

PHILOSOPHICAL
TRANSACTIONS:

A Discovery of Two New Planets about Saturn, Made in the Royal Parisian Observatory by Signor Cassini, Fellow of Both the Royal Societys, of England and France; English't Out of French

Signor Cassini

Phil. Trans. 1673 **8**, 5178-5185, published 1 January 1673

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so many forrein *Virtuosi* of great fame and solid worth, to afford considerable Assistance towards the Propagation of Philosophical Arts, and the Advancement of knowledg. Of which many pregnant Instances and manifest Matters of Fact do bear evidence, as they are with faithfulness, but without artifice or elaboratness, registred in these un-polish't Volumes.

A Discovery of two New Planets about Saturn, made in the Royal Parisian Observatory by Signor Cassini, Fellow of both the Royal Societys, of England and France; English't out of French.

I.

A Discovery of 10 small Fixt Stars, and of one New Planet, first.

A Bout the end of *October* 1671. Saturn pass'd close by *Four* small Fix't Stars, visible only by a Telescope, within the *sinus* of the Water of *Aquarius*, which *Rheita* once took for New Satellits of Jupiter, calling them *Urban-octavians*; but which *Hevelius* (who called them *Uladislavians*) shew'd to be some of the common Fix't Stars, that may every day be seen by a Telescope any where in the Heavens.

This Passage of Saturn gave us occasion to discover in the same place, within the space of 10 minuts, by a Telescope of 17 feet, made by *Campani*, *Eleven* other smaller Stars, one of which, by its particular motion, shew'd it self to be a true *Planet*: which we found by comparing it not only to Saturn and his Ordinary Satellit, discovered 1655 by Mr. *Hugens*, but also to other Fix't Stars, and particularly to three, marked *a, b, d*, in the First Table, where, to avoid a long explication of our first Observations, we have describ'd the way of Saturn, and that of the New Planet, alwayes marked *c*, beginning from *October* 25. unto *Novemb.* 6. We have added to it the Ordinary Satellit, without any particular mark, because he is easie to be known, being in these observations always next to Saturn. The distances are represented in their just proportions; but to

See Tab.
1. Fig. 11.

* Note, that in Tab. 1. fig. 1. the divisions mark'd in the great-st Circle do denote the days of the 3 months, nominat'd within that circle.

make Saturn more remarkable in the Table, he is represented twice bigger than he should be in proportion to the distances*.

These

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These Observations shew a motion of this New Planet that is very manifest in respect of the Fixt Stars, but less sensible in respect of Saturn. Yet it appears, that from *Octob. 25.* unto *Novemb. 1.* his distance from Saturn increased Westward, and from that time unto *Novemb. 6.* it diminished; so that his greatest digression from Saturn hapned in the beginning of *Novemb.* and was found to be of 8 minuts, or of $10\frac{1}{2}$ diameters of Saturns Ring. Whence it was consequent, *that*, if this Planet were a Satellit of Saturn, he must be unto the end of *September* in the inferior part of his Circle, and from the beginning of *November* in the superior part; and *that* his revolution about Saturn was of a long duration, since for 12 days together he not only remain'd on the same Occidental side of Saturn, but there was also little change of apparent distance between him and Saturn. The greatest digression of this Planet was *treble* to that of the *ordinary* Satellit, and this enabled us to judge the Time of his revolution to be *quintuple*, applying to the Satellits that proportion, which *Kepler* hath noted in the Principal Planets, between the periodical Times and their Distances. But there was one circumstance, which made us doubt, whether it were a *Satellit* or a *Principal Planet*, which was; That in the last observations we took notice, that he had a *little* Southern latitude in respect to the Line of the wings of Saturn, which we had not observed in the *first*, when he was nearest to Saturn; which happens not to the other Satellit, which hath always the *more* latitude, the *nearer* he is to Saturn; yet it might well be, that the Circle of this Planet might have some declination from the Circle of the other Satellit, as it comes to pass in the Principal planets, the Circles of which are inclined to one another. However this difficulty made us suspend our Judgment until we could make such a number of observations, as might suffice for a more precise determination.

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I I.

A pursuit of the New Planet.

