



Pre-Maunder-Minimum observations

J.M. Vaquero

Centro Universitario de Mérida (Physics Dept.)

Universidad de Extremadura, Spain



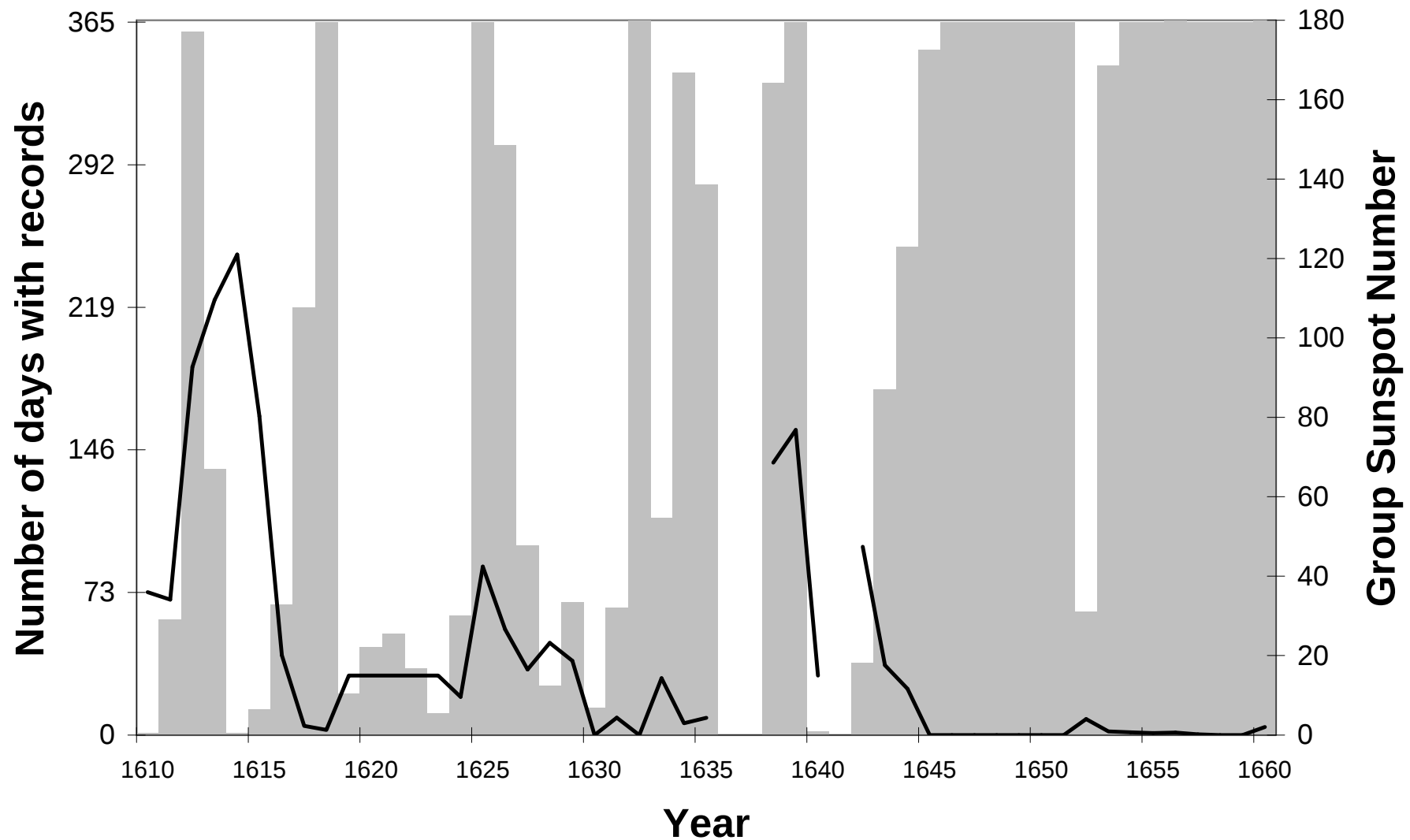


Index

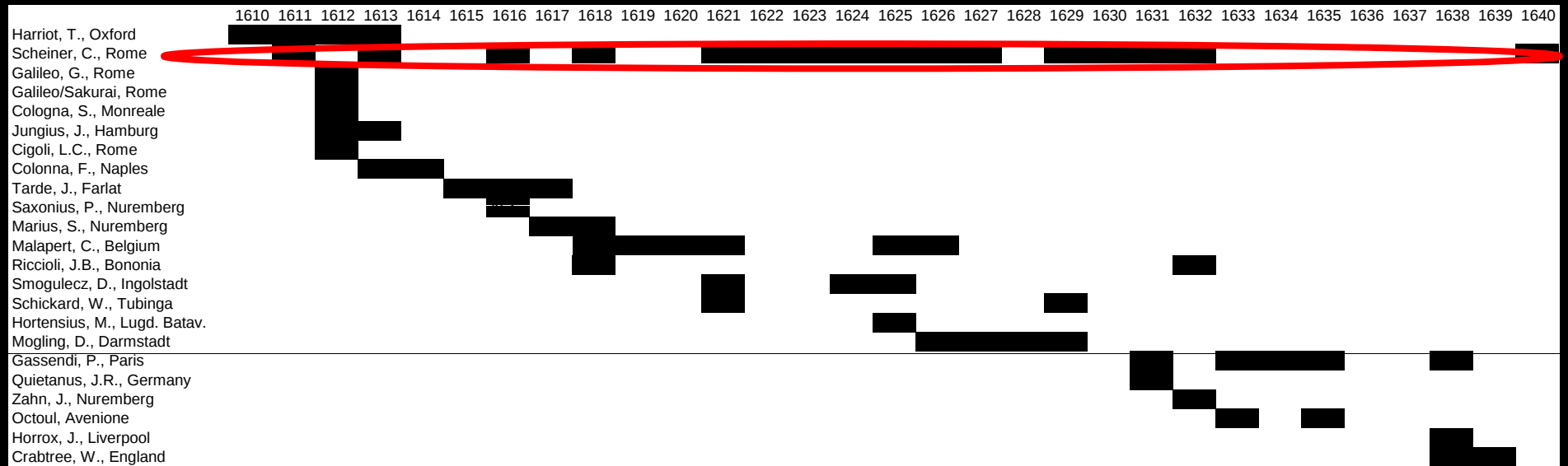
- 1) Solar activity reconstruction by Hoyt & Schatten
- 2) Detecting problems and revising original records
- 3) A [preliminary] butterfly diagram for 1610-1645
- 4) Conclusions



Pre-Maunder Period from Hoyt & Schatten (1998)

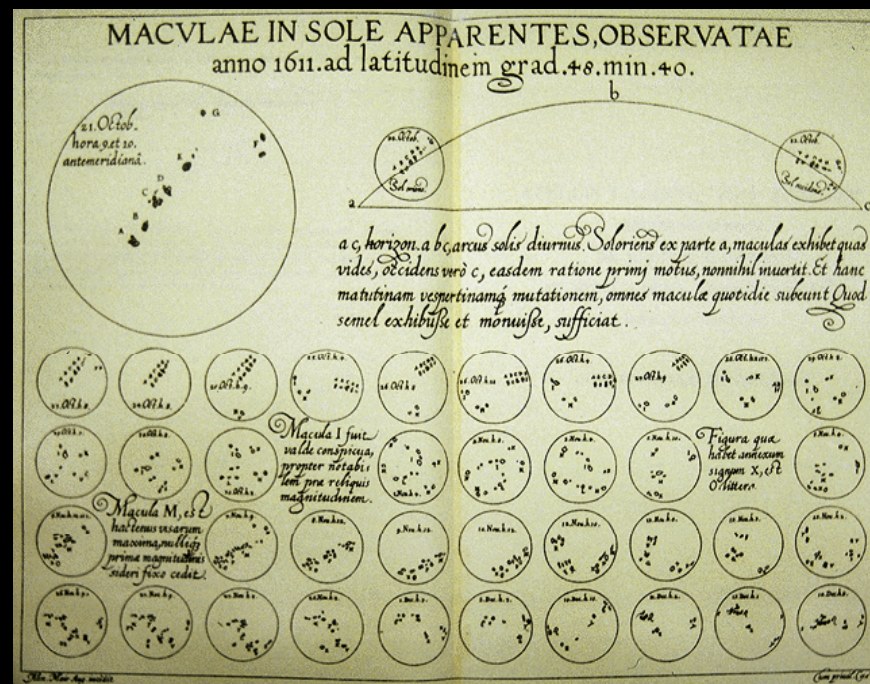
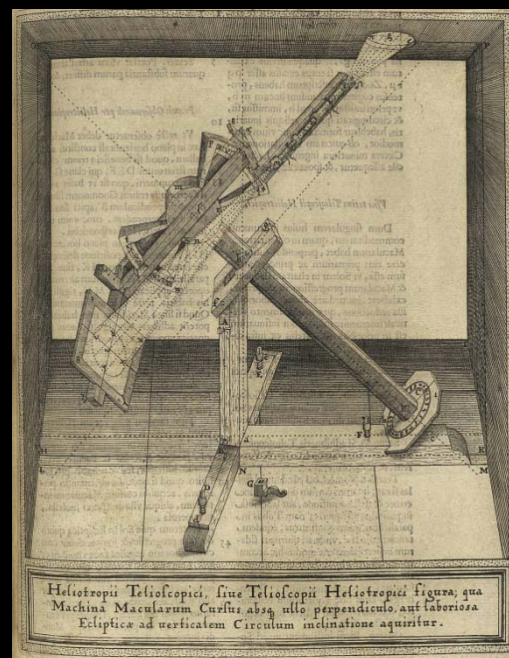
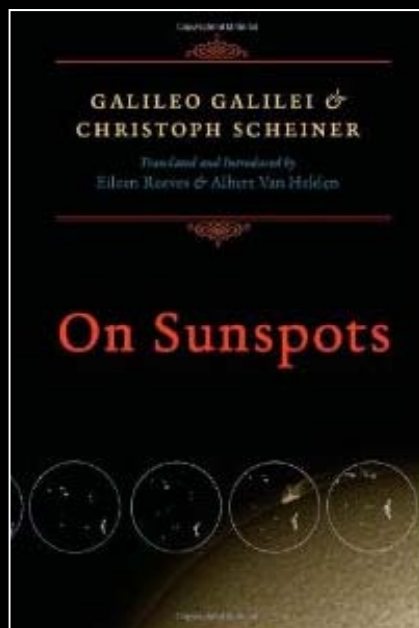
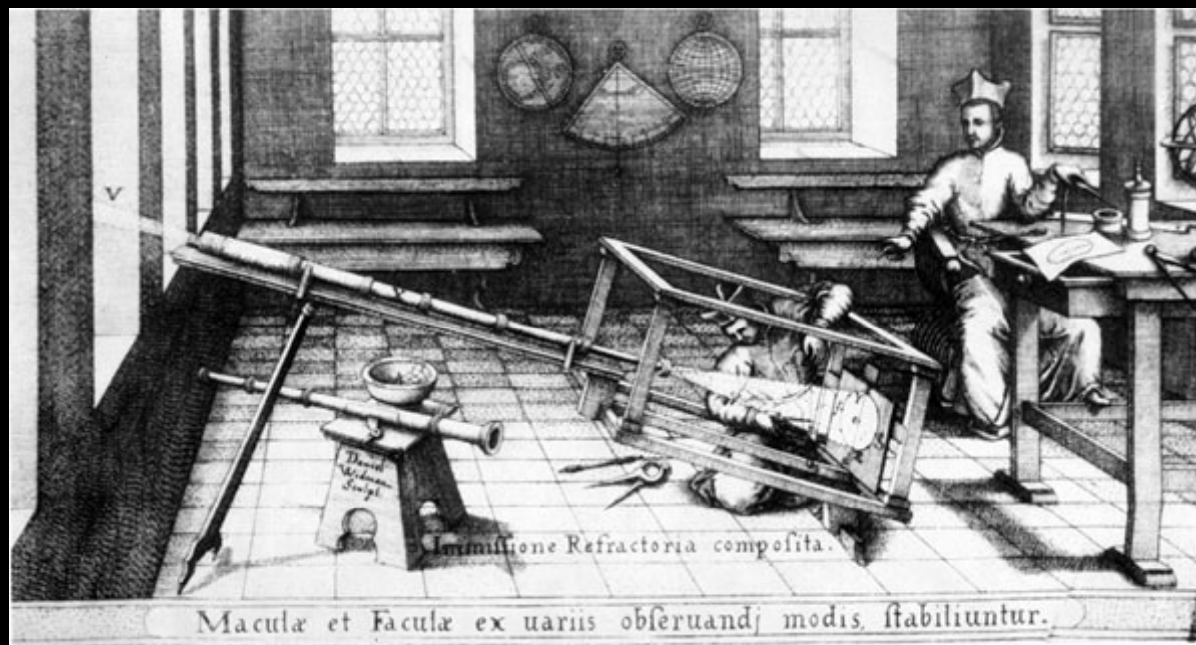


