THE AMERICAN ASSOCIATION OF VARIABLE STAR OBSERVERS

Solar Bulletin

HARRY L. BONDY, EDITOR 61-30 157 ST., FLUSHING 67, N. Y.

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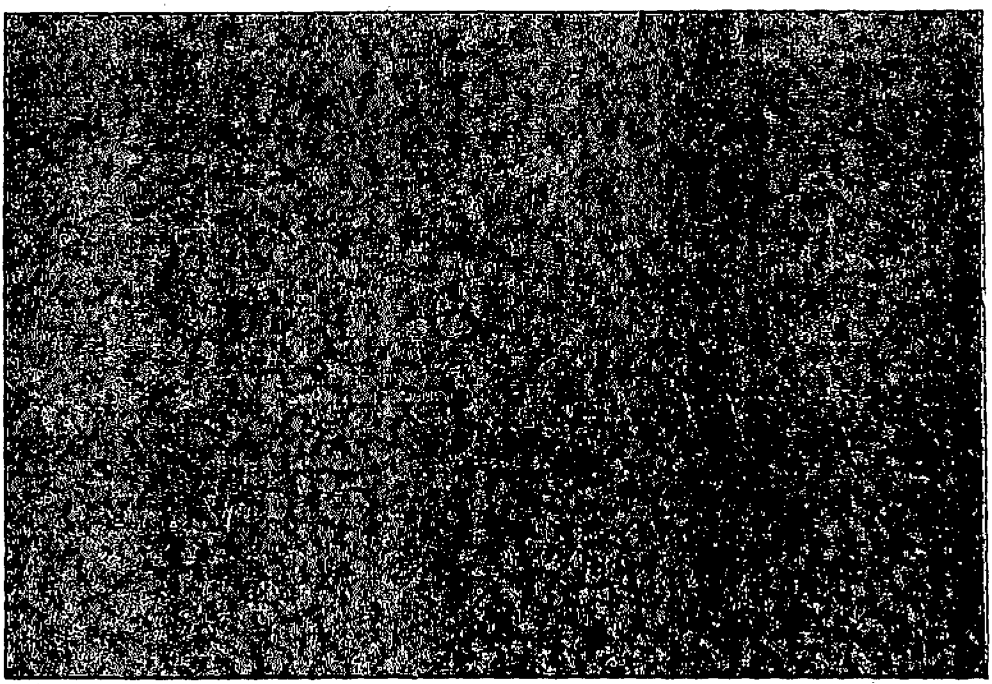

S O L A R   G R A N U L A T I O N

From a high-quality photograph taken by Dr. Martin Schwarzschild's Stratoscope camera from a height of more than 80,000 feet (about 24.4km) on 25 September 1957. Granules of about 1/4 sec. of arc may be seen.

Schwarzschild's Stratoscope photographs give us the first true view of the sun since they are taken from outside most of the earth's atmosphere /troposphere/. The photographs reveal at once more detail than all others taken from terrestrial observatories. At the same time astronomers now realize that the problem of solar turbulence is more complex than thought.

(continued on page 2)

SOLAR GRANULATION (continued from p. 1)

Fortunately, however, it is now quite clear that the perplexing and contradictory results obtained by various workers in their studies of solar granulation arise primarily from the inadequacy of atmospheric seeing conditions.

Studies of the mean diameter of granules; their frequency distribution (sizes); the assymetry of granular versus intragranular space (photometric studies did not support what appeared on photographs); the brightness ratio ; the true lifetimes; velocities in the line of sight (former spectroscopic studies gave too low velocities); differences, if any, between granulation cells outside and near sunspots and in faculae; relationship to the solar magnetic field; relation to the solar cycle (too many contradicting results until now) and many other vexing problems of this critical solar surface called photosphere.

Schwarzschild's results will be eagerly awaited. He intends additional Stratoscope tests in 1959 with perhaps even larger optics. A new epoch in astronomy has started.

One additional question was raised, as Dr. Schwarzschild again pointed out. On July 5th 1885 Janssen of France photographed the sun and secured a picture of solar granulation which is as good as any taken from 80,000 feet high. Yes, as Janssen noted: "obtenue sans intervention de la main humaine", but how?? (This photograph is reproduced in "The Sun" Kuiper ed., page 341).

(For additional information on Schwarzschild's Project Stratoscope read the January 1958 "Sky and Telescope" pp112-115.)

hlb

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Second report on
SOLAR FLARES OBSERVED AT ATHENS-GREECE
during OCTOBER, NOVEMBER, DECEMBER 1957
by

A. Caimis, Dem.P. Elias, J.H. Focas, C.J. Macris

The following observations have been effected through the Lyot-Öhman Filter for Hα delivered by the firm Halle of Berlin, mounted on a 100mm, 175 cm focal length equatorial refractor. A wide field (100 X) eyepiece is used allowing satisfactory contrast. Seeing conditions were in general good. Total observing hours = $106^h\ 22^m$.

During this time 57 flares were observed visually.

Number of flares observed

Month	1-	1	1+	2	2+	
October	23	4	0	1	0	28
November	7	4	0	3	1	15
December	7	3	0	2	2	14
	37	11	0	6	3	57

AAVSO-Solar Division sunspot-number observers in 1957:

The following members participated actively in our sunspot-number program so that the American Relative Sunspot Numbers - R_A' - may be computed for tha National Bureau of Standards. The actual reduction is done by Dr.Sarah J. Hill, Whitin Observatory, Wellesley College.

Names with an asterix denote standard observers; the numbers give the total of monthly reports received during 1957.

