TABLE II.—MAXIMA AND MINIMA IN 1930.

Star	Ph.	Date	J.D.	Mag.	Period	M—m	O—C H	O—C B
S Aquilæ	M	*Dec. 19	5965	9·2	138	64	—	— 4
,,	m	March 23	6059	11·7	158	—	+ 1	—
,,	M	May 12	6109	9·0	144	50	— 5	— 7
,,	m	Aug. 8	6197	11·9	138	—	— 8	—
,,	M	Oct. 7	6257	9·3	148	60	— 4	— 6
R Arietis	M	Jan. 4	5981	9·0	178	89	— 3	+ 4
,,	m	Oct. 14	6264	13·5	186?	—	— 3	—
X Aurigæ	m	Jan. 10	5987	13·3	176	—	—	—
,,	M	April 5	6072	8·9	169	85	+10	+21
,,	m	June 23	6151	12·7?	164	—	+ 9	—
,,	M	Sept. 16	6236	8·7	164	85	+10	+22
,,	m	Dec. 10	6321	12·7	170	—	+15	—
R Boötis	M	*Dec. 17	5963	7·4	225	106	— 3	+ 6
,,	m	April 12	6088	12·6	231	—	+13	—
,,	M	Aug. 12	6201	7·2	238	113	+ 8	+20
,,	m	Dec. 2	6313	12·6	225	—	+15	—
S Boötis	M	Jan. 29	6006	8·2	269	140	— 5	—12
,,	m	June 21	6149	13·4	283	—	— 3	—
,,	M	Nov. 6	6287	8·4	281	138	+ 5	—11
U Boötis	m	Jan. 29	6006	12·1	176	—	—	—
,,	M	April 28	6095	10·7	169	89	—	—
,,	m	Aug. 24	6213	12·1	207	—	—	—
,,	M	Dec. 1	6312	10·0	217	99	—	—
V Boötis	M	Jan. 23	6000	7·8	251	137	+ 4	— 1
,,	m	June 12	6140	10·4	277	—	+20	—
,,	M	Sept. 21	6241	7·4	241	101	—15	—20
R Camelo.	M	*Dec. 16	5962	8·3	284	135	+23	+ 3
,,	m	April 18	6085	13·6	258	—	+ 3	—
,,	M	Sept. 1	6221	8·4	259	136	+15	—14
X Camelo.	M	*Dec. 26	5972	7·8	150	73	+ 8	—
,,	m	March 12	6048	13·2	149	—	+ 8	—
,,	M	May 17	6114	8·4	142	66	— 3	+ 2
,,	m	July 25	6183	12·5	135	—	+ 1	—
,,	M	Sept. 30	6250	8·3	136	67	— 9	— 5
W Coronæ	m	*Dec. 15	5961	13·4	231	—	— 5	—
,,	M	April 1	6068	9·3	234	107	+ 4	— 2
,,	m	Aug. 13	6202	13·0	241	—	+ 8	—
,,	M	Nov. 22	6303	7·8	235	101	+ 1	— 5
W Cygni	m	*Nov. 22	5938	6·7	136?	—	—	—
,,	M	Jan. 17	5994	6·0	175	56	—	— 3
,,	m	March 16	6052	6·5	114	—	—	—
,,	M	May 4	6101	5·8	107	49	—	—32
,,	m	Aug. 11	6200	6·6	148	—	—	—
,,	M	Oct. 2	6252	5·8	151	52	—	—17
,,	m	Oct. 24	6274	6·6	—	—	—	—
R Draconis	m	*Dec. 19	5965	12·3	250	—	— 2	—
,,	M	April 4	6071	7·6	244	106	— 5	— 3
,,	m	Aug. 19	6208	12·4	243	—	— 4	—
,,	M	Dec. 2	6313	7·6	242	105	— 9	— 6
T Herculis	M	Jan. 28	6005	7·1	155	78	—10	— 2
,,	m	April 30	6097	13·6	170	—	— 8	—
,,	M	July 19	6177	8·2	172	80	— 3	+ 5
,,	m	Oct. 15	6265	13·4	168	—	— 5	—
W Lyræ	M	*Dec. 25	5971	7·7	188	90	+ 1	+24
,,	m	April 10	6077	12·0	196	—	+ 1	—
,,	M	July 9	6167	7·6	196	90	— 5	+10
,,	m	Oct. 23	6273	12·1	196	—	+ 1	—
RY Ophiuchi	m	Feb. 16	6024	13·5	142	—	—14	—
,,	M	April 29	6096	7·5	147	72	—11	— 7
,,	m	July 25	6183	13·8	159	—	— 4	—
,,	M	Sept. 24	6244	8·4	148	61	—14	—10
X Pegasi	M	*Dec. 21	5967	9·9	197	96	— 3	+14
,,	M	Aug. 1	6190	9·7	223	—	+20	+26
,,	m	Oct. 21	6271	13·6	200?	—	+ 1	—
R Persei	M	Feb. 6	6014	8·5	203	96	— 6	— 2
,,	M	Sept. 14	6234	9·0	220	—	+ 4	+11
,,	m	Dec. 7	6318	14·1	200?	—	—20	—
V Tauri	m	March 10	6046	14·4	177?	—	+25	—
,,	M	Nov. 5	6286	9·1	177?	—	+11	+ 9
S Ursæ Maj.	m	*Dec. 29	5975	11·6	223	—	— 5	—
,,	M	April 21	6088	7·7	233	113	+13	+ 5
,,	m	Aug. 21	6210	12·1	235	—	+ 5	—
T Ursæ Maj.	m	Feb. 18	6026	13·0	246	—	— 1	—
,,	M	June 6	6134	8·0	253	108	+27	— 7
,,	m	Oct. 11	6261	12·3	235	—	—23	—
R Vulpeculæ	m	Jan. 15	5992	12·8	139	—	— 4	—
,,	M	March 25	6061	8·1	142	69	+ 4	+ 1
,,	m	June 2	6130	12·8	138	—	— 3	—
,,	M	July 31	6189	8·1	128	59	— 5	— 8
,,	m	Oct. 6	6256	12·6	126	—	—14	—
,,	M	Dec. 14	6325	7·4	136	69	— 6	— 9

