THE AMERICAN ASSOCIATION OF VARIABLE STAR OBSERVERS

# Solar Bulletin

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Numbers: 135 - 136

## SOME REMARKS ON THE PRESENT SUNSPOT CYCLE

by W. GLEISSBERG.

Long before the beginning of the current solar cycle, it was expected that the maximum of this 11-year cycle would be very high. It could not be forseen, however, that this maximum would surpass all the maxima observed hitherto. This became evident soon after the beginning of the present cycle, when the rapid increase of solar activity pointed to an extraordinarily high maximum.

Since high maxima are want to occur in the early part of such cycles it seemed probable that the interval from minimum to maximum in this instance would be extremely short.

The observations in fact show that the frequency (= Häufigkeit) of sunspots reached a first peak as early as November 1956, when the monthly average of the Zürich Relative Sunspot Numbers, $R_Z$, amounted to 201.3. After a remarkable decrease of about 85 units which continued until February 1957, sunspot activity again increased and in June 1957 the monthly average $R_Z$ surpassed 200 for the second time. The third and highest peak was reached in September and October 1957 with monthly averages of $R_Z$ being 244,3 and 262,9 respectively (provisional values). (Ed. note: see p. 8 for $R_Z$ defin.)

Since the determination of epochs of maxima is based on <u>smoothed</u> monthly averages of $R_Z$ (computed from data of 13 consecutive months), the exact epoch of the current maximum cannot be known until 7 months after it has occurred. If we suppose that the frequency of sunspots will not again reach such a high level as in September and October of 1957, then the maximum of the present solar cycle occurred in the summer of 1957. This would yield a value of about 3 1/2 years for the interval from minimum to maximum.

Besides its exceptional intensity, the present solar cycle is also unusual with respect to the latitude distribution of the sunspots. Excluding minor, one-day sunspots from records starting with 1878 until the beginning of the present cycle, there were only 12 sunspot groups in latitudes ≥40°.

During the years 1954 - 1957, however, more spot groups of this kind were recorded than within the whole period 1878 - 1953.

APR 17 1958

The most interesting case was a very active sunspot group observed on June 21st and 22nd, 1957, at a northern latitude of 50°. Never before had a group living longer than one day been recorded at such a high latitude. (Ed. note: See Cragg's notes on this group in Solar Bulletin - Sept.-Oct.1957, p.9.)

Towards the end of 1957 the distribution of sunspots over the photosphere presented a unique aspect: While there were already groups within 10° of the equator, other groups still appeared in high latitudes near 40°. This surprising fact may lead to the conclusion that the well-known migration of sunspot zones during each 11-year cycle cannot be satisfactorily explained by supposing that, on each hemisphere of the sun, there exists only <u>one</u> belt shifting steadily towards the equator. Perhaps a better insight into this phenomenon will be supplied by the following hypothesis:

> During the initial phase of each 11-year cycle a number of sunspot belts becomes effective, one after the other, each one of them originating in high latitudes after the preceding one drifted somewhat towards the equator. The number of these belts changes from cycle to cycle, and the intensity of a cycle depends on the number of these belts.

According to this hypothesis, the exceptional height of the maximum of the present solar cycle, the unusual width of the sunspot zones, and the fact that four years after the beginning of this cycle sunspot groups still appear in very high latitudes may all be a result of the large number of successive sunspot belts produced on each hemisphere by the current sunspot cycle.

Istanbul University Observatory
Bayazit, Istanbul, Turkey.
November 15, 1957.

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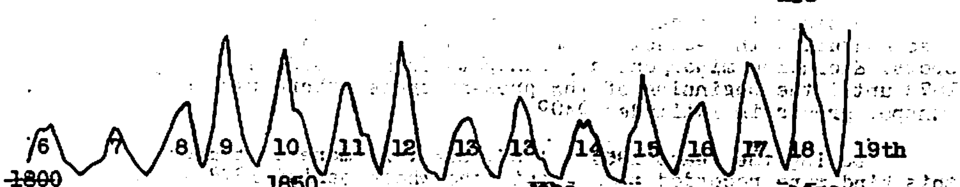
Prof. W. Gleissberg's book DIE HAUFIGKEIT DER SONNENFLECKEN (The Frequency of Sunspots) published in 1952 by Akademie-Verlag, Berlin, is the most concise book available to students of solar activity as expressed in the behavior of sunspots. His studies of the socalled 80-year sunspot cycle have long ago pointed to the necessity of not neglecting this underlying process when considerations are made of individual 11-year solar cycles. The magnitude of the present cycle will make it necessary to study with greater care the "long-cycle" discovered already by Rudolf Wolf.

hlb




11-year cycles (numbered) from 1800 on.