ADAMS* 12
ARBER (Philippines) 12
BEARDSLEY 2
BEETLE* 12
BONDY* 12

BRENNAN*(Australia) 4
von BRONSART (Germany) 8
BUCKSTAFF* 12
CAIMIS (Greece) 8
CHASSAPIS (Greece) 6

CRAGG* 12
CRUICKSHANK 5
DE KINDER (Canada) 11
DEL VECCHIO 10
ELIAS*(Greece) 12

ESTREMADOYRO V.* (Peru) 12
ESTREMADOYRO G. (Peru) 1
EVANS* (Canada) 9
FERNALD* 12
FISHER (Canada) 9

HICKS 3
ITABASHI (Japan) 12
LOEBBICK* 11
LOERDE (Canada) 12
LUFT* 12

MAHER* 12
MANDRUSIAK (Canada) 7
MOORE* 12
NICOLINI (Brasil) 12
PILCHER 1

PILSWORTH* 12
RAINE 4
ROSEBRUGH* 12
THOMAS* 12
THRUSSELL* (England) 12

TRATHEN* 12
VENTER* (South Africa) 12
WALLBILLICH 10
WELLES 10
WOMELSDORFF 12

* * * * * * * * * * * * * *

The following members participated in the "Assymetry of sunspots" for Prof. W. Gleissberg and now under Dr. Metin Hotinli's (Istanbul) direction:

BEETLE 10
CRAGG 12
ELIAS 12
ESTREMADOYRO V. 10
ESTREMADOYRO G. 1
-SOUTH HADLEY OBS. 12

FERNALD 12
PILSWORTH 12
ROSEBRUGH 12
THOMAS 12
TRATHEN 12
WELLS 10

The cooperation of the above named observers is greatly appreciated. Our sincerest thanks to all.

For the Solar Divison-AAVSO

Harry L. Bondy
Chairman, Solar Division

OUT OF OTHER PUBLICATIONS

M. KOPECKÝ, Astronomical Institute of the Czechoslovak Academy of Sciences, Ondřejov, writes about "Sunspot Groups in Heliographic Latitudes ≥ 40°" in THE BULLETIN OF THE ASTRONOMICAL INSTITUTES OF CZECHOSLOVAKIA Vol. IX., No. 1 and, compiling a catalog of such high latitude sunspot groups in the years 1874 - 1956, draws the following interesting conclusions: (free translation from the German text)

1) "The occurrence of sunspot groups in heliographic latitudes ≥40° is not an incidental event, but rather a byproduct of overall solar activity.

2) Groups in heliographic lat. ≥ 40° appear not only at the beginning of individual 11-year cycles, but predominantly at the time of high maxima of the 11-year cycles.

3) There are not only small and short lived sunspot groups in heliographic lat.≥40° but, above all during the time of maxima of the 11-year cycles, also groups with lifetimes of several days and considerable area where also numerous flares are observed.

4) All of this testifies to the fact that the secular 80-year solar cycle is not only evidenced by the number of active centers on the sun, but also by the fact that during the maximum of the 80-year cycle solar activity extends over much larger areas, since the regions of active centers expand in the direction of the sun's poles.

5) During several solar synodic rotations sunspot groups in heliographic lat.≥40° show a tendency to occur in the same areas; together with the appearance of flares in these groups, this recurrence evidences the development of "solar-activity-impulses"*.

6) The mean daily solar synodic rotation in latitudes 40° - 50° amounts to 11.9°.

*) M.N. Gnevyschev, Pulkovo, calls centers of recurrent solar activity "impulses"; these impulses suggest a deepseated origin of solar activity.

M. Kopecký lists six such instances of "impulse-regions", three of which are quite reliable, three others are possible. The one "impulse" region ranging from lat. 40°S to 45°S showed its first group on 3 May 1947 lasting 2 days; another group on 25 May /for 12 days/; the third on 1 July /for 5 days/, and last on 4 August 1947, a one-day group.

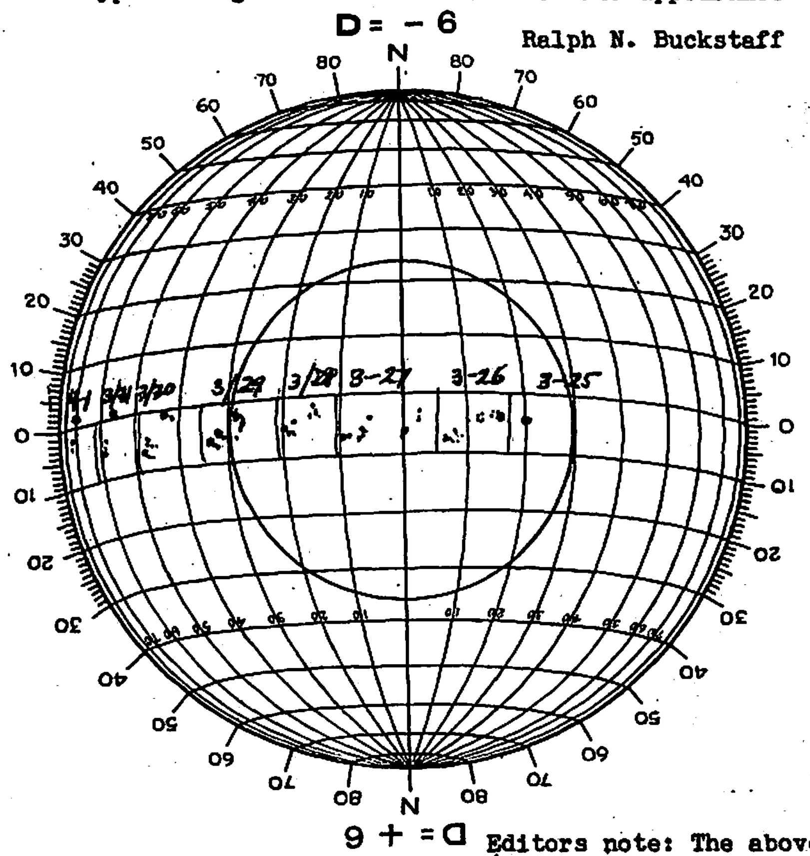
There are 48 groups listed in Kopecký's catalog including one in 1957 (lat. 45N; Jan.18-23). Checking the Mt. Wilson Observatory list of sunspot groups in 1957, an additional 21 groups appeared in lat. ≥40° since! One of these was a 4-day group (dβl) in lat.51°N (June '57); a 7-day group (dαd) and a 2-day group in July; a 12-day (lβpl); 2- and a 13-day group in September; 12-; 5-; 2- and 4-day groups in October; the others were but one-day groups. One group had a recurrence and may have thus lived for 33 days (30 Sep.-1 Nov.; Nos.12666-12743).