See Tab. I. Fig. II. BUT the Sky being over-cast for many days, did interrupt our observations. However we saw Saturn *Novemb. 12.*, *16.*, *17.*, *19.*, *23*; and observed, that he was yet more approach'd to the Fixed stars, *b, d*, but we could find no foot-step at all of the New Planet. And we had little hopes left us of finding him again by the same Telescope, by which he had appeared very small towards the end. Notwithstanding, whilest we expected a greater Telescope, we were not wanting, during some intervals of fair weather, to seek, if we might not again meet with some such Star about Saturn.

See Tab. II. Fig. I. We found then *Decemb. 16.* of the same year, that Saturn had retaken his round figure, and that on the East of him there was a small star, far distant, in a straight line to Saturn, and to his ordinary Satellit, which was Oriental also, but little distant from Saturn. And *Decemb. 24.* we saw this Satellit in the West, and a Star, Oriental likewise, less distant from Saturn than that we had seen the *16th*. But the weather did not permit us to verifie, whether it was the same. At length, *Januar. 18.*, *23.*, *25.* of the year 1672. we saw on the West of Saturn, sometimes one star, sometimes many, far distant, almost in a direct line to his ordinary Satellit; which made us hope to see another time the New Planet towards his greatest Western digression; but these Observations were the last, which the weather suffered us to make, before Saturn did abscond himself in the beams of the Sun.

We represent in the second *Table Fig. I.* some of these interrupted Observations, though they be but made by the estimate of the Eye, and we then were not able to make out what kind of Stars they were.

After my return from a voyage of *Provence*, having brought with me from *Marseilles*, in the beginning of *Novemb. 1672.* an excellent Telescope of 35 foot, which *Campani* had made by order of his Majesty; we set it up in the Royal Observatory, directing it to Saturn, as soon as the weather would give leave,

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to seek for the New Planet. In the first observations, made *Decemb. 13* and *17*, we perceived an Occidental Star, remote from Saturn, which in both these observations had a Southern latitude in respect to the line of his wings; but in the first it was further distant from Saturn than in the second: So that, if this was the same Star, as I *supposed* it to be, not having been able to *make it out*, by comparing it with Fixed ones, there being at that time none within the Aperture of the Telescope; it moved towards Saturn on the East, and consequently (supposing it to be his Satellit) it was in the superior part of his Circle. *See Tab. II. Fig. 1.*

III.

A Discovery of another New Planet.

WE could not see Saturn again but the 23th of *December*, and then in the presence of Messieurs *Hugens, Picard, Mariotte, Romer*, and others of the *R. Academy of the Sciences*, we found a small Star westward of Saturn, *between* him and his Ordinary Satellit, which was on the West also, almost at a double distance. And at that time we had no other reason to suppose it to be different from the former, but that it had no latitude at all in respect of the Line of Saturn's wings. *See Tab. II. Fig. II.*

The weather did not suffer us to see Saturn again till the 30th of *December*; and then we saw a little Star, on the East of him, without any latitude between him and his Ordinary Satellit, which had passed also to the East of him. This observation, compared with the precedent, kept us yet in suspense, because we know not, *whether* this, which seem'd to us the same with that of the foregoing observation, had passed from one side of Saturn to the other, by one only motion slower than that of the ordinary Satellit, and consequently by a little arch of a greater Circle; or whether, during this interval of time, it had made one or more turns by a lesser Circle; which was much more accomodable to the position, in which it had appeared *without* Latitude in both observations; as ordinarily it befalls the Satellits, when they are in their greatest digressions.

But we being not to rely upon these two Observations alone,

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See Tab.
II, Fig. II.

we were very impatient for an opportunity of giving our selves more satisfaction about this *phenomenon*. The heavens were not favourable to us till the 10th of *Januar*. 1673; and then this little Star appear'd to have return'd almost to the same position in respect of Saturn, and his ordinary Satellit, where it had been *Decemb*. 23. That which made us wonder, was, to have found three times consecutively this small Star between Saturn and his Ordinary Satellit, always in a distance almost equal from one and the other. But our admiration ceased at the fourth Observation, made *Januar*. 15, in which the Ordinary Satellit was Oriental, and the New one Occidental, as it had been in the precedent, but a little nearer to Saturn. We had that evening time enough attentively to observe this Planet for a whole hour together, during which we perceived, it approached to Saturn on the West, and consequently was in the superior part of his Circle: which did fully confirm us in the supposition we were inclin'd to, that it was an *Interior Satellit*. Thus the pursuit of another Satellit, which we knew to be further distant from Saturn, and to have a longer period, made us discover this, which is nearer to it, and whose period is shorter.

