Reconstruction of the characteristics of sunspots in the period 1853-1879

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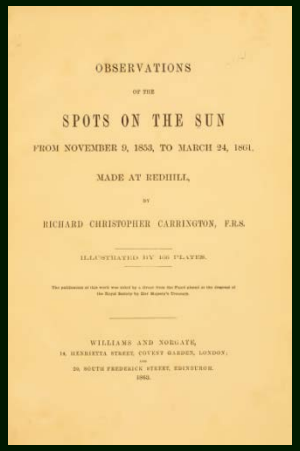
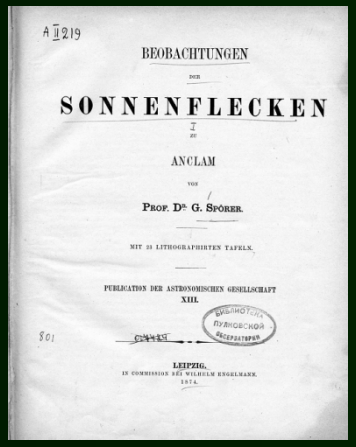
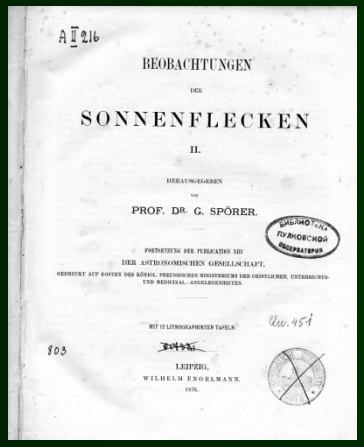
Outline

Our goal was to obtain information on individual sunspots based on sketches.
We performed digitizing catalogs sketches of sunspots R. Carrington 1853-1861 and G. Sporer 1861-1879.

- *Carrington R. C.* Observations of the Spots on the Sun from 1853 to 1861, made at Redhill, Williams and Norgate, London, 1863.
- *Spörer G.* Beobashtungen der Sonnenflecken zu Anclam, Leipzig, 1874.
-*Spörer G.* Beobashtungen der Sonnenflecken von oktober 1871-bis december 1873, Publicationen des astrophysikalischen observatoriums zu Potsdam, Nr 1, Potsdam, 1878.
-*Spörer G.* Beobashtungen der Sonnenflecken von yearen 1874 bis december 1879, Publicationen des astrophysikalischen observatoriums zu Potsdam, Nr 5, Potsdam, 1880.


OBSERVATIONS
OF THE
SPOTS ON THE SUN
FROM NOVEMBER 9, 1853, TO MARCH 24, 1861.
MADE AT REDHILL,
BY
RICHARD CHRISTOPHER CARRINGTON, F.R.S.
ILLUSTRATED BY 138 PLATES.
WILLIAMS AND NORGATE,
14, HENRIETTA STREET, COVENT GARDEN, LONDON;
AND
20, SOUTH FREDERICK STREET, EDINBURGH.
1863.


A II 219
BEOBACHTUNGEN
DER
SONNENFLECKEN
I
ZU
ANCLAM
VON
PROF. Dr G. SPÖRER.
MIT 23 LITHOGRAPHIRTEN TAFELN.
PUBLICATION DER ASTRONOMISCHEN GESELLSCHAFT
XIII.
LEIPZIG,
IN COMMISSION BEI WILHELM ENGELMANN.
1874.


A II 216
BEOBACHTUNGEN
DER
SONNENFLECKEN
II.
HERAUSGEGEBEN
VON
PROF. DR. G. SPÖRER.
FORTSETZUNG DER PUBLICATION XIII
DER ASTRONOMISCHEN GESELLSCHAFT.
GEDRUCKT AUF KOSTEN DES KÖNIGL. PREUSSISCHEN MINISTERIUMS DER GEISTLICHEN, UNTERRICHTS- UND MEDICINAL-ANGELEGENHEITEN.
MIT 12 LITHOGRAPHIRTEN TAFELN.
LEIPZIG,
WILHELM ENGELMANN.
1876.

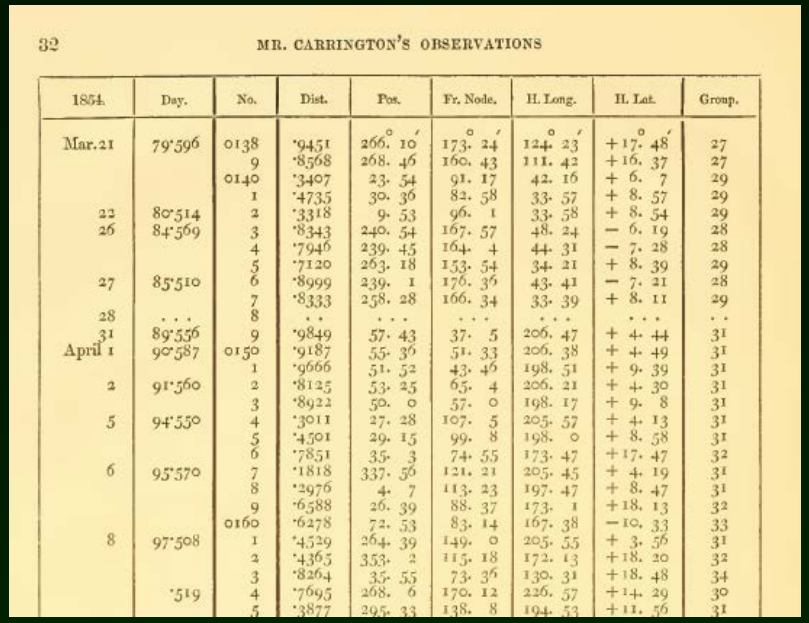

PUBLICATIONEN
DES
ASTROPHYSIKALISCHEN OBSERVATORIUMS
ZU POTSDAM.
Nr. 1.
ERSTEN BANDES ERSTES STÜCK.
BEOBACHTUNGEN DER SONNENFLECKEN
VON OCTOBER 1871 BIS DECEMBER 1873.
VON
PROFESSOR DR. G. SPÖRER.
POTSDAM, 1878.
IN COMMISSION BEI WILHELM ENGELMANN IN LEIPZIG.


PUBLICATIONEN
DES
ASTROPHYSIKALISCHEN OBSERVATORIUMS
ZU POTSDAM.
Nr. 5.
ZWEITEN BANDES ERSTES STÜCK.
BEOBACHTUNGEN DER SONNENFLECKEN
VON JANUAR 1874 BIS DECEMBER 1879.
VON
PROFESSOR DR. G. SPÖRER.
POTSDAM, 1880.
IN COMMISSION BEI WILHELM ENGELMANN IN LEIPZIG.

Types of data.

