THE AMERICAN ASSOCIATION OF VARIABLE STAR OBSERVERS

Solar Division BULLETIN

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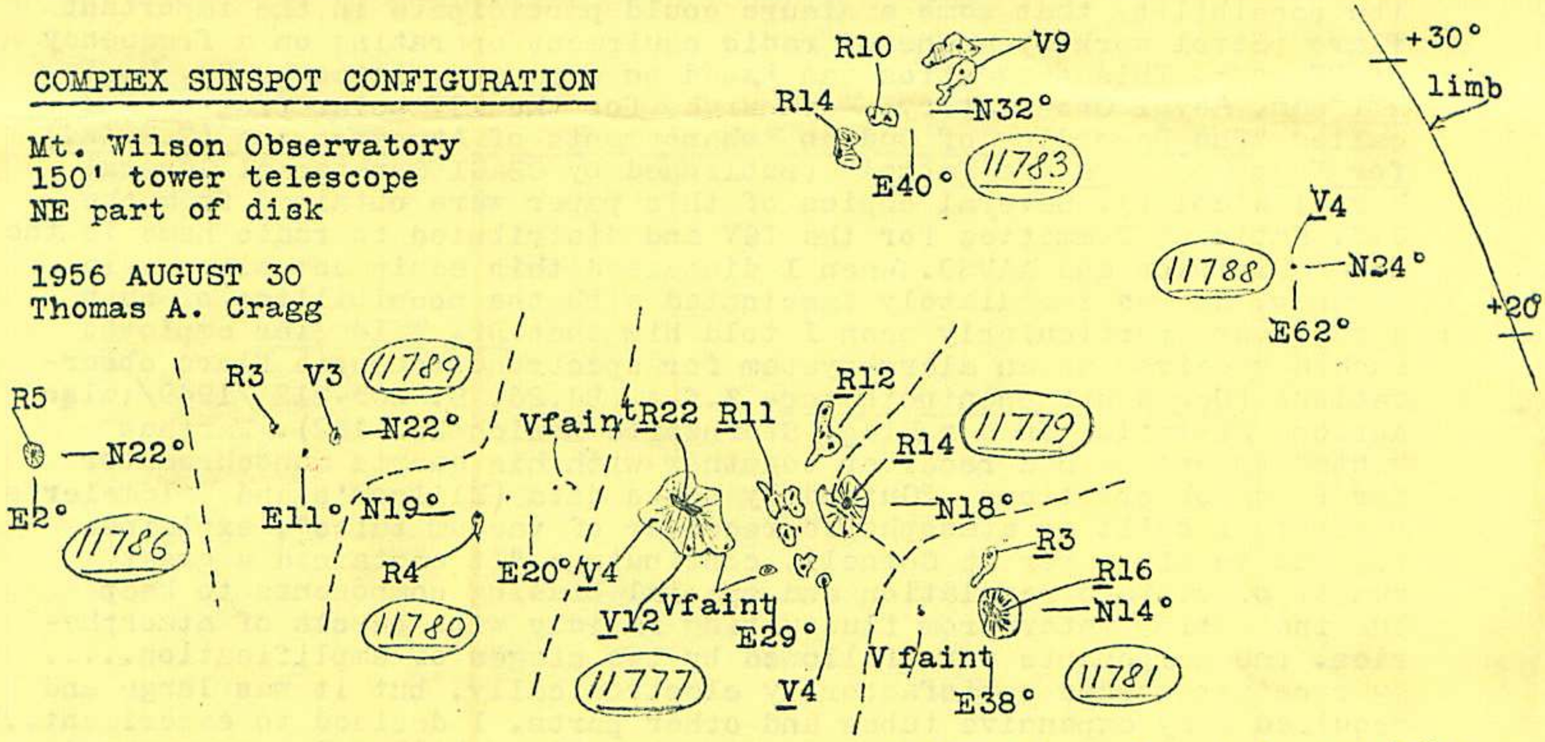
COMPLEX SUNSPOT CONFIGURATION

