SUNSPOT ACTIVITY

DURING THREE SOLAR CYCLES

Zürich Smoothed Sunspot Numbers

(text on page 2)

→ number of months after minimum →
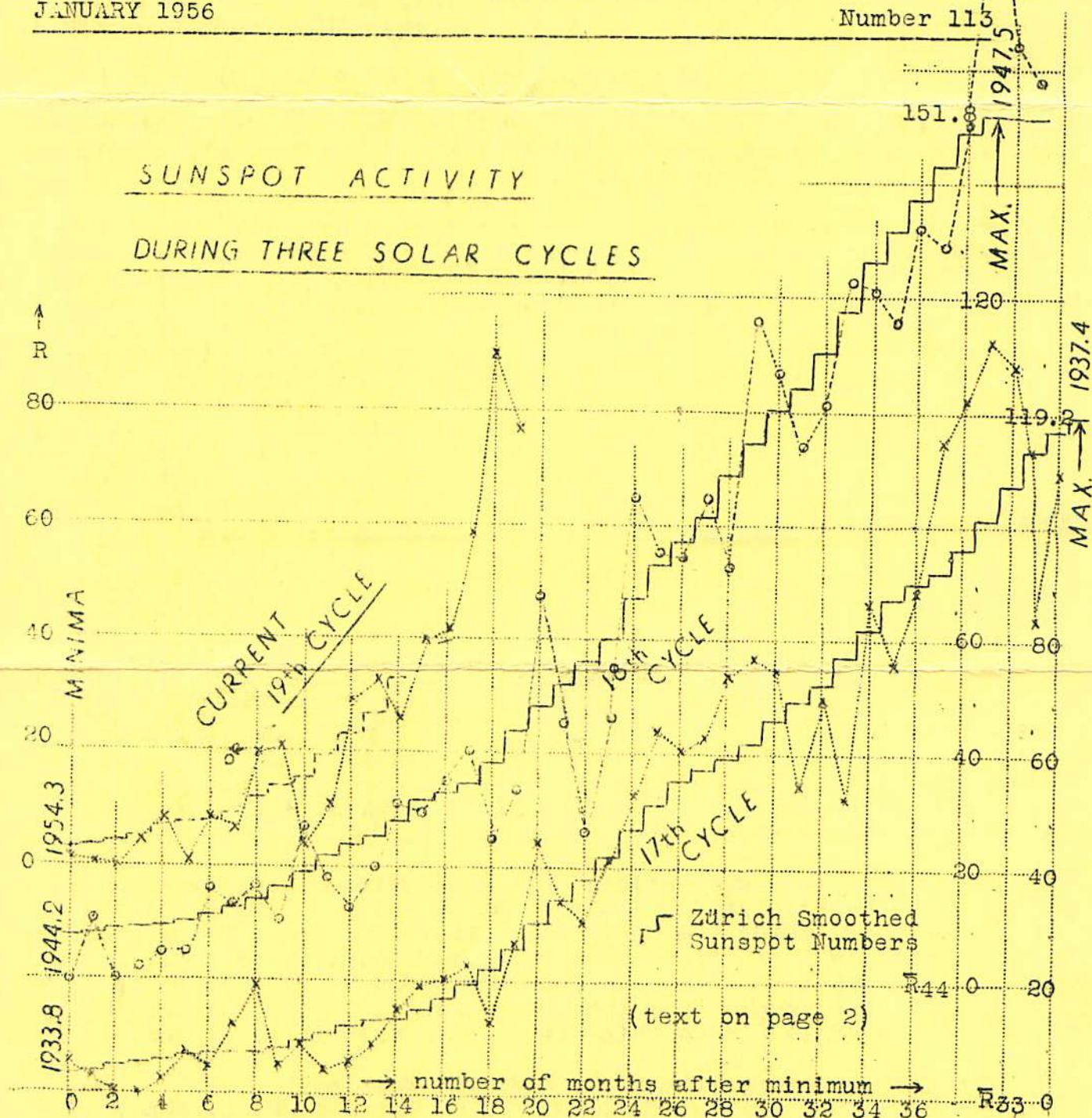
CONCERNING THE FORTHCOMING S U N S P O T   M A X I M U M

On page one are plotted Zürich sunspot numbers of the two preceding
solar cycles - Nos. 17 and 18 - and that of the current, socalled 19th
cycle. For the previous cycles both, the observed monthly "definitive"
numbers (x and o) and the "smoothed" Zürich numbers (⌐) were used (see
Solar Division BULLETIN January 1955 p.5). For the current cycle the
"provisional" numbers for 1955 were also used and thus the "smoothed"
numbers of the 19th cycle are still "provisional" /the difference with
the final numbers is always very minute/.