From the OBSERVATORY OF RALPH N. BUCKSTAFF -

EQUATORIAL SUNSPOTS

A day by day progress of my sunspot group No. 2124. Note how the Leader crossed the solar equator sometimes between March 30th and March 31st, 1958. This group seemed to develop from an A-type group to an E-type during the first 24 hours of its appearance.

Ralph N. Buckstaff



Editors note: The above group (quite likely two groups actually) showed a distinct equatorial drift, but it is not definitely certain if one of the spots did cross the equator; this would require more accurate measurements. Such crossings are very rare, but they occur.

Remarks

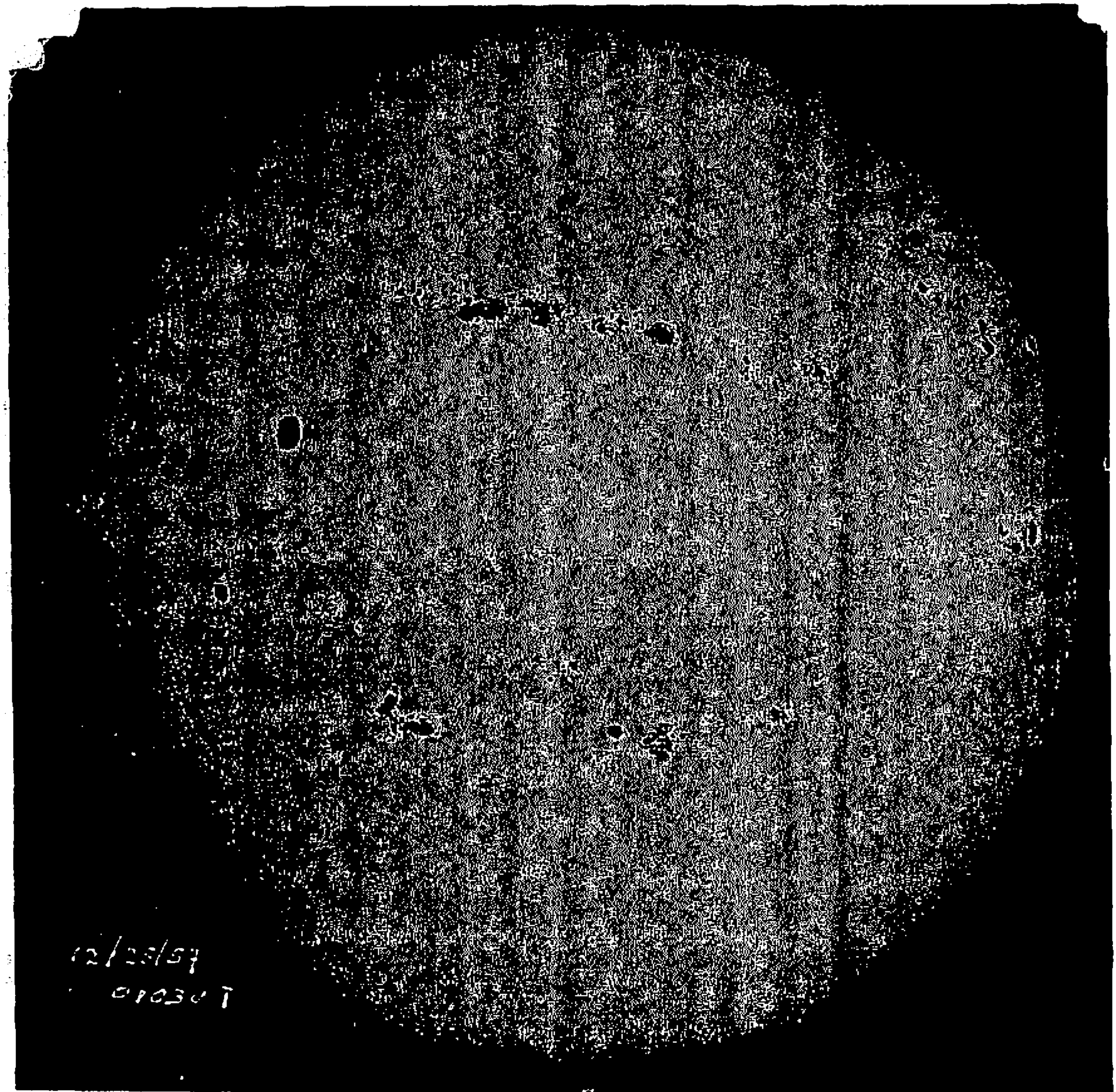
Ephemeris
Date
G. U. Time
Sky
Seeing
P
Bo
Lo
Rotation

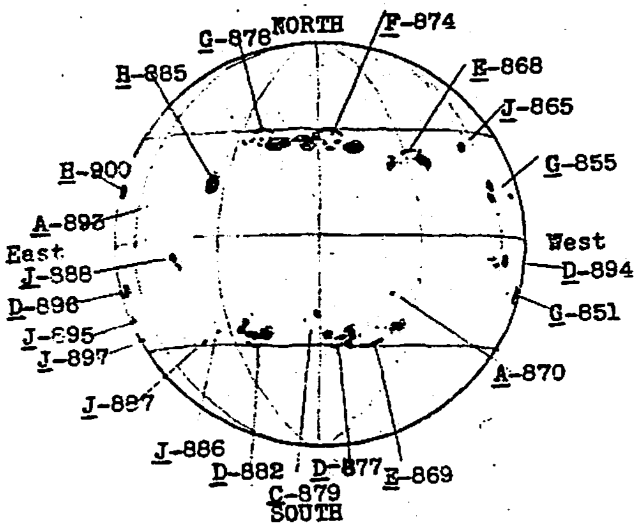
Explanation of Seeing: O Clear Sky; 1 Very thin Cirrus; 2 Light Milky Sky but detail visible; 3 Thin Stratus only darker spots Visible.

THE SUN ON 25th DECEMBER 1957 at 01:03 U. T.

A PHOTOGRAPH by HANS ARBER,

Manila, Philippines.





The SUN on 25 DECEMBER 1957

Schematic notations for HANS ARBER's solar photograph:

The letters give the Zürich sunspot types for each group. The numbers are Mt. Wilson Observatory designation, however all should be preceded by 12...(see also the drawing giving specific polarity data for the 24th December as a comparison).