Observers (time-distribution)

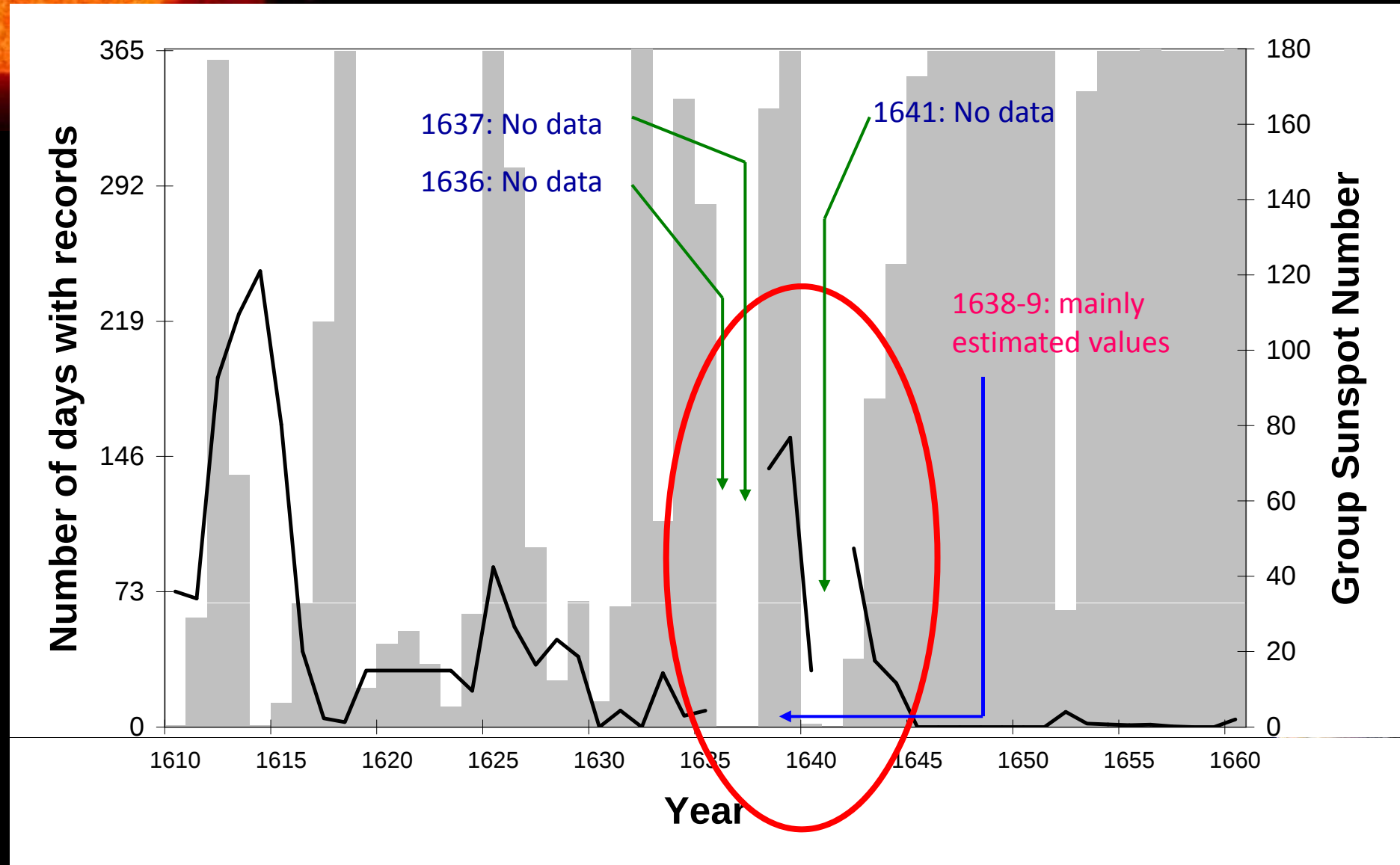


There are no important observers except C. Scheiner!!!



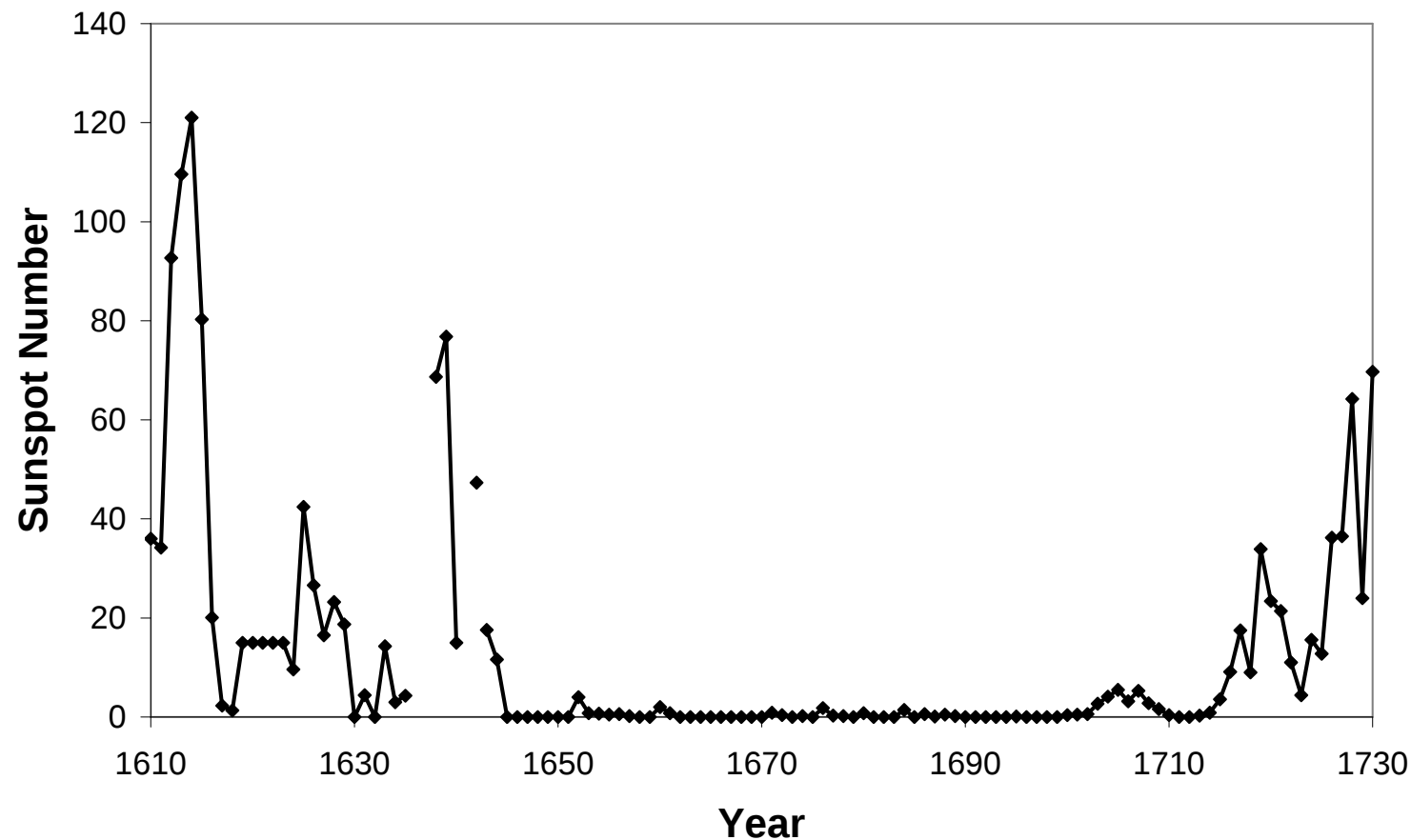


Example of additions/corrections: The onset of the Maunder Minimum



Accepted general scenario for Maunder Minimum (Usoskin, 2008):

- (1) transition from the normal activity to the deep minimum was sudden,
- (2) a 22-year cycle was dominant in sunspot, and
- (3) the recovery of the sunspot activity from the deep minimum to normal activity was gradual.



(1) We have added the **Marcgraf sunspot records**



37/10/

Die 1. Feb. abt. 1.

Die 2. Feb. Alt. O. Merid. 21. 8.

Die 3. 2. Feb. abt. 1.

Die 5. Febr.

Alt. O. Meridiane 22. 6. Nautis 3 in 3.

In alt. Prognos in Or. p. 25. 18. c.

26. 27. 28.

Die 11. Feb.

Alt. O. Merid. 24. 9.

Die 12. Feb. vesp. h. 6. 7. abt.

Die 13. Feb.

Alt. O. Merid. 24. 40.

Die 14. Feb. vesp. h. 6. 7. abt.

Die 15. Febr.

Die 16. Febr.

Die 17. Febr.

Die 18. Febr.

Die 19. Febr.

Die 20. Feb. vesp. h. 6. 7. abt.

Die 21. Feb.

Die 22. Feb.

Die 23. Feb.

Die 24. Feb.

Die 25. Feb.

Die 26. Feb.

Die 27. Feb.

Die 28. Feb.

Die 29. Feb.

Die 30. Feb.

Die 31. Feb.

Die 3. 2. Feb. abt. 1.

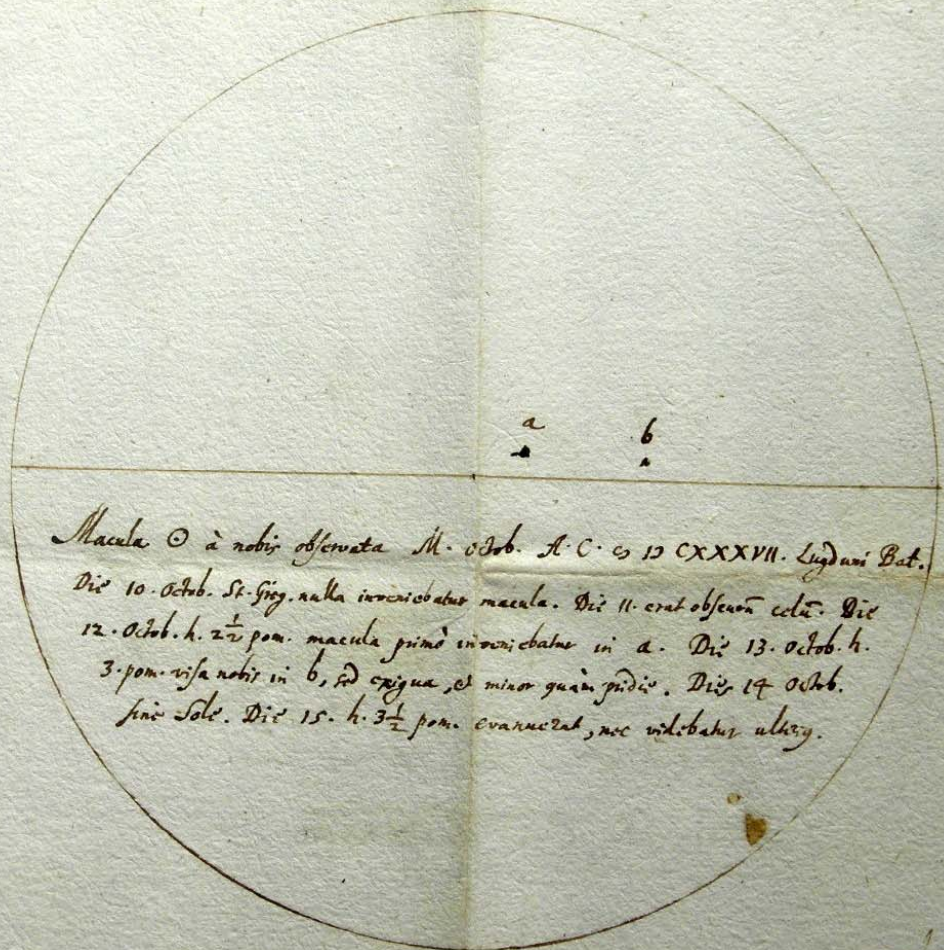
Die 5. Febr.