As can be seen from the graphs of the observed numbers (x,o) the
progress of a sunspot cycle is very irregular. For this reason the
basic course can more readily be noted from "smoothed" numbers - over-
lapping, running means covering 13 months. This procedure "washes-out"
all shortperiod "highs" and "lows" and so reveals the fundamental cycle.

A simple examination of the sunspot graphs shows that cycle 18 had
a steeper, more rapid ascend to Maximum than cycle 17. The 1933 to 1944
cycle (17) 3.6 years to reach Maximum in 1937.4 with a smoothed-number
of 119.2. The 1944 to 1954 cycle (18) took 3.3 years to reach a very
high Maximum of $\overline{R}$ = 151.8 in 1947.5 .

The prediction of the course of sunspot cycles has been a most tan-
talizing effort to many men who tried to base their predictions on the
previous cycles. This superpositioning of past data projected into the
future failed consistently. In 1935 Dr. M. Waldmeier proposed to con-
sider each individual cycle a "phenomenon by itself", a sort of funda-
mental eruption. This view is now accepted by most solar astronomers.
Furthermore Waldmeier formulated several laws of his "eruption hypo-
thesis, which all indicated that the evolution of a sunspot cycle is
essentially characterized by one parameter, namely the sunspot Maximum.
Waldmeier's main conclusion was: "The more active a sunspot cycle -
the higher its Maximum - the faster the rate of increasing spot acti-
vity from the beginning". Waldmeier was able to employ twice his hypo-
thesis and predicted very successfully the 1937 and 1947 Maxima.

A simple graphic analysis of the progress of the current cycle
seems to suggest /what Waldmeier already predicted (see SD BULLETIN
Oct. Nov. 1955)/, that the forthcoming Maximum will be very high and
will arrive very early. It seems to me, judging from sunspot activity
of the past 20 months, that the Maximum of the current cycle will occur
during spring or summer of 1957, perhaps at 1957.3 or only 3.0 years
after the 1954.3 minimum. Furtthermore, if the rate of increased spot
activity is significant, it appears that the forthcoming Maximum will
be higher (as already Waldmeier suggested) than any previous one,
perhaps even of the order of $\overline{R} \sim$ 180 ! It is hard to believe that we
should witness such unprecedented activity - but so it looks now.

There are also some suggestions that geophysical activity - geo-
magnetic, ionospheric, auroral - dependent on solar activity will be
higher than it was during the last cycle. There were more "very great
magnetic storms" and more "ionospheric storms" (H.W.Newton 1951; R.
Bureau 1952 in Relations entre les Phenomenes Solaires et Terrestres)
during the 1933-1944 cycle than during 1944-1954. If the 22-year mag-
netic polarities cycle has anything to do with this is not known.

The next few years promiss to be most interesting.

H. L. Bondy

B O O K S H E L F

REVIEW: M. A. ELLISON, Sc. D.. F.R.S.E.
         "THE SUN AND ITS INFLUENCE"
         Rounthlidge and Kegan Paul Ltd., London 1955; 235 p., $4.50

A non-technical book on the sun, solar phenomena and their
associated terrestrial effects has been long overdue, particularly
in the English speaking world. Such a book is now eminently available
in the edition reviewed here.

Dr. M. A. Ellison, Principal Scientific Officer of the Royal
Observatory, Edinburgh, England, is one of the foremost contemporary
solar astronomers. He is an authority in the important field of the
solar-terrestrial relationship.