Mt. Wilson Observatory
150' tower telescope
NE part of disk

1956 AUGUST 30
Thomas A. Cragg



Mr. Thomas A. CRAGG wrote us: " Group 11777 (see above) looked like an ordinary bipolar /group/, but check those polarities!! After thoroughly checking into the history of this region we felt (i.e. the Mt. Wilson sol. obs. staff) 11779 was a return of 11729 -the northern one of the two large groups with CMP on Aug.5- and 11781 was a return of 11730 -the southern one of the two large groups with CMP on Aug. 5. 11777 is new and formed on the invisible hemisphere. The position of the two returns checks out very closely to where they should be, so we felt justified in grouping (them) the way we did." How many observers figured it this way??

Mr. Frank DeKINDER, Montreal, writes about another interesting group: "A remarkable event of the month /August/ was the appearance of a small group at lat. 50°N on August 16th. It furnished a clear illustration of the slower rate of rotation at lat. 50° than e.g. at lat. 30°. At its appearance there was a difference of 20° in longitude with respect to an H-group in lat. 20°. Five days later, on August 21st, the difference had increased to 30° of longitude."

(continued on page 9.)

RADIO EQUIPMENT FOR DETECTING SOLAR FLARES --

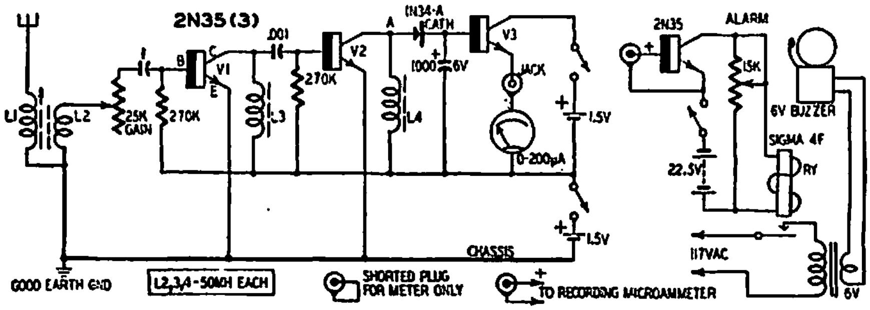
WARSHAW's FLARE INDICATOR

Introduction: One of the highlights presented at the Spring Meeting of the AAVSO at Cornell University came during the Solar Division's session when Mr. David Warshaw presented his "Solar Flare Indicator-Transistorized". At the preceding AAVSO convention (Fall 1955) this chairman discussed various methods of observing flares and stressed the possibility that some amateurs could participate in the important flare patrol work by means of radio equipment operating on a frequency of 27 kc/s. This suggestion was based on a paper written by Dr. M. A. Ellison, Royal Observatory, Edinburgh, for the IGY solar program and called "The Recording of Sudden Enhancements of Atmospherics (S.E.As.) for Purposes of Flare Patrol" (published by CSAGI Scretariat General Marcel Nicolet). Several copies of this paper were obtained from the U.S. National Committee for the IGY and distributed to radio hams in the Solar Division and AAVSO. When I discussed this equipment with David Warshaw, he was immediately fascinated with the possibilites of such a receiver, particularly when I told him that Dr. Waldmeier employed such a receiver as an alarm-system for spectroheliosopic flare observations (Der Eruptionenindikator- Z.f.A. Bd.26, S. 205-212 /1949/;also Astron. Mitteilungen der Eidg. Sternwarte Zürich Nr. 162). Warshaw wanted to use such a receiver together with his quartz monochromator for flare observations. "Guided by these data (Ellison's and Waldmeier's papers), I built an atmospheric receiver of vacuum tubes", explained Warshaw in his paper at Cornell, continuing: "It contained a great number of voltage regulation and special biasing components to keep the indicating meter from fluctuating rapidly with bursts of atmospherics. The components were followed by two stages of amplification..... My receiver worked satisfactorily electronically, but it was large and required many expensive tubes and other parts. I decided to experiment.." Thanks to this decision and Dave Warshaw's fine skill and perseverence a simple, efficient "SOLAR FLARE INDICATOR" was developed. Dr. Ellison in commenting on Warshaw's paper in "Radio Electronics" (August 1956) wrote: "Your model of the SEA indicator sounds most attractive and you have our best congratulations on its success." We can only echo this sentiment, "Congratulations to you, Dave, we have full confidence to hear more about your successful work."

