

The discovery of Neptune

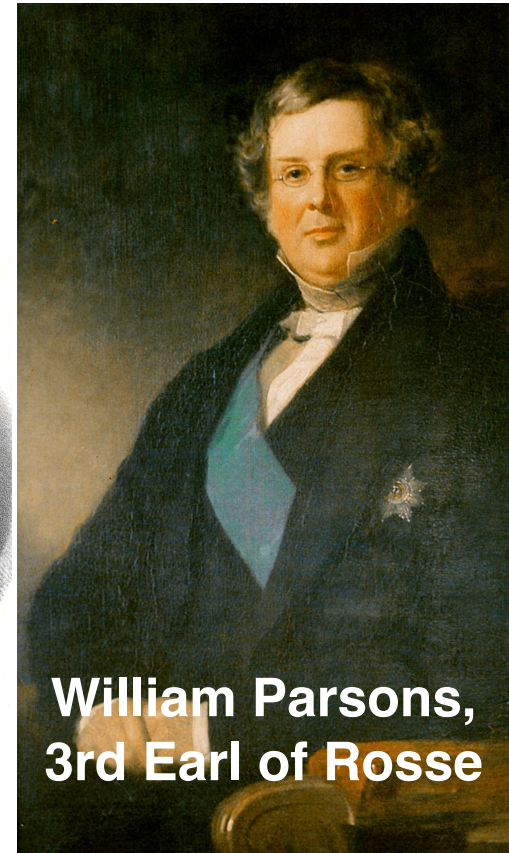
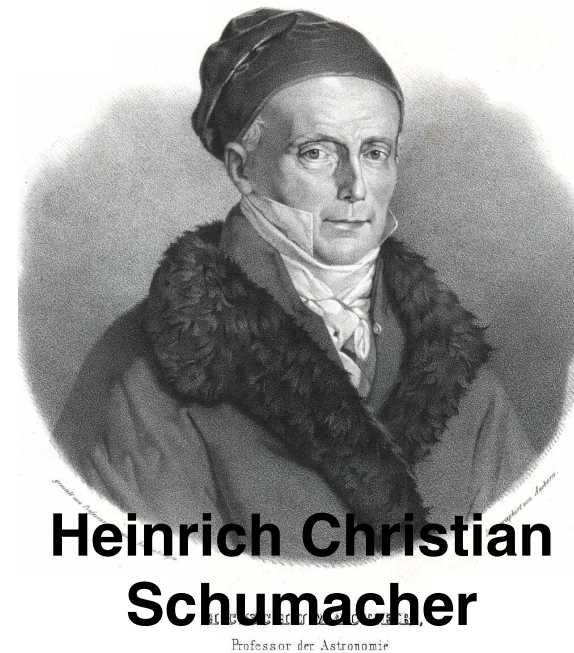
Dramatis personae

Act 3. The Juicy Parts

Davor Krajnović
Kaffeerunde (01.09.2016)

Did anybody look?

- June 1 1846: Le Verrier has a prediction where a new planet can be found
- his work is applauded but not much is happening
- August 31 1846, the prediction of the location is improved + there is an advice: look for a disc (not a star)
- no official search
- Le Verrier in a letter to Schumacher (editor of AN) complains about this
- Schumacher suggests he should contact directly observers with good telescopes: Otto Struve in Pulkovo Observatory and Lord Rosse in Ireland
- Le Verrier writes to Galle and Struve



Why didn't anybody look?

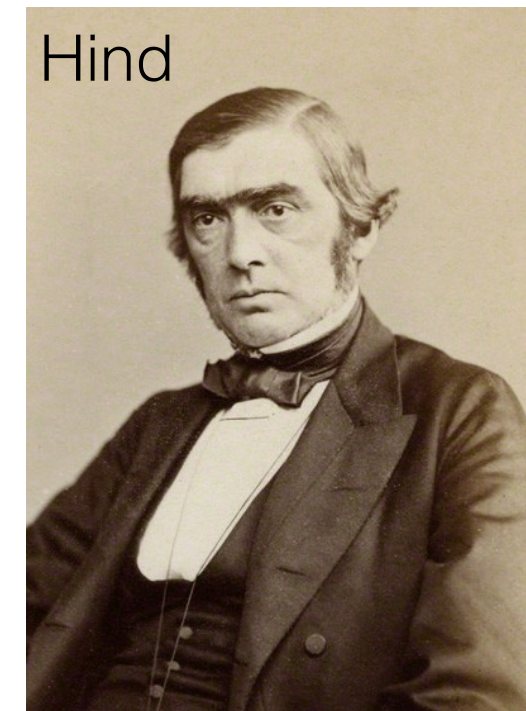
- Maybe observatory directors were not impressed enough by Le Verrier's papers to start the search (e.g. Encke)
- the 1st Le Verrier's prediction had a 10° error: that is a large region of sky to survey, and observatories had their duties:
 - from time keeping to working on the "safe" science (comets and known planets)
 - novel science (like the prediction using very complex math) could have been just a bit too risky after all

Nobody looked. Nobody?

