# Solar Bulletin

THE AMERICAN ASSOCIATION OF VARIABLE STAR OBSERVERS— SOLAR DIVISION

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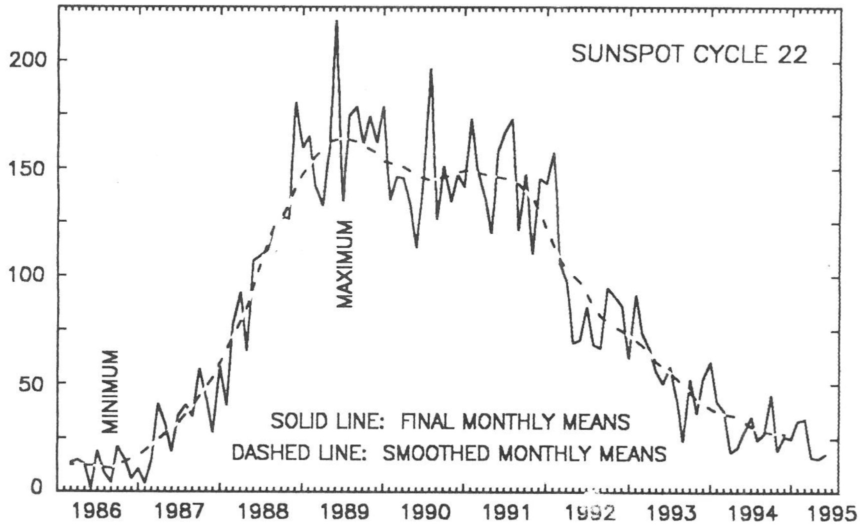
## American Relative Sunspot Numbers for June

$R_a$ Final

| | | | | | |
|---|---|---|---|---|---|
| 1) | 8 | 11) | 23 | 21) | 15 |
| 2) | 9 | 12) | 20 | 22) | 18 |
| 3) | 11 | 13) | 18 | 23) | 17 |
| 4) | 17 | 14) | 10 | 24) | 13 |
| 5) | 35 | 15) | 0 | 25) | 13 |
| 6) | 26 | 16) | 0 | 26) | 13 |
| 7) | 29 | 17) | 9 | 27) | 11 |
| 8) | 34 | 18) | 20 | 28) | 9 |
| 9) | 25 | 19) | 18 | 29) | 16 |
| 10) | 34 | 20) | 14 | 30) | 26 |

Mean: 17.0
Number of reports: 94




**June Summary**: Solar activity was mainly in the very low range during the first sixteen days of June. Events of interest during the period included a large Southern Hemisphere prominence which erupted out to 0.17 solar radii early on the 4th, small filaments that disappeared on the 6th, and active prominences near the location of spotless NOAA/USAF Region 7876 (N12) as it rotated around the Sun's west limb on the 8th. The geomagnetic field was mostly quiet. The >2 MeV electron fluence was initially high, declined to moderate midway through the interval, and was normal after the 10th.

Activity continued to be very low between the 17th and 23rd. Noteworthy events during the interval were limited to a 12-degree filament which disappeared from the Sun's SE quadrant on the 18th. The geomagnetic field was quiet to unsettled with periods of minor storm conditions on the 18th-20th related to a coronal hole. The >2 MeV electron fluence entered the high and very range beginning on the 20th.

Very low daily activity levels continued to be the rule during the final week of June. A small filament near the equator in the NE quadrant disappeared on the 25th, but little else of significance occurred. The Sun's Southern Hemisphere -- by far the more active hemisphere during the decline of cycle twenty-two -- was spotless beginning on the 18th and extending through the remainder of June. (Seven separate groups appeared in the Northern Hemisphere during this interval.) The absence of these spots resulted in the lowest (un-scaled SESC) monthly mean sunspot number for the Southern Hemisphere to occur during the current cycle (4.6). Moreover, for the first time since March 1994 the smoothed mean sunspot number for this hemisphere failed to increase, and in fact, declined.

The geomagnetic field was quiet with minor storm conditions on the 26th due to coronal hole effects. The >2 MeV electron fluence was normal after the 26th. The smoothed mean American Relative Sunspot Number for December 1994 is 26.0.

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The mean estimated American Relative Sunspot Number for 1-15 July is 21. Solar activity was mostly in the very low range during the first two weeks of July. The eighteen-day period of spotlessness in the Sun's Southern Hemisphere ended on the 6th with the appearance of Region 7888 (S11, L340, CAO). The geomagnetic field was quiet to unsettled with scattered high-latitude reports of minor storm conditions early in the period. The >2 MeV electron fluence was normal.