There are numerous effects on Earth caused immediately (as well as with delayed action) by solar flares, the most violent, flash-like eruptions on the sun and occuring in the vicinity of active sunspots. The carriers of this solar stormishness are Ultra-Violet light, soft X-rays, corpuscles /protons, electrons/ and Cosmic rays /nucleons/, as well as the little effective visible spectrum and radio-frequency radiation. The associated changes in our atmosphere /particularly the electrified ionosphere/ cause radio-fade-outs on short waves as well as an enhacement of very long waves, besides other phenomena. Thus during flare activity the "level of thunderstorm atmospherics" originating in tropics may be received on wavelengths of about 11 km in form of a "Sudden Enhacement of Atmospherics"(=SEA) as R. Bureau discovered (1937).

S O L A R F L A R E I N D I C A T O R by DAVID WARSHAW.

(David Warshaw, Technical supervisor, American Cable and Radio Corp., published his complete paper in RADIO ELECTRONICS, August 1956, Vol.XXVII, No. 8, pp.51-53)



Schematic diagram of the solar-flare indicator and alarm system.

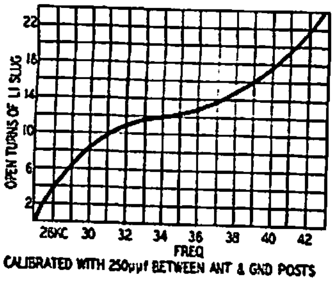
CONSTRUCTION:

A solar-flare indicator can be built at a very small cost. The parts are mounted as shown in Fig. 2. Each coil is mounted with the axis in a different plane to minimize the chances of oscillation. Use No. 14 solid-copper plastic-covered wire to keep the coils rigid. Do not solder the transistor leads-heat will affect their quality. Cut each transistor lead to about ½ inch, which then can be fastened neatly under the screws of the terminal strips. The coupling of L1 and L2 is close and the L2 mounting must be rigid. The optimum spacing between L1 and L2 depends on antenna length and the normal setting of the gain control and must be determined experimentally. Mount the output jack with an insulating or fiber washer to insulate it from the chassis.

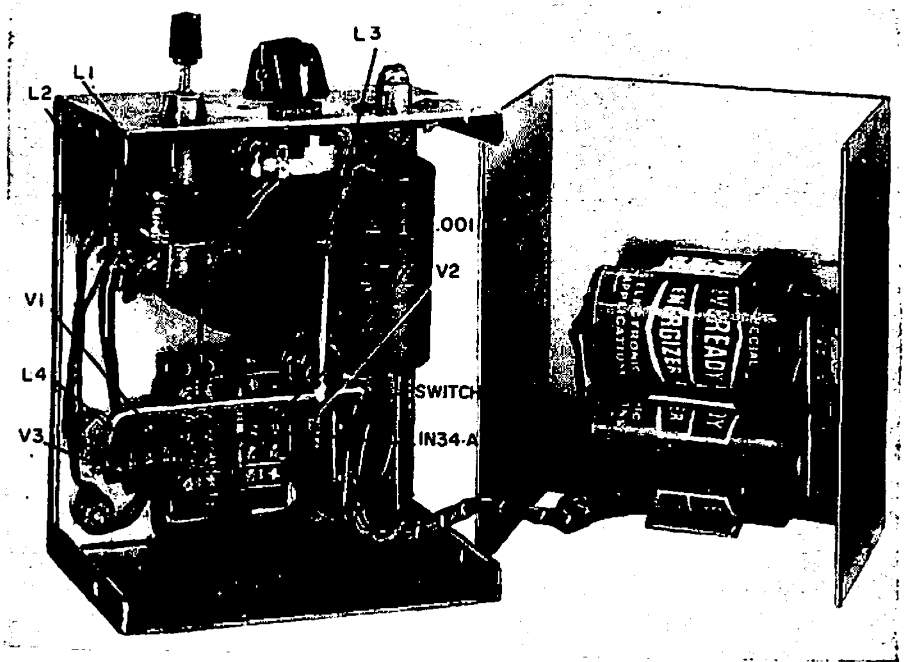
Provision was made for oscilloscope inspection by mounting a pin jack just above the on-off switch, connected to point A. This is not necessary because the parts, used and mounted as shown, should operate within the frequency range of 28 to 43 kc, using an inverted-L antenna 50 feet long(preferably along an east-west line)and 50 feet high. The calibration proved accurate even when parts were interchanged. Unwinding the L1 slug eight turns provides 30-kc reception with a bandwidth of only 200 cycles. The 30-kc setting in New York City is ideal since the nearest possible interfering frequency is 26 kc, used by the Air Force at Marion, Mass., and its bandwidth is extended but the receiver rejects this completely.

