

# Sharing discoveries

The discovery of Uranus (1781-1782) as a new pattern of discovery?

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# Summary

- Introduction: the standard view about scientific discovery (and its limits)
- The concept of shared discovery
- The discovery of Uranus: who discovered what?
- Amateurs and informal networks in 18<sup>th</sup>-century astronomy
- Ruggiero Boscovich's (**Ruggiero/Ruđer/Rogerius/Roger**) scientific network (correspondence):
  - Sharing observational data
  - Sharing the work in progress
- Conclusion: a pattern for astronomical discoveries

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# Discovery: the standard view

- ▶ Discoveries as made by independent researchers or teams:
  - ▶ priority/independence
  - ▶ competition & rivalry
  - ▶ resistance to novelty
    - ▶ Examples:
      - ▶ Discovery of the principle of En. Cons. as a “simultaneous discovery” (Kuhn)
      - ▶ Gallo’s equipe vs Montagnier’s in the HIV-dispute
      - ▶ “Affaire Semmelweis” (cadaveric contamination was rejected as the cause of puerperal fever and death after the childbirth)

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# Competition vs Collaboration?

The „competitive dimension“ in science cannot be questioned as such.

But it can and must be questioned whether competition really represents the main feature in scientific discovery as such.

# What about sharing a discovery?

- ▶ I contend that not always competitive features are the most interesting thing in a process of discovery.
- ▶ I propose the term of “shared discovery” for cases where:
  - ▶ the process involves more than an individual agent
  - ▶ priority not relevant
  - ▶ collaboration more than competition (among the individual agents of the case at hand)
  - ▶ no mutual independence of researchers
  - ▶ resistance to novelties plays a marginal role

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# The case of the discovery of Uranus

**Who came first?**

**Kuhn's problematic account:**

«On the night of 13 March 1781, the astronomer William Herschel made the following entry in his journal: 'In the quartile near Zeta Tauri... is a curious either nebulous star or perhaps a comet'. That entry is generally said to record the discovery of the planet Uranus, but it cannot quite have done that. [...] At what point during 1781 do we want to say that the planet Uranus was discovered? And are we entirely and unequivocally clear that it was Herschel rather than Lexell [who first recognized it as a planet] who discovered it?»

*(Historical Structure of Scientific Discovery, 1977)*

# Brief chronology of a discovery

First observations of a light point (Johann E. Bode's *ex post* reconstruction):

- ▶ Flamsteed (**1690**, 1712, 1715)
- ▶ Bradley (1748, 1750, 1753)
- ▶ Mayer (1756)
- ▶ Le Monnier (1750, 1768, 1769, 1771)

} **FIXED STAR**

First observation of a moving point in the sky:

- ▶ **F.W. Herschel, 1781 March 13th**

(Communication to the Royal Society,  
26th of April: «Account of a Comet»)

} **COMET**

# Who discovered what?

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- First observations of a *light point* (fixed star): Flamsteed & others
- First observation of a *moving object* (as a comet at the beginning): Herschel
- **First attempts to determine the path**: Saron, Lexell, Boscovich, Lalande, who **shared** their data and calculations
  - Particularly important:
    - path determination (parabola or circle?) =
    - nature determination (comet or planet?)

«Any attempt to date the discovery or to attribute it to an individual must inevitably be arbitrary» (Kuhn)

# How to investigate shared discoveries?

«Any attempt to date the discovery or to attribute it to an individual must inevitably be arbitrary»:

- ▶ As crucial as it is, the attempt to determine the orbit of the «new» celestial body involves a plurality of actors, **potentially but not really in competition.**
- ▶ To explore this kind of discovery means:
  - ▶ To account for the *exchange* among the actors involved
    - ▶ Correspondence
    - ▶ Archive material
  - ▶ To explain why the potential competition did not result in a real one

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## Boscovich in France: his contacts with Italy

Place (Boscovich)	Datum	Addressee
Pont-sur-Seine	29 aprile 1781	A. de Cesaris
Pont-sur-Seine	10 giugno 1781	Reggio
Noslon (Sens)	4 luglio 1781	Reggio/de Cesaris
Noslon (Sens)	8 luglio 1781	Reggio
Noslon (Sens)	15 luglio 1781	Reggio
Noslon (Sens)	15 luglio 1781	Baro Boscovich
Bignon	5 agosto 1781	de Cesaris
Bignon	10 agosto 1781	Baro Boscovich
Moussau (Boynes)	8 settembre 1781	Puccinelli
Moussau (Boynes)	22 settembre 1781	de Cesaris
Moussau (Boynes)	29 settembre 1781	de Cesaris
Moussau (Boynes)	6 ottobre 1781	Reggio/de Cesaris
Moussau (Boynes)	11 ottobre 1781	de Cesaris
Moussau (Boynes)	13 ottobre 1781	Reggio/de Cesaris
Paris	19 novembre 1781	de Cesaris
Paris	7 gennaio 1782	de Cesaris
Paris	28 gennaio 1782	de Cesaris
Paris	18 febbraio 1782	de Cesaris
Paris	25 marzo 1782	de Cesaris

# Boscovich & Friends (the astronomic vogue)

Boscovich to Puccinelli (1779, Nov. 5th):

«I came here to this **Prince of Saxony**, and here I remained for two weeks in pleasant company: then — three leagues away — I visited **Monsieur Saron**, the President *a Mortier* of the Parliament of Paris: he is a great man of letters and a great connoisseur of astronomy, possessing many astronomical instruments which he brings along. He loves all my methods and understands them very well, and makes his own calculations basing on them and draws: he is the most honest, friendly, modest man of the world [...]: I spent fifteen days very delightfully and most peacefully together with them and **Monsieur Messier**, who was there and is a truly friend of mine. There was nobody but some curates from the neighbourhood, and one of them – what a peculiar thing! – was a true lover of mathematics, and he has a good understanding of it, and calculates with algebra, and cultivates astronomy.»