Some group types as given above are borderline cases; thus the G-878 /i.e.12878/ could still be called E-type or even an extreme C; in any case this group was already in its decay. In reverse, E-869 could already be considered as G-type. Note the latter's proximity with D-877.

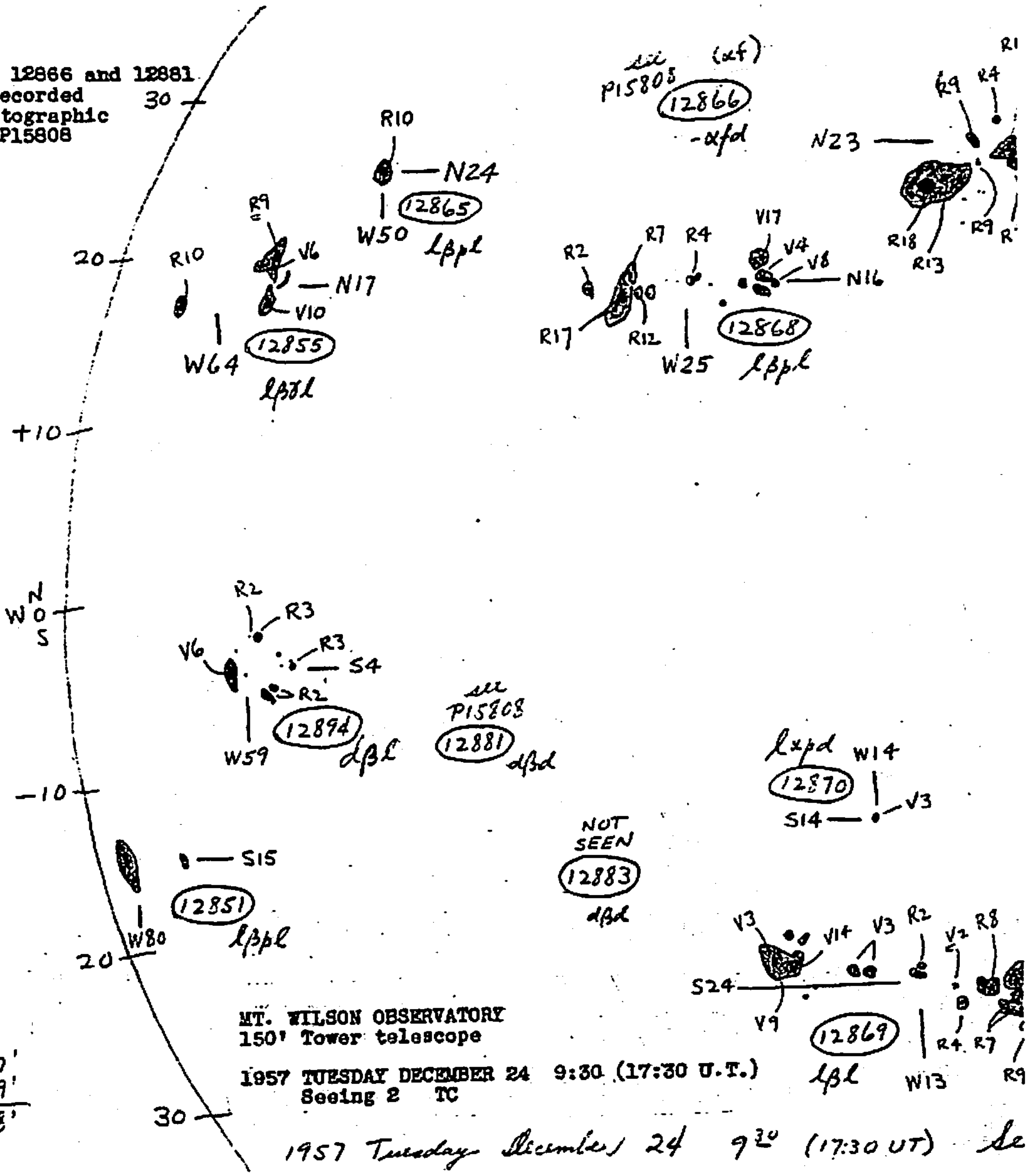
The sun of 25th December 1957 as shown in the fine photograph by HANS ARBER, Manila, Philippines, at 01:30 U.T. gives us a good illustration of the magnitude of the current solar cycle.

During the seven days between the 20th and 26th December 1957 the sun showed greater sunspot activity than ever recorded. The Zürich Sunspot Numbers, extending to 1749, exceeded 300 on five days with the highest R_Z on record i.e. 355 on the 24th and 25th

Comparably, solar radio noise on 2800 Mc/s as recorded in OTTAWA, Canada, (which independently corroborates the practical value of sunspot numbers as a solar index) reached a flux value of over 300 watts/m^2/cycles/sec. bandwidth x 10^{-22} on possibly nine days between the 20th-28th (the 25th is missing) with a maximum value of 377 on the 23rd and 370 on the 24th December.

(continued on p. 10)