The very narrow bandwidth of the receiver is due to the high-Q ferrite coils. Only parts shown should be used. The 1,000-μf 6-volt dry electrolytic provides a charge-discharge time constant to keep the current in the dc amplifier steady between atmospheric pulses and to indicate average readings on the meter. This is also affected by the gain control, which could cause oscillation when set too high. If oscillation occurs and the meter goes off scale, turn the gain control down and flip the switch off, then on again, allowing the capacitor to discharge itself during the off period.

For visual inspection of the atmospheric pulses, an oscilloscope may be connected to point A and chassis. The scope may be used for visual alignment with a signal generator when the receiver has a very long antenna or long indoor lead-in which will increase the capacitance across L1 and thus lower the frequencies. The antenna should be about 50 feet above ground and as long as possible. At these low frequencies a very small part of a wavelength is several hundred feet long. A 50-foot-long inverted-L single-wire antenna about 50 feet high (or 200 feet long with a 500-$\mu\mu$f series capacitor) was used to produce the calibration chart. A 250-$\mu\mu$f capacitor across the antenna and ground terminals, as a dummy antenna, will also give the same figures. Every 75 feet added to the antenna length will reduce the calibration chart frequencies by roughly 5 kc.



Receiver calibration chart



Layout of indicator parts - all chokes are supported by heavy wire

At 30 kc atmospheric pulses reach approximately 250 peak microvolts per meter in daytime and 700 at night between latitudes 30° and 50°; latitudes 50° to 90° one-tenth these values; 10° to 30° twice; 0° to 10° five times. These are standard values for receivers of 10-kc bandwidth and vary as the square root of receiver bandwidth. The batteries should last for years since the current drain is less than milliampere. Observe the polarity carefully- the wrong polarity may ruin the transistors.

The receiver (sensitivity 33μv per meter for 25μamps output) may be used to indicate solar flares by the 0-200-μamp meter built into the unit or by an alarm buzzer which may be plugged into the phono type jack at the top. The alarm system consists of an additional transistor and buzzer in a small metal container which plugs into the solar-flare indicator and can be adjusted to sound off at any desired meter reading.

The recording microammeter method is best for indication and a running record can be kept for future reference. This method is quite expensive. However, if used, it should be set to run at 1 inch per hour. Whether the alarm or recorder method is used, either may be easily plugged into the unit. The switch should be turned on and the gain control set to the highest meter reading possible at night, but not during a local thunderstorm. The

The receiver will then be ready for any sudden increase after sunrise of about 100% - which may indicate a solar flare. The night readings are always two to three times higher than the daytime reading normally, because of better atmospheric propagation.

PARTS FOR SOLAR-FLARE INDICATOR:

2 - 270,000-ohm ½-watt resistors; 1 -25,000-ohm potentiometer; 1 -.001 (disc); 1 -1 (metallized paper); 1 -1,000μf (6-volt electrolytic), capacitors; 3 -2N35 transistors; 1 -1N34A diode; 1 -coil (L1), 60-120 mh (J. W. Miller 6324 width-linearity coil or equivalent); 3 -coils (L2, L3, L4), 50 mh, 110 ohms, 75 ma (J. W. Miller 6310 or equivalent); 2 -1.5-volt size-D cells; 1 - double cell holder; 1 -output jack and insulating washers 1 -meter, 0-200μamps; 1 -dpst switch; 2 -5-terminal barrier strips; 2 -binding posts; 1 -box.