- 4 searches (in my - limited - knowledge)
- Paris Observatory: **Hervé Faye**
 - search abandoned after a few nights on 12.08. (before the final prediction of Le Verrier)
- Private Observatory of George Bishop: **John Russell Hind**
 - 7-inch Dollond telescope
 - in contact with Hervé Faye, assistant of Arago at the Paris Observatory
 - from Faye: the new planet should not move more than 30' during 3 months —> it should be close to where it is predicted
 - not successful, probably not fully systematic
- Berlin Observatory: **Johann Gottfried Galle** (of course) - 1 night - SUCCESSFUL
- Cambridge Observatory: **James Challis** - secret search!



Faye



Hind

- John Russell Hind
 - discovered 10 asteroids
 - later Superintendent of the Nautical Almanac

Airy

- Sir George Biddle Airy (1801 - 1892)
- Lucasian Professor of Mathematics (1826 -1828)
- Plumian professor of Astronomy and Experimental Philosophy and Director of Cambridge Observatory (1828-1835)
- Astronomer Royal (1835 - 1881)
- Work on mathematics, physics and astronomy
 - Airy function, Airy disk, stress function method, diffraction theory, Venus, Uranus observations, mean density of Earth, Airy (Reference) Geoid, synthesis and re-reduction of Moon observations for 80 years,
- organisier:
 - Cambridge Observatory (installed major equipment), Royal Greenwich Observatory (modernised and improved), Prime Meridian (1851), 19th century Venus Transit...
- family man:
 - met Richarda Smith (1804 - 1875) in 1824, proposed after 2 days, allowed to marry in 1830, had 9 children
- reputation tarnished by the Neptune affair
- but, the first man to recognise the possibility to look for Neptune!



Challis

- James Challis (1803 - 1882)
- Plumian Professor of Astronomy and director of Cambridge Observatory
- work in physics, astronomy and theology
- teacher to G.G. Stokes, J.C. Adams, William Thompson (Kelvin), J.C. Maxwell...
- “Victorian Unified Field Theory” - inert spherical atoms embedded in elastic fluid ether
- “At a later time, or under less amiable circumstances, he would have been branded a charlatan.”
- “He would now be as forgotten as his peculiar ideas had not the events surrounding the discovery of Neptune in 1846 given him a genuine opportunity for scientific immortality.”
- “But he fumbled it.” (quotations from Eggen 1971)