Groups 12866 and 12881 were recorded on photographic plate P15808

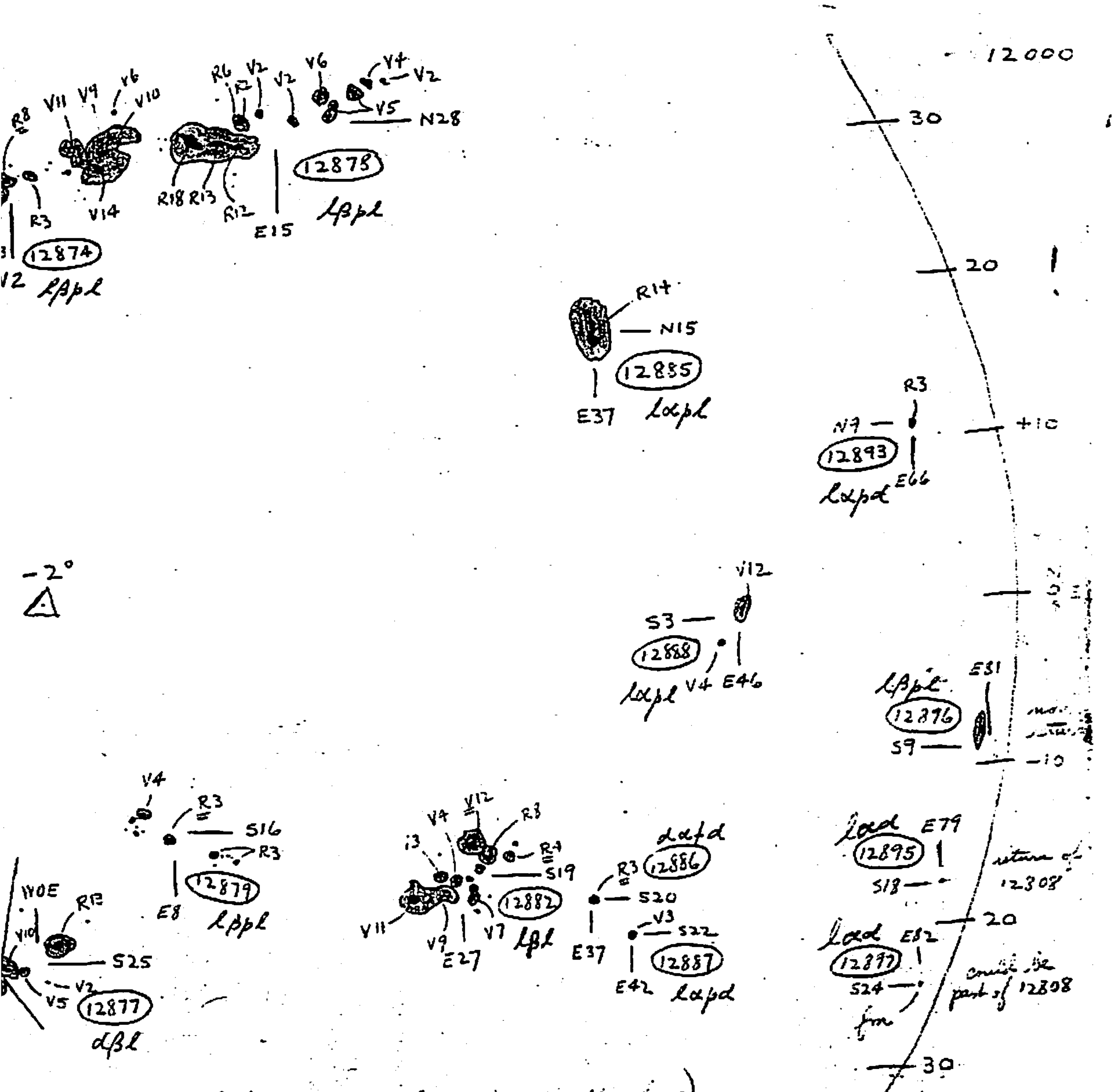


MT. WILSON OBSERVATORY
150' Tower telescope

1957 TUESDAY DECEMBER 24 9:30 (17:30 U.T.)
Seeing 2 TC

1957 Tuesday December 24 9^30 (17:30 UT) Se

342° 47'
5° 49'
336° 58'



…g 2 TC (R's all seemed systematically low)

The Mt. Wilson Observatory recorded more than 20 sunspot groups daily from the 20th through the 31st December. There were 24 specific sunspot groups on the 25th and 26 on the 26th.

The distribution of sunspots varied from almost 30° North to 28° South; the near-equatorial region ranged from 9° North to 3° South. The largest group (F-type; Mt. Wilson No. 12874) had an area of about 1300 millionths of the solar hemisphere - nothing exceptionally large.

What about other aspects of solar activity on this day? The National Bureau of Standards' monthly "Solar-Geophysical Data" reported that at least 31 flares plus 10 subflares were observed by various I.G.Y. flare patrol centers. There were two of class 2 flares. Most active was the region around the sunspot group #12894 in the western part near S 4°. The associated sunspot group was born only on the preceding day!!

Paralleling this near-western limb region was one in the Northern hemisphere -N17°- around # 12855 which had mixed magnetic polarities (βγ). Finally, the two large northern groups near the central meridian - Nos. 12874 and 12878 - showed repeated flare activity as did also the little group # 12879 in the southern hemisphere near CM. The other large southern groups showed little, if any, flare activity.

Both, the near-limb and the central regions with flares had associated "short-wave" fadeouts (SWF). There were six recorded SWF's on this day.

There were also several "solar radio noise storms". On 2800 Mc/s the National Research Council in Ottawa recorded six "outstanding events"; Cornell recorded four on 200 Mc/s and Boulder three on 450 Mc/s.

Prominence activity was minute. Meudon, France, reported only 3 minor limb prominences in the NW quadrant; two in the NE. A large filament (prominence superimposed i.e. projected on the solar disc) extended itself at N40 and between W20 and almost W60 in longitude.

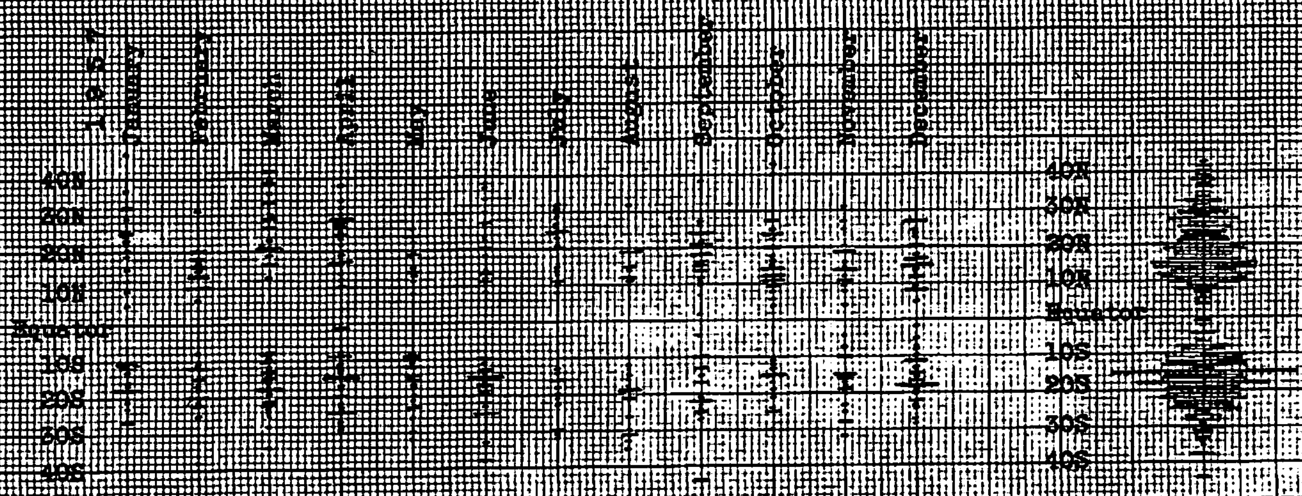
At its western limb passage the prominent regions of the central zone, both N and S, were associated with the rare yellow coronal line and with maxima in the green coronal line, thus further confirming the high extent of solar activity.