IV.

An Hypothesis of the Motion of the Interior Satellit.

Then it was, that comparing the Observations together, we began to find the Rule of the Motion of the New Interior Satellit. For the two last shew'd us, that in 5 days he had made more than a whole revolution. The first observation compar'd with the third made us Judge, that in 18 days he had made a Number of revolutions, almost whole ones, which certainly were four; each of them was of $4\frac{1}{2}$ days: So that between the 10th and 15th it might be, that there had been one revolution of $4\frac{1}{2}$ days, or two revolutions of $2\frac{1}{2}$ days each.

But the combination of the first with the second made us conclude the period of $2\frac{1}{2}$ days. We therefore judged by these observations; *That* this last Planet finishes his revolution about Saturn in $4\frac{1}{2}$ days; *that* the Semidiameter of this Circle is of three

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three Semidiameters and a fourth of Saturn's Ring; and *that* he was towards his greatest Occidental digression the 23th of *December*, and *Januar.* 1. about 7 a clock in the evening.

Upon these grounds, after the fourth Observation, we made an *Ephemerid* of this Planet, as it is represented in *Tab. II. Fig. III*; where we added that of the old Satellit; that so by the Observations where both are to be nigh to Saturn, men might be able to distinguish them: And this *Ephemerid* hath serv'd us since, untill the Occultation of Saturn; without having found any other difference in the following Observations, but that, as for the nearest Planet, the Return to the same place, after one revolution of $4\frac{1}{2}$ days, is made one hour later; so that one circuit is finish't in 4 days and 13 hours. We have also learned by the following observations, that when the *Interior* Satellit is much distant from his great digressions, he hath some Southern latitude in respect to the Line of the wings in the Upper semicircle, and some Northern latitude in the Inferior; as hath also the Old Satellit, which hath more of it in proportion to the diameter of his Circle.

See Tab.
II. Fig. III.

The Observations of this Planet were made not only with the Telescope of *Campani*, but also with one of *Divini* of 36 foot; and with one of the same length of *Mons. Borelli*, who is a Member of the *R. Academy* of the Sciences.

V.

A Return to the Observations of the New Exterior Satellit of Saturn.

OUR application to observe the Planet nearest to Saturn, in the small time we had at evenings, by reason of his proximity to the Sun-beams, had diverted us from the other more remote Planet. But *February* 6. we began to see him again; and the weather favour'd us well enough to observe him almost all the days following untill the 20th of *February*, except the 9th and 18th.

See Tab.
II. Fig. 1.

He was conveniently seen by *Campani's* Telescope of 17 foot, by which the first discovery of it had been made; and by another of 20 foot, made by *Le-bas*, with which *Mr. Picard*

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observed him also unceffantly, and sometimes in the Company of Mr. *Hugens* and Mr. *Mariotte*. The first observations of the distances were made by an Estimate of the Eye, comparing the *exterior* Satellit to Saturn and to the other Satellits. The last were made by the measure of the Time between the passage of the Planet, and that of the Center of Saturn.

This New Planet did more and more remove from Saturn till the 9th of *February*, when we measur'd the difference between his passage and that of the Center of Saturn to be 30" of an hour, which give at least 10 diameters of Saturn; but on the 20th, he was already too near the beams of the Sun, to measure his distance; which yet by estimat was judged greater than it had been the 19th. The diverse scituations of this Planet, in respect of Saturn and of the Line of the wings, between *Febr. 6.* and *19.* are represented on the lower part of *Tab. II. Fig. I.*

By the apparent swiftness of his Motion during the first days, 'tis easie to see, that this Planet had been seen in Conjunction with Saturn *Febr. 3.*; and by his motion on the West it appears, that he was in the inferior part of his Circle: And because during this time of 17 days he removed more and more from Saturn, 'tis certain that he remained in the same quadrant of the inferior Occidental Circle above 17 days, and that his whole Revolution is *more* than 68 days.