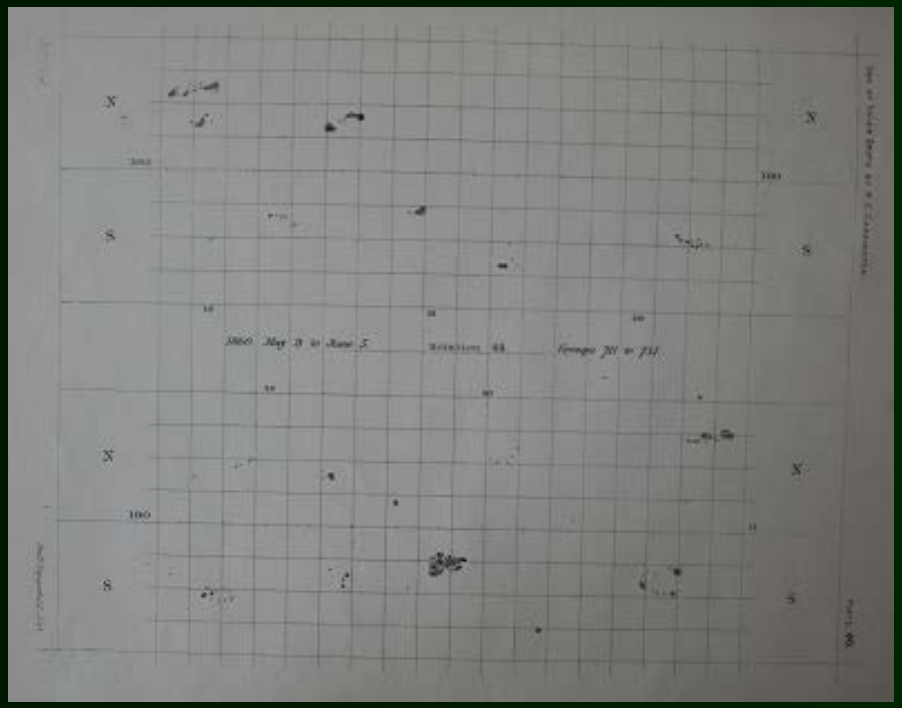
R. Carrington

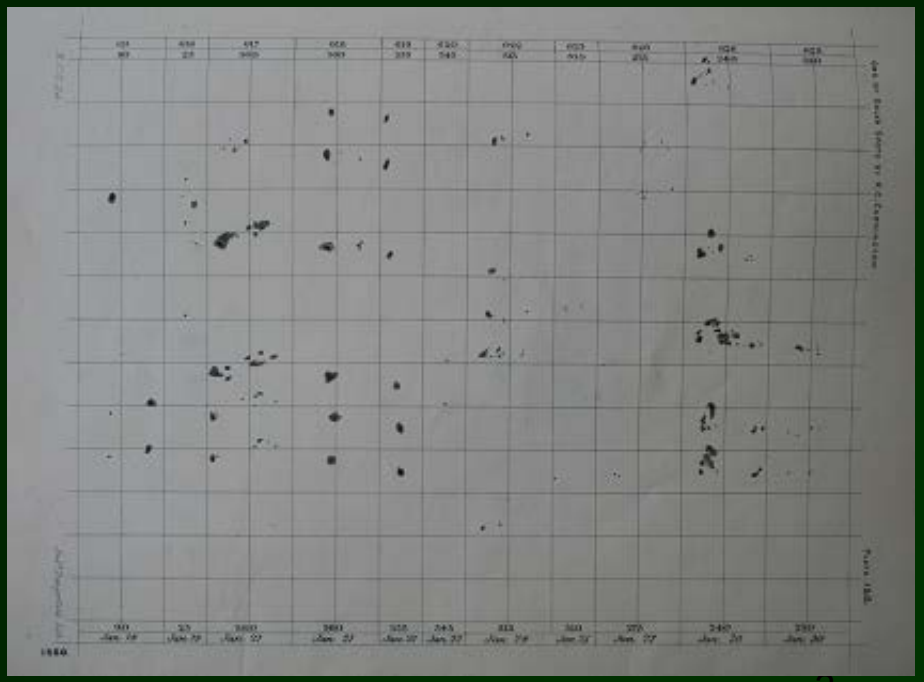
1. Tables of observations.
2. Synoptic maps.
3. Sketches of individual spots.



32 MR. CARRINGTON'S OBSERVATIONS

1854.	Day.	No.	Dist.	Pos.	Fr. Node.	H. Long.	H. Lat.	Group.
				° ′	° ′	° ′	° ′	
Mar. 21	79·596	0138	·9451	266. 10	173. 24	124. 23	+17. 48	27
		9	·8568	268. 46	160. 43	111. 42	+16. 37	27
		0140	·3407	23. 54	91. 17	42. 16	+ 6. 7	29
		1	·4735	30. 36	82. 58	33. 57	+ 8. 57	29
22	80·514	2	·3318	9. 53	96. 1	33. 58	+ 8. 54	29
26	84·569	3	·8343	240. 54	167. 57	48. 24	− 6. 19	28
		4	·7946	239. 45	164. 4	44. 31	− 7. 28	28
		5	·7120	263. 18	153. 54	34. 21	+ 8. 39	29
27	85·510	6	·8999	239. 1	176. 36	43. 41	− 7. 21	28
		7	·8333	258. 28	166. 34	33. 39	+ 8. 11	29
28	. . .	8	. .	. . .	. . .	. . .	. . .	. .
31	89·556	9	·9849	57. 43	37. 5	206. 47	+ 4. 44	31
April 1	90·587	0150	·9187	55. 36	51. 33	206. 38	+ 4. 49	31
		1	·9666	51. 52	43. 46	198. 51	+ 9. 39	31
2	91·560	2	·8125	53. 25	65. 4	206. 21	+ 4. 30	31
		3	·8922	50. 0	57. 0	198. 17	+ 9. 8	31
5	94·550	4	·3011	27. 28	107. 5	205. 57	+ 4. 13	31
		5	·4501	29. 15	99. 8	198. 0	+ 8. 58	31
		6	·7851	35. 3	74. 55	173. 47	+17. 47	32
6	95·570	7	·1818	337. 56	121. 21	205. 45	+ 4. 19	31
		8	·2976	4. 7	113. 23	197. 47	+ 8. 47	31
		9	·6588	26. 39	88. 37	173. 1	+18. 13	32
		0160	·6278	72. 53	83. 14	167. 38	−10. 33	33
8	97·508	1	·4529	264. 39	149. 0	205. 55	+ 3. 56	31
		2	·4365	353. 2	115. 18	172. 13	+18. 20	32
		3	·8264	35. 55	73. 36	130. 31	+18. 48	34
	·519	4	·7695	268. 6	170. 12	226. 57	+14. 29	30
		5	·3877	295. 33	138. 8	194. 53	+11. 56	31



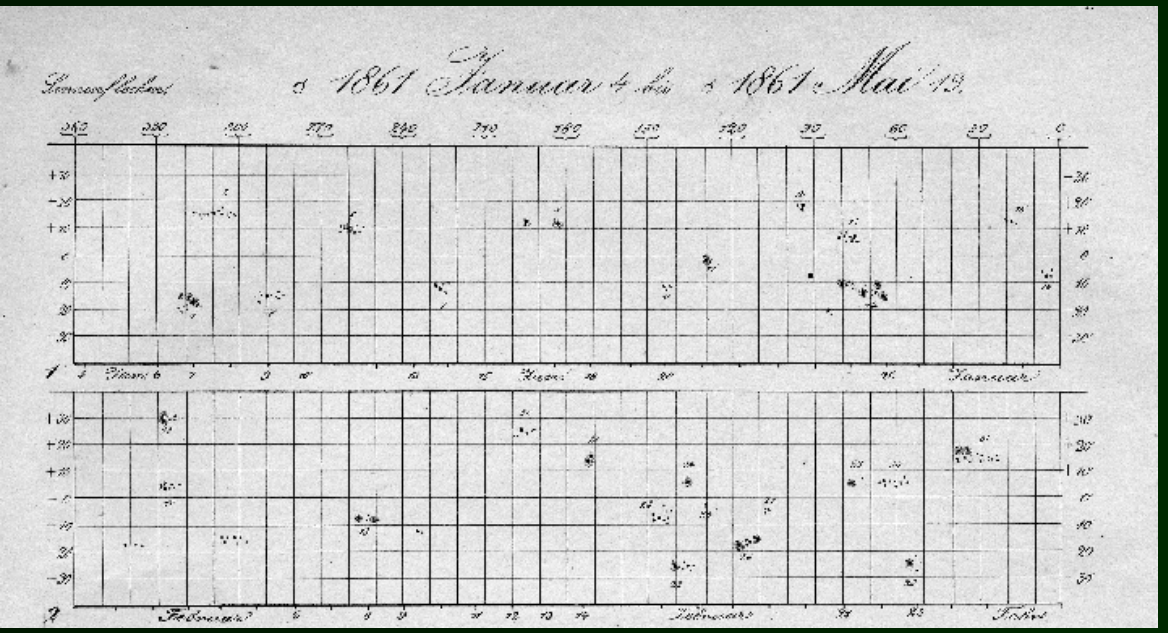


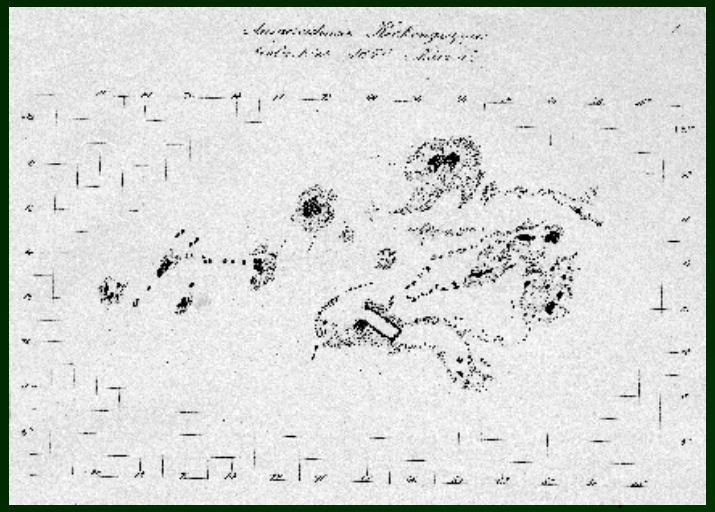
Types of data.