PARTS FOR ALARM SYSTEM:

1 -15,000 -ohm potentiometer; 1 -2N35 transistor; 1 -phone jack; 1 -22.5volt battery; 1 -filament transformer; 1 -6-volt buzzer; 1 -relay, 115 volts ac, 2 ma or less (Sigma 4f or equivalent).

David Warshaw
544 State Street
Brooklyn 17, N. Y.

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Additional references:

M. A. Ellison: "Ionospheric Effects of Solar Flares" Publ.of the Royal Obs Edinburgh, Vol.1, No.4 (1950)

"The H_α Radiation from Solar Flares in relation to Sudden Enhacements of Atmospherics of Frequencies near 27 kc/s" - Journal of Atmospheric and Terrestrial Physics, Vol.4, Nos.4/5; 1953, pp 226-239, also in Communications from the Royal Observatory, Edinburgh, No. 6 (This paper carries the most detailed reports sofar published on SEA recordings-ed. note)

Robert R. Lee: "Radio Equipment for detecting solar flares", High Altitude Observatory of the University of Colorado, Solar Research Memorandum No.57 (Feb. 1956) (this paper refers also to recording of Sudden Cosmic Noise Absorption (SCNA) due to flares.)

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Ed. note: We all share Mr. Warshaw's enthusiasm for his "flare indicator", however some oversimplifications and errors appeared in his article in Radio-Electronics which require attention. Not all flares can be detected by recording SEAs as Dr. Ellison concludes after a 5 year run; "about 50% of Class 1 flares have associated SEAs (80% of Class 2; 100% of class 3)".He also notes:"The smaller SEAs from Class 1 flares are often difficult to distinguish if the traces are unsteady.."Interference from local sources and thunderstorms cannot be avoided. Ellison also stresses "this method does not enable one to distinguish with any useful degree of certainty between flares of the three different classes." One might also mention here that the "frequency /radio/ of hydrogen in space, 1420 mc,"as Warshaw wrote, IS NOT "emitted from flares..of radio stars", but by neutral hydrogen in interstellar gas. None of this can in the least lessen the importance of recording SEAs, nor detract from Warshaw's fine work.

SOLAR FLARES SEEN IN W H I T E L I G H T

Hardly any book on solar astronomy fails to mention the remarkable observation by Carrington and Hodgson made on September 1, 1859 (see Solar Division BULLETIN July-August 1956), and yet one never reads about any other flare seen in white light. That historical observation is, however, not unique as Mme. MARGUERITE D'AZAMBUJA, Meudon Observatory, pointed out in her article in L'ASTRONOMIE, April 1947 (Vol. 61, p.114). Following are the pertinent paragraphs in Mme. d'Azambuja's article dealing specifically with "white flares". We are indebted to Mr. Frank DeKinder, Montreal, for the translation.

"I would like to say a few words about a solar phenomenon which is very rare, although not as rare as generally thought. This phenomenon is of short duration and delicate to observe, but its occurence is of great interest in the study of sunspots and particularly important in our better understanding of terrestrial effects due to solar activity.

"I am speaking here about flares visible in white light, the classical example, and seemingly unique one, being the observation made by CARRINGTON AND HODGSON in 1859. These were the circumstances: While observing independently a large sunspot group, these two astronomers suddenly noticed coming to life a brilliant light which changed rapidly its position in the group and faded completely in five minutes. At the very moment of this apparition a minor magnetic perturbation was recorded. Several hours later a violent magnetic storm took place. According to an expression used at that time, "the sun was caught in the very act". In spite of the great interest that this observation aroused it seems that R. F. SECCHI and his assistant R. F. FERRARI, who witnessed such a flare in 1872, were the only ones untill recent times."(note: the following paragraph dealt with modern methods of observing regularly flares with spectrohelioscopes)