Alt. O. Meridiane 22. 6. Nautis 3 in 3.

In alt. Prognos in Or. p. 25. 18. c.

26. 27. 28.

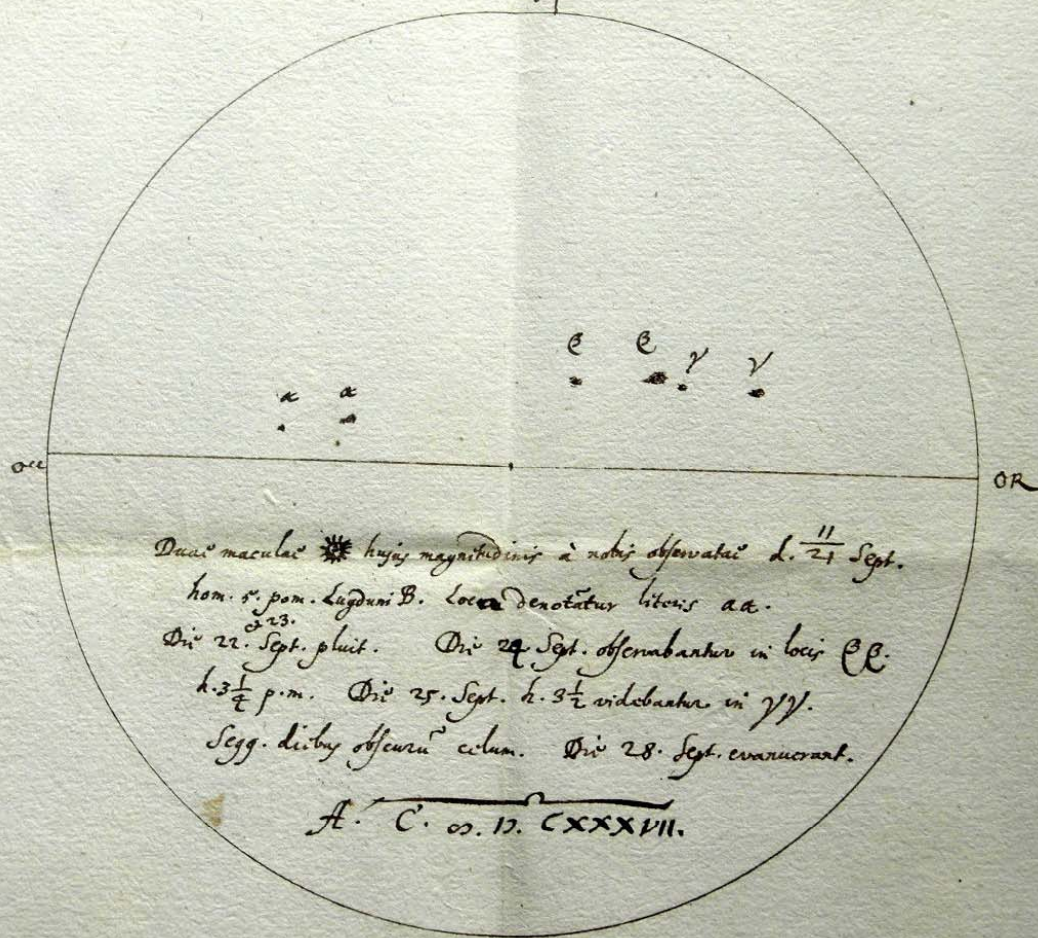




Macula ☉ à nobis observata M. Octob. A.C. 610 CXXXVII. Lugduni Bat.
Die 10. Octob. St. frig. nulla inveniebatur macula. Die 11. erat obscur. cel. Die
12. Octob. h. 2 $\frac{1}{2}$ pom. macula primò inveniebatur in d. Die 13. Octob. h.
3. pom. visa nobis in b, ad exigua, et minor quàm p. die. Die 14. Octob.
fuit Sol. Die 15. h. 3 $\frac{1}{2}$ pom. evanuerat, nec videbatur ulterius.

No. 100. 100. 100.
 100. 100. 100.

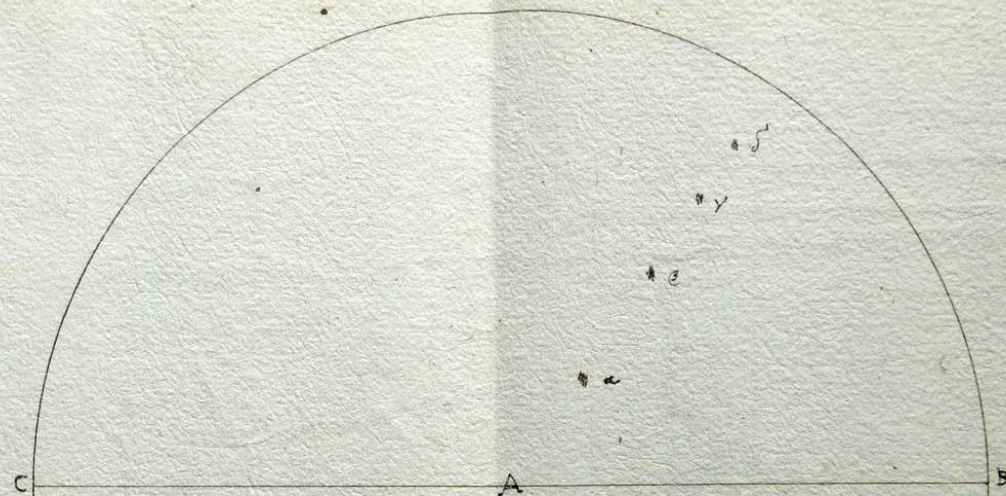
Sept.



Duae maculae  hujus magnitudinis a nobis observatae d. $\frac{11}{21}$ Sept.
hor. 5. pom. Lugduni B. loca denotatur literis αα.
Die 22. Sept. pluit. Die 24. Sept. observabantur in locis εε.
h. 3 $\frac{1}{2}$ p.m. Die 25. Sept. h. 3 $\frac{1}{2}$ videbantur in γγ.
Seqq. diebus obscurum celum. Die 28. Sept. evanuerant.

A. C. os. 12. CXXXVII.

M.



Placuta. Obs. observata à die 9. in 12 Junij, Sc. Greg.

ubi a. notat locū ejus ad 9 Junij $3\frac{3}{4}$ p.m.

B ad 10. Jun. h. 6. γ ad 11. Jun. h. $1\frac{1}{2}$.

et δ ad 12. Jun. h. eadem

observatum. Diu 13. Junij

circa idem tempus quoniam

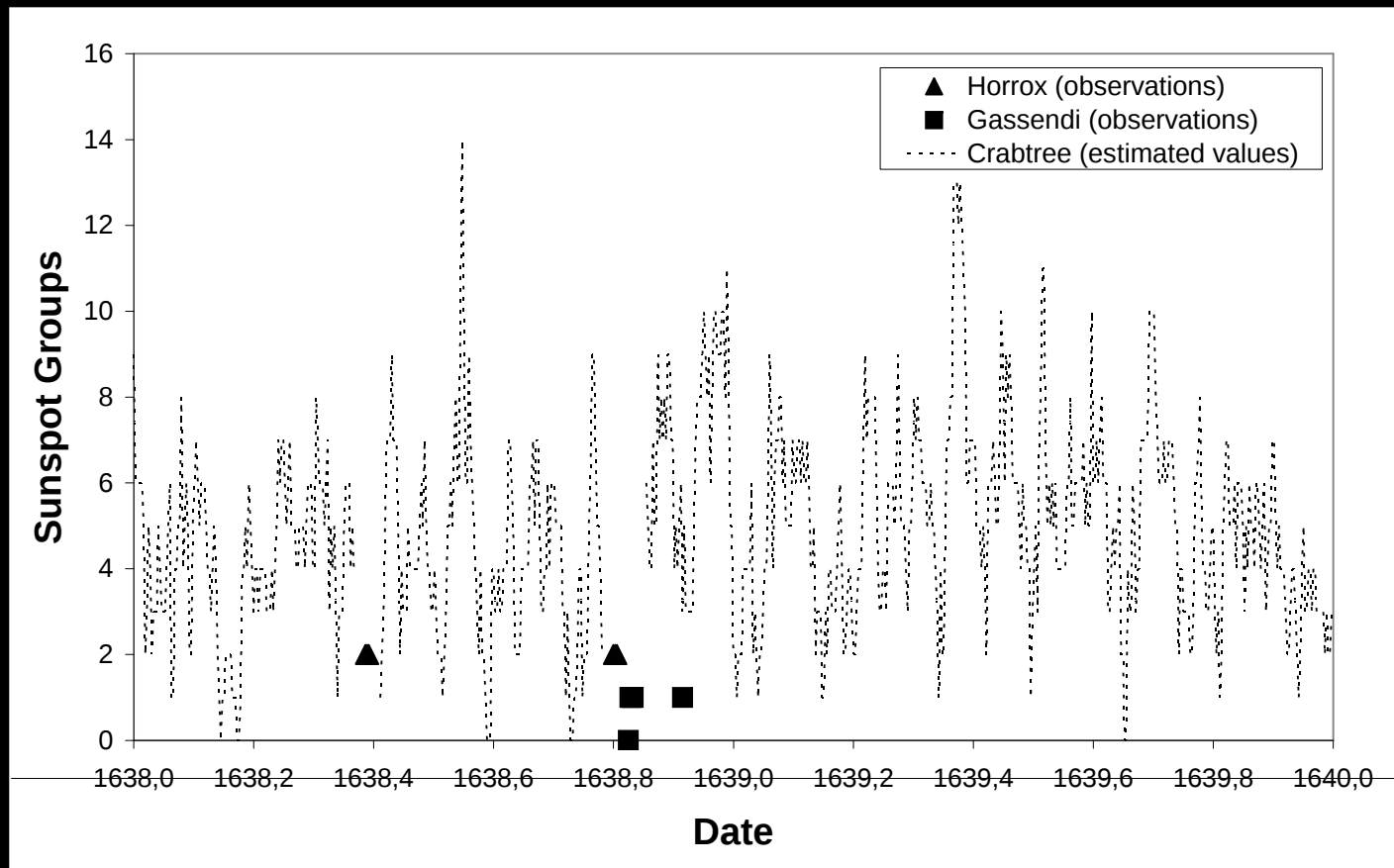
quidam ab nobis

evanuerat.

ANNO - 17 CXXXVII. Lips. Batavi

(2) We have **eliminated the estimated** (not observed) values from Crabtree's comments (1638-1639).

Hoyt and Schatten (1998) wrote in their Bibliography: “According to a letter by Crabtree the average number of spot groups seen in 1638 and 1639 were 4–5 per day. The database has Greenwich fill values to give 4–5 groups per day. This substitution technique was used to simplify the analysis. This is the only place in the entire database where we do this type of substitution”.



Vaquero (2007), Adv Spa Res



(3) We have corrected the dates and the numbers of sunspot groups of Horrox observations in HS98 (from Julian calendar to Gregorian Calendar).

JEREMIÆ HORROCCII,
LIVERPOLIENSIS ANGLI, ex Palatinatu
LANCASTRIÆ,
OPERA POSTHUMA;

viz.

Astronomia *Kepleriana*, defensa & promota;
Excerpta ex Epistolis ad *Crabtræum* suum.
Observationum Cœlestium Catalogus,
Lunæ Theoria nova.