Papers Communicated to the Association.

Galileo and Simon Mayer.*

By PROFESSOR PIETRO PAGNINI.

The controversy between Galileo and Simon Mayer (Marius) for priority in the discovery of Jupiter's satellites may be said to begin with the publication of Mayer's *Mundus Jovialis* is 1614, wherein he claims to have discovered them in December, 1609, and with Galileo's accusations of falsehood and plagiarism in his *Saggiatore* published in 1623.

Mr. J. H. Johnson has recently dealt with this controversy† in a manner which leaves little more to be said on the subject, especially as regards the critical examination of the observations of Galileo and Marius so exhaustively dealt with by Oudemans and Bosscha.‡

* Translated by W. P. Henderson; communicated by W. Alfred Parr

† The Discovery of the First Four Satellites of Jupiter by J. H. Johnson, *B.A.A. Journal*, Vol. 41, pp. 164-171.

‡ J. A. C. Oudemans et J. Bosscha, *Archives Neerlandaises des Sciences Exactes et Naturelles*, Série II, Tome VIII, pp. 115-189; and J. Bosscha, *idem*, Série II, Tome XII, pp. 258-307 and 490-528.

Conclusions differing somewhat from Mr. Johnson's, and almost in complete agreement with those of Bosscha, would appear to emerge from the publications mentioned above. Mr. Johnson's article and the extracts he quoted from the *Mundus* contain all the essential facts relating to the dispute, but in addition to these the following translation of an extract from the *Saggiatore*,* in which Galileo claims to have unmasked Marius and reveal him as a liar, may be brought forward here:—