G. Sporer

1. Tables of observations.
2. Synoptic maps.
3. Sketches of individual spots.

No.	1861	p	φ	hel. φ	l	L	b	
				2te Rotationsperiode				
	Febr. 7 kleine Flecke					342.6	− 18.0	Carr. No. 917
18	Jan. 31. Febr. 9 kleine Gruppe, dann vergrössert					328	− 30	Carr. No. 918
17	Gruppe max. Febr. 8.					327	+ 5	Carr. No. 919
	kleine Flecke					303	− 14	Carr. No. 920
19	Gruppe von mehreren Flecken					253	− 8	Carr. No. 921
	einige Flecke					231	− 12	Carr. No. 922
20	Gruppe, Febr. 9 zahlreich, dann vermindert					196	+ 24	Carr. No. 923
21	Febr. 9.539	57° 29′	15′ 26″	71°70	86°74	169.6	+13.7	Behofter Fleck.
	13.577	23 15	7 19	26.70	142.76	169.5	+13.8	
	17.526	282 56	10 24	39.52	198.25	167.2	+13.8	Carr. No. 924
23	Gruppe mit behoften Theilen					147	− 7	

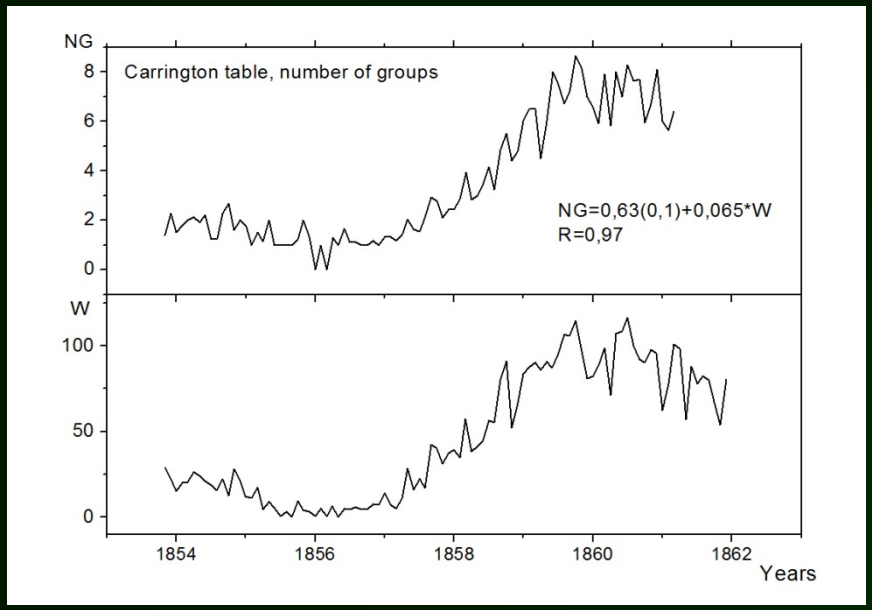




Tables of observations.

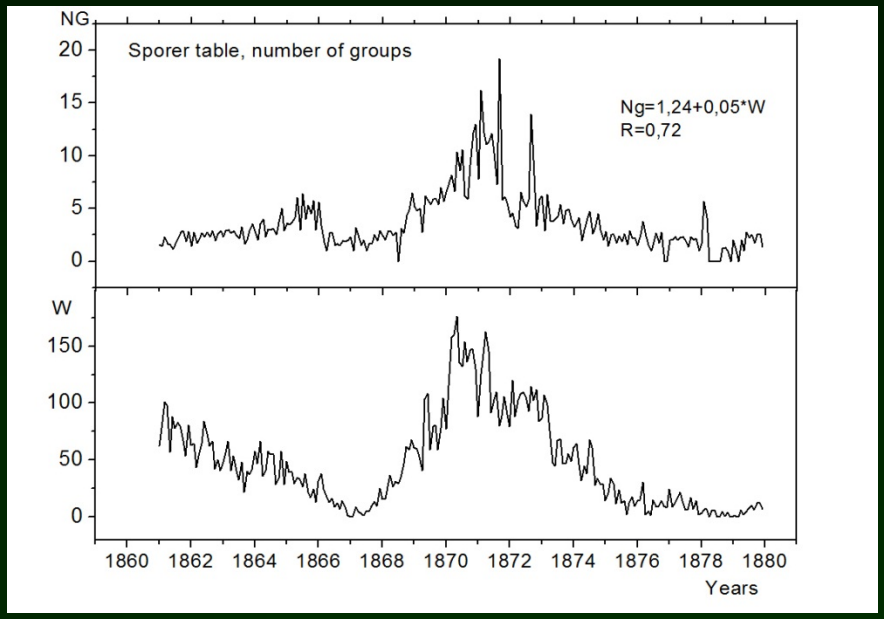
Comparison of the number of sunspot groups with an index of sunspots

R. Carrington



The number measurement of sunspot groups: 3069

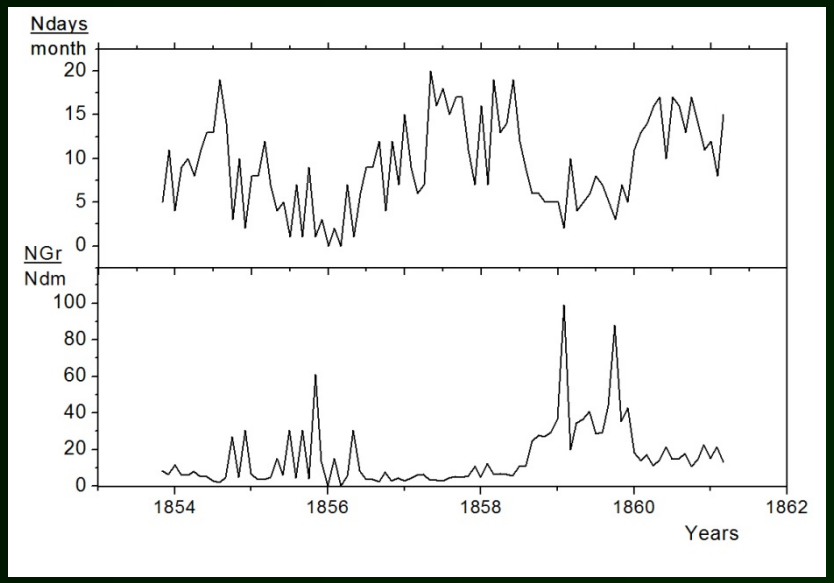
G. Sporer



The number measurement of sunspot groups: 10016

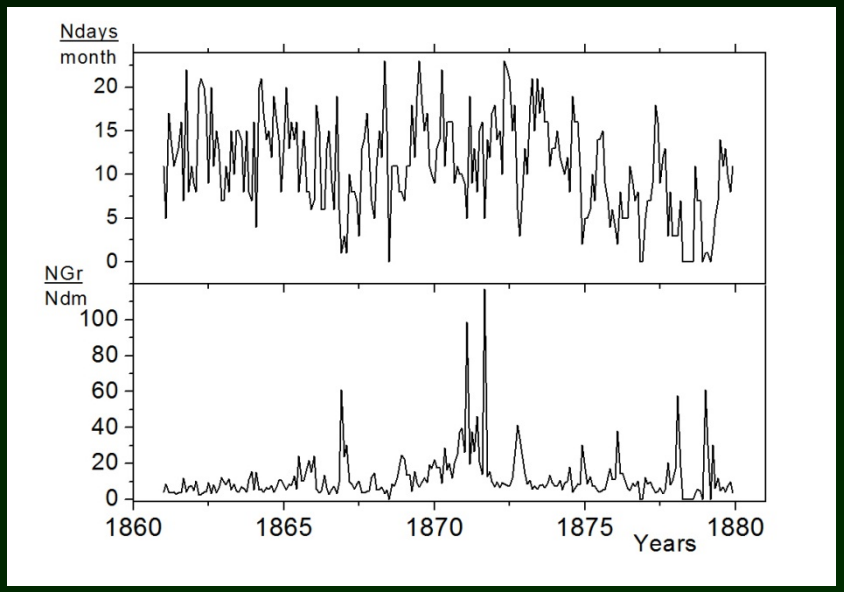
Tables of observations.
The number of days of observation per month.