More WHITE FLARES observed.

The FRAUNHOFER INSTITUT reported in its DAILY MAP OF THE SUN two more instances of white flares. On March 23rd 1958 two of their solar stations - Freiburg and Capri - observed a 3+ flare in "integrated /white/ light". This major flare occurred in the rising F-type sunspot group roughly at 14° South and 77°West starting at 0950 U.T. and lasting for more than two hours. Maximum occurred some 20 minutes after the beginning.

The other "white flare" was observed at Freiburg on March 30th 1958 at 34N and 63E. A 1+ flare was recorded at 0806 to 1001 according to the Fraunhofer Instut's map in an E-type group.

A notation in H.L.Bondy's solar log shows a "bright area" in the central component of this same E-group. The observation was made under adverse seeing /thick cirro-stratus/ at 1606 U.T..



LATITUDE distribution of all sunspot groups recorded by RALPH N. BUCKSTAFF at his observatory in Oshkosh, Wisc. during 1957. Each small square represents one specific group. Note the large extent in latitude and the apparent short period drifting of the mean-distribution of sunspots.

DAILY AMERICAN RELATIVE SUNSPOT NUMBERS - R_A:--

for JANUARY, FEBRUARY, MARCH, APRIL and MAY 1958:

day	Jan.	Feb.	Mar.	Apr.	May	day	Jan.	Feb.	Mar.	Apr.	May
1	213	154	120	261	199	16	300	162	169	111	117
2	222	143	114	271	211	17	240	145	171	145	120
3	195	152	159	227	265	18	215	121	151	157	130
4	218	159	186	281	240	19	198	103	188	159	159
5	185	176	214	276	212	20	178	156	144	161	161
6	120	119	212	235	172	21	203	159	160	176	171
7	225	160	145	201	183	22	229	171	166	175	158
8	212	131	182	206	153	23	143	129	191	179	197
9	187	155	173	176	176	24	123	156	208	164	206
10	249	117	171	174	180	25	184	183	180	144	175
11	243	160	162	154	188	26	198	139	233	173	173
12	269	143	163	105	148	27	142	108	243	155	145
13	235	128	166	117	152	28	129	85	237	187	153
14	279	130	200	92	107	29	118		287	188	189
15	223	143	166	119	120	30	155		278	223	179
						31	144		268		190

Monthly mean: JANUARY 199.2 FEBRUARY 141.7 MARCH 187.0

APRIL 179.7 MAY 171.9

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ZÜRICH PROVISIONAL SUNSPOT NUMBERS for JANUARY, FEBRUARY, MARCH, APRIL and MAY 1958 - dependent on observations made at Zürich Observatory and its stations in Locarno and Arosa (Switzerland).

day	Jan.	Feb.	Mar.	Apr.	May	day	Jan.	Feb.	Mar.	Apr.	May
1	214	138	109	290	250	16	290	129	155	108	110
2	213	148	90	292	246	17	247	135	164	147	116
3	200	146	140	245	269	18	230	137	162	168	123
4	217	144	185	245	268	19	212	139	155	191	140
5	191	148	203	244	267	20	190	145	154	192	132
6	192	156	215	212	223	21	192	152	156	218	162
7	205	156	220	246	198	22	173	150	163	212	165
8	210	157	187	248	177	23	192	160	187	201	171
9	232	164	177	204	150	24	137	145	204	181	204
10	252	157	181	197	181	25	137	187	180	206	192
11	253	165	168	159	166	26	143	160	194	182	170
12	255	177	156	140	160	27	182	141	226	190	157
13	262	163	145	127	114	28	160	118	292	198	160
14	270	174	158	96	103	29	130		302	207	192
15	284	154	165	99	106	30	110		338	208	178
						31	132		342		181

Monthly Mean: January: 202.8; February: 151.6; March: 189.4

April: 195.0; May: 175.2

REPRINT:

Eidgen. Sternwarte Zürich (Switzerland)

Definitive Sunspot - Numbers for 1957

Day	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
1	160	108	155	140	124	158	185	144	244	236	266	230
2	189	120	164	152	121	163	194	148	225	234	250	217
3	211	102	137	135	118	180	204	162	190	242	232	230
4	224	110	128	160	106	169	235	163	173	217	214	243
5	226	110	124	138	92	159	213	158	171	219	201	266
6	252	123	147	108	138	194	226	163	160	227	182	245
7	224	138	147	138	140	170	192	157	137	234	177	190
8	207	151	144	160	150	145	152	141	172	244	158	197
9	166	157	180	163	162	168	162	121	215	267	192	152
10	153	142	186	150	195	158	135	89	240	264	226	148
11	151	136	210	121	211	140	107	96	245	232	232	151
12	155	132	224	114	204	160	93	116	253	236	231	157
13	134	122	228	143	197	178	97	104	252	244	221	161
14	121	130	175	122	214	158	136	135	251	232	210	167
15	86	142	156	162	210	225	156	157	247	264	177	174
16	100	153	146	181	196	239	184	195	252	268	179	187
17	112	140	150	202	179	252	203	197	258	251	181	205
18	143	132	147	205	185	272	218	196	273	222	185	225
19	170	123	147	207	173	274	223	186	290	217	194	249
20	170	117	122	208	182	272	238	170	302	230	207	284
21	177	123	120	214	205	265	250	138	334	237	234	299
22	193	130	137	218	159	242	255	114	302	241	263	316
23	191	132	152	226	180	232	265	108	268	254	251	343
24	209	134	145	248	186	235	265	110	238	276	238	355
25	184	139	160	251	150	208	227	132	234	240	211	355
26	168	131	170	223	132	212	206	164	215	293	199	337
27	150	141	155	215	132	220	173	181	226	280	201	275
28	141	129	152	221	143	190	158	204	242	317	215	260
29	132		154	177	162	180	142	236	242	334	215	275
30	107		172	155	179	204	159	252	224	317	184	274
31	108		145		179		150	261		299		255
Mean	165.0	130.2	157.4	175.2	164.6	200.7	187.2	158.0	235.8	253.8	210.9	239.4