"Simon Marius writes in the second part of his *Mundus Jovialis*, in reference to the sixth phenomenon, that he diligently observed how the four Jovian planets are never found in a line parallel to the ecliptic unless they are at their maximum elongations from Jupiter; and when they are within those distances they always incline notably from the said line . . . and to justify such an appearance he states that the paths are inclined towards the south from the plane of the ecliptic when in the superior part of their orbits, and towards the north when in their inferior. Now this doctrine is full of fallacies, which openly display and testify to his fraud. Firstly, it is not true that the orbits of the Medicean stars are inclined to the plane of the ecliptic; on the contrary, they are always equidistant from it. Secondly, it is not true that those same stars are never exactly in a straight line among themselves unless they are at their maximum elongations from Jupiter. . . . And finally it is false to say that when they are inclined to the plane of the ecliptic they incline towards the south when in the upper part of their orbits, and towards the north when in the lower; on the contrary, it is only at certain times when they incline in that manner, and at other times they incline in a contrary manner, that is towards the north when in the upper part of their orbits and towards the south when in the lower. But Simon Marius has unconsciously exposed his error because he has neither understood nor observed this matter. . . . Now Simon Marius writes of having observed how the four stars were always inclined towards the south when in the upper part of their orbits, the observations were therefore made at a time when Jupiter was in north latitude, but when I made my first observations Jupiter was south and remained south for a long time, and was never north, so that the four stars would only appear, as Marius describes them, more than two years later; therefore if he ever saw and observed them it was not until two years after I did. Here he is convicted by his own observations of having lied about having made those observations before me."†

In order to arrive at some conclusion about this dispute, apart from all preconceived and irrelevant opinions, it is necessary to find satisfactory answers to the following questions:—

i. Could Marius have observed Jupiter's satellites at some date before Galileo's *Nuncius*?

* *Edizione Nazionale della Opere di Galileo*, Vol. VI, pp. 215-217.

† For original see Appendix I.

ii. If he actually saw those *stellulæ* did he honestly and with full comprehension recognise them as the satellites of Jupiter?

iii. Was it before or after he became aware of the *Sidereus Nuncius* that he realised that he was faced with a new and hitherto unknown phenomenon?

iv. Can he be accused of falsehood and plagiarism?

v. Are Galileo's accusations in the *Saggiatore* justified?

It is obvious that the answers do not depend entirely upon astronomical considerations or upon trustworthy documents, they are also dependent in a great measure upon psychological and moral considerations; that is, upon the characters of the two men, especially upon that of Galileo.

One of the earliest documents which mentions Mayer's discovery is a letter of his reproduced in the preface to Kepler's *Dioptrice*,* published in 1611. It leaves no doubt that in that year Kepler knew of Mayer's observations.

"Thus writes Marius to a mutual friend: 'In the first place I shall prove that Venus is illuminated by the sun and that it is sickle-shaped, &c.' Since the end of the previous year (at that time Galileo in Florence wrote to Prague regarding the Mother of Love and predicted those things which appeared to Marius in that order) up to the end of April in the current year, aided by the Belgian telescope, I saw and observed Venus repeatedly and diligently when it was nearest to the earth, to the west as well as to the east. In the fourth place I shall deal with the new Jovian planets which move around Jupiter as the other planets do round the sun, yet at different distances and periods. I have found the periods of the two outer ones and have constructed tables, so that at any time we may know how many minutes they are distant from Jupiter, to the right or to the left. And these two last chapters are absolutely the most extraordinary of any period. And other happenings may occur while I am working."†

Mr. Johnson refers to the *Frankischer Kalender oder Practica* of 1612, a work published before Mayer's *Mundus*; this is believed to be the same as that mentioned in Kepler's works,‡ from which the following quotation has been extracted:—

"Since the past year I have indicated in detail the leading purpose of my *Prognosticon* in the dedication of that calendar, inasmuch as in that dedication I announced some new observations made by me with the Dutch instrument, and in particular

* Joannis Kepleri, *Dioptrice*, &c. MDCXI. Some of the pages of this work, and particularly those passages which refer to Galileo's discoveries will be reproduced in the reprint of the *Edizione Nazionale delle Opere di Galileo* as an Appendix to the second part of the third volume together with some fresh matter, hitherto unpublished, extracted from Galileo's manuscripts and those of his disciple Vincenzo Renieri who especially devoted himself to the observation of Jupiter's satellites.