Ed. note: We are pleased to reprint here the main results obtained during the first three months of the IGY by the National Observatory of ATHENS, Greece, in their flare patrol observations. The four observers who secured these fine data have contributed for many years to the program of the Solar Division-AAVSO. We wish to congratulate them on their success.

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REPORT ON SOLAR FLARES OBSERVED AT ATHENS DURING JULY, AUGUST AND SEPTEMBER 1957 by

A. CAIMIS, DEMETRIUS P. ELIAS, J. H. FOCAS, C. J. MACRIS *)

The following observations have been effected through the Lyot-Øhman Filter for Hα delivered by the Firm Halle of Berlin, mounted on a 100 mm; 175 cm focal length equatorial refractor. Observations were carried out visually pending the completion of an installation for both photographic and visual work. A wide field (100x) eyepiece is used allowing satisfactory contrast. Seeing conditions were in general good. Observations started on July 4th 1957.

Total number of hours through September 30th = $210^h\ 16^m$

Individual observers:

| | | |
|---|---|---|
| CAIMIS | $60^h$ | $05^m$ |
| ELIAS | 119 | 06 |
| FOCAS | 12 | 37 |
| MACRIS | 18 | 28 |

During these observing hours a total of 147 flares were observed visually.

94 flares - importance 1-; or 64.0%
45 flares - importance 1; or 30.6%
8 flares - importance 2; or 5.4%

This means an average of 69.9 flares (including the subflares) per 100 hours.

Number of flares observed monthly:

| Month | 1- | 1 | 1+ | 2 | total |
|---|---|---|---|---|---|
| July | 27 | 13 | 5 | 4 | 49 |
| August | 40 | 8 | 4 | 1 | 53 |
| September | 27 | 12 | 3 | 3 | 45 |
| Total | 94 | 33 | 12 | 8 | 147 |

*) Members of the Astronomical Institute of the National Observatory of Athens, Greece; Director Prof. Dr. S. Plakidis.

* * * * * * * * * * *

OUT OF OTHER PUBLICATIONS:

Dr. W. BRUNNER - HAGGER (Zürich) wrote in ORION, the publication of the Swiss Astronomical Society, Jan.-March 1957 Nr.55, about Rudolf Wolf's discovery of the "great sunspot cycle of 83 respectively 178 years."

Dr. Brunner-Hagger quotes Rudolf Wolf writing in the "Astronomische Mitteilungen" of the Federal Observatory, Zürich, Vol. 8; No. 74, Oct. 1889 (pp 131-138) about "An attempt to identify the great sunspot-cycle-period" where Wolf listed all sunspot observations made before the discovery of the telescope (about 150 such observations, mostly from Chinese annals) from 188 A.D. to 1610. Wolf wrote: "...besides the mean period of 11.11 years, there exists decidedly an even greater period P in the frequency of sunspots and aurorae. However, the available material of observations, being too limited, permits one only to say that P must be somewhere between 50 and 100 years.."

"If I (Rudolf Wolf) had to decide at this time (Oct. 1889), I would preferably select a period of 83.33 years ..."

Brunner-Hagger then continues to point out that the low Maximum of 1907 ($R_{Max.}$=64.2) was followed by the large Maxima of 1947 and 1957.