Yearly Mean: 190.2

M. Waldmeier

Editor's note: The following article contains some interesting ideas on the diurnal sunrise pattern as recorded on 27 kc/s in our SEA program and first described by Bondy using as an illustration records secured by Del Vecchio (see SOLAR BULLETIN-Sept.-Oct. 1957 /Nos.133/4/ pp 3-4). The complex process of ionization in the D-layer is quite a problem for ionospheric physicists and it is hoped that Warshaw's ideas may in some way help to a better understanding of this ionization mechanism.

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IONIZED BAND MAY BE DISCOVERED FROM S.E.A. TRACINGS

By DAVID WARSHAW

Tracings of Sudden Enhancements of Atmospherics (=S.E.A.) made by SOLAR DIVISION - AAVSO stations around the 40th latitude have revealed a strange phenomenon. As described in the SOLAR BULLETIN for Sept. Oct. 1957, most S.E.A. records show a typical "sunrise pattern". About 36 minutes before sunrise there is a "dip" in the 27 kc/s trace followed by a "hump" pattern approximately 20 minutes before sunrise. This then is followed by the more pronounced "drop" which precedes and extends beyond the stations sunrise proper.

Sudden Enhacements of Atmospherics result from the increase of pulses originating in lightning storms which are reflected from the D-layer of the ionosphere as a result of some solar fleres. Ionospheric layers of various heights and electron densities are formed by ultra violet radiation from the sun. The high F_2-layer exists both day and night. It reflects more atmospheric pulses to a receiving station than the low D-layer because it is from 150 to 240 miles above the earth. Atmospheric pulses from sources 1,000 miles away require only one hop, or reflection, from the F_2-layer to reach us.

The D-layer does not exist at night but begins to take form gradually as the sun's direct rays reach the region 30 to 54 miles above the earth and begin to ionize it. Because of its relatively low height, the D-layer cannot reflect atmospheric pulses from sources 1,000 miles away with only one hump.

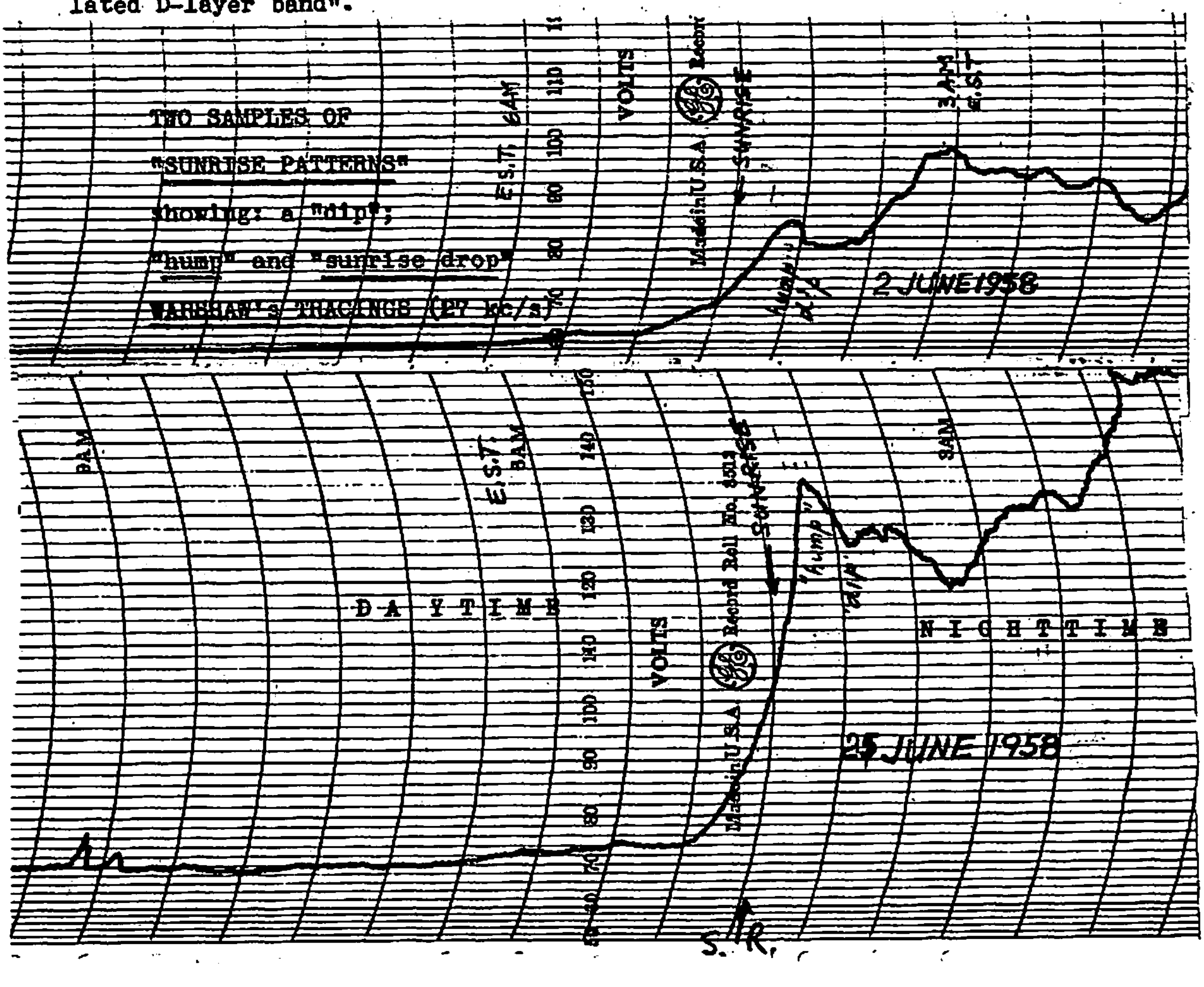
In an effort to solve the "mystery of the pre-sunrise dip and hump", a graphic analysis was attempted to reveal this process. At the New York latitude (40°N) one degree, or 4 minutes of the earth's rotation, equal about 50 miles. The following illustration is drawn to scale to show the proper relationship of the earth's surface, the D-layer, the sun's rays and the relative time scale before sunrise.