† For original see Appendix II.

‡ *Kepleri Opera Omnia*. Frankfurt. Vol. II. MDCCCLVIII, p. 470. "*In præfactione* (*d.d. Jun*, 1612) *et Prognosticum Astrologicum in annum* 1613 *haec marius dicit* . . . ."

I announced that Venus is illuminated by the sun and that it increases and decreases in splendour as the moon does. In the *Prognosticon* I have also recorded the four Jovian planets several times, together with a general hypothesis thereon, and stated that I had found the periods of the four planets and gave their tables."*

No other *Prognosticon* is known,, hence Mayer's preface to the *Prognosticon* of the previous year is also unknown; in any case the letter in the *Dioptrice* is certainly earlier than the *Prognosticon* referred to above, and is therefore undoubtedly valuable as evidence. The *communis amicus* mentioned in the *Dioptrice* appears to be Vickenius (Nicholas Wickens); Mayer's letter dated on July 6th, 1611, was sent on to Kepler who, on July 11th, 1611, replied to Wickens. So that accepting Mayer's assertion *a fine anni superiori* as true, his observation must be assigned a date shortly before that of the letter quoted by Bosccha dated December 30th, 1610,† which Odontius, reader of mathematics at Altdorf, received from Marius and passed on to Kepler. The letter to Odontius is, together with those in the *Dioptrice* and the *Prognosticon*, the third document which furnishes evidence that Marius was investigating the movements of the satellites and other phenomena which he had observed with the *Perspicillum Belgicum* even before he published his *Mundus*.

This is confirmed by Kepler's interpolation in the quotation from Mayer's letter which leads to the conclusion that in 1611 he was convinced that Mayer's observations were independent of Galileo's, at least as regards the observations of Venus, because the words *prout a fine anni superiori* must refer to the end of 1610, and *usque in Aprilem presentis* to the year 1611. On the other hand one cannot assume, with the same degree of certainty, that the observations of the satellites were made before December 30th, 1610. Marius recorded them for the first time in his letter to Odontius dated December 30th, 1610.

The *Dioptrice* therefore seems to show that Mayer's observations on the phases of Venus were made independently of Galileo, and at a date not far distant from that of Galileo's letter of December 11th, 1610, to Giuliano de' Medici, Grand-ducal ambassador at Prague, which contained the well-known anagram. This date may therefore be accepted as approximately the earliest date of the first documentary evidence of Mayer's observations. The letter to Odontius contains a diagram showing the relative distances of the Jovian satellites, agreeing with Mayer's observation of December 30th, 1610; this furnishes a proof that before that date he had realized the nature of the satellites.

If it were possible to assign a more definite date to Mayer's assertion in the letter in the *Dioptrice* another important factor would be available for deciding this controversy, but with all these uncertainties one can only admit that at some indeter-

* For original see Appendix III.

† Bosscha, *loc. cit.*, pp. 491 *et seq.*

minate time, undoubtedly before the end of 1610, Marius had observed the satellites of Jupiter and had realized their true nature.

These three documents, especially the *Dioptrice* and the letter to Odontius, which is rather earlier than the *Mundus Jovialis*, would appear to be, at first sight, more than sufficient to inspire confidence in the reliability of the whole of the *Præfatio ad candidum lectorem*. In the writer's opinion, it is just these documents which give rise to doubts and depreciate the value of the evidence contained in the account in the *Præfatio*.

It is well known that as soon as Galileo had published his *Nuncius* in March, 1610, he sent a copy to all the most renowned scholars, and to his friends and correspondents, both in Italy and abroad; Kepler naturally was among those who received the work. He immediately published his *Dissertatio cum Nuncio Sidereo* on April 19th, 1610, and later on the *Narratio de Observatis a se quatuor Jovis satellibus erronibus** which is dated *Pragæ* 11 *Septembris anno MDCX*. Not only does Mayer's name not appear in these two publications, but it is not even mentioned in letters written by Kepler† in 1610 to Galileo, Giuliano de' Medici, Magini, Horky, and Mueller.