R. Carrington



The number of observation days: 827
Mean: 9.29

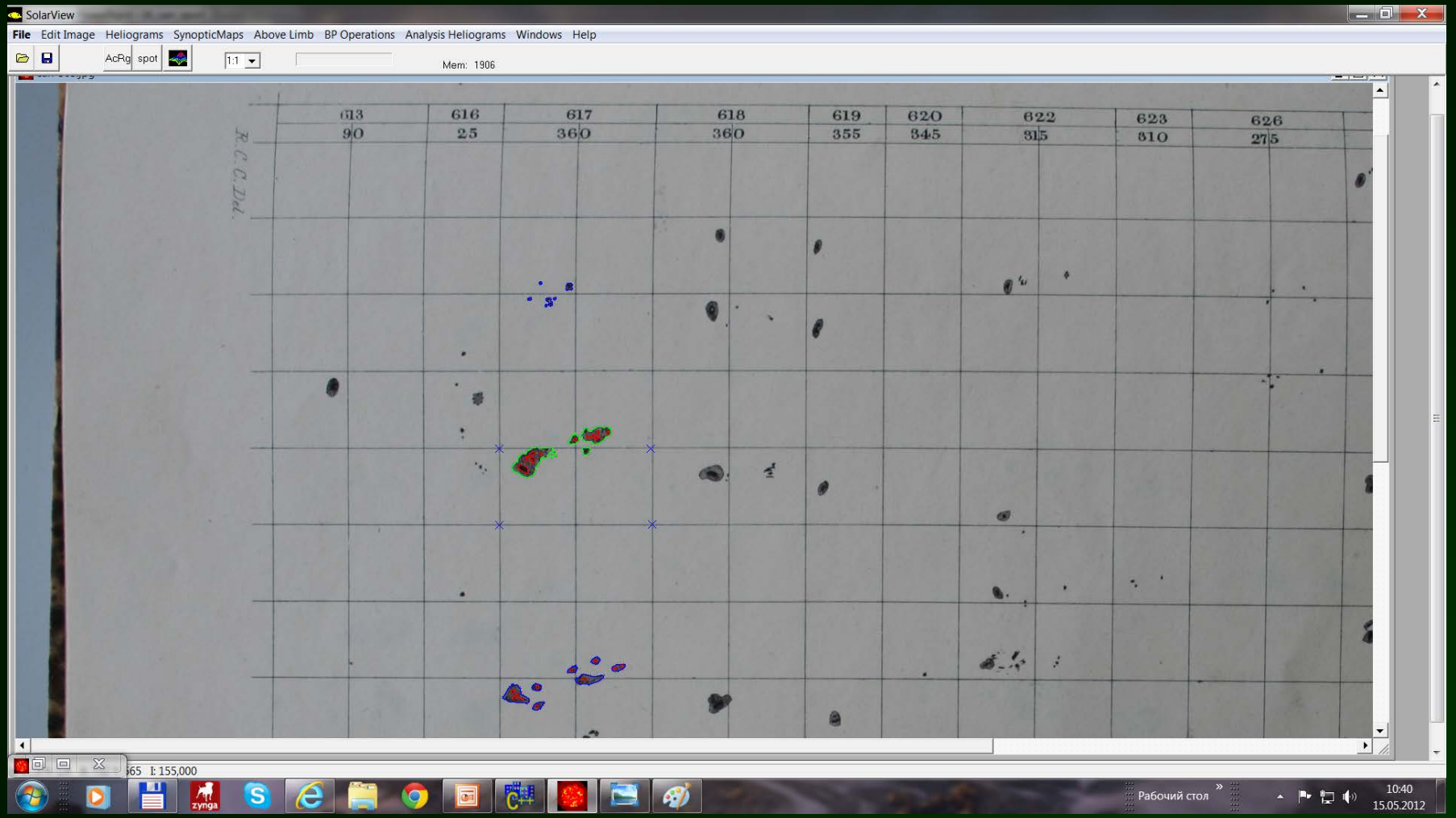
G. Sporer



The number of observation days: 2506
Mean: 10.99

Graphic data

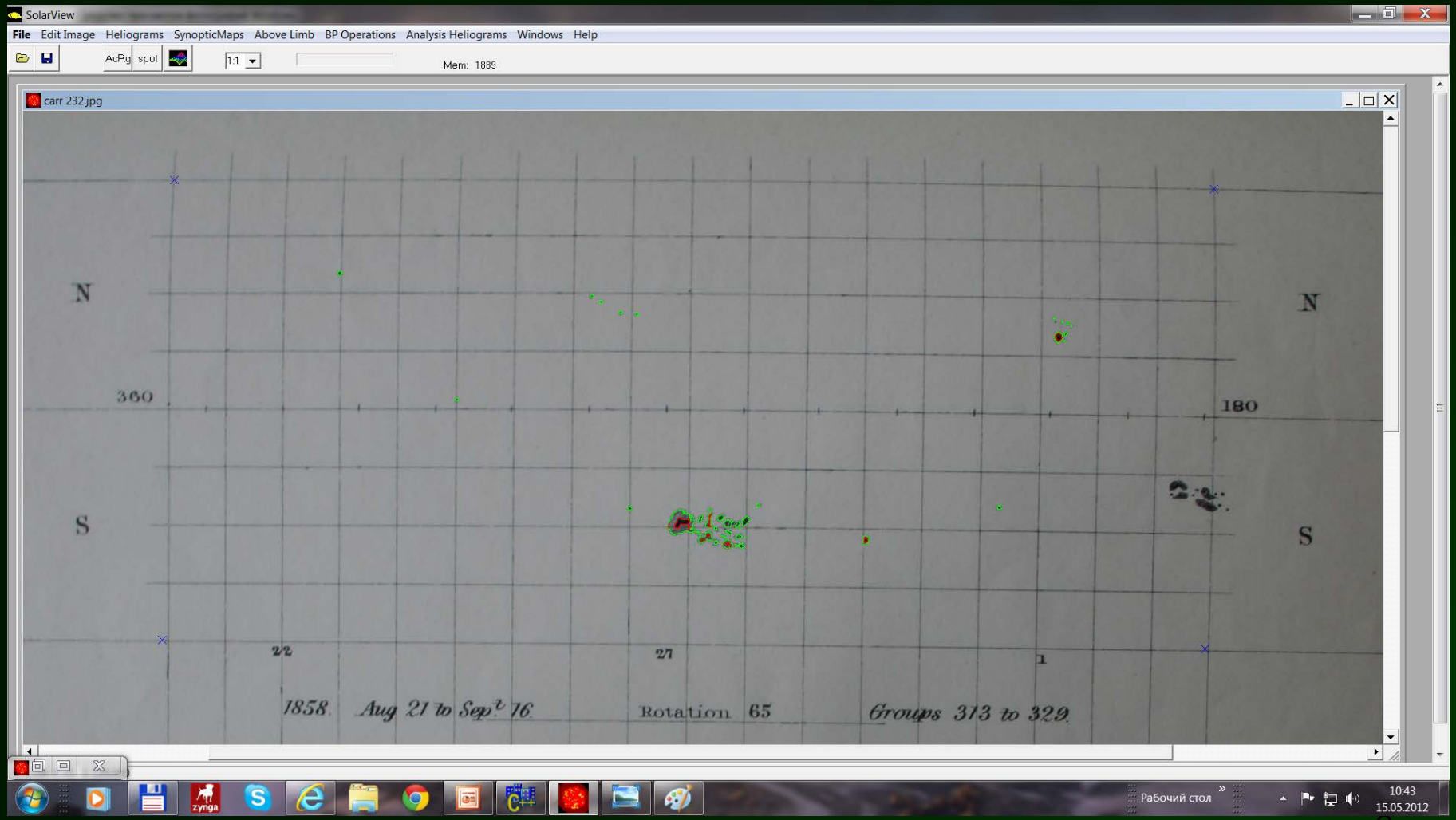
Carrington daily data



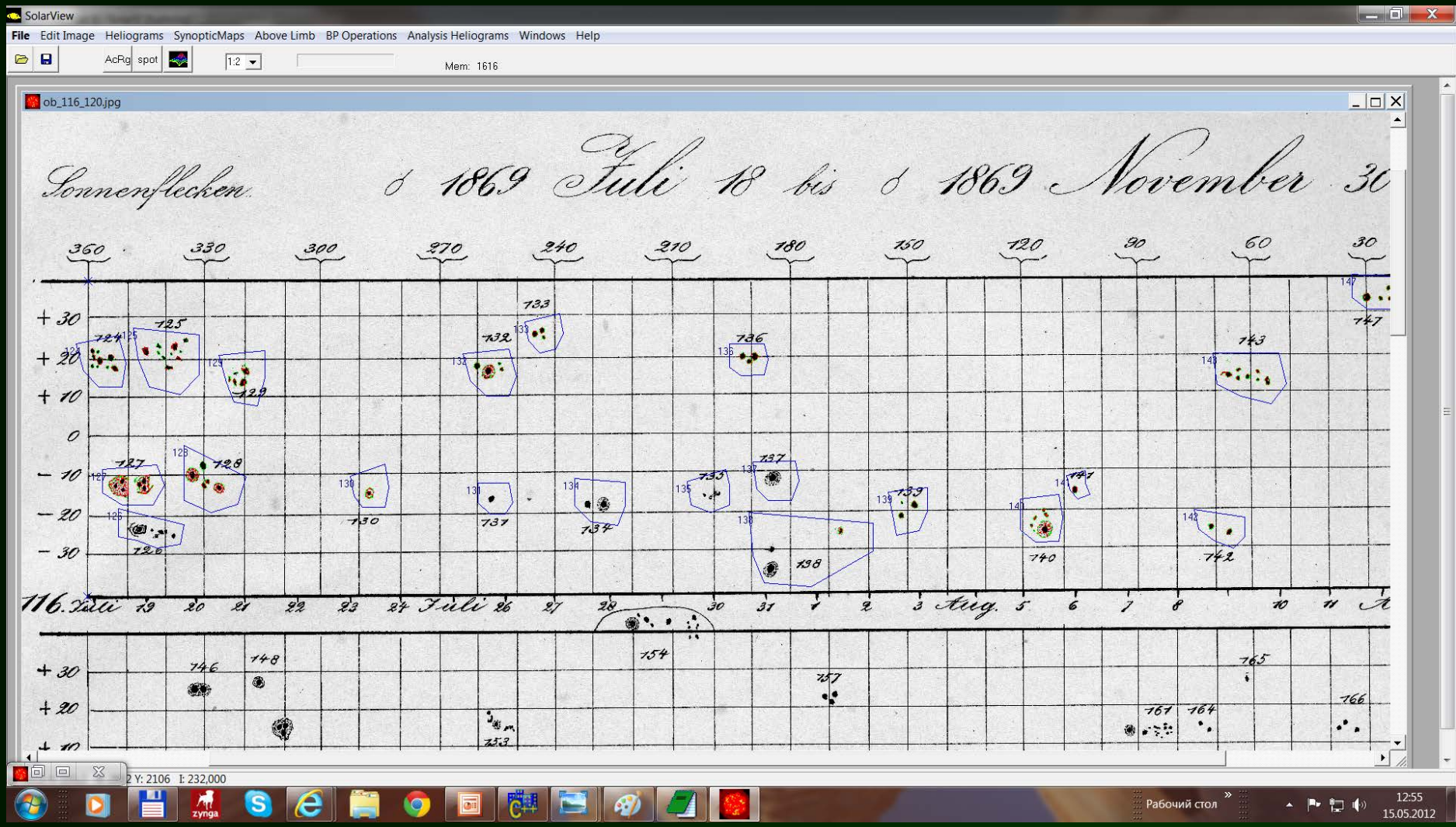
q	fi	L	r/R	Smhm	Spx	dq	dfi	yrs	cntr	mn	mx	al	flux	leng	fimin	fimax
12.93	340.81	340.81	0.000	-105.4	215.0	1.34	1.81	74.6	0.46	28	105	-5.1	-7.86e+03	0.1	339.9	341.7