Fortunately also for solar observers and students, Dr. Ellison
is an outstanding active observer himself and this is quite apparent
on the pages of this lucid book "The Sun and Its Influence". This
book deals straight-forward with all known solar phenomena and their
factually established geophysical effects. It does not stray into
any speculative, unfounded relationships such as the complex, ill-
understood solar-weather effect. Nor are any astronophysical hypothe-
ses advanced or pet theories propounded. But I shall not drool here
about the virtues of this book, rather let me describe its content.

Chapter I. "The Sun and its Radiation" acquaints the reader
with fundamental solar parameters-diameter, mass, distance, tempera-
ture and radiation distribution. Here also are described the atmosphe-
ric levels - the photosphere, chromosphere and corona - as well as
solar energy generation /Hydrogen fusion/ is briefly outlined.

Chapter II."The Sun's Activity" describes the known photosphe-
ric phenomena: granulation, faculae and sunspots. The characteristics
of sunspots and the 11-year cycle are described in crisp fashion and
supplemented with some fine drawings of spots by Ellison. "The Sun's
Atmosphere, Chapter III, describes chromospheric phenomena - the
plages /=chromospheric faculae/; filaments /=prominences projected
on the solar disc/; flares and limb prominences. Here we learn about
the wealth of information contained in a spectral line, its intensity,
shape, position. The corona, its structure and form are briefly de-
scribed.
Chapter IV."The Ionosphere" brings us to that terrestrial re-
gion most subject to solar activity. Prof. C. W. Allen's classical
work relating solar activity indices with ionospheric and geomagnetic
activity is here discussed. The basic problems of radio propagation
and finally the long range forecasting of ionospheric conditions from
sunspot-numbers are explained. "Solar Flares and their Terrestrial
Effects" make up Chapter V. Here we learn about the remarkable solar
flares, their behavoir and how they are recorded. Their effects on
the Earth, both, simulataneous /i.e. instantly observed/ magnetic
crochets, fade outs, enhancements of atmospherics, as well as the de-
layed magnetic and ionospheric storms and aurorae; the former due to
radiation /U.V.;X-rays/, the latter due to corpuscular streams.(These
terms are all clearly defined in the book). I do not know of any book
in English or German that describes so clearly what Ellison does in
these two chapters.

"The Sun and the Earth's Magnetism" are discussed in Chapter VI, and "The Aurora" in Chapter VII. Chapters VIII and IX comprise "Radio Waves from the Sun" and "Cosmic Rays" respectively. An "Appendix" on how certain quantities can be derived /solar mass, radiation laws, synodic rotation...), a fine Bibliography and Index conclude this fine book.

Perhaps there are some insignificant minor errors (e.g. Fig. 1.1 either the height of the chromosphere is far too exaggerated and the prominence is not, or the latter is a "very, very minor prominence" - actually prominences occur in the corona; p. 9 radiation pressure is insignificant in the Sun /see Kuiper ed. The Sun p.40), it is gas pressure that counters sol. gravitation; p. 37 Zürich's k-factor is 0.60)

This is as fine a book as anyone interested could wish to get. It is not only excellent for the amateur, but also for the professional who wishes to introduce the fundamentals of solar astronomy in lucid form before going into astro- or geophysics. For anyone interested in some of the problems that the Geophysical Year(IGY)will try to resolve this is a most timely book.

H.L.Bondy

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N E W   B O O K S :

M. Waldmeier: "Ergebnisse und Probleme der Sonnenforschung" Leipzig 1955, Akademische Verlagsgesellschaft Geest & Portig 389 p. ($12.00)

This is the second, revised and enlarged edition of a contemporary classic textbook originally published in 1941 and dealing with "the results of solar research and its problems". As a reference book it deals with all aspects of solar astronomy and astrophysics. In some parts it deals in detail with topics superficially treated in The Sun (Kuiper ed.) /e.g. solar rotation/. The new portions contain coronographic research based primaryly on Arosa results (where some of the finest records have been obtained), and solar radio emission.