He was these last days at a distance almost equal to that which he had about the end of *Octob. 1671*; so that in 480 days or thereabout he made a certain number of Intire revolutions, which can be no more than 7; since each of them is without question of more than 68 days. If you should count 7 of them, each would be $68\frac{1}{2}$ days; if you count 6, each would be 80 days; if you count but 5, each would be 96 days. But this last supposition can by no means be made to agree with the two Observations of *Decemb. 1672*, and the first doth not agree so well with them as the second.

The proportion of the apparent distances in the observations of *February*, which are the best, would make us estimate each of his Revolutions between 80 and 96 days; but the proportion of the greatest digression of 1671, compared with that

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that of the two other Satellites, together with their periods, agrees better with 80 days. Therefore in the *Ephemerid* which we give of one Revolution, we follow this, untill we get a more precise determination, which requires a greater number of Observations, that cannot be begun but towards the next summer Solstice, by reason of the Oblique Ascension of Saturn, and his Southern latitude, which will keep him long in the beams of the Sun.

An Extract of a Letter, Written by David von der Becke, a German Philosopher and Physitian at Minden, to Doctor Langelott, Chief Physitian to his Highness the Duke of Holstein now Regent, concerning the Principles and Causes of the Volatilisation of Salt of Tartar and other Fixed Salts: Printed at Hamburg, 1672.

THis Learned Author, having exploded the Useless and Empty terms of *Faculties, Qualities, &c.* and recommended the Investigation of Nature by *Experiments* guided by *Reason*; commends, for the practice of this latter, that excellent Naturalist and Physitian, Dr. *Joel Langelott*, in that Discourse of his, touching the great Use of *Digestion, Fermentation, and Grinding* in Chemistry; of which a Breviate was given in *Numb. 87.* of these Tracts. Out of which Discourse he chuseth, before all, to elucidate that part, which treats of the *Volatilisation of Salt of Tartar*, as a Subject, which he had likewise considered and inquired into.

Having therefore (as he affirms, and as will appear by the sequel,) formerly taken pains in the like Fermentation of Tartar for the *Volatilizing the Fixt Salt* thereof, he endeavours here to declare his thoughts about the *Causes* of his undertaking that labour, and of the *Manner* how that Volatilisation is performed. In the doing of which he labours to shew, *first*, The *Causes* of the *Fixation* of the Salt of Tartar: *Secondly*, The *Reasons* of the *Volatilisation*: And *lastly*, what *degree* of *Volatility* the Salt of Tartar hath acquired in that Fermentation made with its own Ferment.

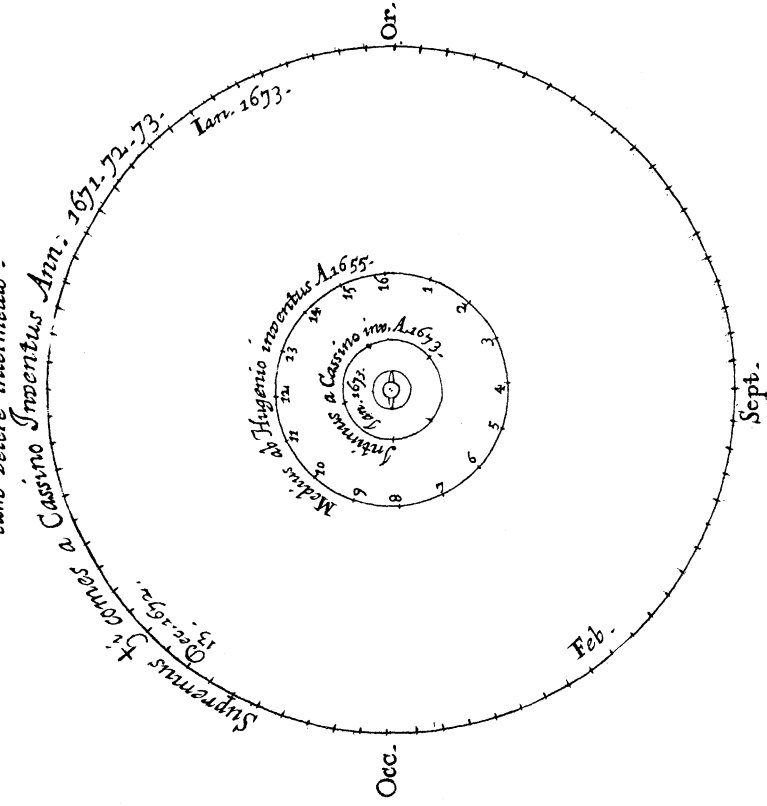
As to the *first*, he begins with blaming those, that divide