Kepler's reticence leads to the logical conclusion that up to the date of the publication of the *Narratio* in September, 1610, or shortly before that date, he had received no communication from Marius regarding his astronomical discoveries as is stated in the *Dioptrice*.

Two questions immediately arise. Did Marius know, directly or indirectly, of the *Nuncius* before September 1610, and had he by that time seen and realized the nature of the satellites?

A reasonable answer to both is that if Marius knew of Galileo's *Nuncius* or of Kepler's *Dissertatio* before September 11th, 1610, which in the writer's opinion is practically certain, he could not have seen and recognised the satellites, as such, before that date. Otherwise it is difficult to understand why he did not communicate such an extraordinary phenomenon to Kepler; and it is still more difficult to understand his neglect to publish his discovery at once in order to establish his claims to priority, and to avoid the risk of being forestalled by others who already possessed telescopes.

On the other hand if it is admitted that Marius had no knowledge of the *Nuncius* or of the *Dissertatio* before September 1610, and that he had actually seen all that he described in the *Præfatio ad candidum lectorem* in his *Mundus* and in his letter to Odontius, then one can only conclude that for some time up to a date not far short of September 11th, 1610, he had not realized the significance of what he had seen, and that it was only towards the end of 1610 after he had learnt of Galileo's dis-

* Vide also *Edizione Nazionale delle Opere di Galileo*, Vol. III, part I.

† Vide *Edizione Nazionale*, Vol. X. Kepler to Galileo April 19, August 9, October 25. Kepler to Giuliano de' Medici May 3. Kepler to Magini May 10. Kepler to Horky August 9. Kepler to Mueller December 18.

covery, that his recollection of what he had observed led him, unconsciously and presumably in good faith, to reconstruct his marvellous discovery. Its full significance would probably never have occurred to him but for the publication of the *Nuncius*. In fact one may say that he lacked the ready intuition which inspired Galileo.

It is only on this hypothesis that Kepler's omission to mention Marius in the *Dissertatio* and in the *Narratio* can be reconciled with the account in the *Præfatio ad candidum lectorem*. That is to say, by accepting Mayer's observations made early in 1610 of the *stellulæ* about Jupiter, but denying that he was then able to explain or account for the phenomenon. And further, if at some date before the end of 1610 he had understood the significance of the phenomenon, he would not have confined himself to referring to the *Prognosticon* of the previous year in the issue for 1613 (dated 1612) as evidence of his discovery; he would undoubtedly have mentioned an earlier and more definite date in support of his claims. But in view of the explicit statement in the *Prognosticon*, any such date could not possibly have been earlier than the middle of 1610, and still less could it have referred to a time up to December 29th, 1609, the date given by Marius in his *Mundus*.

This is all that the writer asks his *candidi l ctores* to accept as his comments on a subject in which he is deeply interested.

It now remains to examine the passage in the *Saggiatore* relating to the accusation of plagiarism and falsehood, but not in the light of scientific criticism. That has already been undertaken by Oudemans and Bosscha, in their memoirs mentioned above. It must be candidly admitted that Galileo overstepped all limits in defending the priority due to him *de jure* and *de facto*. The greater part of the accusation in the passage already quoted is not in the least justified by his erroneous statement regarding the latitude of the satellites; that argument therefore falls to the ground. Extenuating circumstances can, however, be found for Galileo's rash statements on psychological grounds whose origins go back to the dispute with Baldissare Capra. The recollections kindled by the name of the author of the *Mundus*, the unpleasant surprise produced by certain phrases in the *Præfatio* so similar to some in his *Nuncius*, the name *Perspicillum Belgicum* given to an instrument which Galileo had so ostentatiously presented to the Venetian *Signoria*, and the publication of those tables of mean motions which had forestalled his *atlantica fatica*, all these combined to wound his pride and to stir up his combative nature, so ready for the fray and so given to bitter and provocative criticism, with the result that his obstinacy and irritability often made him exceed the limits admissible in legitimate defence. Looked at calmly and objectively, it must be obvious that among the faults of the *Saggiatore*, a work otherwise so full of inestimable riches, this accusation of plagiarism and falsehood, unsupported by complete evidence, does not count in favour of Galileo's dispassionate judgment.