There is a possibility that a "narrow ionized band" exists some 50 miles above the earth's surface where the sun's rays first penetrate this region. This "band" has almost certainly the same electron density as that region of the actual D-layer located on the opposite side of the sunrise terminator as seen from the earth's surface. The parallel rays of the sun form a greater angle to this "band" than to the adjoining area. This detached band, because of its height above the earth, receives the ultra vioted solar radiation before the earth's surface underneath this band.

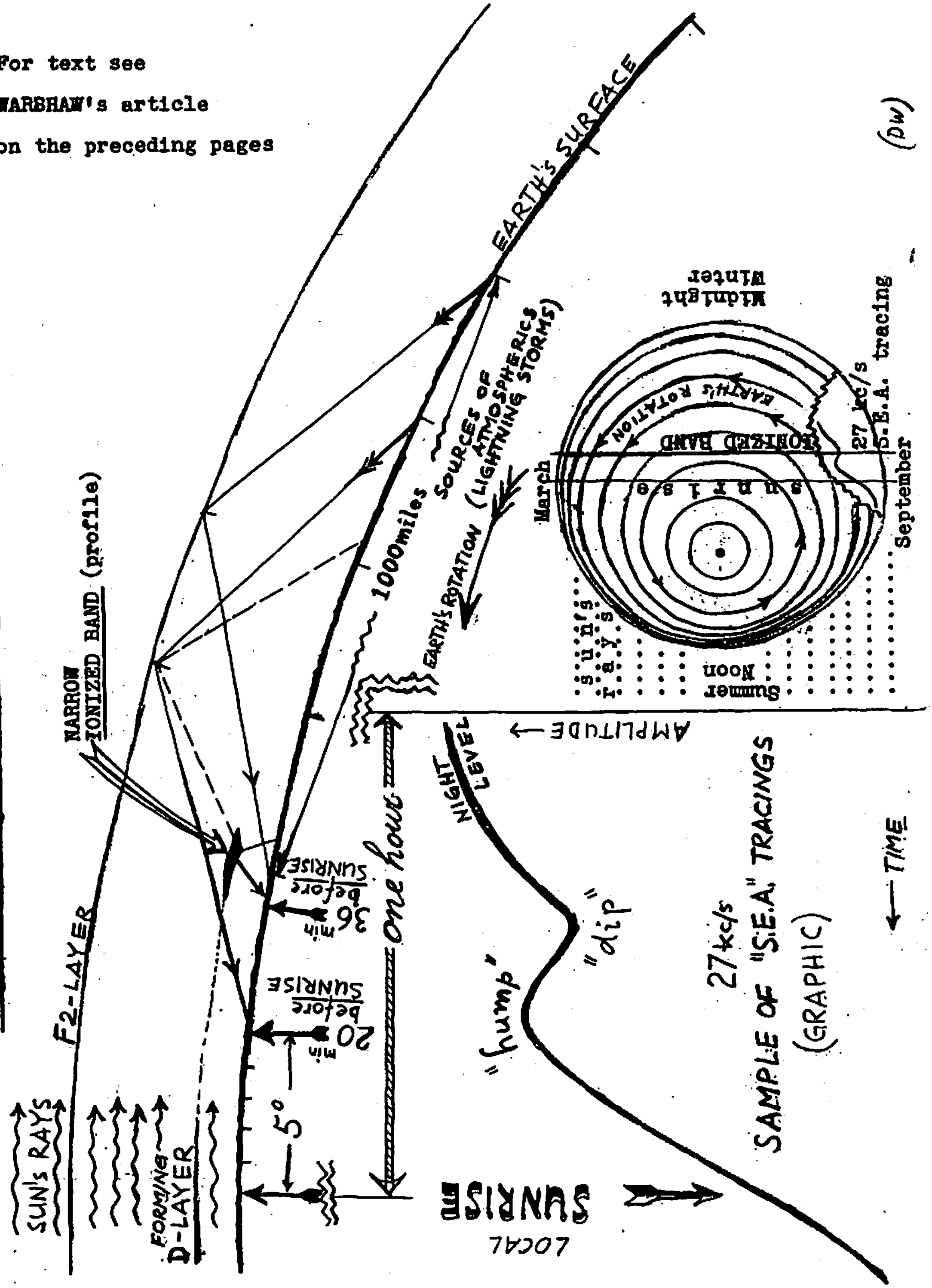
Such a "band of ionization" would interfere with reflections from the F_2 layer (as revealed by the high night-time level on the tracings), and this would result in fewer atmospheric pulses being received in the station located below. The "dip" in the tracings seems to confirm this mechanism.

About 20 minutes before the station's sunrise, when the earth has rotated to a position (as shown on p.16) where the reflections from the F_2-layer are once again possible, a "hump" appears in the tracings corresponding with this change in rotation. The slow decline in the tracings begins immediately after the precursor "hump" occurred, because the normal, day-time D-layer gradually assumes to take its form and in this process begins to interfere with the reflections from the F_2- layer.

It seems therefore quite possible that such an interfering "band of ionization" as postulated here encircles the earth in a plane at right angles to the sun's rays at about 50 miles above the earth and about 100 miles wide. This "band" may be called a "separate-" or "isolated D-layer band".



For text see
WARSHAW's article
on the preceding pages



A GRAPHIC ILLUSTRATION OF WARHAW's "ISOLATED D-LAYER BAND"