Accedunt

GUILLIELMI CRABTRÆI, Mancestriensis,
Observationes Cœlestes.

In calce adjiciuntur

JOHANNIS FLAMSTEDII, Derbienfis,
De Temporis *Æquatione* Diatriba.
Numeri ad Lunæ Theoriam *Horroccianam*.



LONDINI,

Typis GULIELMI GODEID, Impensis J. MARTYN Regalis
Societatis Typographi, ad insignē Campanæ in Cosmetorio
D. Pauli, Anno Domini M. D. C. LXXIII.

Et Observationes cœlestes.

309

putaveris te alterum ad Septentrionem, alterum ad Austrum conspexisse.

Maii 22, h. 3. P. Radios Solares intromisi per Tubum Opticum in cameram obscuratam, (densis tenebris non opus est:) atque in limbo orientali, prope viam regiam (ut puto,) vidi duas nigras maculas. Major distabat à Solis margine min. 3'. Maculæ diameter longior erat quasi min. 30", brevior quasi min. 20", eratque in forma Ovali.

Maii 23, h. 3. P. Major duarum absuit à margine min. 1, 20".

Maii 24, h. 3. P. absuit min. 0, 25"; jamque facta erat minor quam reliqua, quæ à margine distabat min. 1'.

In magna distantia erant hæ maculæ colore cæruleo, cum rubro misto. Et circa Solis discum erat circulus cæruleus, inter exteriorem rubrum, & viridem interiorem, sicut in Iride; sed pro varia vitri positione subinde variabantur hi colores.

Esset macula illa, si rotunda, Venere major, possitque Cometæ instar esse. Si à Sole projiceretur quantum inde Terra distat, adinstar stellæ appareret, nisi forsitan à Terrâ nimis distaret.

Post illos tres dies maculas nullas vidi. Tempus est ut reverterentur eadem, sed nubes impediunt observationem.

Est autem Tubus hic meus ex vulgaribus unus, pretii 2s. 6d, conculi tamen cum duobus aut tribus aliis, quos mutuo habui, sed meo (quantum ego judico) inferioribus.

Hunc modum existimo egregium fore ad observandas Eclipses. Admittit enim discum Solarem tantæ magnitudinis in parva distantia, ut fere minuta secunda possis observare; atque lucem ab umbrâ accuratè distinguit, si ad justam longitudinem educatur.

Stellas fixas dum contueor, nihil video aliud quam radios undecunq; emissos, pro vario vitri positione situs mutantes.

Mars videtur ejusdem quasi magnitudinis cum Jove: *Keplerus* tamen & *Lansbergius* multo majorem faciunt.

Si Mars sit Terrâ major, oportet Solis parallaxin multò minorem esse quam vult *Keplerus*.

Ex Epist. Julii 25. 1638, Toxtethæ.

Postquam te viderim, nihil à te accepi, necdum ad te scripsi quicquam.

Lingomontanius tandem nactus sum. Habet ille multas observationes Planetarum omnium, præsertim in oppositione Solis, sed breviter describas.

(4) We have eliminated one spurious observation by Gassendi on 1 Dec 1638.

PETRI
GASSENDI
DINIENSIS
ECCLESIAE PRÆPOSITI
ET IN ACADEMIA PARIENSI
MATHESEOS
REGII PROFESSORIS
ASTRONOMICA,

VIDELICET

- I. Institutio Astronomica cum Oratione Inaugurali.
- II. Observationes Cælestes.
- III. Mercurius in Sole visus & Venus inuisa.
- IV. Nouem Stellæ circa Iouem visæ.
- V. Solstitialis altitudo Massiliensis.

TOMVS QVARTVS.
CVM INDICIBVS NECESSARIIS.



LVGDVNI,
Sumptibus LAVRENTII ANISSON.
& IOANNIS BAPTISTÆ DEVENET.

M. DC. LVIII.
CVM PRIVILEGIO REGIS.

Commentarij.

417

¶ circiter medium vsurpata, & Procyon 3500—800. hoc est
Q & Arcturus 3500—3200. hoc est 17. grad. 2. min.

D 11 17. Manè, cùm die superiore ab antelucano vsque tempore in ipsam vsque no-
nem nixisset, superfuere deinde nobis, quæ Famulo licet ad S. Vincenrium progressio vi-
sis à 4. matutina quibuldam nubium hianibus: & Agarrato tamen Cælo Aquis Sextiis scæno,
diffiterunt inter se

2c & Spica mp 1700—1982. hoc est 31. grad. 31. min. idque hora 6.

Q & Spica mp 3700—1714. hoc est 30. grad. 2. min.

Q & 2c 2000—1714. hoc est 1. grad. 33. min.

Q & Arcturus 1700—3150. hoc est 40. grad. min. 15.

D 11 29. Manè, nihil visum Aquis-Sextiis (vi neque etiam die superiore tam Aquis-
Sextiis, quàm Diniz) Famulo autem ad Sanctum Vincenrium, diffiterunt Cælo satis
pulcro

Q & Spica mp 1000—3150. hoc est 18. grad. min. 47. Alta Q 6. grad. 50. min.

Arcturus & Spica mp 3500—2420. hoc est 32. grad. min. 53.

2c & Q 1500—2960. hoc est 1. grad. 48. min.

Q & 2c 3200—3010. hoc est 0. grad. min. 53. forte—3500. hoc est 1. grad. min. 1. Alta 2c

3. grad. 40. min.

Q (opinor non 2c) & Q 1500—2740. hoc est 3. grad. min. 51.

Q & 2c iterum 3500—3210. hoc est 0. grad. min. 51. Retulit hanc distantiam optime acceptam.

D 12 30. Manè, Agarrato, Aquis-Sextiis, diffiterunt inter se

Q & Aultrina laux 3500—3131. hoc est 12. grad. min. 38. Audita iam fuerat hora 6.

& laux eodem 3500—2111. hoc est 8. grad. 47. min.

& Spica mp 3500—2271. hoc est 14. grad. 6. min.

& laux Borei 3500—1796. hoc est 11. grad. min. 7.

Q & 2c 1000—1597. hoc est 3. grad. min. 53.

Q & 2c 2000—1597. hoc est 1. grad. 17. min.

Q & Spica mp 1900—1569. hoc est 30. grad. 13. min.

2c & Spica mp 3500—1872. hoc est 31. grad. min. 54.

2c & Q 2000—1690. hoc est 1. grad. 43. min.

Eodem Manè, Famulo ad S. Vincenrium, diffiterunt inter se

Laux 3500—1770. (forte pro 1707) hoc est 9. grad. 15. min.

Spica mp & laux Aultrina 1000—1770. (forte pro 1707) hoc est 21. grad. 21. min.

Spica mp & Arcturus 3500—2430. hoc est 32. grad. 56. min.

Q & Spica mp 3500—1900. hoc est 30. grad. 1. min. Altitudo Arcturi 45. grad. 13. min.

2c & Q 3500—3104. hoc est 2. grad. min. 2.

2c & Spica mp 3500—2280. (opinor pro 280) hoc est 31. grad. 8. min.

Q & Q 1500—2780. hoc est 3. grad. min. 47.

Q & 2c 3500—3101. hoc est 2. grad. 1. min. Alta 2c 8. grad. 0. min.

Q & Q iterum 3500—2700. hoc est 3. grad. min. 51.

MENSE DECEMBER, Die 1. Manè (fuerat Die 1. Cælum vtroque obductum)
diffiteret Agarrato Aquis-Sextiis

2c & Q 3900—3400. hoc est 2. grad. min. 31. Sic-ne?

Q & laux Aultrina 3500—2910. hoc est 15. grad. min. 38.

Q & laux Borei ipsi perpendicularis 1900—1661. hoc est 13. grad. min. 31.

Q & 2c 1900—2980. hoc est 4. grad. min. 41.

Q & Q 3500—3049. hoc est 4. grad. 21. min.

Q & Spica mp 1900—2000. hoc est 32. grad. 17. min.

2c & Spica mp 3500—1960. hoc est 32. grad. 14. min.

Eodem Manè Famulo ad S. Vincenrium, diffiterunt inter se

Laux Libræ 3500—1834. hoc est 8. grad. 54. min. Debit 2. grad. min. 2. An alia Stella.

Spica mp & Arcturus 3500—2420. hoc est 32. grad. min. 53.

2c & Q 3500—3410. hoc est 0. grad. min. 27. Altitudo Arcturi 49. grad. 0. min.

2c & Spica mp 3500—2330. hoc est 32. grad. min. 24. Alta 2c 6. grad. 0. min.

Q & Spica mp 3500—2360. hoc est 32. grad. min. 34. Alta Q 9. grad. 5. min.

Q & 2c 3500—2790. hoc est 3. grad. 44. min.

Q & Q 3500—2260. hoc est 3. grad. min. 51.

2c & Q iterum 3500—3410. hoc est 0. grad. min. 27.

D 12 4. Manè (fuerat Cælum superiore obductum) diffiteret Agarrato Aquis-Sextiis Co-
ro vigente, & filio paracuro

Q & Aultrina laux 3500—4320. hoc est 18. grad. 43. min.

Q & Borei laux 3500—822. hoc est 16. grad. 13. min.

Q & margo Q Boreis, vicinique 3500—3145. hoc est 3. grad. 51. min.

Q & Q 3500—2559. hoc est 4. grad. min. 49.

2c & Spica mp 3500—2242. hoc est 32. grad. min. 56.

2c & Q 3500—3432. hoc est 2. grad. min. 21. Meo manè hoc non vacuit. Et de hac Q ap-
paritione tantum.

Gassendi Observationes.

DD d D 12



(5) We have changed the **record by Rheita [1642]**.

O C V L V S ENOCH ET ELIÆ

S I V E
RADIVS SIDEREOMYSTICVS
P A R S P R I M A
A V T H O R E

R. P. F. ANTONIO MARIA
SCHYRLEO DE RHEITA

ORD. CAPVCINORVM CONCIONAT. ET
PROVINCIAE AVSTRIÆ AC BOHEMIÆ
QVONDAM PRÆLECTORE

*Opus Philosophis, Astronomis, & rerum celestium aquis aspi-
masoribus non tam utile quàm iucundum.*

Quo omnium Planetarum veri motus, stationes, & retrocessiones, sine
vllis epicyclis & æquantibus, tam in Theoria Tychonica, quàm Coper-
nicana compendiosissimè & iucundissimè demonstrantur exhibentur-
que. Hypothesis Tychonis quoad absolutam veritatem stabilitur ac fa-
cilior ipsa Copernicana redditur, reformatur, & ad simplicissimam nor-
mam & formam reducitur.

HISCE ACCESSERVNT

*Notæ harmonicae determinationes motuum & proportionum Planetarum ad invicem. Item plurimæ
aliæ novitates celo ab Authore deductæ. Probabilissima causa fluxus & refluxus Oceani. Ratio
brevis conficiendi Telescopium astronomicum. Et vltimò Planetologium mechanicum & novum,
quo paucissimis rotis veri omnium Planetarum motus iucundè exhiberi queunt.*

Quia delectasti me Domine in factura tuarum: & in operibus manuum tuarum exultabo. Ps. 91.

A N T V E R P I Æ,
Ex Officina Typographica HIERONYMI VERDVSSII.
M. DC. XLV.

Cum Gratia & Privilegio.

242

LIBER QVARTVS.

& Sol morbo illo palloris, & sæcu-
lum tristiori caligne laborarint.
Idem sub Constantino Principe,
& Irene contigisse ferunt circa an-
num Christi 797. Quorum tem-
pore per 17. integros dies, adeo
nusquam visus est Sol, adeo tenuis
radios telluri immisit, vt mundo
aut omnino abreptus, aut certè ra-
dijs & gratissimâ luce spoliatus
exutusque crederetur. Enimverò
in vastissimo tunc oceano oberan-
tes, neque cursum suum per te-
nebras dirigere, neque telluri insi-
stentes cœptum iter & negotia-
tiones humanas prosequi potue-
runt.