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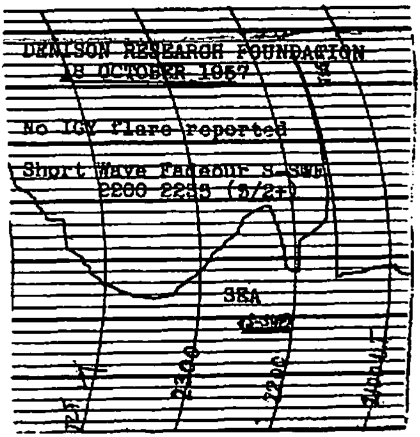
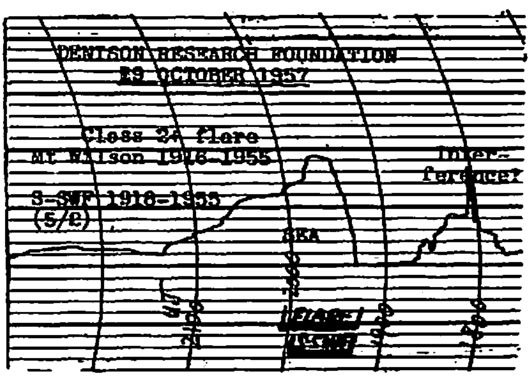
ANOTHER SEA-STATION reporting to the AAVSO Solar Division Program.

A Warshaw-SEA-receiver built by Val Isham, Columbus, Ohio, was transferred to the DENISON RESEARCH FOUNDATION, in Powel, Ohio, where it is in operation under Mr. G. H. PIETERSON's, Research Assistant, supervision since August 1957. Mr. Val Isham's location in Columbus suffered greatly from local intereferrnce.

Following are two fine examples of SEA's recorded by Mr. Pieterson at the DENISON RESEARCH FOUNDATION:

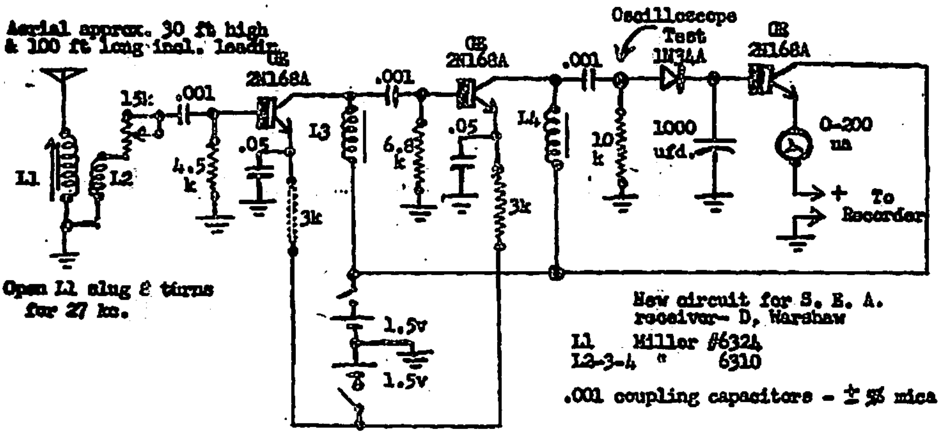


## Additional notes on the WARSHAW SEA-receiver.

In the original circuit* the second class A stage was direct-coupled to the class B stage which used a second battery. This lowered the sensitivity because it put a slight reverse bias on the diode. It also was dependent on the transistor's variable beta and temperature with a collector current flow of only 150 microamperes.

In the new circuit shown here, the last stage is AC coupled to put a slight forward bias on the detector diode which increases the sensitivity of the circuit and still uses only two batteries,- one for emitter current bias and the other for collector supply voltage. Emitter current bias is used to stabilize the operating point. This bias was adjusted for about half a milliampere collector current flow, so that the receiver now operates with a higher beta and is only dependent on the transistor's alpha which is essentially constant with temperature variations.