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J. Gordon Vaeth: "200 MILES UP" The Ronald Press Co., 1955. 261 p. $5.00

The second, revised and enlarged edition of Vaeth's 1951 book deals extensively with present day rocket research of our atmosphere and the results sofar obtained. It is profusely illustrated with photographs of and from rockets, and explanatory drawings. It describes what is known about the atmospheric layers (troposphere, stratosphere, ozonosphere, ionosphere and exosphere); the recording instruments used: high altitude baloons and rocket research. The V-2, Aerobee, Viking as well as the "Minimum Satellite" and future problems are described and discussed . All in all, a most informative and enjoyable book.

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NOTE: Thanks to the Editors of "The Observer's Handbook", Royal Astronomical Society of Canada, the Solar Division BULLETIN will be able to supply our readers with EPHEMERIS FOR THE PHYSICAL OBSERVATION OF THE SUN in 1956 for 10¢. Write the Editor.
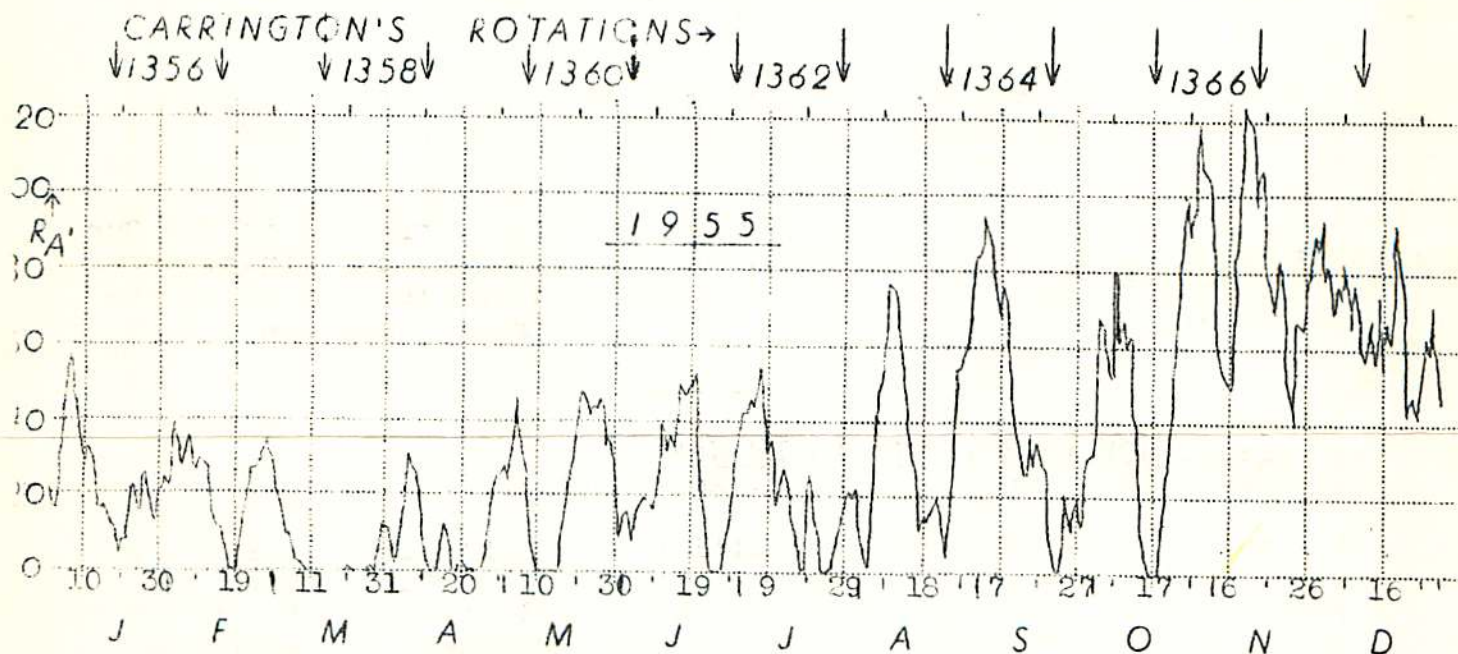
AMERICAN RELATIVE SUNSPOT NUMBERS for DECEMBER are included in the summary of daily R_A' figures for 1955 on page 6.

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ZURICH PROVISIONAL SUNSPOT NUMBERS for DECEMBER 1955 R_Z
Dependent on observations at Zürich Observatory and its
stations in Locarno and Arosa.