"Two recent observations of flares seen in white light call attention to this phenomenon again. Dr. MAURICE DU MARTHERAY of Geneva, General Secretary of the Astronomical Society of Switzerland, wrote in the society's bulletin "ORION", April 1946, No. 11, p.192: ""... on March 5th 1946, for the third time in thirtyeight years, we had the unusual opportunity to observe on a projection screen a magnificient eruption, withnessed also by two other persons, all equally estounded... Between the principal and its following component there appeared suddenly a brilliant white spot at about 12:24 Central European Time (11:24 UT). In less than one minute, at 12:25, this spot shone like a true white star between the two sunspots... At 12:26 the brilliant light was already dimming and at 12:27 there remained only a pale white spot on the photosphere."" At 11:30 UT a significant Sudden Ionsospheric Disturbance /SID/ was recorded at several stations.

"Mr. M. A. Ellison, an English astronomer who participates in the international flare patrol with his spectrohelioscope, kindly communicated to us his manuscript which will appear in the Monthly Notices of R.A.S.. He describes the great flare of July 25th 1946 (see L'Astronomie, 1946, p.215). Between measurements and drawings made at the spectrohelioscope Mr. Ellison took photographs of the solar spectrum of this disturbed region every three minutes.

"One of these photographs taken at 16:27 UT fell exactly between the times when two spectroheliograms were taken at Meudon, and on this particular photograph the continuum adjoining the bright Fraunhofer lines of the flare also brightened. This exceptional emission lasted less than six minutes. At this very moment the flare must have been visible in white /integral/ light, but apparently it was not observed by anyone. This could have been possibly because its brightness did not exceed sufficiently the brightness of the photosphere, or more probably, because nobody watched the sun at that very moment. /note: Dr. Ellison's paper appeared in Monthly Notices, 106, 500,1946/ We may therefore question if these sudden "white flares" are really as exceptional as they seem to be and therefore question if this rarity is not due to the fact that the solar disc is not under sufficient patrol.

"The points in common in these observations of /white/ flares seem to be as follows: In a sunspot group, generally a large and active one of recent formation, there appears and develops suddenly within a few seconds - at most in one minute - a very brilliant white light, far more brilliant than anything on the photosphere including faculae. This bright light may change position or may remain stationary. At the end of a few minutes - five minutes appear a maximum - the light fades and disappears. These flares must not be confused with the pink veils which one often sees over parts of sunspots."

/note: the final paragraph in Mme. d'Azambuja's article mentions the importance of flare patrol and new radio astronomy techniques, and she concludes by stressing the need to report "white flares", giving the time to the minute, duration, position and any other information./

Footnote: To the best knowledge of this writer two more white flares were recorded. One occured in the large spring 1951* group and was observed by Messrs.G. et R. PORRET, Creteil, France, and was reported by Dr. d'Azambuja in L'Astronomie** The other occured most recently during the famous February 23rd 1956 limb flare and was observed, according High Altitude Observatory"1956 Solar Activity Summary I" p.8., in Japan.

It should be clear that this is not a "maybe-yes, maybe not" phenomenon. In the few known instances it was always quite a startling event - brilliant and short-lived. With the approaching exceptionally high sunspot maximum a number of very great flares (imp. 3; 3+) will occur and some will undoubtedly show the white light continuum. Careful and very patient "patroling" of large, active spots for an extended time and repeatedly, may bare fruit of major importance to solar astronomy.

*on 18 May 1951 at 1300 **May 1951 issue p.209

H.L.Bondy

A reproduction of Dr. Maurice du Martheray's drawing of the March 5th 1946 "white flare".

SOLAR DIVISION NEWS.

For a good number of years, Mr. WILLIAM A. REID, Hawthorne, N.J., was of great assistance to the Solar Division and particularly to Neal J. Heines, our former chairman. Mr. Reid's "reduction sheets", the summaries of sunspot-number observations, were greatly appreciated by our active members. He performed this tedious work with care and carried it on in spite of many difficulties. Last spring, illness in his family forced him to give up this work for lack of his already severely curtailed free time. We are greatly indebted to William A. Reid for everything he so unselfishly did for our Solar Division.