# Boscovich & Friends

Boscovich in France: learned influential friends



Charles Messier  
1730-1817



Jean-Baptiste-Gaspard  
Bochart de Saron  
1730-1794



Joseph-Jérôme  
L. de Lalande  
1732-1807



Franz-Xaver von  
Sachsen  
1730-1806

# Astronomic vogue in the late 18th century

- Stendhal, *La Chartreuse de Parme* (1839):

- The abbé Blanès, a curate loving astronomy:

« L'abbé Blanès, personnage d'une honnêteté et d'une vertu primitives, et de plus homme d'esprit, passait toutes les nuits au haut de son clocher; il était fou d'astrologie. Après avoir usé ses journées à **calculer des conjonctions et des positions d'étoiles, il employait la meilleure part de ses nuits à les suivre dans le ciel**. Par suite de sa pauvreté, il n'avait d'autre instrument qu'une longue lunette à tuyau de carton [...]. Les paysans redoutaient l'abbé Blanès comme un grand magicien [...]. Ses confrères les curés des environs, fort jaloux de son influence, le détestaient [...]. Fabrice l'adorait: pour lui plaire, il passait quelquefois des **soirées entières à faire des additions ou des multiplications énormes**. » (ch. II. Ed. Gallimard/Pléiade, pp. 38-39)

# Astronomic vogue in the late 18th century

## ► Stendhal, *La Chartreuse de Parme* (1839):

### ► Fabrice (the main character):

« Fabrice entra alors sur la petite place de l'église; ce fut avec un étonnement allant jusqu'au délire qu'il vit, au second étage de l'antique clocher, la fenêtre étroite et longue éclairée par une **petite lanterne** de l'abbé Blanès. L'abbé avait coutume de l'y déposer, en montant à la **cage de planches qui formait son observatoire**, afin que la clarté ne l'empêchât pas de lire sur son **planisphère** [...]. » (ch. VIII, p. 170)

« Quand il n'était pas avec la petite Marietta [an actress Fabrice fell in love with], on le voyait à **l'Observatoire** [of Bologna], **où il suivait un cours d'astronomie**. » (ch. XIII, p. 223)

# Astronomic vogue in the late 18th century

► Rousseau, *Les Confessions* (Partie I, Livre VI: round 1766)

« [...] Je m'affectionnai par préférence à l'exacte mesure des tems et à **la marche des corps celestes**. J'aurois même pris du gout pour l'astronomie si j'avois eu des instrumens; mais il fallut me contenter de quelques élémens pris dans les livres, et de quelques observations grossières faites avec une **lunette** d'approche, seulement pour connoitre la situation generale du Ciel [...]. J'avois acheté un **planisphère celeste pour étudier les constellations**. J'avois attaché ce planisphère sur un chassis [...] et pour l'éclairer sans que le vent soufflât ma chandelle, je la mis dans un seau à terre entre les quatre piquets; puis regardant alternativement le planisphère avec mes yeux et les astres avec ma lunette, je m'exerceois à connoitre les étoiles et à discerner les constellations. »

(Ouvres complètes, I/VI. Ed. Gallimard/Pléiade, p. 240)

# The importance of non-professionals

- ▶ Non-professional astronomy as a ground on which astronomical ideas could flourish and circulate in 18<sup>th</sup> century.
- ▶ There were a plurality of actors which we can't leave aside in reconstructing history and structure of scientific discoveries.

## Mr Herschel *who?*

Herschel as a non-professional at the time of his Uranus observations. **Bode's paper** («Über einen im gegenwärtigen 1781sten Jahre entdeckten beweglichen Stern, den man für einen jenseits der Saturnusbahn laufenden, und bis er noch unbekannt gebliebenen Planeten halten kann», 1781):

**D**iese merkwürdige Entdeckung am Himmel, wodurch sich wohl dereinstens das gegenwärtige Jahr in einer astronomischen Entdeckungs-Geschichte unter allen seinen Vorgängern auszeichnen möchte, haben wir folgendem glücklichen Zufall zu danken. **Ein sehr aufmerkfamer Liebhaber der Astronomie zu Bath in England**

# Mr Herschel *who?*

Herschel as a non-professional at the time of his Uranus observations. **Bode's paper** (1781):

In der Gazette litteraire vom Jun. 1781. heisst dieser wackere Mann: **Mersthel**; im Journal Encycloped. vom Julius, **Hertschel**; in einem Schreiben des Herrn Maskelyne an Herrn Messier, **Herthel**; in einem andern Schreiben desselben an Herrn Mayer in Mannheim, **Herrschell**; Herr Darquier nennt ihn **Hernstel**. Wie ist nun eigentlich sein Name? - - - Er soll von Geburt ein **Deutscher** seyn.

# Summary

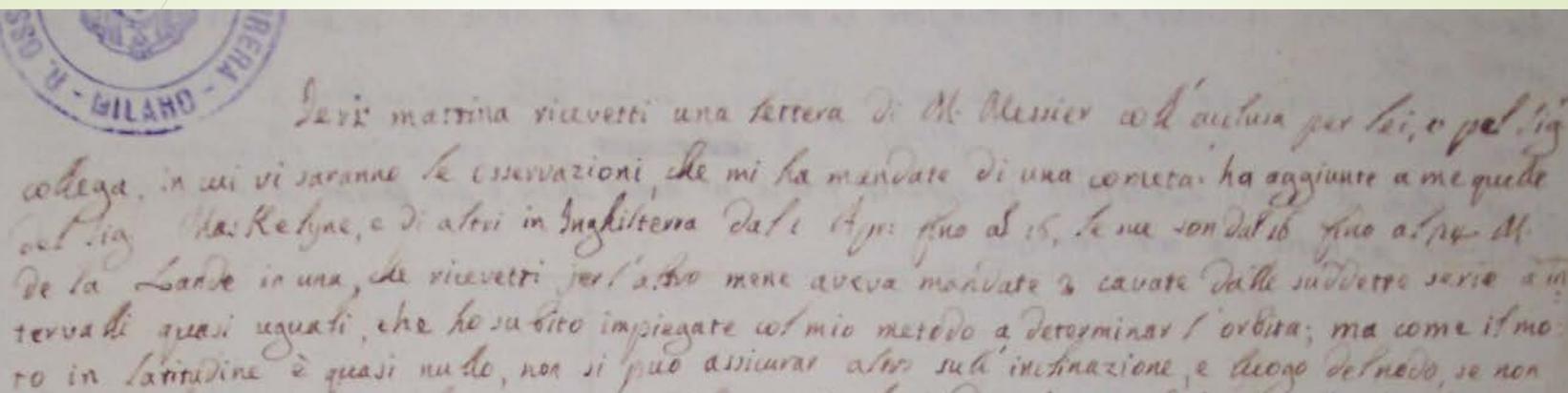
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# Boscovich's letter of April 29th, 1781



Ieri mattina ricevetti una lettera di M. Messier coll'annexa per lei, e per il sig. collega. In cui vi saranno le osservazioni che mi ha mandate di una cometa: ha aggiunte a me quelle del sig. Maskelyne, e di altri in Inghilterra dal 1. Apr. fino al 16. Le mie son dal 16. fino al 24. M. de la Lande in una, che ricevetti jeri l'altro mene aveva mandate 3 cavate dalle suddette serie a intervalli quasi uguali, che ho subito impiegate col mio metodo a determinar l'orbita; ma come il moto in latitudine è quasi nullo, non si può assicurar altro sull'inclinazione, e luogo del nodo, se non

«Yesterday morning I received a letter by Messier with an annex to you and your colleague. It should contain the observations of a comet he sent to me. He added up to me those made by Maskelyne and others in England from April 1st [or 2nd] to the 16th, while the observations by himself [i.e. Messier's observations] are from the 16th till the 24th. Monsieur de La Lande, in a letter I received the day before yesterday, had sent me three observations [...], which I have immediately used with my method for determining the orbit.»