Iterum Anno 1547. per totam
vastissimam Europæ plagam, So-
lis radij sanguineo colore adeo de-
leti videbantur trium dierum
spatio; vt mundo vltimum iam
quasi inciperent prænuntiare diem.
Denique tempore, quo Rudol-
phus II. Augustus ex humanis ab-
reptus fuerat, Solem per plures
dies, suâ tristissima facie & luce ob-
fuscata ingentem terricolis denuò
metum & horrorem incussisse fe-
runt.

*Quidam
Solem si-
milium
montis
Ætnæ pu-
tant.*

Horum igitur solarium prodi-
giorum meritò causam indagare
liceat. Aliqui putant Solem instar
alterius montis Ætnæ, aut Vesu-
uij recrementa sua in extimam su-
perficiem proflare, & veluti pluuiâ
fauillarum inde adeo conspergi
& vndique circumdari, vt mundo
inde quasi eripiaturs dies, splendore
omni Solis intercepto, donec eru-

ctante flammâ agmen illud fa-
uillarum ab extrema superficie
dispergatur, aut fauillæ depascan-
tur. Quæ sententia, si Solis ignis
supponatur alimento & pabulo
foueri, fortè aliquid probabilitaris
obteneret. Quod si verò Sol, velut
purissimum elementum & im-
permixtus ignis, pabulo nullo in-
degeat, sed diuinæ potentia, vol-
untatis & conseruationis vis ei
vtique, vt conseruetur sufficiat;
non video vnde Soli illa recre-
menta, & vtrina materia proue-
nire queat.

Fortè haud etiam ineptè ta-
lium accidentium ratio assignari
posset; scilicet si dicamus Soli fre-
quentem illum luorem & pallo-
rem, ex macularum, seu stellarum
solarium nimium quâdoque con-
currentiū agmine cōtingere. Ad-
eum enim quandoque discus solaris di-
ctis stellis & maculis scatet, vt mi-
rum haud sit eius inde lumen no-
tabilissimè hebetari debilitari-
que.

Certè quod iam diximus, pro-
pria experientiâ Colonix Anno
1642. experti sumus: dum ingen-
tem stellarum solarium turmam
maiorum & minorum per 14. dies
& vltra sibi iniucem continuâ fe-
rie succedentium cum stupore, so-
larem discum adeo occupare vidi-
mus, vt lux eius, maximè media,
& intensissima, haud leuiter illis
fuerit hebetata. Nam tubo opti-
mo, in medio solaris disci globum
perfectissimè rotundum, subni-
grum,

CAPVT SECVNDVM.

243

subnigrum, pugni magnitudinem
quali excedentem conspeximus;
idque directissimo aspectu; qui &
per octiduum Solis haud exiguum
portionē eclipsauit: maximalque
aëri turbationes, vtpotè ventos,
imbres, & frigora in medio lunij
attulit: prout crebris obseruatio-
nibus iam à multis annis cōm-
pertum habemus: scilicet ferè sem-
per aëris insigniores, & magis
notabiles mutationes ex dicta-
rum stellarum solarium discum
subeuntium agmine contingere &
euenire.

*Macula
in Sole
obseruata
anno
1642.*

Ex profecto perspicuum est, ma-
culas illas penitiori obrutu di-
rectè per optimum & longi-
giorem tubum astronomicum,
(qui totum simul solem
discum discoperiat exhibeatque)
conspēctas, aliam quàm circula-
rissimam & rotundam figuram
ostendere, vt frequenter experti
sumus. Itaque toties semper sola-
res eclipses contingere necesse est,
quoties stellæ dictæ Solem sub-
eunt; subeunt autem frequentissi-
mè; ergo multò frequentiores &
plures contingunt nobis solares
eclipses, quàm vulgus arbitrat.
Sed quis obsecro talium eclipsium
arcanos respectu telluris nostræ
effectus hæcenus penetravit? vt
quid ergo paupelli illi deceptores
Astrologi, ex astris de futuris con-
tingentibus diuinare non erubescunt,
cū multa præsentia in
astris ignorent sidera & ita cæcis &
falsis suis prognosticis procedant,
Pars I.

ac si dicta astra aut penitus in re-
rum natura non essent; aut sine in-
fluxu essent.

An non insipientem medicum
illum iudicares, qui aut ignoratis
penitus, aut saltē non attentis
interioribus humani corporis mē-
bris, eorumque in totum animale
corpus naturali & necessario influ-
xu; ex sola inferiorum quorun-
dam inspectione patienti, longio-
rem, aut breuiorem vitam præsu-
meret vaticinare, longiturnum
morbum, fortunam & familia?
Quâ ergo ratione dictorū Astro-
logorum, pleraque celi nobilissi-
ma astra eorumque in inferiora
influxus & energiam, aut omnino
ignorantium, aut saltē vix vni-
bram virtutum illorū cognoscen-
tiū turba cæco iudicio, & prognos-
ticiis suis fictis tantopere hodie
mundum excæcare, hominesque
inanibus ac mendacibus verbis
cæco quasi verbere ferire non du-
bitat? Cumque semper æquiuo-
cè mentiantur prognosticando;
mirum non est ea quæ aliàs reuerā
casu tantum contingunt quando-
que, etsi præter intentionē prognos-
tificantium, accidere, sicque præ-
dictionibus eorum à simpliciori-
bus fidem haberi. Certè ipso sta-
tim fronte æquiuoco prædictio-
num suarum produnt, à quo ta-
lem diuinationem, scientiā, aut veri-
tatis insipientiam suam hauriant;
scilicet non nisi ab illo, (puta dia-
bolo) qui hoc ipsissimo modo
quondam famosum illud & no-
tum

H h 2 tum



(6) We have incorporated a sunspot record by Horrox in 4 December 1639.

JOHANNIS HEVELII
MERCURIUS
 In Sole visus Gedani,
 Anno Christiano M DC LXI, d. III Maji, St. n.
 Cum aliis quibusdam rerum Cœlestium observa-
 tionibus, rarisq; phœnomenis.
Cui annexa est,
V E N U S
 In Sole pariter visa, Anno 1639, d. 24 Nov. St. V.
 LIVERPOLIÆ, A JEREMIA HORROXIO:
 NUNC PRIMUM EDITA, NOTISQUE ILLUSTRATA.
Regibus accedat succindita
HISTORIOLA,
 Novæ illius, ac miræ Stellæ in collo Ceti, certis anni temporibus clarè admodum
 affulgentis, rursus omnino evanescentis.
Non enim
GENUINA DELINEATIO,
 Paracelsianorum, & Parellorem quorundam
 datu ratiocinationum.



Cum Privilegio Sac. Cæsareæ, & Regiæ P. & S. Majestatum
GEDANI
 AUTORIS TYPIS, ET SUMPTIBUS,
 imprimbat SIMON REINIGER.
 ANNO M DC LXI.

IN SOLE VISA. 115

Deque ipso Solis gremio, clausisque latebris
 Erui, obscura pallentia sidera nocte,
 Mercurium Veneremque, sacri & penetrabilis Regis
 Antae inuicem rumpit secretaque iussit
 Confusus, O facinus tui Solis immita Promethy
 Ecce docem ingenis vero cultoribus, & quem
 Commentis hominum, cæcis pelagoque forem
 Errorum, O si qua est Cœlestiudicia juvenis
 Preferat, & tanti discat miracula Tubi.

Hæc ego machinâ Veneri insidiatus, descripsi in chartâ circum, cujus diameter, dimidium
 ferè pedem æquabat. Majori enim commodè uti non sinebat loci angustia. Divisiones verò satis
 accuratas ædificabat hæc quantitas. Neque enim scrupulosus scabatur limbus Quædrentis
 quinquaginta pedes in radio completentis: quantum quis unquam Astronomorum condidit: Et
 mihi quidem magis probatur, hæc mensura quam amplior: quia Solis imaginem admittit, etiam mi-
 norem, clariorem tamen & minus tremulam.

Circuli peripheriam in gradus 360, usitato more partitus sum; Diametrum vero in partes æ-
 quales 30 quot circiter scrupula occupat Solis Diameter apparet. Harum singula in particulas 4
 dissecta sunt: omnes igitur 120. Potuitque adhuc, si placuisset minutius dividi: sed relinqueban-
 tur cætera oculorum æstimationi, quavis divisione reali in tam parvis certior. Cogita igitur, singu-
 lare partes tricesimas, in scrupula secunda 60 divisas ea ratione quæ hæcenus in Astronomia
 consuevit.

Deinde sub horam observationis recessi in aptam cameram, clausisque adversus latem fen-
 estris, Tubum opticum ad iustam longitudinem extensum, per foramen ad solem direxi: radioli-
 que Solares per Tubum transiunt, circulo prius descripto, ad angulos rectos excepti: Solis imago
 circum exactè complente, diligenter denum & sæpe adipei, nigrum quodcumque in depicta
 Solis luce adversus.

Quamvis autem propria motuum Venerum reformatio, quam ante inceperam, & cui maxi-
 mè fidendum esse non dubitavi, ante horam tertiam post meridiem diei 24, quidvis expectare
 vetabat. Tamen aliorum fere omnium Astronomorum calculis, conjunctionem longe maturius
 (nonnullis etiam in diem 23) promittentibus, nolui tam opinioni propriæ, nec dum factis confir-
 matis favere, ut exinde nimium securus, de ipsâ observatione periclitaret, quocirca & die 23 ma-
 ximè autem toto 24, operi intentus, per intervalla temporis opportuna experimentum capere
 non neglexi.

Observavi enim die 24 à Solis exortu ad horam usque nonam, item paulò ante decimam ipso-
 que demum meridie, & hor. 1 pomeridianâ & aliis temporibus ad majora avocatus, quæ utique ob
 hæc parerga negligi non decuit: At omnibus iis momentis, nihil penitus in Sole conspexi, exceptâ
 quadam pusillâ & communi *Maculâ* particulis quasi tribus à Solis centro ad sinistram remota
 quam etiam diebus præcedentibus, & sequentibus in Sole notavi: Ergo illa nihil ad Venerem.

Præterea autem 2 15 post meridiem, quo primum tempore cœli vastitudo sepe vacabat, ac
 easdem penitus nubes ad oblatam veluti divinitus occasionem invitavit volentem; Ubi ecce gra-
 tissimum spectaculum, & tot votorum materiem notavi *maculam* novam, insolita magnitudinis,
 figuræque omnino circulari, supra limbum Solis sinistram jam totaliter ingreßam: adeo ut mar-
 gines Solis & *Maculæ*, ad sinistram præcisè coinciderent, formantes angulum contactus: Statim
 hanc Veneris umbram esse minime dubius ad sedulam illius observationem me accinxi.

Primo pro Inclinatione Linæ diametrali perpendiculariter ad Horizontem insistenti circuli
 tamen plano ob Solis altitudinem aliquantum reclinato, inveni Veneris umbram hora dictâ 3 15
 Solis discum intrasse grad. 62 30' circiter (certe inter gr. 60 & 65) à vertice ad dextram. Hoc
 iterum in obscurâ camerâ: Ergo foris in ipso Cœlo contrarium evenit, ut possunt leges optice
 fatique Venus inferior centro Solis, distans grad. 62 30' à parte Solis infimâ, seu Nadir, ut vo-
 cant Arabes; Duravit autem ad omnem sensum eadem Inclinatione ad Solis occalum finemque ob-
 servationis.

Secundo distantiam centrorum Solis & Veneris ter observavi ut sequitur,

Horologium	Centrorum distantia
3 15'	14' 24"
3 35	13 30
3 45	13 0
3 50 Solis occasus apparet.	

Verus Solis occasus fuit hor. 3 45 apparet, ob refractionem, minutis circiter 5 sequebatur, ve-
 rum horologium ergo satis exactum.