We are grateful for your help, Bill Reid, and earnestly hope that before long you will be able again to pursue your astronomy.

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One of the most ardent coworkers of the Solar Division is Mr. DAVID W. ROSEBRUGH. Though I worked closely with our former chairman, I got the greatest inspiration from Dave. To me he is as close to an ideal amateur astronomer as humanly possible. Combining great observational talent and instrumental skill with objectivity and a keen interest in progress seems Dave's trade mark. When in 1953 the Solar Division was on rocks, Rosebrugh gave us a lift we could not get elsewhere. He undertook the most exacting work, namely the reduction of the American Relative Sunspot-Number -R_A'. This responsible task he carried on without any delay whatever until June of this year when he decided to give up his heavy schedule. Our most sincerest thanks go to David W. Rosebrugh for a job well done and best wishes for a well deserved rest. Still, we are glad to add, Rosebrugh will continue to help us with his observations, advise and cooperation.

Thanks to you, Dave, I hope that the Solar Division will never disappoint you and that it will carry on in a manner you will always be proud of to be associated with.

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We are happy to announce that thanks to Mrs. Margaret W. Mayall, Director, and our paternal organization, tha American Association of Variable Star Observers /AAVSO/ we have a new computer for R_A'.

Dr. SARAH J. HILL, Whitin Observatory, Wellesley College, Wellesley, Mass., has kindly agreed to undertake the reduction of the American Relative Sunspot-Number -R_A'. The July and August R_A' were computed by Dr. Hill. We are fortunate to have Dr. Hill to help us and grateful for this assistance.

Harry L. Bondy
Chairman, Solar Division-AAVSO

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SUNSPOT PHOTOGRAPHS.

The Federal Observatory of Zürich, Switzerland, is in charge of assembling material for an exhaustive study of the evolution of sunspots. This work for the I.A.U. will be based primarily on solar photographs. We would like to request our members who are able to take sunspot photographs to keep us informed about the DATES, TIMES and other particulars of any solar photographs they may be taking. This information will be forwarded to the Federal Observatory in Zürich so that, if it could be of any importance to fill a gap in their series, they should know about it. You need not send us your photographs.

(Continued from page 1)

Mr. Thomas A. Cragg also commented on this "very high latitude spot", saying:"Measures of plates here /at Mt. Wilson Obs./ indicate its mean latitude -just the leader- was about 49°N. It moved quite slowly across the disk, about 11½° per day. An article about this group is being prepared."

Dr. Helen Dodson, McMath-Hulbert Observatory, writing about the "High Latitude Sunspot, August 13, 1953" (P.A.S.P. Vol.65, No.386, Oct. 1953) which occured in latitude 52°N and lasted only about 2 hours, commented: "Spots with latitudes as great as 50° that last more than one day are very rare." It seems that in many ways the current solar cycle will bring about quite a number of "rare phenomena" together with a most intensive maximum. Careful solar observers will make the most out of this opportunity.

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More notes for the sunspot observer:

During this period of high sunspot activity it is often very difficult to separate properly individual sunspot groups as Mr. Cragg's example on p. 1 so clearly shows. There is no fixed, no perfect rule concerning the identity of a group. This is particularly vexing with large, extended or closely packed sunspots. The general appearance of a bipolar group's structure, its distribution more or less along lines of latitude, even the slight inclination of the groups axis (the preceding component being in lower latitude in respect to the following component) are the usual points identifying a group. In addition to this we may greatly profit by taking into consideration the evolutionary charcteristics of group types. Let me illustrate this by an example: On 25 March 1956 there was an "old type" H-group near the central meridian /lat.33°N/. It hardly changed since it came over the eastern limb- so it was pretty well "settled". On 26 March a small spot appeared just west of the old H-group. Was this now a C-type group, a case of rejuvenation as it were? This could not be decided visually, however, on the following day, the 27 March, there was another small spot further west and on the 28th this developed into a new group itself! The new group grew from an A-type (on the 25th), to B-type (on 26th) into a Cf-type (the f-indicating the f-component /following/ being more prominent/), while the very close by H-group hardly changed at all. (I was able to confirm this evolution when I visited Mr. Cragg at the Mt. Wilson Obs. and examine their magnetic polarities). It is good to examine with caution old-type groups (G-H-J) that show signs of "rejuvenation". It is a good practice to use group-type classification and compare the daily evolution before the final "group-count" is made.