# The mysterious annex

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## Observazioni mandate da M. Maskeline a M. Messier

1781.	Jours vrai	Ascen. om.	Decl. B.
Avril-1.	9 <sup>h</sup> ... 58.	84... 21. 9.	23... 34... 1.
2.	8... 34.	84... 21. 36.	23... 33... 37.
3.	9... 6.	84... 24. 29.	23... 33... 40.
6.	7... 35.	84... 29. 57.	23... 33... 58.
9.	10... 41.	84... 36. 14.	23... 34... 21.
10.	9... 7.	84... 38. 14.	23... 34... 25.
13.	8... 51.	84... 44. 56.	23... 34... 39.
14.	8... 7.	84... 47. 8.	23... 34... 39.
16.	8... 26.	84... 51. 50.	23... 34... 30.



There's something wrong: this should be the annex. The letter was dated on 29th of April; and yet observations (by Lalande) are until May...

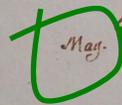
## Observazioni di M. Messier

1781.	Jours vrai	Ascen. om.	Decl. B.
Avril-16.	9... 8... 45.	84... 57... 31.	23... 34... 58.
17.	7... 58... 35.	84... 53... 39.	23... 35... 0.
18.	7... 44... 21.	84... 56... 22.	23... 35... 0.
19.	8... 7... 26.	84... 58... 50.	23... 35... 6.
20.	7... 38... 38.	85... 1... 26.	23... 35... 7.
21.	8... 13... 28.	85... 4... 20.	23... 35... 9.
22.	8... 47... 8.	85... 6... 43.	23... 35... 18.
23.	8... 27... 33.	85... 9... 48.	23... 35... 26.
24.	7... 47... 9.	85... 12... 13.	23... 35... 30.



1781.	Autre mandate	de la Lalande	Ascen. om.	Decl. B.
Mag-26.	10... 10	85. 15. 20	13. 36. 20	
7.	9... 6	85. 35. 6	13. 36. 26	
7.	8. 35	85. 51. 38	13. 36. 38	
25.	J. Vero 8. 50	86. 54. 11	13. 37. 43	

1781.	Autre mandate	de la Lalande	Ascen. om.	Decl. B.
Mag-26.	T. Med. 10... 10	85. 15. 20	13. 36. 20	
7.	9... 6	85. 35. 6	13. 36. 26	
7.	8. 35	85. 51. 38	13. 36. 38	
25.	J. Vero 8. 50	86. 54. 11	13. 37. 43	



# Uranus, May 1781

Particular of the annex

		Altre mandate dal Sig. De la Lalande	
		T. Med.	
26.	10...10	85. 18. 10	13. 36. 10
Mag. 12.	9... 6	85. 36. 6	13. 36. 16
7.	8. 35	85. 52. 38	13. 36. 38
	T. Vero		
15.	8. 50	86. 54. 11	13. 37. 53

Observations de M. Messier, à Paris.

MOIS & JOURS.	TEMPS VRAL.	ASCENSION DROITE.		DÉCLINAISON.
		H. M. S.	D. M. S.	
1781. Avril. 16	9. 8. 45	84. 51. 31	23. 34. 58.	
30	9. 51. 54	85. 29. 30	23. 35. 30.	
Mai. 1	8. 11. 9	85. 32. 41	23. 36. 3.	
2	8. 27. 3	85. 35. 53	23. 36. 6.	
5	8. 58. 40	85. 45. 28	23. 36. 23.	
6	8. 10. 49	85. 48. 24	23. 36. 29.	
7	8. 39. 7	85. 51. 38	23. 36. 38.	
8	8. 49. 49	85. 54. 43	23. 36. 41.	
11	8. 46. 22	86. 5. 1	23. 36. 54.	
12	8. 41. 31	86. 8. 18	23. 36. 57.	
16	8. 29. 56	86. 22. 5	23. 37. 18.	
20	8. 54. 9	86. 36. 7	23. 37. 43.	
21	8. 50. 11	86. 39. 43	23. 37. 43.	
23	8. 43. 26	86. 46. 59	23. 37. 52.	
24	8. 45. 0	86. 50. 35	23. 37. 52.	
25	8. 49. 54	86. 54. 11	23. 37. 53.	
26	8. 45. 49	86. 57. 46	23. 37. 56.	

Uranus observations made by Messier in May 1781 and published in Lalande, "Mémoire sur la planète de Herschel", dic. 1781

# Boscovich's hand

Osservazioni mandate da M. Maskeline  
 a M. Messier

1781.	Jours vrai	Ascen. om.	Décli. B.
Avril-1.	9 <sup>h</sup> ... 58.	84... 21..g"	23... 34... 1."
2.	8..... 34.	84... 21..36.	23... 33... 37.
3.	9..... 6.	84... 24..29.	23... 33... 40.
6.	7..... 35.	84... 29..57.	23... 33... 58.
9.	7..... 41.	84... 36..14.	23... 34.. 21.
10.	9..... 7.	84... 38..14.	23... 34.. 25.
13.	8..... 51.	84... 44..56.	23... 34.. 39.
14.	8..... 7.	84... 47.. 8.	23... 34.. 39.
16.	8..... 26.	84... 51..50.	23... 34.. 50.

1781.	Jours vrai	Ascen. om.	Décli. B.
Avril-1.	9 <sup>h</sup> ... 58.	84... 21..g"	23... 34... 1."
2.	8..... 34.	84... 21..36.	23... 33... 37.
3.	9..... 6.	84... 24..29.	23... 33... 40.
6.	7..... 35.	84... 29..57.	23... 33... 58.

Messier's hand

Osservazioni di M. Messier

1781.	Jours vrai	Ascens. om.	Déclin. B.
Avril-16.	9... 8... 45.	84... 51... 31.	23... 34... 58.
17.	7... 58... 35.	84... 53... 39.	23... 35... 0.
18.	7... 44... 21.	84... 56... 22.	23... 35... 0.
19.	8... 7... 26.	84... 58... 50.	23... 35... 6.
20.	7... 38... 38.	85... 1... 26.	23... 35... 7.
21.	8... 13... 28.	85... 4... 20.	23... 35... 9.
22.	8... 47... 8.	85... 6... 43.	23... 35... 18.
23.	8... 27... 33.	85... 9... 48.	23... 35... 26.
24.	7... 47... 9.	85... 10... 13.	23... 35... 30.

maybe...