12.53	341.31	341.31	0.000	-5.4	11.0	0.41	0.50	54.1	0.61	48	62	-36.9	-2.92e+02	0.0	341.0	341.5
12.90	340.83	340.83	0.000	-17.2	35.0	0.62	0.60	45.7	0.67	28	61	-15.1	-7.84e+02	0.0	340.5	341.1
12.81	340.12	340.12	0.000	-4.4	9.0	0.52	0.20	54.9	0.60	44	61	0.0	-2.42e+02	0.0	340.0	340.2

Total groups: 4 Area: -132.4 sig2: 0.0

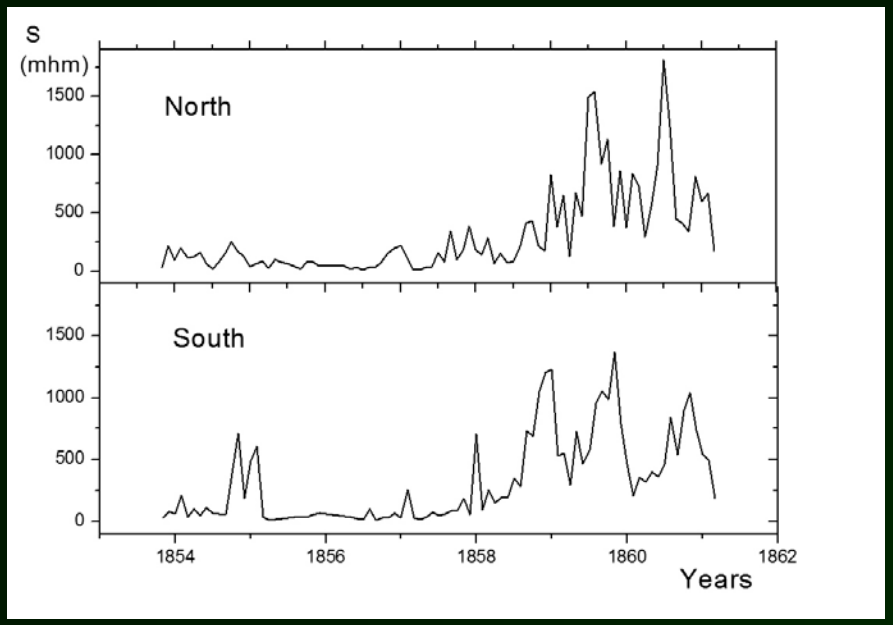
Carrington synoptic maps



Sporer synoptic maps

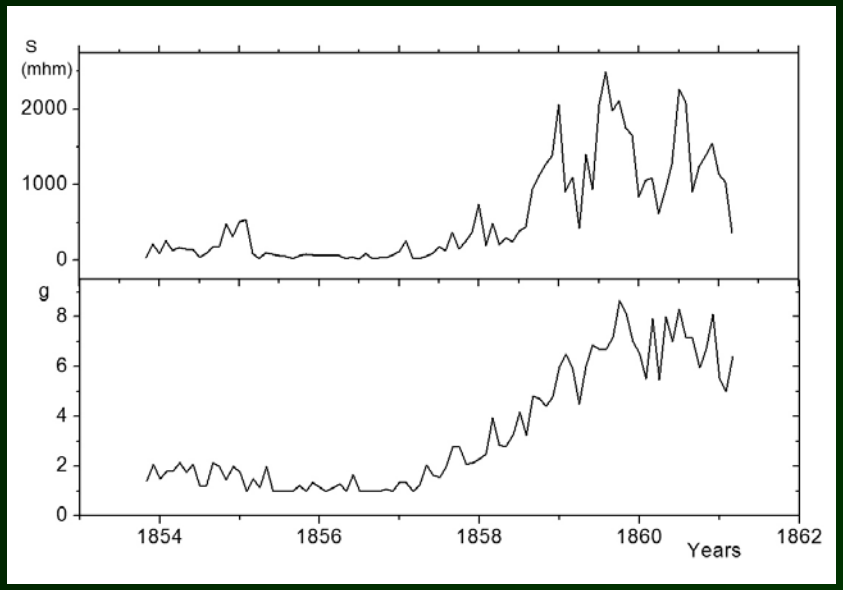


Indices of activity according to digitize drawings of sunspots (Carrington)