1 Ter-

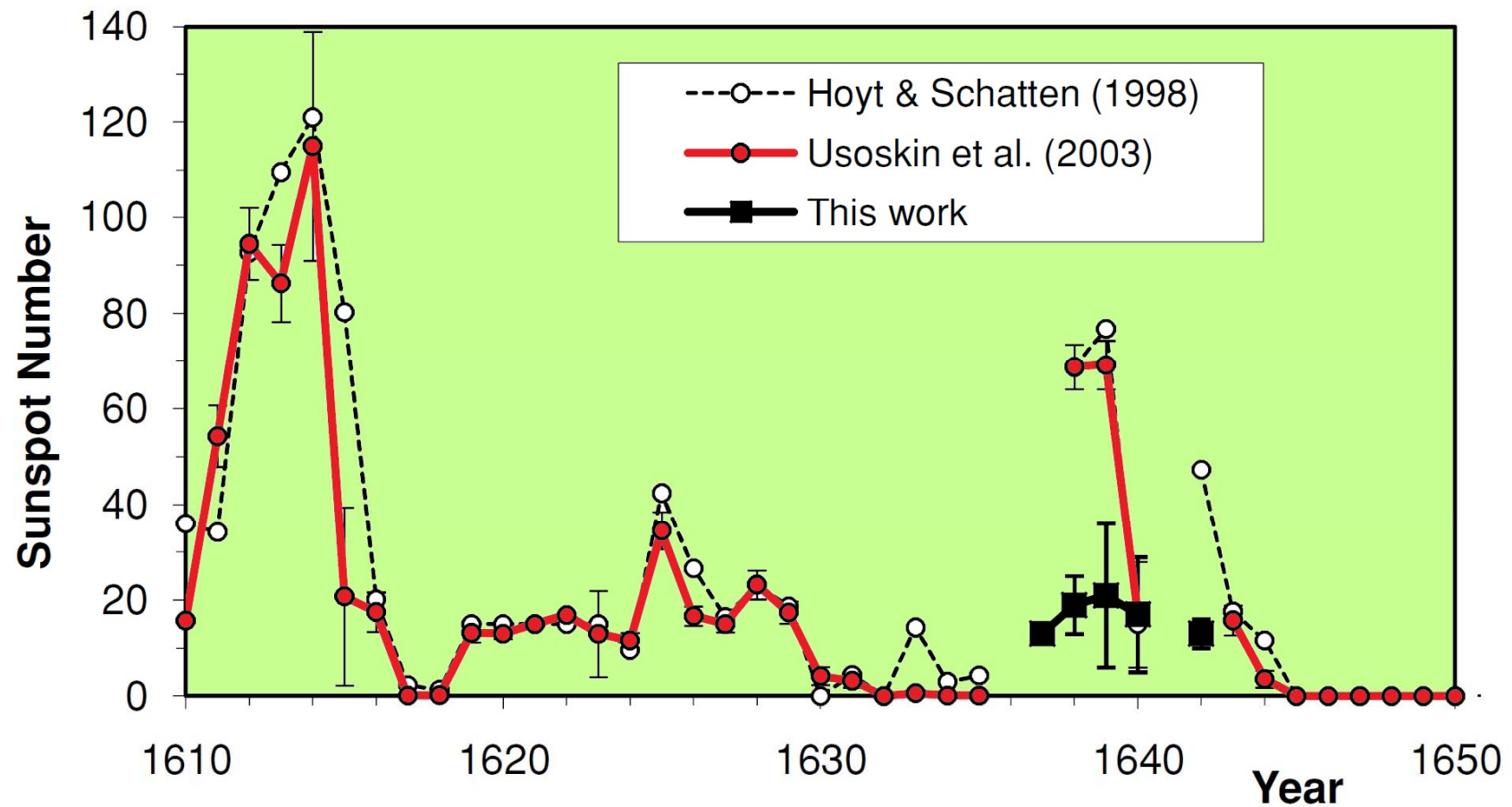
non neglexi.

Observavi enim die 24 à Solis exortu ad horam usque nonam, item paulò ante decimam ipso-
 que demum meridie, & hor. 1 pomeridianâ & aliis temporibus ad majora avocatus, quæ utique ob
 hæc parerga negligi non decuit: At omnibus iis momentis, nihil penitus in Sole conspexi, exceptâ
 quadam pusillâ & communi *Maculâ* particulis quasi tribus à Solis centro ad sinistram remota
 quam etiam diebus præcedentibus, & sequentibus in Sole notavi: Ergo illa nihil ad Venerem.
 Horâ autem 2 15 post meridiem, quo primum tempore observationem repetere vacabat, dis-

Observatio die
 24 Nov. St. 7ul.

Venus circa ve-
 speram in disco

We can use a statistical procedure (Usoskin, Mursula & Kovaltsov, 2003) to reconstruct yearly group sunspot number from sparse daily observation.



Vaquero et al. (2011), ApJ



A simple test to check inconsistencies in sunspot number series

Active days, AD, are days with sunspots reported on the solar disc.

AD has been taken as a reliable indicator of solar activity, especially during periods of minimum activity (Maunder, 1922; Harvey and White, 1999; Usoskin, Mursula, and Kovaltsov, 2000, 2001, 2004).

In fact, an equivalent index (inactive days with no spots) was used by Schwabe (1844) to discover the solar cycle.

Schreiben des Herrn Professors *Plantamour*, Directors der Sternwarte in Genf, an den Herausgeber.
Genève 1844. Janvier 23.

Monsieur,

Je suis très-reconnaissant de la prompte communication que vous nous avez faite de la lettre de Mr. *Gauss* par votre circulaire du 5 Janvier. La forme exceptionnelle de l'orbite de cette comète, qui fait une espèce de transition à la forme des orbites planétaires, est un fait fort intéressant. Ce n'est qu'après que j'ai eu le temps de comparer les éléments calculés par Mr. *Goldschmidt* *) avec les positions observées à Genève; mais avant d'indiquer les résultats de cette comparaison, je vous donnerai d'abord les observations de la comète, que j'ai faites depuis ma dernière lettre.

T. moy. Genève.	AR. appar.	Decl. appar.
1843 Déc. 17,3692	5 ^h 13 ^m 10 ^s 36	+3° 20' 36" 9
1844 Janv. 9,2950	5 8 20,77	3 24 1,7
11,3118	5 8 35,07	3 31 48,9
12,3410	5 8 44,48	3 36 7,4
16,3813	5 9 41,06	3 54 57,7
18,4221	5 10 20,29	4 5 33,9

*) Die ersten Elemente des Herrn Doctors *Goldschmidt*. S.

J'ai trouvé maintenant les différences suivantes entre les longitudes et latitudes géocentriques calculées au moyen des éléments de Mr. *Goldschmidt* et les longitudes et latitudes données par l'observation.

		Erreurs des éléments	
		Longitude.	Latitude.
1843 Décembre	3	+ 29' 5	— 4' 3
	9	+ 3,9	— 20,8
	17	— 19,8	— 28,0
1844 Janvier	9	— 30,9	+2' 1,3
	11	— 21,6	+2 21,5
	12	— 6,6	+2 31,9
	16	+ 36,4	+3 23,1
	18	+1 5,6	+3 50,0

Cette comparaison montre que les éléments ont besoin d'une correction, pour pouvoir représenter les observations du mois de Janvier; mais, avant d'entreprendre cette correction, j'attendrai que la comète ait terminé son apparition; car j'espère pouvoir l'observer encore pendant quelque temps, quoiqu'elle ait déjà beaucoup diminué d'éclat.

E. *Plantamour*.

Sonnen-Beobachtungen im Jahre 1843. Von Herrn Hofrath *Schwabe* in Dessau.

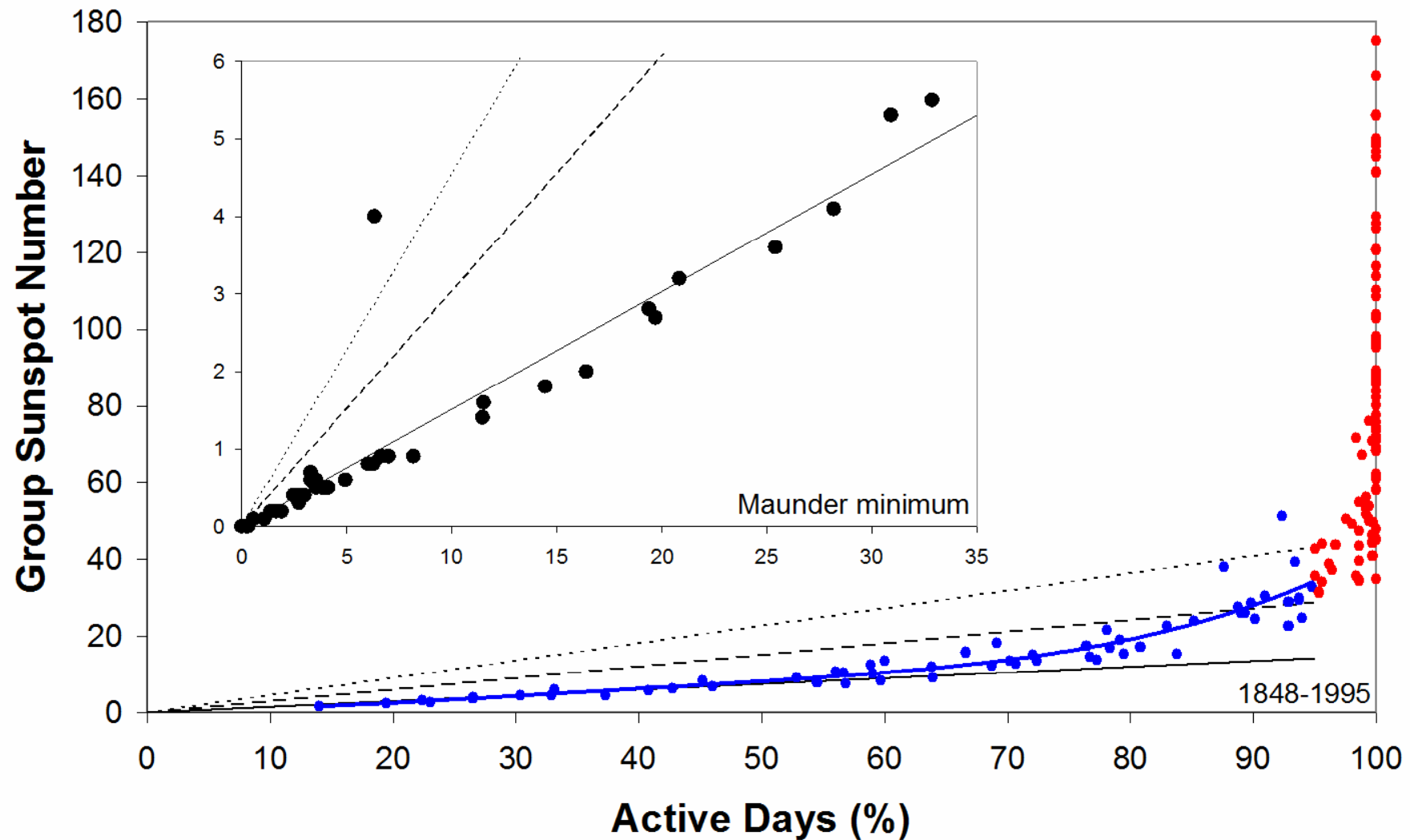
Die Witterung war in diesem Jahre so äusserst günstig, daß ich die Sonne an 312 Tagen genau beobachten konnte, dennoch zählte ich nur 34 Gruppen Sonnenflecken, von denen die meisten aus einzelnen kleinen Flecken oder Punkten und wenige aus mehreren behafteten Kernflecken bestanden. Zu diesen zahlreichern Gruppen gehörten vorzüglich drei, welche sich durch ihre Beständigkeit auszeichneten. Im Januar, Februar und März trat eine dieser Gruppen dreimal, im April, Mai und Juni eine andere viermal und im Juli, August und September eine dritte dreimal ein. Die zahlreichsten und größten Flecken enthielt die zweite der genannten Gruppen; ihr westlichster und größter Flecken war bei den beiden ersten Vorübergängen mit unbewaffnetem Auge als ein feines Pünktchen kenntlich, indem er bei dem ersten Vorübergang am 30^{ten} April 1' 8" 36 und bei dem zweiten am 31^{ten} Mai 1' 37" 72 im größten Durchmesser hatte.