Boscovich's hand

Autre mandate dal Sig. de Lande			
26.	T. Med. 10... 10	85. 18. 10	11. 36. 20
Mag. 2.	9... 6	85. 35. 6	11. 36. 26
7.	8. 35	85. 51. 38	11. 36. 38
15.	T. Vero 6. 50	86. 54. 11	13. 37. 43

Autre mandate dal Sig.			
26.	T. Med. 10... 10	85. 18. 10	11. 36. 20
Mag. 2.	9... 6	85. 35. 6	11. 36. 26
7.	8. 35	85. 51. 38	11. 36. 38

# A letter by Messier

30

ascens.  $\delta$ ,  
 $84^{\circ} 21' 56''$   
 $84 51 31$   
 $85 12 13$

Qu'il humeuodette avec toute la consideration.  
 Messieurs  
 L'arin hotel cluny. 25. avril 1781.  
 Comme vos lettres content fort chieres et que je ne suis pas en mesure de vous en repondre  
 Je suis tres humble et tres obssisant serviteur.  
 Messier

Une observation bien importante et bien interessante est celle cy. J'ai recu il y a peu de jours  
 une lettre de m. Maskelyne, dans laquelle il me mandoit, qu'il parviendroit a une nouvelle  
 Comete; mais toute differente de celles que j'avois observees jusqua present. C'est a dire sans  
 aucune apparence d'atmosphere, de chevelure ny de queue. Elle ressemble aux Etales spec  
 de la 6. grandeur et en angleterre les astronomes regardent cette Comete comme une nouvelle  
 planete. Son mouvement en ascension droit est de 8. seconds de tems ou de 2 min.  
 de degre par jour. La declinaison est presqu'en nul. Elle fait l'ordre des signes.  
 De puis la lettre de m. Maskelyne, j'en ai encore vu ce n'est pas que j'ay pas ete si tempre que j'ai pu la  
 trouver et la revoir moi me, a cause de son ressemblance avec les Etales spec de la 6. grandeur.  
 voici trois positions d'apres lesquelles vous connoitrez son mouvement et que vous pourrez la  
 trouver et l'observer. J'ay vu ces trois positions elle est exactement aux Etales de la 6. grandeur  
 brillante comme elle l'est avec une queue ny queue. La premiere observation est celle de m. m. Kelyne.

	ascens. $\delta$ ,	declin. B.
4. vrai.	84 21 56	2 33 37
6	84 51 31	2 34 58
24	85 12 13	2 35 30

Qu'il humeuodette avec toute la consideration.  
 Messieurs  
 L'arin hotel cluny. 25. avril 1781.  
 Comme vos lettres content fort chieres et que je ne suis pas en mesure de vous en repondre  
 Je suis tres humble et tres obssisant serviteur.  
 Messier

Comme vos lettres content fort chieres et que je ne suis pas en mesure de vous en repondre, voici une adresse que vous pourrez  
 envoyer pour m'ecrire  
 une 1. enveloppe airtete, mais sans cachet, a m. Messier astronome de la marine, de l'academie  
 des sciences, rue des mathurins, hotel Cluny a Paris. m. de Castries.  
 une 2. enveloppe cachete, a m. m. Blouin, premier commis de la marine a Versailles.  
 Je joins ici le modele.

Messieurs  
 Messieurs Raggio et Cesario, -  
 astronomes de Milan.  
 A Milan.  
 Italia

Messieurs.

Un observation bien importante et bien interessante est **cellecy**. J'ai recu il y a peu de jours une Lettre de **M. Maskelyne**, dont la quelle **il me m**andoit, qu'il pervissoit une **nouvelle Cométe; mais toute différente de celles que j'avois observées jusqu'à present: C'est a dire sans aucune apparence d'atmosphère, de chevelure, n'y de queue: Elle ressemble aux Etoiles fixes de la 6.e grandeur, et en Angleterre les astronomes regarde cette Cométe comme une nouvelle planète**. Son mouvement en ascension droite n'est que de 8 secondes de tems à de 2 min. de degré par jour. Sa déclination est presque nul. Elle fuit l'ordre des signes.

D'apres la Lettre de M. Maskelyne, je l'ai cherchée et ce na pas été sans peine que j'ai pù la trouver et la reconnaitre, à cause de sa ressemblance avec les Etoiles fixes de la 6.e grandeur. Voici trois positions d'apres les quelles, vous connaîtra son mouvement et que vous pourai la trouver et l'observer: figuré vous quelle rassemble exactement aux Etoiles de la 6.e grandeur, brillante comme Elle sans cheveleures n'y queue. La premiere observat. est celle de M. Maskelyne.

[--OBSERVATIONAL DATA--]

J'ai l'honneur d'être avec toute la considération.

Messieurs

Vôtre très humble et très  
obéissant serviteur  
Messier

Paris hôtel Cluny. 25. avril 1781

# Some conclusions as hints about Boscovich's astronomical activity...

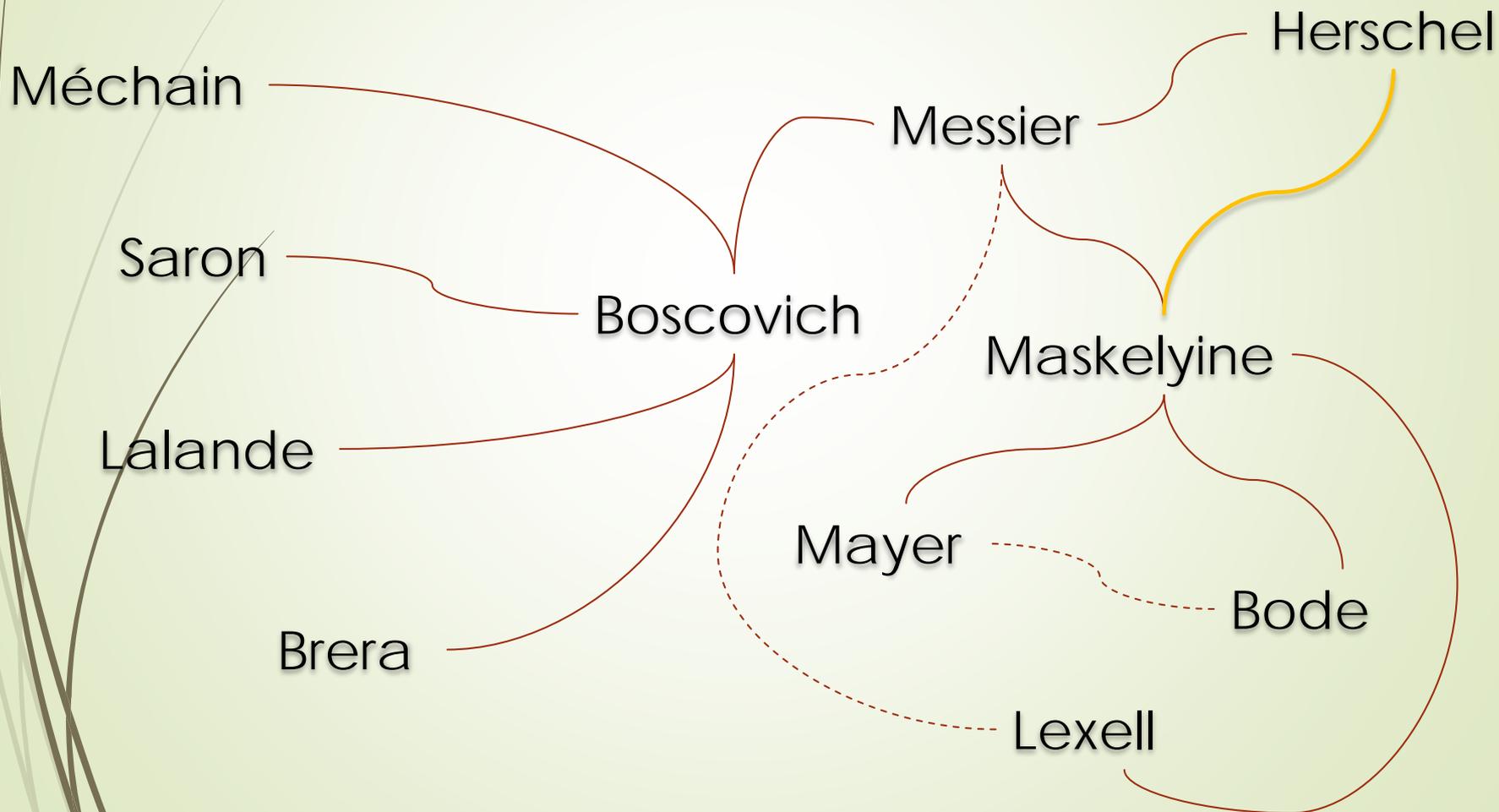
1. Messier's letter (25th of April) to Brera astronomers was forwarded by Boscovich on 29th of April, 1781.
2. Messier's, Maskelyne's & Lalande's observations were forwarded to Brera by Boscovich as well (maybe on the 1st of June).