Careful sunspot-projection drawings are, next to photographs, the best way to keep a close record on sunspots. This method is highly to be recommended.

It might also be mentioned that during this period we have to examine the solar disk with great care. The sunspot zones in both hemispheres are very broad, extending almost from 10° latitude to 50°. Often one can see actually four sunspot belts - two in the lower latitudes and another two in high latitudes. Such a separation is very significant for the two prominence zones which behave somewhat differently in their overall trend during the solar cycle (the one moving polewards, the other towards the equator). Faculae show an even broader distribution; there we find even a polar "facular cap" (Waldmeier).

HLB

AMERICAN RELATIVE SUNSPOT NUMBERS $R_{A'}$ for JULY and AUGUST 1956

day	Jul.	Aug.	day	Jul.	Aug.	day	Jul.	Aug.	day	Jul.	Aug.
1	154	133	9	140	110	17	73	145	25	82	170
2	147	137	10	154	102	18	68	159	26	85	182
3	143	141	11	176	123	19	58	192	27	82	209
4	133	141	12	166	126	20	70	198	28	105	175
5	142	134	13	169	122	21	75	211	29	107	203
6	151	119	14	143	127	22	80	217	30	127	175
7	151	122	15	138	125	23	73	224	31	123	175
8	152	107	16	115	137	24	73	196			

Monthly mean: JULY $R_{A'}$ = 128.5 AUGUST $R_{A'}$ = 155.7

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ZURICH PROVISIONAL SUNSPOT NUMBERS for JULY and AUGUST 1956

Deoendent on observations at Zürich Observatory and its stations in Locarno and Arosa.

day	Jul.	Aug.	day	Jul.	Aug.	day	Jul.	Aug.	day	Jul.	Aug.
1	162	140	9	150	152	17	98	131	25	90	154
2	155	148	10	157	165	18	67	173	26	100	178
3	133	146	11	162	146	19	65	192	27	116	196
4	153	149	12	216	148	20	71	217	28	104	198
5	138	152	13	192	150	21	78	224	29	108	200
6	139	149	14	156	140	22	86	237	30	130	214
7	163	151	15	156	143	23	113	213	31	140	182
8	158	140	16	144	143	24	84	232			

Monthly mean: JULY R_Z = 128.5 AUGUST R_Z = 171.1

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NUMBER OF SUNSPOT GROUPS OBSERVED DAILY AT MOUNT WILSON OBSERVATORY 1956

day	JUNE	day	JUNE	day	JULY	day	JULY	day	AUGUST	day	AUGUST
1	7	16	10	1	12	16	11	1	10	16	10
2	9	17	11	2	11	17	10	2	11	17	14
3	7	18	8	3	10	18	7	3	10	18	8
4	6	19	10	4	12	19	4	4	10	19	17
5	7	20	11	5	13	20	4	5	11	20	19
6	9	21	11	6	11	21	6	6	12	21	16
7	8	22	8	7	12	22	5	7	14	22	17
8	7	23	9	8	11	23	6	8	11	23	17
9	11	24	10	9	12	24	4	9	11	24	19
10	10	25	9	10	13	25	5	10	8	25	13
11	9	26	7	11	13	26	5	11	9	26	19
12	10	27	8	12	12	27	7	12	10	27	20
13	10	28	11	13	11	28	9	13	10	28	17
14	11	29	12	14	10	29	9	14	8	29	20
15	11	30	12	15	11	30	11	15	10	30	16
						31	12			31	13

Mean: JUNE 9.3 JULY 9.3 AUGUST 13.5