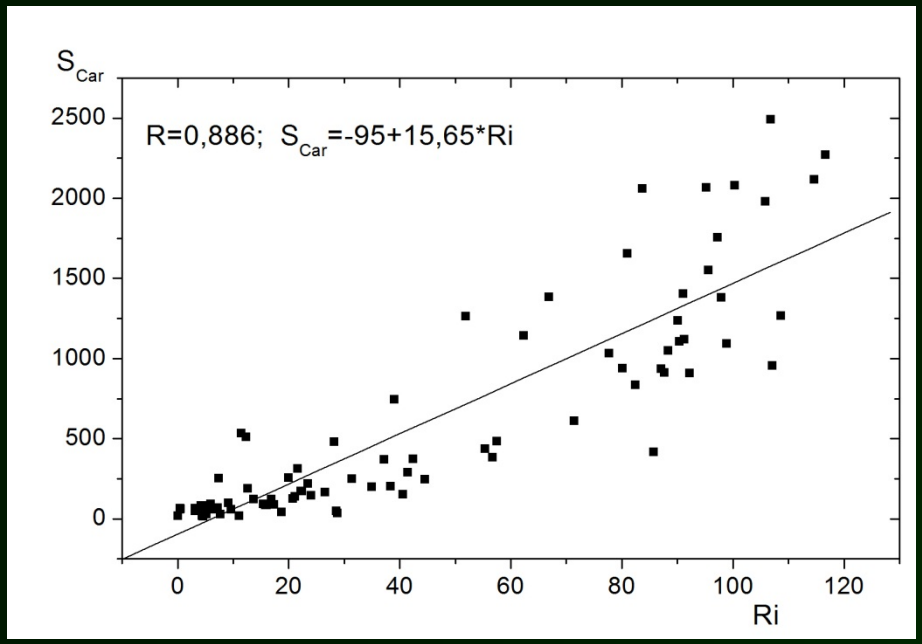


The sunspots area in the northern and southern hemispheres.

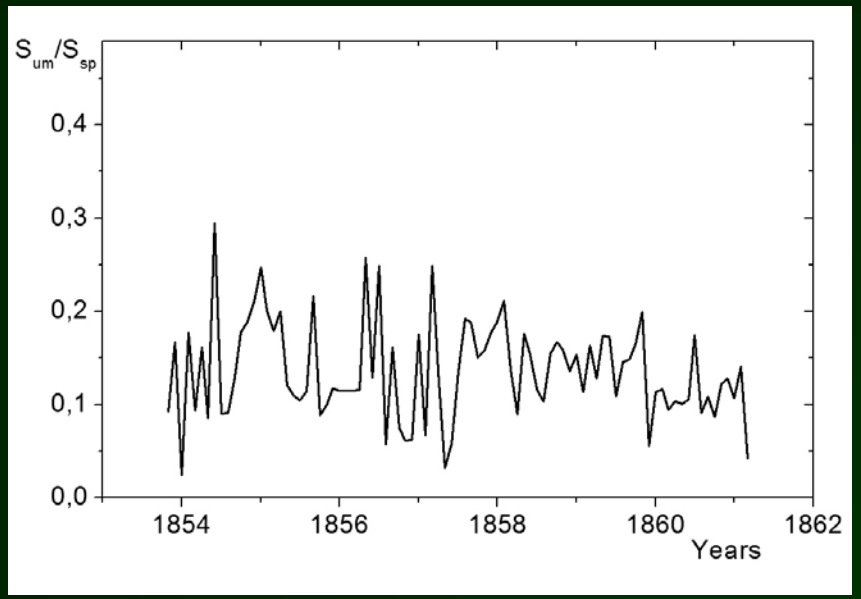
The total area of sunspots and the number of groups.



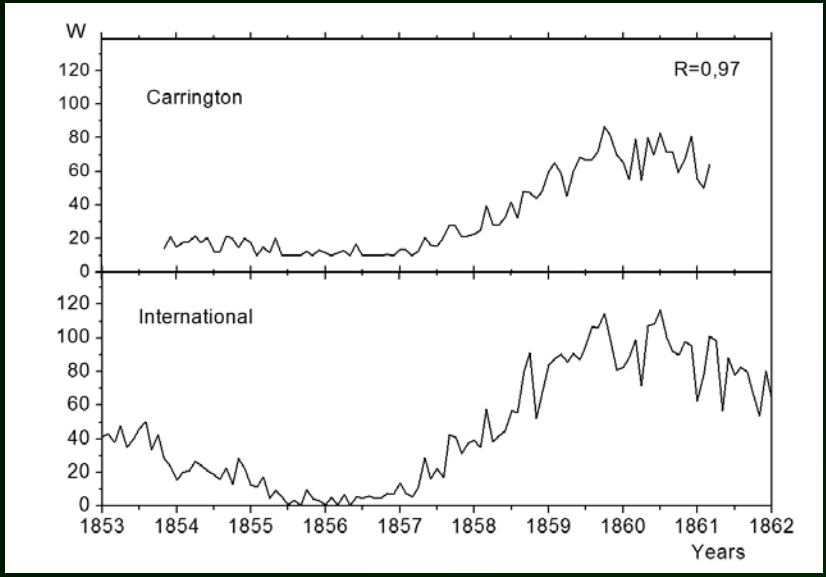
Indices of activity according to digitize drawings of sunspots (2)



The ratio of umbra area to the total sunspots area

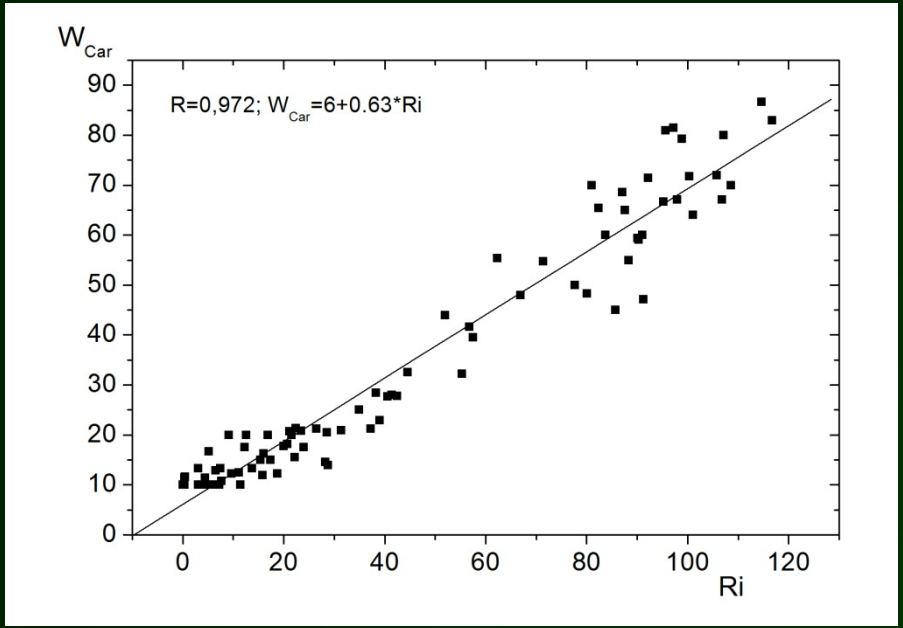


Indices of activity according to digitize drawings of sunspots (3)