This new circuit stabilizes the transistor collector current against temperature variations. The collector current without stabilization increases with temperature and in turn increases the power dissipated in the transistor to increase its own temperature. This is accomodated with record traces showing oscillatory increases in the trace which is objectionable. The circuit is dependent on negative feedback, similar to electron tube cathode bias, emitter current being stabilised by the degeneration produced by the emitter resistor at direct current. At the amplified frequency the capacitor bypasses the emitter resistor. The circuit is more sensitive than the original unstabilised circuit and therefore greater output and efficiency is obtained. The current drain is adjusted for less than half a milliampere each, which is about shelf-life for the batteries. L3 and L4 may be toroidal inductors of 50 millihenries if even greater output and less stray magnetic field is desired, however toroids are expensive. The 2N35 transistors (used in the original circuit were found to increase in leakage with age so these have been replaced with GE 2N168A which stand up much better and are priced about the same.

*) SOLAR DIVISION BULLETIN Sept.-Oct.1956

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Brooklyn 17, N. Y.

(Ed. note: The above is a special insert- more in future issues )

## DAILY AMERICAN RELATIVE SUNSPOT NUMBERS - $R_{A'}$ - FOR 1957.

| Day | Jan. | Feb. | Mar. | Apr. | May | Jun. | Jul. | Aug. | Sep. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 157 | 68 | 144 | 113 | 124 | 144 | 181 | 102 | 244 | 219 | 241 | 206 |
| 2 | 137 | 58 | 158 | 127 | 125 | 168 | 166 | 126 | 198 | 245 | 234 | 206 |
| 3 | 169 | 70 | 120 | 132 | 119 | 173 | 198 | 132 | 163 | 225 | 198 | 203 |
| 4 | 198 | 106 | 121 | 132 | 85 | 168 | 199 | 126 | 169 | 223 | 243 | 264 |
| 5 | 194 | 84 | 92 | 150 | 106 | 175 | 206 | 116 | 165 | 221 | 200 | 209 |
| 6 | 209 | 102 | 111 | 136 | 106 | 167 | 197 | 142 | 113 | 196 | 202 | 251 |
| 7 | 153 | 104 | 137 | 137 | 117 | 134 | 153 | 125 | 112 | 226 | 167 | 192 |
| 8 | 145 | 126 | 114 | 164 | 134 | 146 | 144 | 126 | 165 | 257 | 170 | 167 |
| 9 | 124 | 150 | 141 | 160 | 156 | 153 | 129 | 114 | 186 | 216 | 214 | 151 |
| 10 | 99 | 119 | 177 | 143 | 151 | 140 | 119 | 90 | 197 | 201 | 229 | 121 |
| 11 | 102 | 98 | 170 | 117 | 156 | 144 | 98 | 97 | 234 | 219 | 208 | 124 |
| 12 | 118 | 108 | 191 | 117 | 190 | 165 | 76 | 95 | 232 | 245 | 199 | 116 |
| 13 | 110 | 103 | 178 | 97 | 161 | 175 | 106 | 109 | 226 | 245 | 199 | 125 |
| 14 | 85 | 114 | 145 | 93 | 205 | 155 | 113 | 133 | 250 | 190 | 191 | 151 |
| 15 | 66 | 143 | 112 | 124 | 179 | 200 | 141 | 163 | 256 | 207 | 176 | 169 |
| 16 | 54 | 136 | 114 | 190 | 197 | 198 | 148 | 173 | 219 | 212 | 164 | 205 |
| 17 | 81 | 121 | 124 | 187 | 159 | 221 | 175 | 175 | 214 | 186 | 150 | 194 |
| 18 | 138 | 121 | 123 | 193 | 182 | 265 | 186 | 175 | 220 | 161 | 148 | 213 |
| 19 | 151 | 99 | 126 | 180 | 172 | 229 | 189 | 173 | 223 | 191 | 157 | 257 |
| 20 | 142 | 92 | 128 | 198 | 187 | 233 | 211 | 125 | 223 | 194 | 165 | 288 |
| 21 | 138 | 97 | 108 | 188 | 173 | 221 | 220 | 112 | 232 | 203 | 188 | 328 |
| 22 | 144 | 123 | 132 | 195 | 172 | 222 | 252 | 95 | 279 | 228 | 235 | 342 |
| 23 | 123 | 98 | 139 | 226 | 174 | 212 | 227 | 86 | 220 | 223 | 226 | 295 |
| 24 | 138 | 116 | 122 | 229 | 185 | 208 | 189 | 99 | 225 | 263 | 190 | 312 |
| 25 | 155 | 116 | 102 | 209 | 126 | 192 | 171 | 145 | 219 | 259 | 163 | 375 |
| 26 | 151 | 102 | 112 | 183 | 116 | 169 | 166 | 144 | 181 | 265 | 132 | 307 |
| 27 | 125 | 106 | 149 | 198 | 137 | 158 | 155 | 167 | 191 | 277 | 173 | 292 |
| 28 | 115 | 121 | 143 | 188 | 146 | 150 | 138 | 191 | 222 | 276 | 196 | 292 |
| 29 | 96 | | 135 | 180 | 163 | 172 | 110 | 210 | 211 | 283 | 180 | 246 |
| 30 | 88 | | 139 | 151 | 159 | 192 | 112 | 236 | 246 | 317 | 201 | 238 |
| 31 | 98 | | 132 | | 134 | | 97 | 228 | | 234 | | 231 |
| Mean: | 129.1 | 107.2 | 133.5 | 161.2 | 151.5 | 181.6 | 160.4 | 139.7 | 207.2 | 229.2 | 191.3 | 227.9 |