The conclusions which may be drawn from what has been said above are:—

i. That Marius only observed Jupiter's satellites with full comprehension of their nature towards the end of 1610 as is proved by the documents which have come down to us.

ii. That if good faith be admitted as regards the assertion that he observed the *stellulæ*, as stated in the *Præfatio* to the *Mundus*, it does not follow that he realized their nature before the publication of the *Nuncius*.

iii. That for the rest the *Mundus* may be rated as the work of an astronomer who, although mediocre and ambitious, knew how to make observations as far as his instruments and the methods of his day permitted, and who did contribute, to some extent, to the solution of the knotty problem of the satellites' orbits.

iv. That if Galileo transgressed the limits of legitimate defence, his accusations were not altogether unfounded; he was the first to appreciate, with ready intuition, the importance of the phenomenon he had observed, and further, his timely publication of the *Nuncius*, and the date it bears, effectually shut out any claims for priority or attempts at vindication which are not supported by reliable documentary evidence.

APPENDIX I.

"Scrive Simone Mario nella seconda parte del suo Mondo Gioviale, alla considerazione del sesto fenomeno, d'aver con diligenza osservato, come i quattro pianeti Giovali mai non si trovano nella linea retta parallela all'eclittica se non quando sono nelle massime digressioni da Giove, ma che quando son fuori di queste sempre declinano con notevole differenza da detta linea . . . . e per salvare cotal apparenza, statuisce i lor cerchi inclinati dal piano dell'eclittica verso austro nelle parti superiori, e verso borea nelle inferiori. Or questa dottrina è piena di fallacie, le quali apertamente nutrano e testificano la sua fraude.

"E prima, non è vero che i quattro cerchi delle Medicee inclinano dal piano dell'eclittica; anzi sono eglino ad esso sempre equidistanti. Secondo, non è vero che le medesime stelle non sieno mai fra di loro puntualmente per linea retta se non quando si trovano costituite nelle massime digressioni da Giove . . . . E finalmente, è falso che quando declinano dal piano dell' eclittica, pieghino sempre verso austro quando sono nella metà superiore de'i loro cerchi, e verso borea quando sono nell'inferiore; anzi in alcuni tempi solamente fanno le loro declinazioni in cotal guisa, ed in altri tempi declinano al contrario, cioè verso borea quando sono ne' mezzi cerchi superiori, o verso austro nell'inferiori. Ma Simon Mario, per non aver nè inteso nè osservato questo negozio, ha inavvertitamente scoperto il suo fallo . . . . Ora scrivendo Simon Mario d'aver osservato come le dette quattro stelle sempre declinano

verso austro quando sono nelle metà superiori de' loro cerchi, adunque tali sue osservazioni furono fatte in tempo che Giove aveva latitudine boreale; ma quando io feci le mie prime osservazioni Giove era australe, e tale stette per lungo tempo, nè si fece boreale, sì che le latitudini delle quattro stelle potessero mostrarsi come scrive Simone, se non più di due anni dopo; adunque, se pur egli già mai le vide ed osservò, ciò non fu se non due anni dopo di me.

" Eccolo dunque già dalle sue stesse osservazioni convinto di bugia d'avere avanti di me fatte cotali osservazioni."

Appendix II.

" Sic igitur Marius ad communem nostrum amicum: . . . . 'Tertio demostrabo Venerem non secus illuminari a sole eamque corniculatam, διχότομον, etc. reddi, prout a fine anni superioris (quo ipso tempore Galilaeus Florentia Pragam scripsit de matre amorum, haec Mario sic ordine apparitura jam tunc praedixit) usque in Aprilem praesentis a me ope Perspicilli Belgici multoties et diligentissime observata et visa est, quando Venus proxima terrae erat, cum occidentalis, tum orientalis. Quarto agam de novis planetis Jovialibus, qui circa terram ferunter ut planetae reliqui circa Solem inaequali tamen interstitio et periodo Duorum extremorum periodos jam indagavi tabulasque construxi, ut inde omni tempore facillime sciri possit, quot minutis distent a Jove ad dextram sinistramve. Haecque duo capita ultima sunt plane inaudita omni aevo. Forsan alia etiam interim dum laboro occurent."