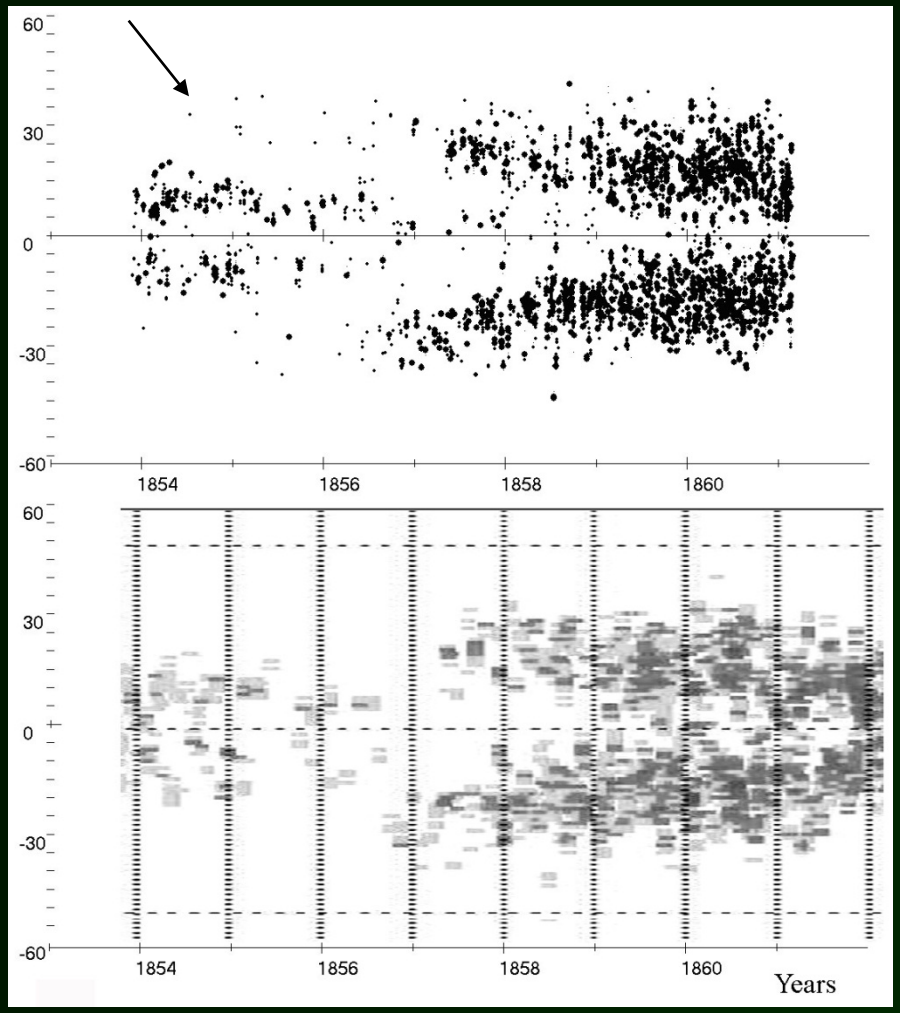


Data on individual sunspots and groups allow us to calculate the W-index

The relationship between the sunspot index derived from the catalog [Carrington, 1863] and the international sunspot index Ri.



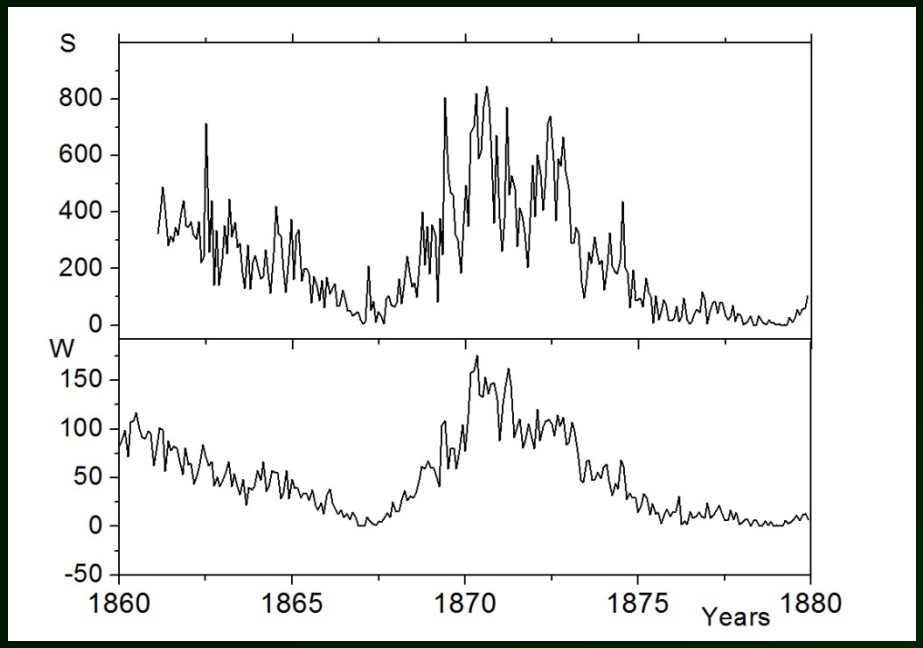
Latitude-time distribution (Carrington)



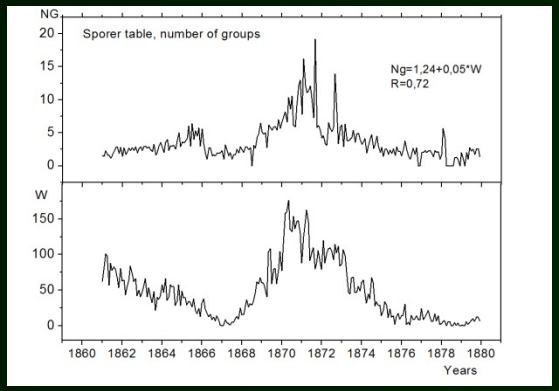
The first sunspots of the 10th cycle appeared at 1854.6, in the northern hemisphere and 1855.12 in the southern hemisphere. This is somewhat earlier officially recognized minimum activity was 1856.0. The spots of the 9th cycle of activity can be traced in the equatorial region until the beginning of 1857. Thus, the overlap of 9.10 cycles of ~ 2.4 years.

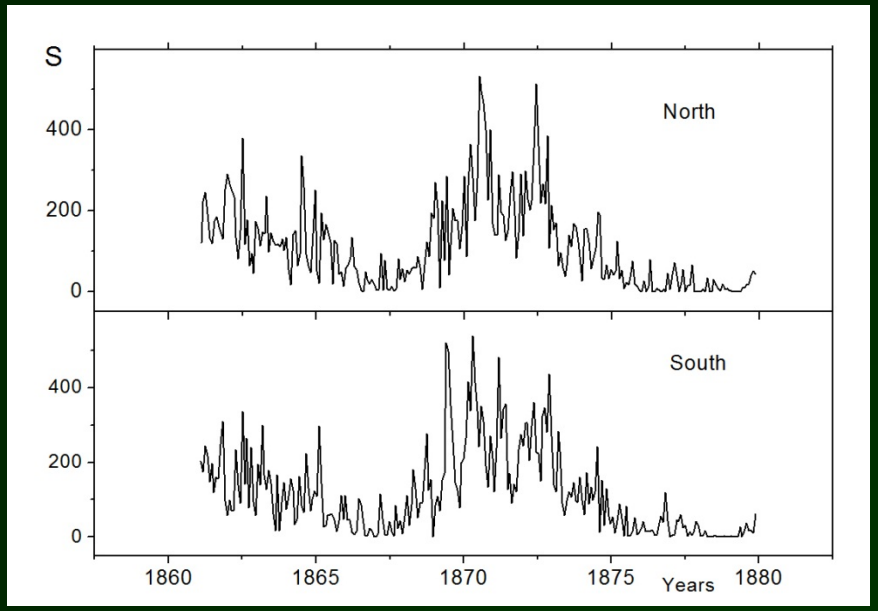
Comparison of latitude-time diagrams of sunspot distributions in the catalog R. Carrington (top) and observational G. Schwabe (bottom) [Arlt and Abdolvand, 2010].

Indices of activity according to digitize drawings of sunspots (Sporer)