**Y E A R L Y M E A N: 168.3**

The American Relative Sunspot Numbers are reduced by Dr. Sarah J. Hill, Whitin Observatory, Wellesley College, from observations made by members of the Solar Division-AAVSO. They are computed for the National Bureau of Standards and are published, in addition to this SOLAR BULLETIN, also in the NBS-CRPL SOLAR-GEOPHYSICAL DATA issues and SKY AND TELESCOPE.

The above sunspot numbers are illustrated in graphic form on page 8 of this issue. Comments on the overall sunspot activity during 1957 will appear in our January-February issue.

ZURICH PROVISIONAL SUNSPOT NUMBERS for OCTOBER, NOVEMBER, DECEMBER 1957, dependent on observations made at Zürich Observatory and its stations in Locarno and Arosa.

| day | Oct. | Nov. | Dec. | day | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|
| 1 | 244 | 265 | 216 | 16 | 289 | 180 | 189 |
| 2 | 240 | 256 | 206 | 17 | 268 | 191 | 205 |
| 3 | 249 | 230 | 218 | 18 | 228 | 225 | 227 |
| 4 | 233 | 210 | 225 | 19 | 223 | 183 | 249 |
| 5 | 230 | 200 | 258 | 20 | 235 | 208 | 284 |
| 6 | 239 | 180 | 220 | 21 | 250 | 235 | 298 |
| 7 | 224 | 175 | 164 | 22 | 255 | 275 | 302 |
| 8 | 250 | 155 | 187 | 23 | 260 | 250 | 330 |
| 9 | 274 | 190 | 137 | 24 | 285 | 236 | 345 |
| 10 | 270 | 230 | 143 | 25 | 247 | 200 | 357 |
| 11 | 220 | 224 | 150 | 26 | 310 | 198 | 366 |
| 12 | 260 | 220 | 153 | 27 | 286 | 171 | 269 |
| 13 | 246 | 185 | 155 | 28 | 340 | 235 | 260 |
| 14 | 258 | 180 | 164 | 29 | 350 | 192 | 275 |
| 15 | 250 | 177 | 170 | 30 | 330 | 162 | 274 |
| | | | | 31 | 306 | | 255 |

Mean:

OCT. : 262.9

NOV. : 207.3

DEC. : 233.9

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Note: AMERICAN RELATIVE SUNSPOT NUMBERS are listed in the year-end tabulation on page 6.