Day	R_Z	Day	R_Z	Day	R_Z	Day	R_Z
1...	99	9.....	60	17.....	70	25.....	53
2...	87	10.....	74	18.....	85	26.....	61
3...	75	11.....	86	19.....	89	27.....	62
4...	86	12.....	79	20.....	92	28.....	65
5...	100	13.....	71	21.....	105	29.....	72
6...	100	14.....	63	22.....	85	30.....	81
7...	84	15.....	75	23.....	64	31.....	70
8...	72	16.....	76	24.....	51		

Mean RZ for December: 77.2

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AMERICAN RELATIVE SUNSPOT NUMBERS - R_A' - 1955.

The daily American Relative Sunspot Numbers plotted in the above
graph are given on page 6. Note the 27-day recurrence which is caused
by the solar synodic rotation. Certain active regions returned again
and again. Thus region 55-K (HAO) centered around long. 165° started
in May and is still active in Jan.'56. It is interesting that this
northern region was accompanied with an almost equally active region
in the southern hemisphere.

DAILY AMERICAN RELATIVE SUNSPOT NUMBERS R_A'
1 9 5 5

Day	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
1	21	25	29	12	28	15	35	23	85	32	103	80
2	16	33	22	2	25	16	42	10	86	54	88	83
3	16	40	19	6	32	9	42	5	96	69	66	71
4	29	35	14	7	47	16	46	3	92	68	58	79
5	37	28	10	21	35	19	45	25	83	61	53	75
6	53	31	10	32	31	20	51	43	75	53	51	85
7	57	36	3	29	23	20	55	48	69	82	64	80
8	47	27	3	26	8	18	42	58	78	64	85	67
9	38	26	2	15	0	18	32	78	67	69	105	79
10	28	30	0	9	1	23	35	78	53	61	125	63
11	32	29	0	3	0	40	18	76	38	64	122	57
12	31	28	0	0	0	32	21	70	36	43	121	60
13	28	15	0	1	1	33	27	53	30	36	98	69
14	17	13	0	0	0	36	28	45	27	10	108	57
15	16	11	0	13	0	34	20	32	38	6	108	75
16	17	11	0	13	6	51	10	30	30	0	81	54
17	14	1	0	5	17	48	7	12	35	0	74	70
18	11	0	0	0	24	49	1	15	29	0	71	63
19	10	0	0	0	29	51	25	14	28	15	84	94
20	4	0	0	3	40	53	27	16	9	26	67	91
21	8	12	2	2	48	34	14	19	3	30	54	78
22	9	19	0	1	48	21	11	20	1	47	40	62
23	22	27	0	1	42	9	0	11	4	57	68	44
24	22	27	0	1	44	0	0	4	23	81	68	47
25	15	29	0	0	44	0	1	16	15	95	67	45
26	25	31	0	2	46	0	2	26	12	102	78	54
27	26	33	2	14	33	0	10	54	20	92	80	64
28	16	36	0	21	36	6	12	55	12	97	90	62
29	13		6	25	34	12	17	59	15	120	88	73
30	21		13	26	24	18	22	61	31	109	95	63
31	22		12		20		21	75	·	107		48

Mean: 23.3   4.7   21.7   23.2   40.7   82.0
       22.6   9.7   23.4   36.6   56.5   67.5

MEAN DAILY AMERICAN RELATIVE SUNSPOT NUMBER in 1955 R_A' = <u>34.6</u>

Sunspot activity in 1955 returned to a level it had in 1952. It de-
creased somewhat in the first three, four months of 1955. The low
numbers of March and April were not only due to a diminution of spot
activity, but also,(as can be seen from the graph and the rotation
marks)(p.5), solar rotation during these months brought the inactive
regions to face the Earth, while the active ones were on the invisible
hemisphere. From April on a steady increase continued till the end of
1955, reaching a peak in November with R_A' = 125, the highest value
since September 1951! There were 39 spotless days and 10 days with
R_A'=1. With the exception of perhaps some ephemeral spots, there were
only "new cycle" spots in 1955.   hlb