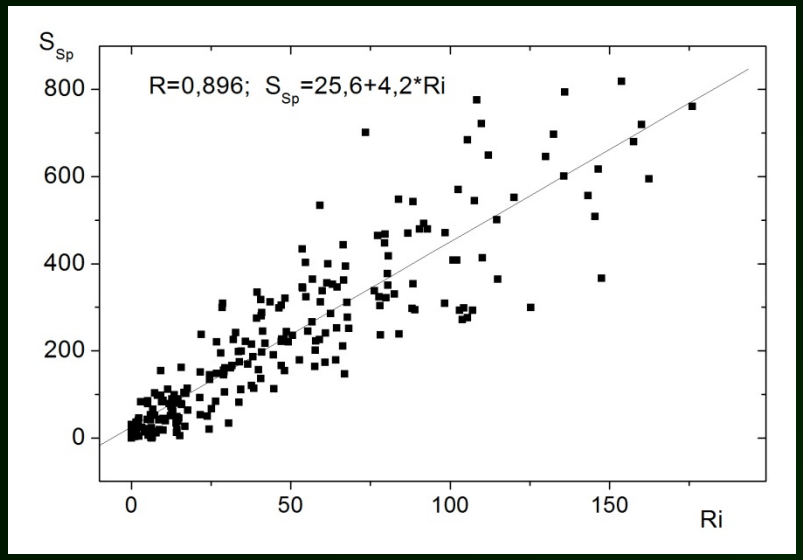


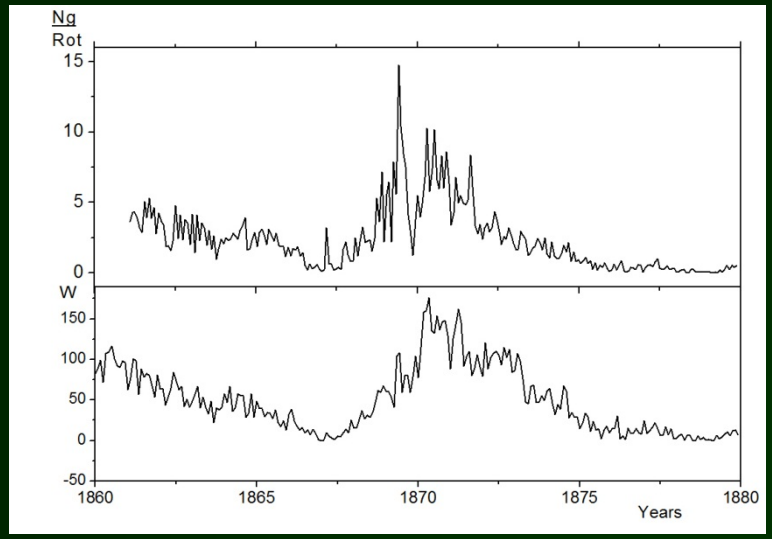
Indices of spot areas and Wolf numbers better describe the phase of decline of the 9th cycle of activity than the number of groups.



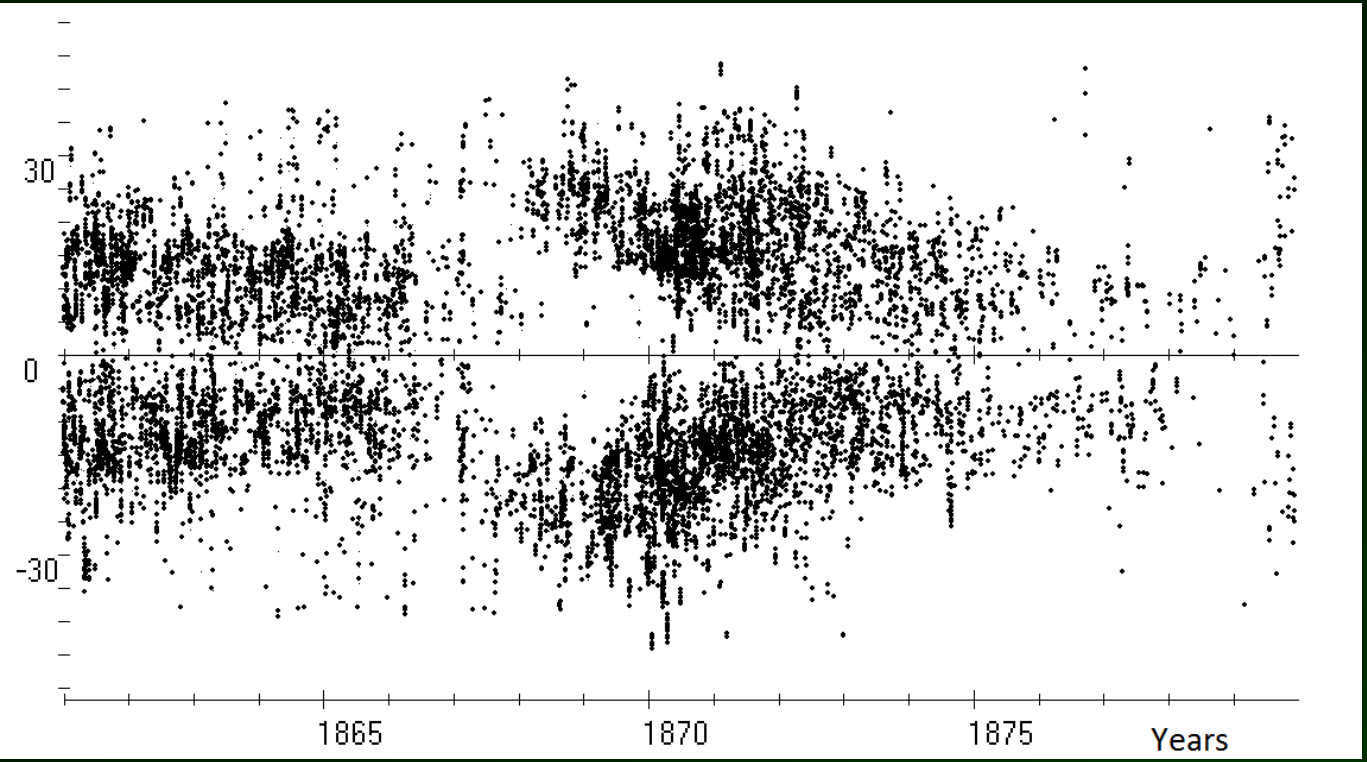


Indices of activity according to digitize drawings of sunspots (Sporer 2)

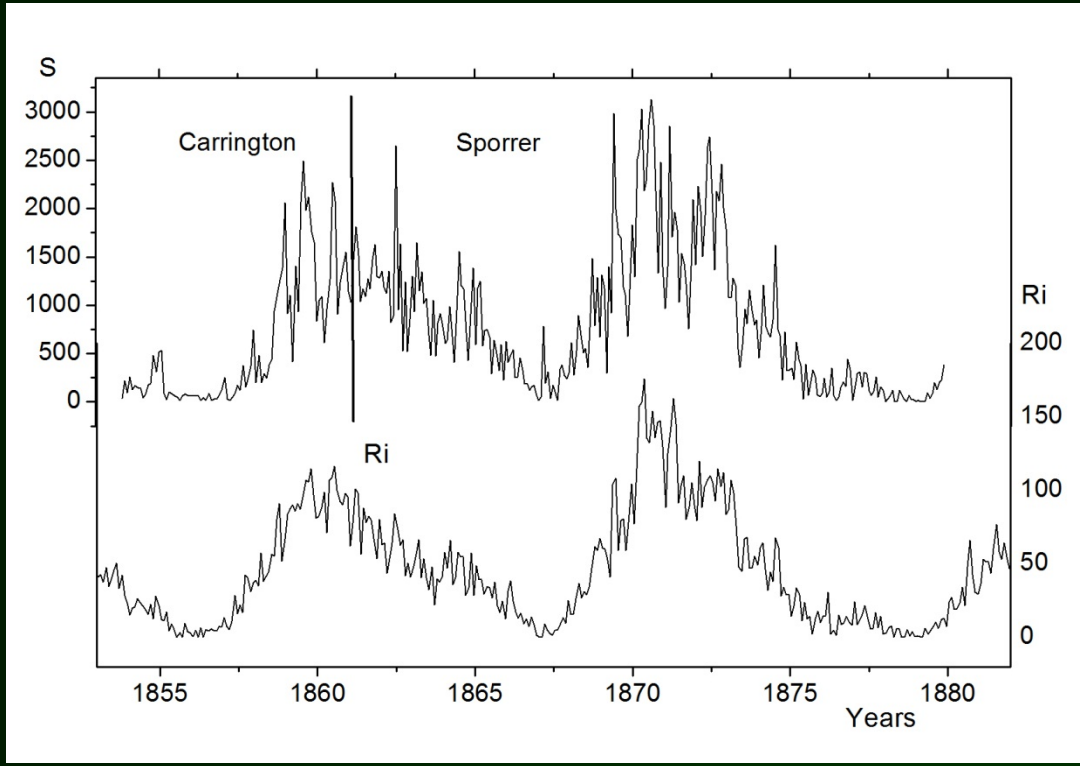




Latitude-time diagram of the sunspot distribution according to Sporer



The combined area index of sunspots according to Carrington and Sporer



Conclusion

In total we have been allocated in the 9831 catalog Carrington sunspots and 4946 sunspot umbra. On the synoptic maps 3762 sunspots and 1730 sunspots umbra. This allowed us to reconstruct the characteristics of the 3069 sunspot groups for the period from 9.11.1853 to 04.01.1861.

According to the catalogs Sporer was allocated 12402 sunspots, and ~ 5,000 sunspot umbra in the period 1861-1879.

Digitized data allowed determining the coordinates, area, and the relative position of other geometrical parameters of individual sunspots, umbra and sunspots groups. These data provide an opportunity to study in detail the fine structure of the end of the 9,10 and 11 cycles of activity. An electronic database of selected structures.