[A Portion of the above information was obtained from the **Space Environment Laboratory**]

## The Amplitude of Solar Cycle 23

Many methods are used to predict the amplitude of a solar cycle prior to its onset, but only the precursor technique has won approval from the scientific community. This technique works on the notion that the solar cycle begins some years before solar minimum with the appearance of long-lived coronal holes which give rise to sequences of 27-day recurrent geomagnetic disturbances.

A number of these applications use the long record of geomagnetic storms to correlate their occurrence with the amplitude of the next solar cycle. But there are two limitations. First, even in the declining phase such disturbances can result from other sources, making it necessary to correct for current cycle events such as coronal mass ejections. And second, the time of onset of recurrent geomagnetic activity seems to vary from cycle-to-cycle. Any method which relies on activity over (say) the last three years of the cycle may incorrectly estimate the precursor activity, and thus the amplitude of the new cycle.

Thompson (Solar Physics, **Vol. 148**, 1993) developed a version of the precursor method that avoids both of these pitfalls. The technique is simple; it correlates the total number of geomagnetic disturbances in each cycle with two parameters -- the maximum amplitude of the current and following cycle. If a disturbance is defined as a day with Ap $\geq$ 25, it is found that both cycles are close to equally important in determining the number of disturbed days. The equation obtained is

$$N_c = \underset{\pm 45.8}{-47.9} + \underset{\pm 0.33}{2.20}\, R_c + \underset{\pm 0.32}{1.88}\, R_n$$

where $N_c$ is the number of geomagnetic disturbances in the current cycle, $R_c$ is the maximum amplitude in sunspot number of the current cycle and $R_n$ is the maximum amplitude of the next cycle.

This relationship gives a method of predicting the amplitude of the next cycle because at solar minimum we know the number of disturbed days and the maximum amplitude of the cycle just ended. Thompson has applied this method to predict the amplitude of eleven previous cycles, resulting in a r.m.s. error in sunspot number amplitude of only 17.

What are the prospects for Cycle 23 when using this technique? A final prediction can only be made at solar minimum, but knowing the number of disturbed days thus far in Cycle 22, a lower limit can be established. This estimate builds to a final prediction at minimum.

Using data up to March 1995, we find

$$R_{23} \geq 141.$$

With solar minimum likely to be more than twelve months later than March 1995, this limit will increase. However, even at this stage, the prediction indicates that Cycle 23 will be a large solar cycle and has excluded a small or average cycle.

-- *Richard Thompson* --
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## Sudden Ionospheric Disturbances (SES) Recorded During May 1995

Records were received from A5,9,40,50,59,61,62,63,65,68,69,70,71,72,73,74,75,76,77,78,80,81,82,83,84,85

| Day | Max | Imp | Def | Day | Max | Imp | Def | Day | Max | Imp | Def | Day | Max | Imp | Def |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 13 | 0506 | 1- | 5 | 14 | 1215 | 2 | 5 | 16 | 1304 | 1- | 5 | 17 | 2001 | 1- | 5 |
| 13 | 0727 | 1 | 5 | 15 | 1829 | 1 | 5 | 16 | 1400 | 1 | 5 | 17 | 2218 | 1- | 5 |
| 13 | 0825 | 1 | 5 | 15 | 1950 | 1 | 5 | 16 | 1725 | 1- | 5 | 18 | 1510 | 1- | 5 |
| 13 | 1250 | 1 | 5 | 15 | 2112 | 1+ | 5 | 16 | 1908 | 1+ | 5 | 21 | 0204 | 1- | 5 |
| 13 | 1658 | 1 | 5 | 16 | 0815 | 1 | 5 | 16 | 2031 | 1 | 5 | 21 | 1722 | 1- | 5 |
| 13 | 1824 | 1- | 5 | 16 | 1000 | 1+ | 5 | 17 | 0538 | 1- | 5 | 22 | 2306 | 1- | 5 |
| 14 | 0132 | 1 | 5 | 16 | 1127 | 1- | 5 | | | | | | | | |

**Analysts:** J. Ellerbe; S. Hansen; M. Hayden; P. King; A. Landry; R. Papp; G. Rosenberg; A. Stokes; M. Taylor; P. Taylor; L. Witkowski
Frequencies recorded (kHz): 16.8; 18.3; 19.6; 20.3; 21.4; 23.4; 24.8; 28.5; 30.6; 48.5; 51.6;

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