Appendix III.

" Vor einem Jahr habe ich in der dedication selbigen Calenders die vornembsten Ursachen meines Prognosticirens umbständiglich angezeigt. Diewiel ich aber eben in solcher dedication etlicher Newer durch das Niderländische Instrument von mir besehehner observation gedacht, als vornemblich der Veneris, dass sie von der Sonner erleuchtet werde, an dem liecht ab-und zuneme, wie der Monn. Hab auch in Prognostico zu unterschiedlichen malen der 4 Newen Jovialischen Planeten, sampt irer generali Hypothesi erinnerung gethan, und dass von mir allbereidt der periodus dess vierdten erforschet und tabulae gerechnet worden . . . ."

(The author desires to express his thanks to Mr. W. P. Henderson, of Florence, for kindly undertaking the translation of this paper.)

Second Report on the Computation of the Perturbations of Tempel's Comet, 1866 I.

By A. C. D. Crommelin, D.Sc., F.R.A.S.

One of the " Sayings of the Week," given in the *Observer* for June 21, is the following by Sir James Jeans, " A comet

was brought home to me by recognition of their great departure from the regularity which characterises the other members of the Sun's family. A slight alteration in the conditions of a comet's approach to Jupiter may make a difference of months in the comet's subsequent period. Now there were several fairly near approaches of Tempel's Comet to Jupiter during the fifteen revolutions between 1366 and 1866: it is beyond human power to deduce the circumstances of these approaches with perfect accuracy. Hence I no longer feel confident that our forecast of the date of the next perihelion will be right within a month or two. We must trust to luck, and hope that the errors will to a certain extent balance themselves in this long period, and give a fair approximation to the mean motion in 1866.

Once we assume this mean motion, the problem of finding the circumstances of the next return becomes a soluble one. At the meeting on May 27 I indicated the beginning of February 1933 as the probable date of perihelion. I have since that time been studying the perturbations of the comet by Jupiter and Saturn for the two revolutions 1866 to 1933 with greater accuracy. I found that the improvement in accuracy led to an earlier date of return, which gives more favourable conditions for observation. The comet approached Jupiter within 1 unit on approaching perihelion in 1899, and $1\frac{2}{3}$ unit on its outward journey. This double approach called imperatively for recomputation with a smaller time-interval, which was taken as 2° of mean anomaly, instead of 6° in the original computation.

I think it is well to tabulate the dates of intermediate perihelion passages that were deduced assuming that the value of n in 1366 was $106''.3820$. No great accuracy is claimed for these, but they should be a decided improvement on the original computation:—

Rev.	Julian Day	Date of Perihelion				n
						$''$
1	2220283·46	1366	Oct.	21	O.S.	106·3820
2	2232502·53	1400	April	4		106·1856
3	2244556·60	1433	April	5		107·3594
4	2256531·24	1466	Jan.	17		107·5359
5	2268603·15	1499	Feb.	5		105·9826
6	2280815·66	1532	July	13		104·3498
7	2293215·77	1566	June	15		104·7318
8	2305410·09	1599	Nov.	24	N.S.	106·2058
9	2317473·94	1632	Dec.	3		107·2916
10	2329548·88	1665	Dec.	25		105·8924
11	2341763·93	1699	June	6		104·3138
12	2354135·34	1733	April	20		104·6203
13	2366367·76	1766	Oct.	16		105·7008
14	2378495·18	1799	Dec.	30		107·0413
15	2390532·35	1832	Dec.	14		106·6845
16	2402664·47	1866	March	3		105·3035

The last date is $51{\cdot}33^{d}$ later than the actual perihelion passage.

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