An 149 Tagen, die durch alle Monate ziemlich gleich vertheilt waren, bemerkte ich keine Flecken und nur selten einiges bedeutende Lichtgewölke; meistens war die Oberfläche der Sonne vollkommen gleichförmig hell und bei günstiger Luft zeigte sie sich wie mit feinem Griessande oder hellen Körnern bestreuet.

Schon aus meinen früheren Beobachtungen, die ich jähr-

lich in dieser Zeitschrift mittheile, scheint sich eine gewisse Periodicität der Sonnenflecken zu ergeben und diese Wahrscheinlichkeit gewinnt durch die diesjährigen noch an Sicherheit. Obgleich ich schon in Band 15. Nr. 350 pag. 246 der Astr. Nachrichten die Menge der Gruppen in den Jahren 1826 bis 1837 angab, so füge ich doch hier noch ein vollständiges Verzeichniß aller meiner bisher beobachteten Sonnenflecken bei, worin ich neben der Zahl der Gruppen auch die Zahl der Beobachtungstage und der fleckenfreien Tage angemerkt habe. Die Zahl der Gruppen allein giebt nämlich keine hinreichende Genauigkeit zur Beurtheilung einer Periode, weil ich mich überzeugt habe, daß bei sehr starken Anhäufungen der Sonnenflecken eine etwas zu geringe bei dem sparsamen Erscheinen derselben eine etwas zu große Anzahl der Gruppen gerechnet wird. Im ersten Falle fließen oft mehrere Gruppen zu einer einzigen zusammen und im zweiten trennt sich leicht eine Gruppe, durch Auflösung einiger Flecken, in zwei einzelne. Hiermit wird wohl die Wiederholung des frühern Verzeichnisses entschuldigt sein.

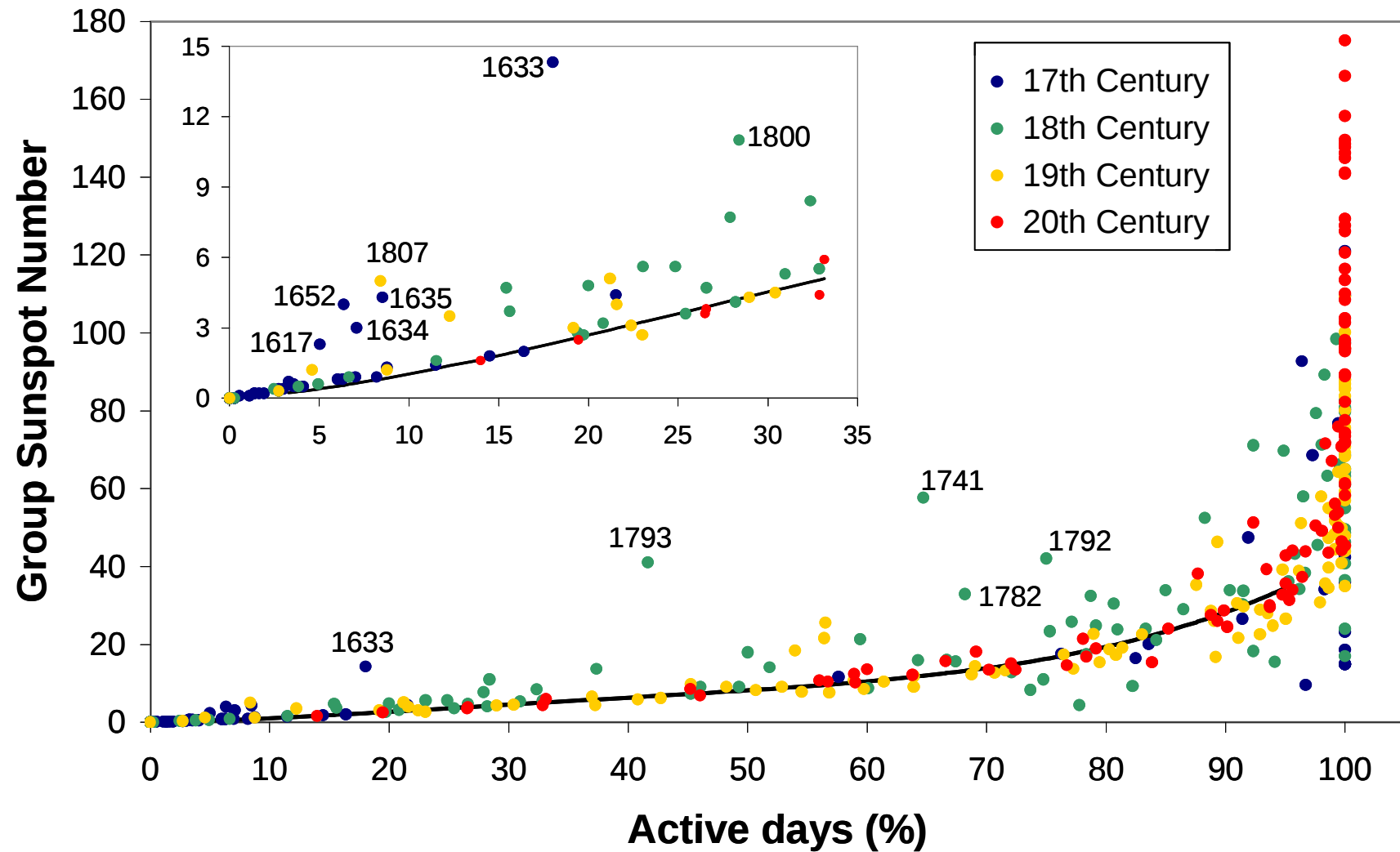
Jahr.	Gruppen.	Fleckenfreie Tage.	Beobachtungstage.
1826	118	22	277
1827	161	2	273
1828	225	0	282



Vaquero et al. (2012) *Solar Phys.* **277**, 389

Relationship between GSN and AD for 1848–1995 from Hoyt & Schatten (1998). Polynomial fit (order 4) is shown for AD < 95% (blue line and points). Graphic inserted shows the same relationship during the Maunder minimum. Black lines represent the theoretical values for an average observer with 1 (continuous), 2 (dashed), and 3 (dotted) groups for each active day.





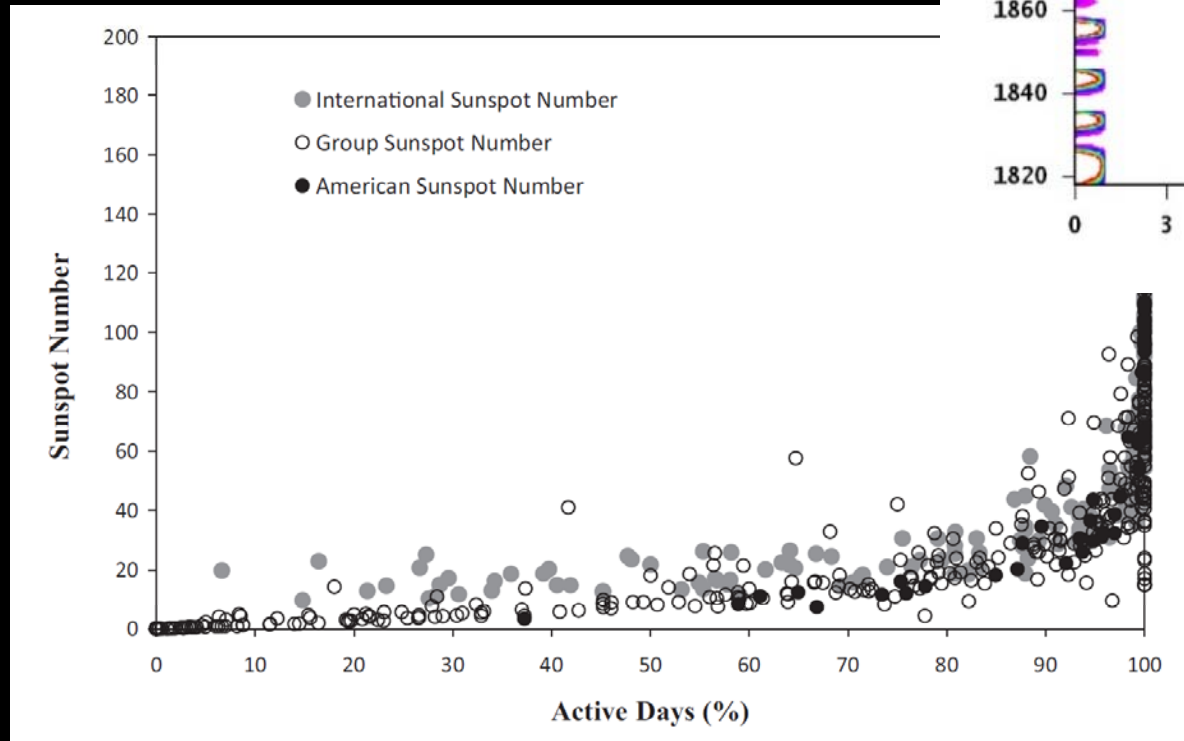
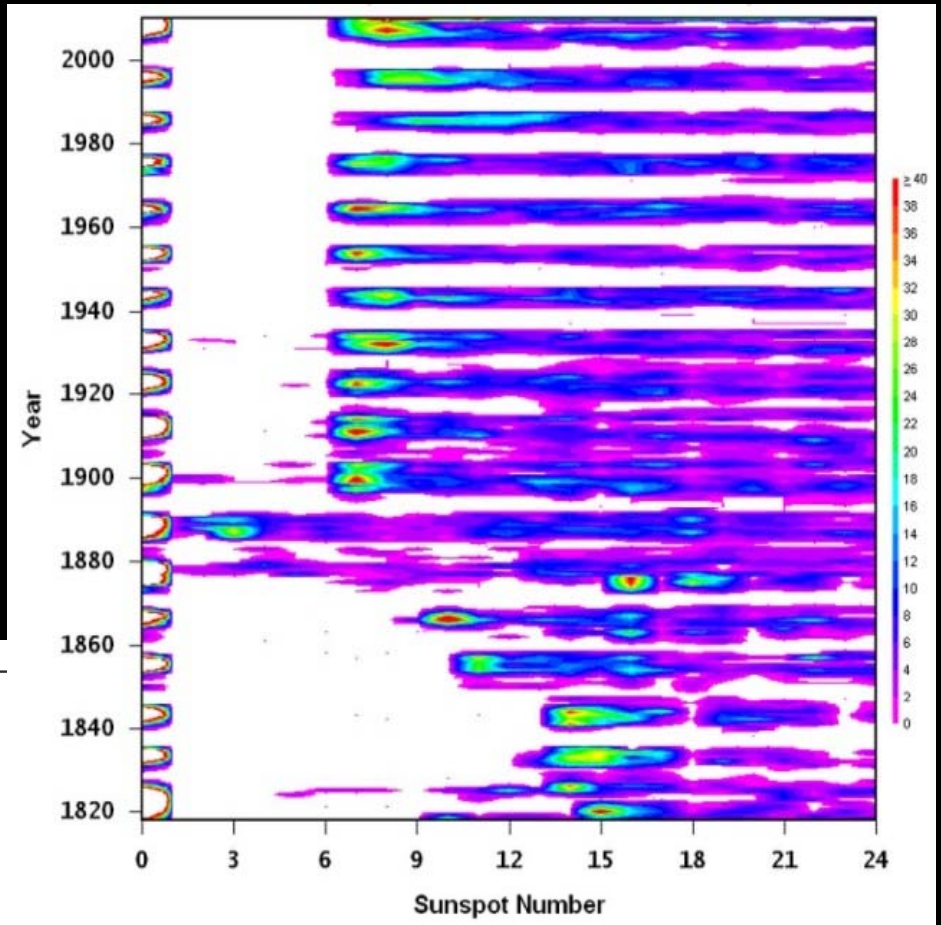
Vaquero et al. (2012) *Solar Phys.* **277**, 389

Relationship between GSN and AD for all available data from Hoyt & Schatten (1998). Black line is the polynomial fit of last Figure. The inset presents an enlarged version but restricted to values AD < 35%.