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MEAN SUNSPOT AREAS COMPUTED BY THE UNITED STATES NAVAL OBSERVATORY

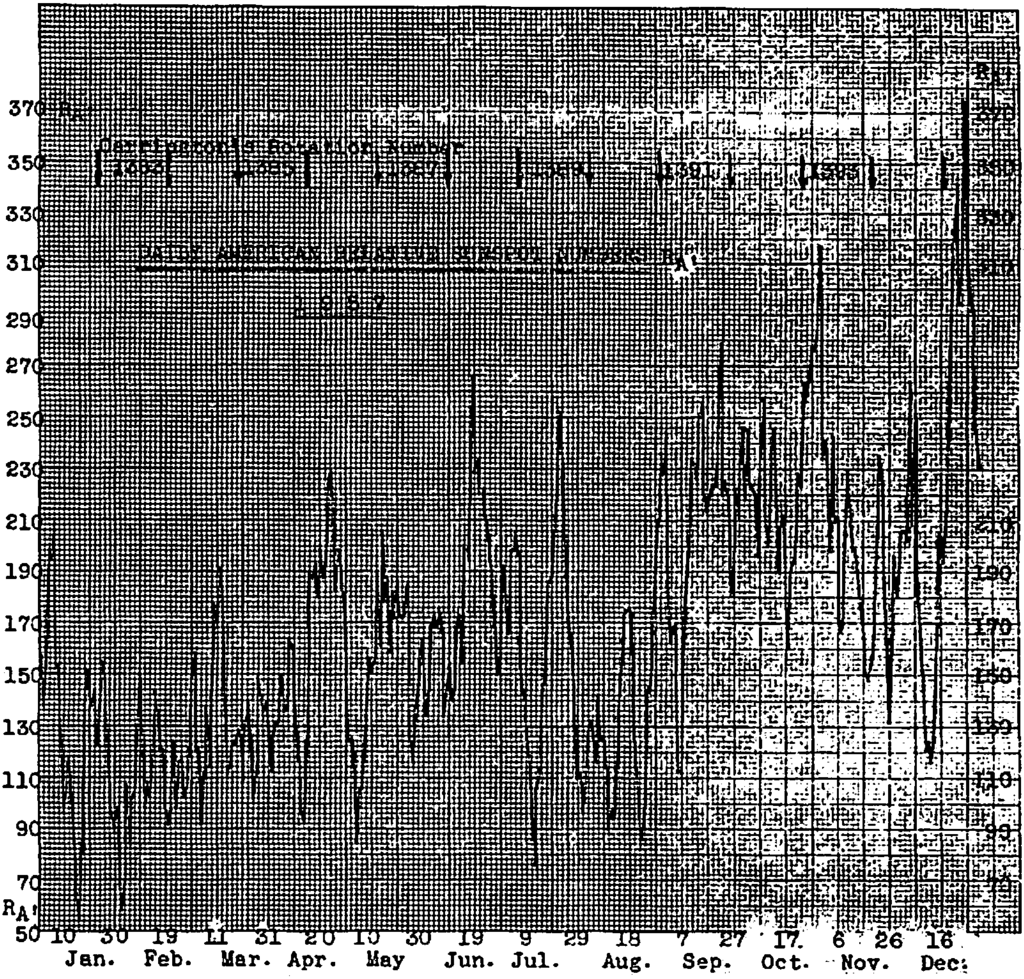
These data are based upon measurements made at the Naval Observatory on plates secured either there or at the Mt. Wilson Observatory and were reduced by Miss Winifred Sawtell Cameron. They were published in the Naval Observatory Circulars 79 through 84.

| | | | |
|---|---|---|---|
| 1957: | JANUARY* | 2971 | millionths of the visible hemisphere (27d*) |
| | FEBRUARY | 1803 | (25d) |
| | MARCH | 2224 | (29d) |
| | APRIL | 2546 | (29d) |
| | MAY | 3016 | (30d) |
| | JUNE | 5104 | (30d) |

d* = mean for x number of days

* * * * * * * * * * *

The number of sunspot groups observed daily at Mt. Wilson Observatory during the first six months of 1957 was published in our July-Aug. issue.




At the end of 1957 it can be said, unequivocally, that this very year is without comparison in the annals of solar astronomy. With the exception of sunspots with greatest area /these have been conspicuously absent/, all records in sunspot statistics have been broken.

And yet, even so, it is not possible to be certain when Sunspot Maximum occurred. Most likely the epoch of Maximum for this cycle will fall into late summer of 1957. However, it is not excluded that this epoch will be moved further to the end of the year or even into 1958! We may not know this for another six or more months.