 | | |
| | | | 8018 | +55 | 308 | −10 | 55 | 145 | 8 | | |
| | | | 8023 | +67 | 320 | +4 | 69 | 24 | 5 | | |
| | | | | | (253) | (−7) | | 350 | 27 | | |
| Feb. 8 | 11 | 22 | 8026 | −37 | 202 | +16 | 44 | 48 | 4 | VG | U. S. Naval. |
| | | | 8026 | −27 | 212 | +15 | 35 | 24 | 1 | | |
| | | | 8022 | −13 | 226 | −9 | 13 | 24 | 1 | | |
| | | | 8025 | +28 | 267 | −9 | 28 | 36 | 2 | | |
| | | | 8018 | +53 | 292 | −11 | 53 | 6 | 1 | | |
| | | | 8018 | +68 | 307 | −11 | 68 | 24 | 1 | | |
| | | | | | (239) | (−7) | | 162 | 10 | | |
| Feb. 9 | 10 | 55 | 8028 | −82 | 145 | −10 | 82 | 145 | 1 | G | Mt. Wilson. |
| | | | 8027 | −44 | 183 | +9 | 48 | 48 | 7 | | |
| | | | 8026 | −23 | 204 | +15 | 32 | 48 | 5 | | |
| | | | 8026 | −14 | 213 | +14 | 26 | 12 | 1 | | |
| | | | 8022 | −3 | 224 | −7 | 3 | 12 | 3 | | |
| | | | 8025 | +41 | 268 | −10 | 41 | 24 | 1 | | |
| | | | | | (227) | (−7) | | 289 | 18 | | |
| Feb. 10 | 10 | 50 | 8028 | −68 | 145 | −10 | 68 | 145 | 1 | F | U. S. Naval. |
| | | | 8027 | −32 | 181 | +10 | 36 | 48 | 2 | | |
| | | | 8026 | −12 | 201 | +15 | 26 | 36 | 3 | | |
| | | | 8026 | −3 | 210 | +15 | 23 | 12 | 1 | | |
| | | | 8022 | +11 | 224 | −6 | 11 | 12 | 3 | | |
| | | | 8025 | +55 | 268 | −9 | 55 | 6 | 1 | | |
| | | | | | (213) | (−7) | | 259 | 11 | | |
| Feb. 11 | 11 | 25 | 8028 | −55 | 145 | −10 | 55 | 97 | 3 | F | Do. |
| | | | 8027 | −17 | 183 | +9 | 24 | 24 | 3 | | |
| | | | 8026 | +12 | 212 | +13 | 23 | 73 | 6 | | |
| | | | | | (200) | (−7) | | 194 | 12 | | |
| Feb. 12 | 10 | 52 | 8028 | −42 | 145 | −11 | 42 | 73 | 2 | F | Do. |
| | | | 8026 | +27 | 214 | +13 | 34 | 97 | 3 | | |
| | | | | | (187) | (−7) | | 170 | 5 | | |
| Feb. 13 | 11 | 30 | 8030 | −58 | 116 | +4 | 60 | 48 | 6 | G | Mt. Wilson. |
| | | | 8028 | −28 | 146 | −12 | 28 | 97 | 1 | | |
| | | | 8029 | 0 | 174 | +12 | 19 | 24 | 2 | | |
| | | | 8026 | +40 | 214 | +13 | 45 | 121 | 10 | | |
| | | | | | (174) | (−7) | | 290 | 19 | | |
| Feb. 15 | 12 | 28 | 8031 | −80 | 67 | −3 | 80 | 48 | 1 | F | U. S. Naval. |
| | | | 8030 | −25 | 122 | +5 | 29 | 48 | 3 | | |
| | | | 8028 | −1 | 146 | −12 | 5 | 97 | 1 | | |
| | | | 8026 | +71 | 218 | +13 | 74 | 97 | 1 | | |
| | | | | | (147) | (−7) | | 290 | 6 | | |
| Feb. 16 | 12 | 2 | 8031 | −68 | 66 | −3 | 68 | 145 | 4 | F | Do. |
| | | | 8028 | +12 | 146 | −12 | 13 | 97 | 1 | | |
| | | | | | (134) | (−7) | | 242 | 5 | | |
| Feb. 17 | 12 | 3 | 8031 | −55 | 66 | −3 | 55 | 145 | 4 | G | Do. |
| | | | 8028 | +25 | 146 | −12 | 25 | 97 | 2 | | |
| | | | | | (121) | (−7) | | 242 | 6 | | |
| Feb. 18 | 12 | 21 | 8031 | −47 | 60 | −5 | 47 | 48 | 3 | F | Do. |
| | | | 8031 | −40 | 67 | −1 | 41 | 24 | 1 | | |
| | | | 8028 | +39 | 146 | −12 | 39 | 121 | 2 | | |
| | | | | | (107) | (−7) | | 193 | 6 | | |
| Feb. 19 | 11 | 49 | 8031 | −33 | 61 | −5 | 33 | 36 | 3 | G | Do. |
| | | | 8031 | −27 | 67 | −2 | 28 | 12 | 1 | | |
| | | | (*) | +35 | 129 | −13 | 35 | 97 | 11 | | |
| | | | 8028 | +52 | 146 | −12 | 52 | 73 | 1 | | |
| | | | | | (94) | (−7) | | 218 | 16 | | |
| Feb. 20 | 12 | 1 | 8031 | −13 | 68 | −2 | 15 | 48 | 4 | F | Do. |
| | | | (*) | +49 | 130 | −13 | 49 | 145 | 6 | | |
| | | | 8028 | +65 | 146 | −13 | 65 | 48 | 1 | | |
| | | | | | (81) | (−7) | | 241 | 11 | | |
| Feb. 21 | 11 | 3 | 8032 | −77 | 351 | +15 | 79 | 73 | 4 | F | Do. |
| | | | (*) | +60 | 128 | −15 | 60 | 48 | 3 | | |
| | | | (*) | +68 | 136 | −13 | 68 | 121 | 1 | | |
| | | | | | (68) | (−7) | | 242 | 8 | | |
| Feb. 23 | 11 | 5 | 8032 | −49 | 353 | +17 | 54 | 291 | 5 | F | Do. |
| | | | | | (42) | (−7) | | 291 | 5 | | |