## ...and some more general conclusions about Uranus discovery

Boscovich's network shows that the scientists involved in the search for Uranus real nature were aware of acting as a **network of individuals**:

- Information distributed by 'nodal individuals' in the network: Boscovich, Messier, Maskelyne...
- Boscovich's important role: he propagated observations (performed by others), created, refined and offered (his own) methods of investigation (further scientific correspondence with Brera).

# Boscovich's network reconstructed



# Summary

- Introduction: the standard view about scientific discovery (and its limits)
- The concept of shared discovery
- The discovery of Uranus: who discovered what?
- Amateurs and informal networks in 18<sup>th</sup>-century astronomy
- **Ruggiero Boscovich's scientific network (correspondence):**
  - Sharing observational data
  - **Sharing the work in progress**
- Conclusion: a pattern for astronomical discoveries

# Some problems in comet theory

- ▶ Basis: Newton's theory, based on three assumptions.
  1. the orbit of a comet is approximately parabolic
  2. curvature of terrestrial orbit is unessential in accounting for comet paths
  3. away from the perihelion and for short time intervals the comet orbit is rectilinear (with uniform velocity)

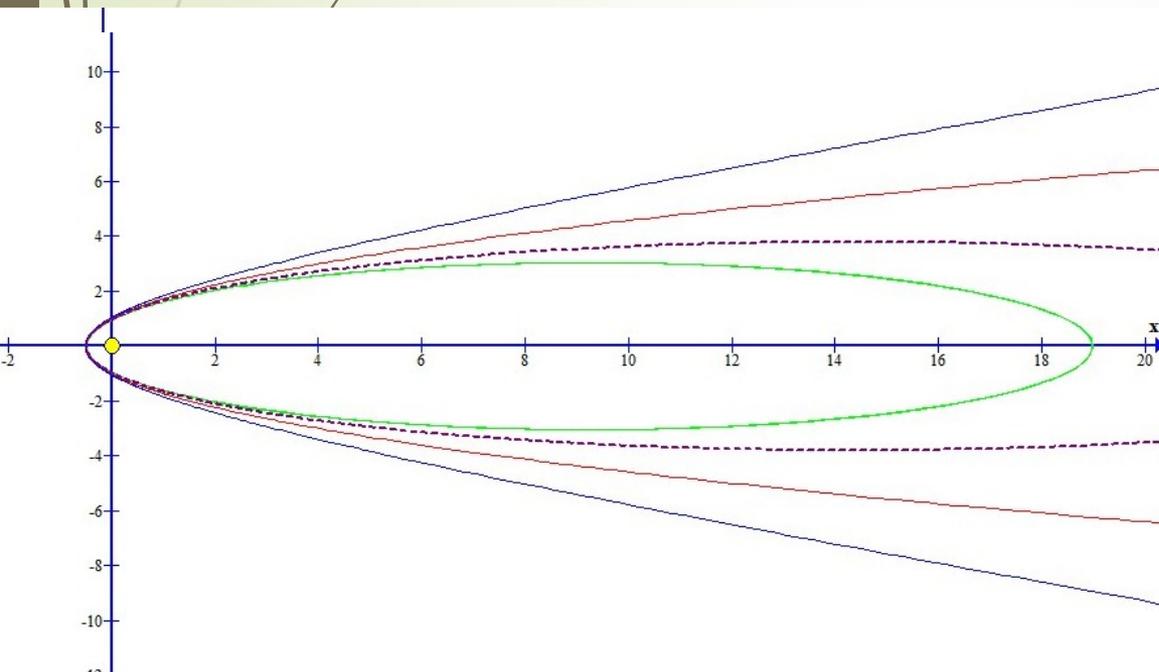
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Halley's Comet orbit:  
 $e = 0.967$

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    - CORRECTIONS BY LOYS DE CHÉSEaux (1744) AND BOSCOVICH (1746)
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    - ▶ CORRECTION BY BOSCOVICH (1774)

# One more problem. If the body is far away...

## ► Advantage

a small arc of the orbit (e.g. of Uranus) can really be considered as rectilinear and the velocity of the object as uniform.

## ► Drawback

calculations determine *more* orbits; you have to wait much time to get the 'real' orbit.

# One more problem. If the body is far away...

In Anders Lexell's words

(he was the first to determinate a quasi-circular orbit):

« J'ai bientôt conçu que pour les observations fait pendant la premiere apparition [that is between the 17th of March 1781 and the 28th of May], **on pourroit trouver des orbites paraboliques qui satisferoient**, & que même la détermination de ces orbites admettroit une très grand latitude. Et ce sentiment s'est trouvé ensuite verifié par les calculs, qui m'ont convaincu que **pour satisfaire aux observation du 17 de Mars & 28 de Mai on peut employer des orbites paraboliques [...], sans qu'il resulte des erreurs trop considérables dans les observations intermédiaires**. Il est donc prouvé par ces recherches que por satisfaire aux observations de la premiere apparition, **on peut trouver un infinité d'orbites**. »

(Recherches sur le nouvelle planète..., 1783)

# Back to Boscovich...

- ▶ Boscovich also searched for a refinement of his 1774-method.
- ▶ On June 10th, he writes to his Brera colleagues: "I don't know yet whether it is a comet or a planet; but I'm beginning to believe it is a planet".
- ▶ His efforts would result in the "Teoria del nuovo astro osservato prima in Inghilterra" (published 1782).