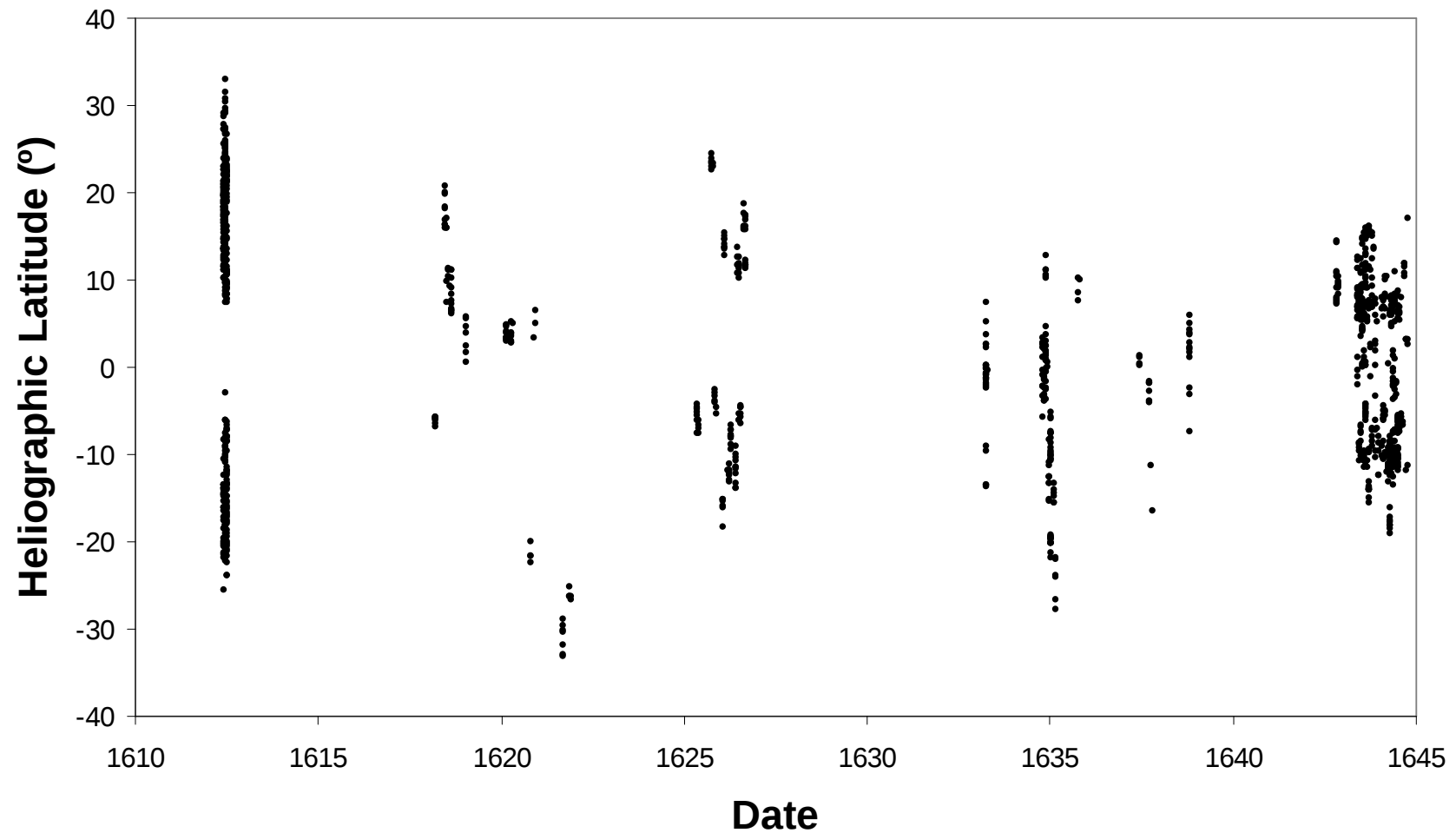
Clette et al. (2014)



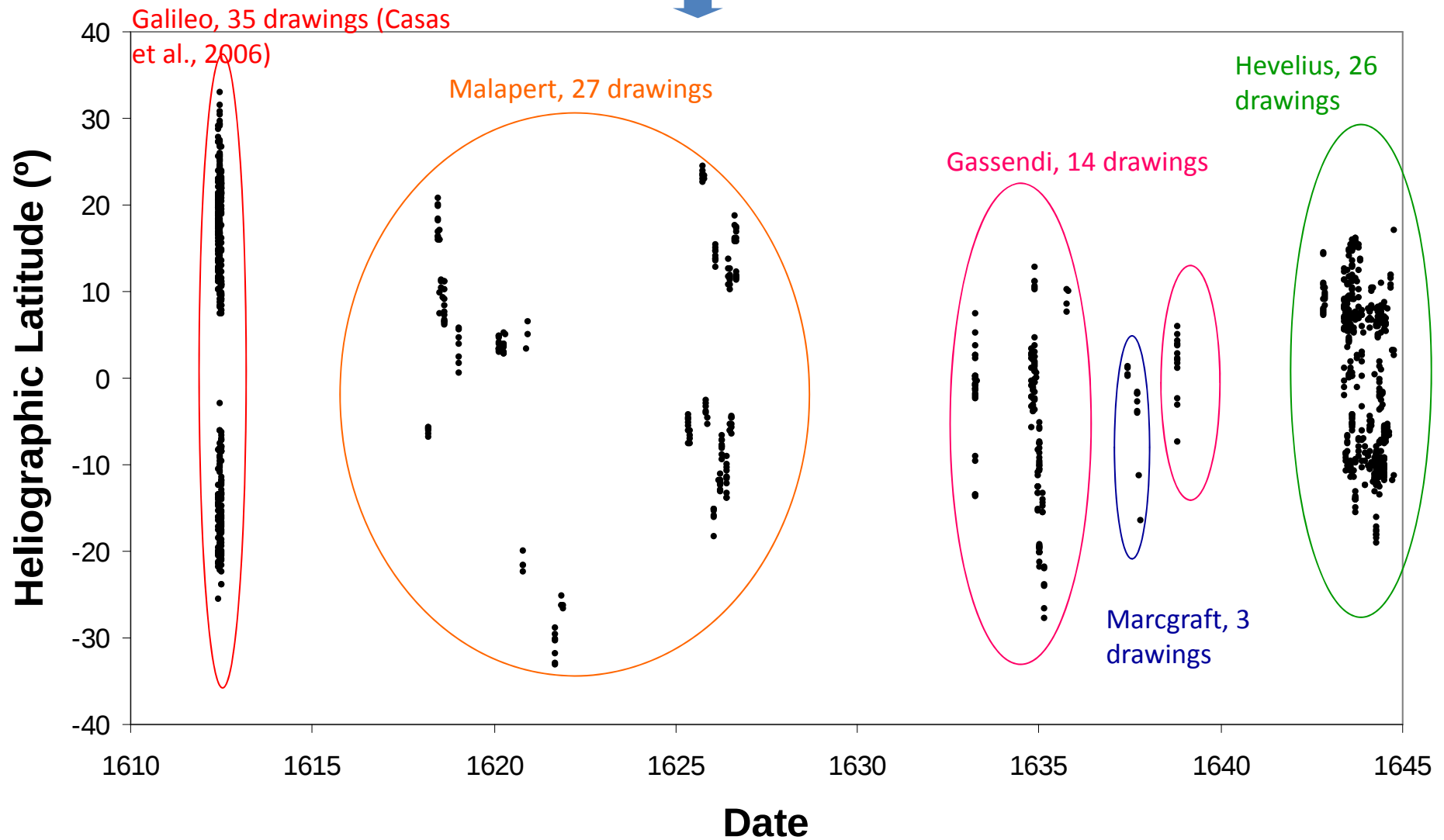
Vaquero et al. (2014)



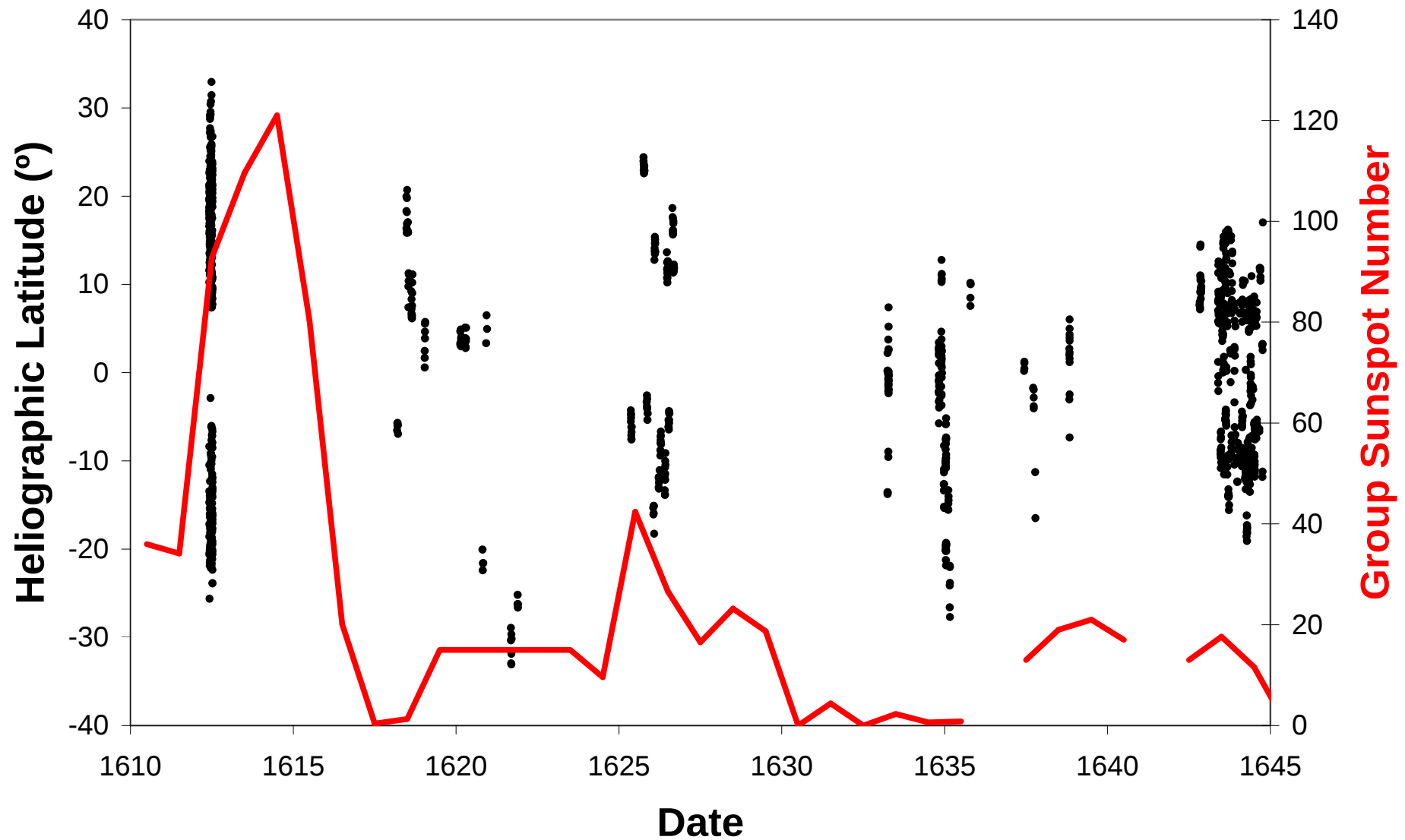
**And, finally, this very recent
result (to be checked)...**



Rainer Arlt is measuring sunspot positions from *Rosa Ursina* by Scheiner (1625-1626 mainly)!



ONLY 105 DRAWINGS!!!



This incomplete (and no revised) butterfly diagram suggests solar minima at 1620 and 1631±2 (approximately, only 105 drawings)





Conclusions

- 1) The group count database (provided by Hoyt & Schatten) has a key role in our understanding of solar activity during the last centuries.
- 2) Some problems can be detected and corrected using the original observations (historical documents).
- 3) A [preliminary] butterfly diagram for 1610-1645 indicates that the uncertainties in solar activity reconstructions during this periods can be large.



***Thank you
very much!***

**Comments,
suggestions, etc.:**

jvaquero@unex.es