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Salt

Tab. I.

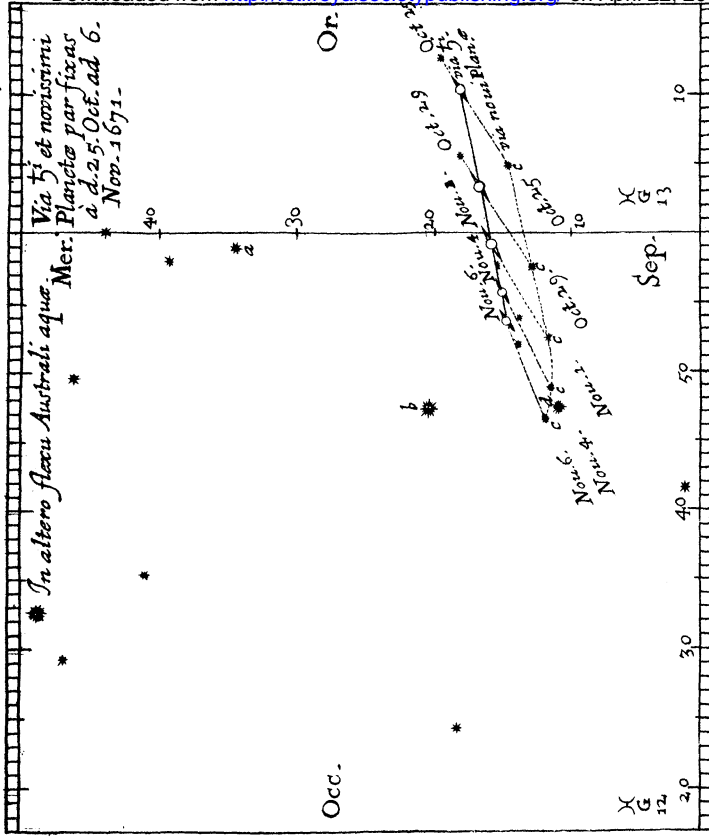
I
Planetae novi circa h^{oc} Reg^o Observatio detecti,
cuius vetere intermedio.



II

Trans. N^o. 92.
Via h^{ic} et novissimi
Mer. Planetæ par fixas
a. d. 25. Oct. ad 6.
Nov. 1671.

In altero flaccu Australi aque.



Parall^{us} Eclipticæ ad 9. 2. latit Aust^{rum}

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X
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Observat. aliquot hⁱ rotundi cum stellis
in recta linea cum ipso et vetere Satellite.

Mer.

1671 Dec. 16. 24.

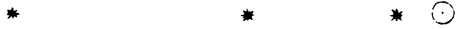


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1672. Jan. 23.



1672. Jan. 25.



Occ. Or.

1672. Dec. 13. 17.



Digressiones Comitis extimi à h^o ad
occidentem à d. 6. ad 19. Feb. 1673.



* * * * *
19 17 16 15 14 13 12 11 10 8 7 6

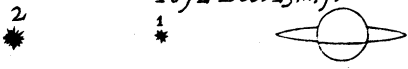
Sept.

Observat. novi Intimi Comitis hⁱ.

1. novus Intimus. 2. vetus medius.

Mer.

1672 Dec. 23. h. 7.



Dec. 30.



1673. Jan. 10.



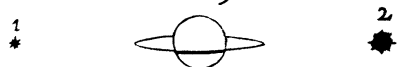
Jan. 15.



Jan. 17.



Jan. 19.



Sept.

III

Systematis Saturni pars

intima, Comite aucta.