# Sharing solutions, or sharing the work in progress

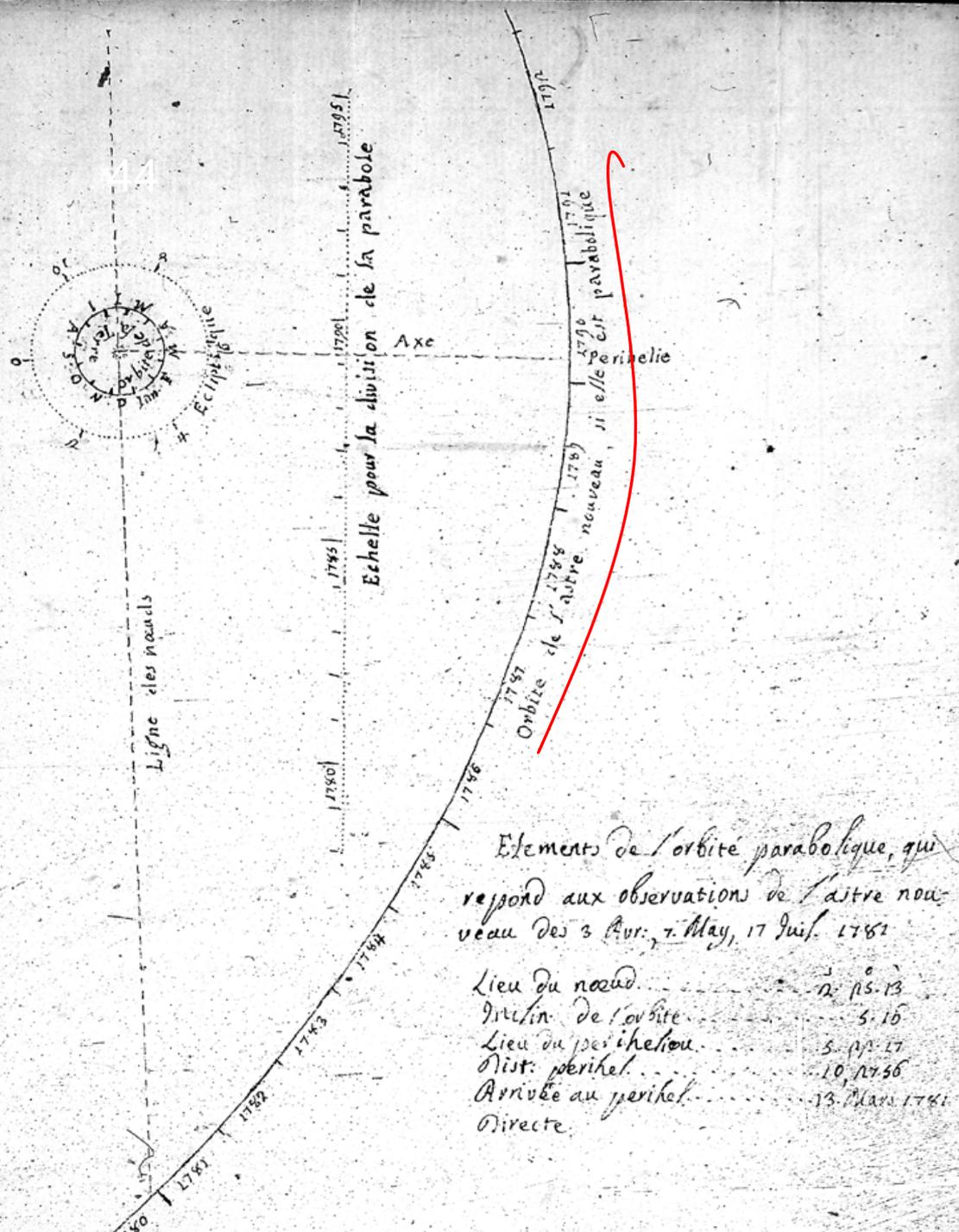
Noslon presso Sens 15 Lu: 1781

Il mese passato vi scrissi nell'arrivare qua, e la vna colla carina di Aniza mi giunse il giorno dopo, essendovita a Borse sulla Senna, ben che avessi scritto, che mi ha mandavero qua. Speravo di ricever jen il pacchetto ordinario di Versailles, in cui forse vi sarà ancora la vna lettera. Lo sogho ricever il sabato; ma jen non venne, e verrà probabilmente Digiani.

In risposta alla passata, godo che voi, e Aniza vi troviate tanto bene: salutatemmi essa, e ditelo, che non ho oggi tempo da scrivere a vea do da rispondere a vane lettere, ed essendo stato occupatissimo anche per varie ricerche geometrico-astronomiche. Ho fatti molti calcoli per una nuova cometa, che fu scoperta in Cangi a 18 scorso: ma è piccola, e lontana: non si è resa notabile che a gli Astronomi e cannonchiali. Ha cominciato nella testa della grand'orsa, indi è ita verso l'eclitica, e va all'emisfero australe scostandosi, e dal sole e da noi. Ho anche lavorato molto per un astro straordinarissimo, di cui vredo avervi scritto. Ho mandata una lettera di 60 pagine sul suo corso straordinarissimo. Esso ha pochissimo movimento: è duram.<sup>o</sup> lontanissimo molto al di là di Saturno: il sole l'ha nascosto, ma uno di questi giorni si rivoderà. Mi ha dato molta pena per sciluppate delle teorie intere svarie, e far de' calcoli, ne quali a quest'ora ho della scinta, onde io mi vna metta molte volte da capo. Tutto questo, e altri oggetti mi occupano

Noslon presso Sens, 15  
Lu:[glio] 1781

“Ho mandato una lettera di 60 pagine sul suo corso straordinarissimo. Esso ha pochissimo movimento: è sicuramente lontanissimo molto al di là di Saturno...”



Attachment to the letter  
 by Ruggiero to Natale  
 Boscovich, 1781  
 August 10<sup>th</sup>. Then  
 reproduced as the first  
 plate in Boscovich,  
 “Teoria del nuovo astro  
 osservato prima in  
 Inghilterra”, 1782

# First version of the “Teoria del nuovo astro osservato prima in Inghilterra”

- ▶ The sixty-page letter must have been a first version of Boscovich’s “Teoria del nuovo astro” (devoted to give a more general theory of orbit determination).
- ▶ Boscovich sent it to Brera astronomers. He asked them for collaboration:
  - ▶ He proposed they should apply it to the “new star” (Uranus)
  - ▶ He wanted it to be published in the *Effemeridi*

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- **Conclusion: a pattern for astronomical discoveries**

# The Will to Share

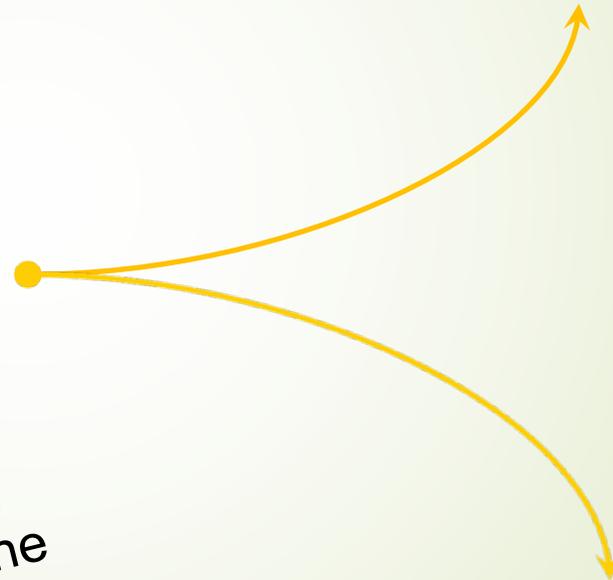
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## **Willingness to scientific exchange**

Boscovich as an example of sharing the work in progress; but the only one who took the opportunity of Uranus in order to extend his theory of comets.

Observational work

Theoretical work



# Priority questions?

## *Back to Uranus again...*

A priority question raised by **Lexell** about Uranus: he claimed to have been the first having determined a circular orbit (or, having recognized Uranus as a planet).

**Boscovich** ascribes this to **Méchain** (on the basis of his method!), without regard for Lexell's claim (maybe without knowing it).

But the question never turned into a dispute. For astronomers as a community, Herschel was the discoverer, because he could recognize something moving in the sky, and this was the crucial thing. On the contrary, the belief that 'Herschel's comet' was a planet and the search for a corresponding orbit developed very soon in the astronomer community and it had been shared by most scientists from the beginning.

# Competition or collaboration? Independence or Interdependence?

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Priority disputes don't  
emerge



Competition is  
unimportant



No resistance to novelty

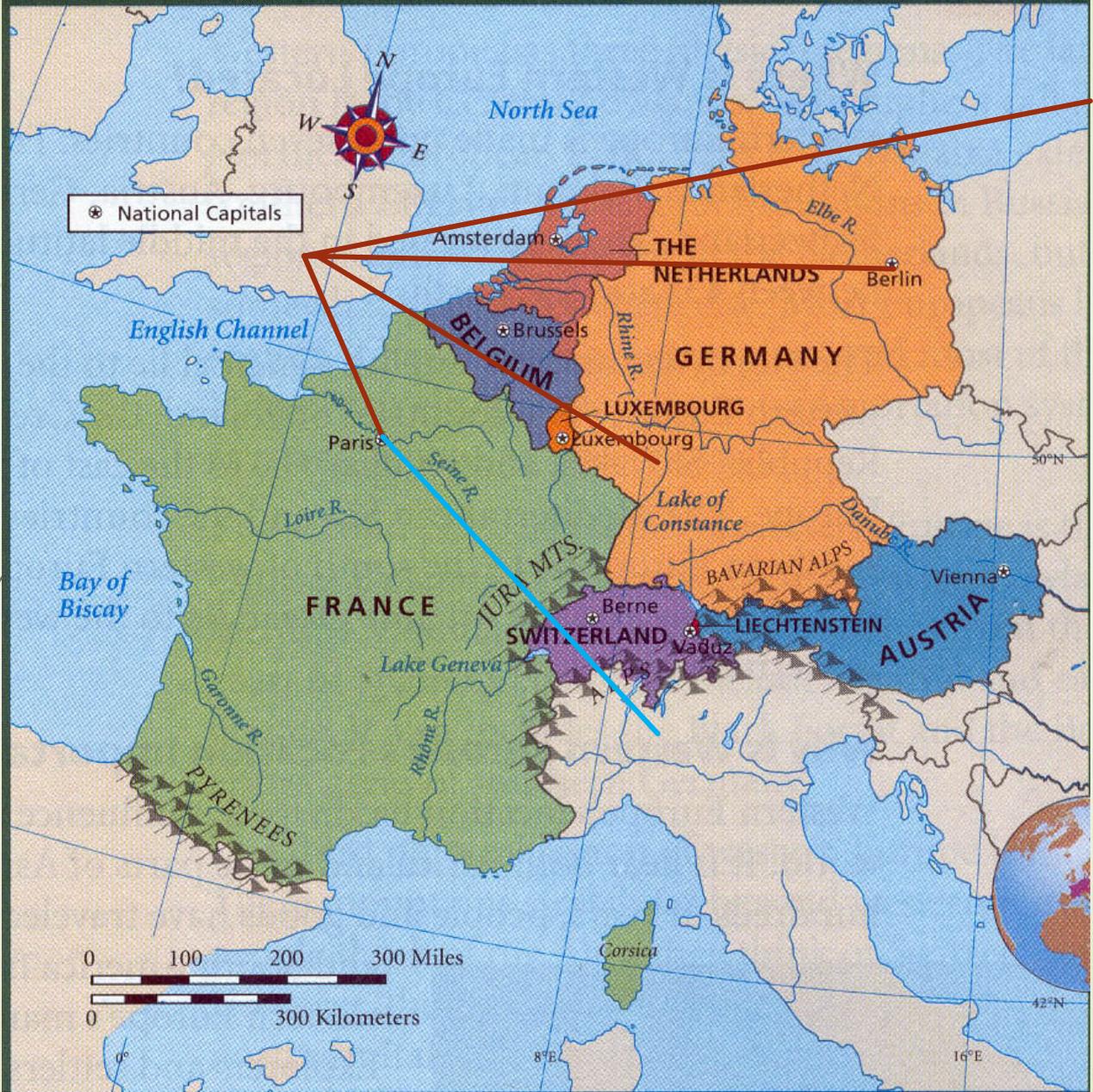


Collaboration appears a  
more promising habit in order  
that any individual researcher  
could get new knowledge



this implies a process of sharing knowledge and  
excludes independence of major results.

# Western Europe



# A typical pattern of behavior for astronomers?

- ▶ The 18<sup>th</sup> century-astronomical community was strongly internationalized. *Why?*
  - ▶ Lab location is normally unimportant in physical or chemical experiments, but is very relevant for astronomical observations (parallax changes with observer's position!).

- ▶ **So, the apparently altruistic behavior is due to the peculiar structure of astronomical knowledge:**

Data exchange = huge collection of observations = accuracy in calculations = better predictions.

## A further example

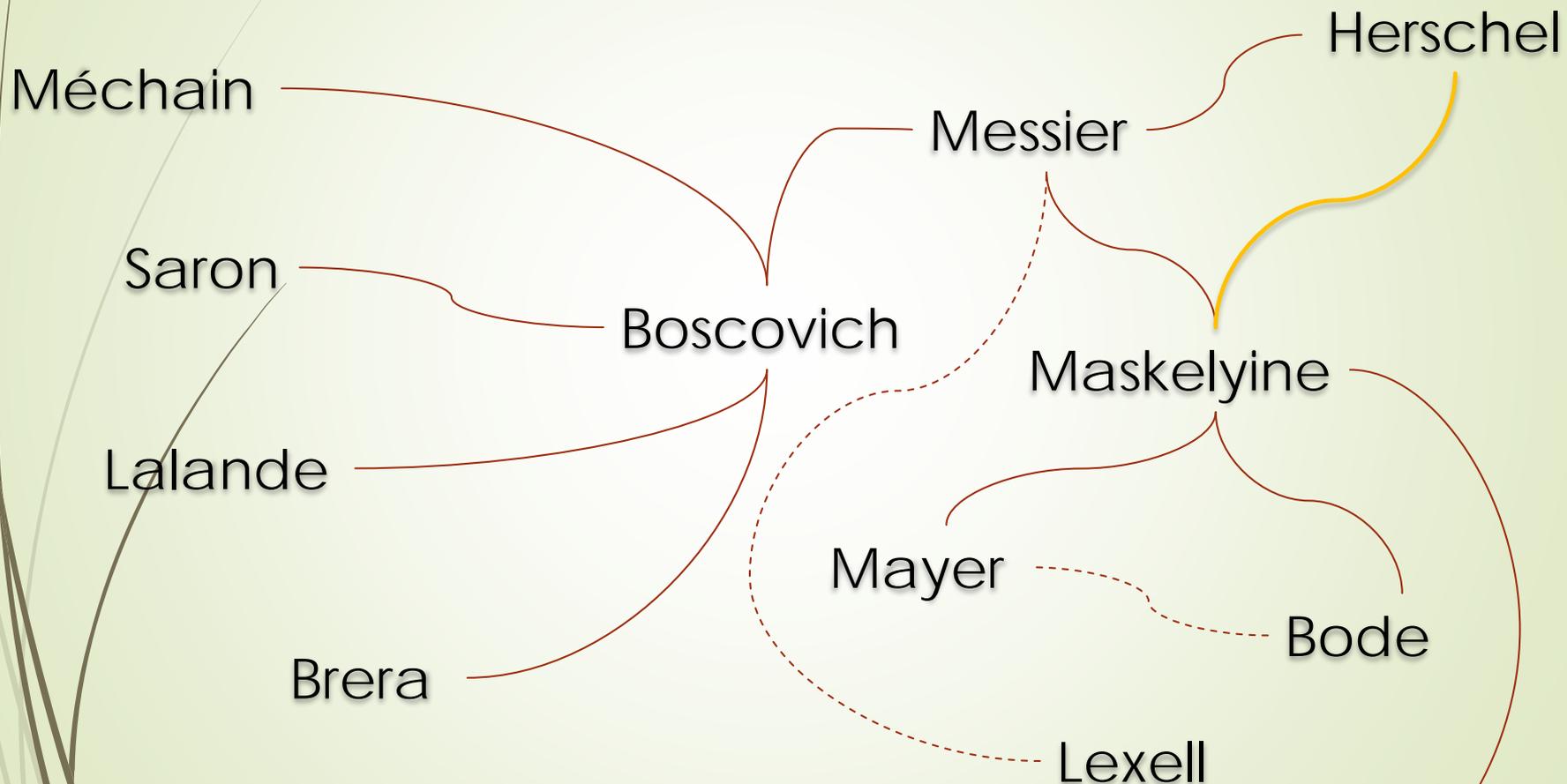
**The discovery of Ceres, the first observed asteroid, by Giuseppe Piazzi (1801).**

- The story begun as a search for a 'lacking planet' in the vast empty space between Mars and Jupiter...
- But that space was not empty: in January 1801 Piazzi discovered "a tiny star" or even "a comet" in Taurus.
- This triggered a 'blog of information', and the most prominent astronomers shared their data in Europe in order to determine the path of the new object (soon recognized as a new planet, afterwards as one of the relics of a larger planet, disrupted in the past, i.e. an asteroid).
- The story came to an end with Gauss's predictions of 1801 and the publication of his method (1809).

# A provisional conclusion and a sketch of further research

- ▶ On the one hand, shared-discovery model is probably *the* pattern of discovery when questions cannot be answered by individuals alone but “structurally” request a plurality of actors.
- ▶ On the other hand, science *is* an intersubjective domain, *where circulation* of ideas, thoughts, practices *dominates*.
- ▶ So, “instinctively”, the question arises: Is this view “exportable” into other scientific contexts? (A more general process of shared knowledge?)

# Network: a metaphor?



Nodes (actors): individuals (astronomers)

Links: «vague» *information* about the new comet (Uranus)



# Not only social...

- ▶ *Social* networks fall short of grasping an essential feature:
  - ▶ They take communication of data, calculations, scientific results, etc., as a matter of fact
  - ▶ But in the Uranus story **the disposition to scientific exchange** – the habit of collaboration – **is dictated by the structure of astronomy** (call it an **epistemic constraint**)
  - ▶ It is such disposition that favors scientific change. **Contrarily to this, scientific networks do not account for the scientific change**
  - ▶ So links should represent more than social features
- ▶ Moreover, the concept of a social network does not free from *psychologism*: the idea that what really counts are the intentions of the individual subjects involved in the process of knowledge
  - ▶ In particular, it might remain implicit the (naive) assumption that «individual, intentionally-guided human actors are the makers of science, the producers of knowledge» (Ibarra 2012)

# Epistemic networks

- ▶ An apter description is maybe that of *thought collective* (Fleck 1935):
  - ▶ It is defined as «a community of people which are in thought exchange or in mutual interaction». According to Fleck, it accounts for the scientific change, for it embodies «the carrier(s) of the historical development of a field of thought [...], even of a particular thought style».
  - ▶ An update is the concept of «reasoning style» (that properly updates Fleck's «thought style», linked to the collective idea), advanced by Hacking (1992); furthermore, the idea of «epistemic cultures» (Knorr Cetina 1999)
  - ▶ Correspondingly, an update of «thought collective» might be the idea of *epistemic networks*, therefore insisting on publicity, collaboration, and exchange
    - ▶ The emphasis here is on the knowledge exchange (not on the individuals), for thoughts and concept circulate and are modified while they circulate – not in people's *heads* but in their *hands* so to speak: Maskelyne modifies Herschel's idea because he was more familiar with astronomy...



# The problem of epistemology (1936)

- ▶ «The fundamental error in many discussions from the field of epistemology is the (more or less open) manipulation of the symbolic epistemological subject, known as 'human spirit', 'human mind', 'research worker' or simply 'man' ('John', 'Socrates'), which has no concrete living position, which does not basically undergo changes even in the course of centuries and which represents every 'normal' man regardless of the surroundings and the epoch. Thus it is to be absolute, unchanging and general. One says for instance that a man's sources of knowledge are empirical experiences, but one does not think that, for a very long time, the source of almost the entire knowledge of every man was, in Europe, simply book and school.»