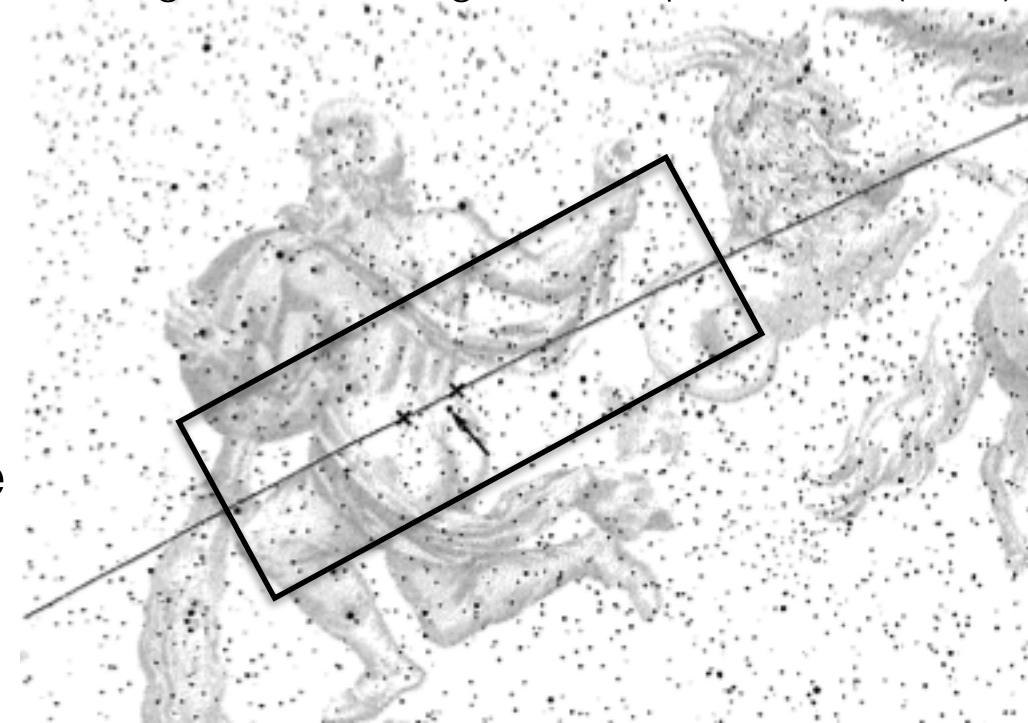


The secret search

- in June 1846 Airy reads Le Verrier's prediction on the location of Neptune - it is similar to that of Adams' (from 1845)
- Le Verrier asks Airy to search for the planet, Airy rejects it
- on 9 July, Airy suggests Challis to start a (secret) search around Le Verrier's prediction
- search started 29.07.1846. - possibly the extensive sky-search in history (>3000 stars!)
- Adams provides several other prediction, ranging some 20° !
- Challis simply didn't believe in the accuracy of the prediction
- Challis saw Neptune twice, but didn't "recognise" it:
 - on 04. and 12.08. observed same region
 - compared stars up to #39
 - #49 on 12.08. moved from its position of 04.08. —> Neptune
 - 29.09. "~~Last one~~ seems to have a disk"
- Challis had Argelander's Hora XXII chart (adjacent to Bremiker's Hora XXI), which covered the region where Neptune was in August!



Image from: Sandage "The Neptune File", (2003)



Who gets the credit?

- Galle, d'Arrest - they saw it following instructions
- Le Verrier - he predicted it and published all his work
- Adams
 - claim to have predicted the position within 1° of Le Verrier's solution already in October 1845
 - nothing was published until 7 weeks after the discovery
- Airy in June 1846, in a letter to a colleague, says that Adams' solution "reached him first" —> no indication when it actually happened, but
- Airy writes to Adams on 5 Nov 1845 thanking him for "the paper of results" and asks him a question, which Adams doesn't answer
- the crown document (contains a table of difference between predicted and observed position of Uranus, with little explanation) has date possibly inscribed later (in different handwriting - most likely Airy)
- it is most likely that Adams' had a solution in October 1845, but he never published anything, didn't answer Airy, made several other incorrect predictions in July 1846

1845 October

According to my calculations, the obs^d irregularities in the motion of Uranus may be accounted for, by supposing the existence of an ext^a planet, the mass & orbit of wh. are as follows

Mean Dist. (assumed nearly in accordance with Bode's law)

38.4

Mean sid^e mot. in 365.25 days

$1^\circ 30' 9''$

Mean Long. 1st Oct^r 1845

$323^\circ 34'$

Long. Perih^{on}

$315^\circ 35'$

Eccentr^y

0.1610

Mass (that of Sun being unity)

0.0001656

Did Brits steal Neptune?

- yes and no
- it was the astronomical question of the time: hardly surprising two people worked on it
- Adams did work on the theory of Uranus and predicted a location of Neptune before Le Verrier, but
- his 1845 prediction was most likely neither final nor “clean”, which might explain why he never published anything on the matter (although published other things).
- Airy did initiate a search based on the two independent predictions. He did all he could that the biggest astronomical discovery of the age happens in Cambridge.
- After the discovery, Airy, Challis and Adams had to explain why their secretive search failed (and why was it secretive at all?).
- all three of them declared Le Verrier as the “discoverer”, (in particular Airy), but exaggerated Adams’ contribution (his prediction was not really within 1° of Le Verrier’s) and did not mention that he made a number of wrong predictions (after Le Verrier’s papers were known).
- the issue became of national importance and there is no denying that the might of the British scientific establishment ensured Adams’ fame (at least in English speaking world)

Press war

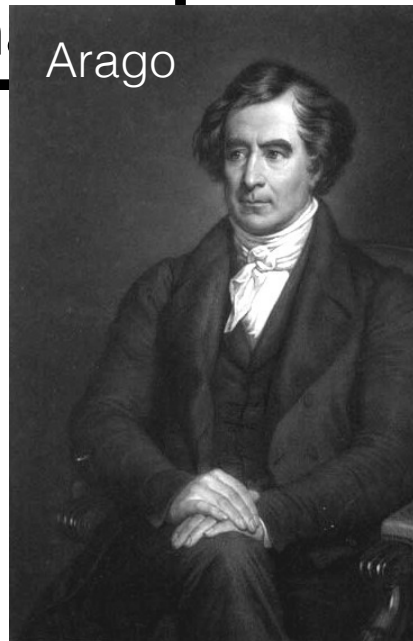
- Challis and Adams announce the distance to Neptune (30 AU) and propose a name “Oceanus” (on 17 Oct. 1846)

J. Hind: “it is no more likely to succeed with the French (who have the only right to name it) than if it had been dubbed ‘Wellington’”

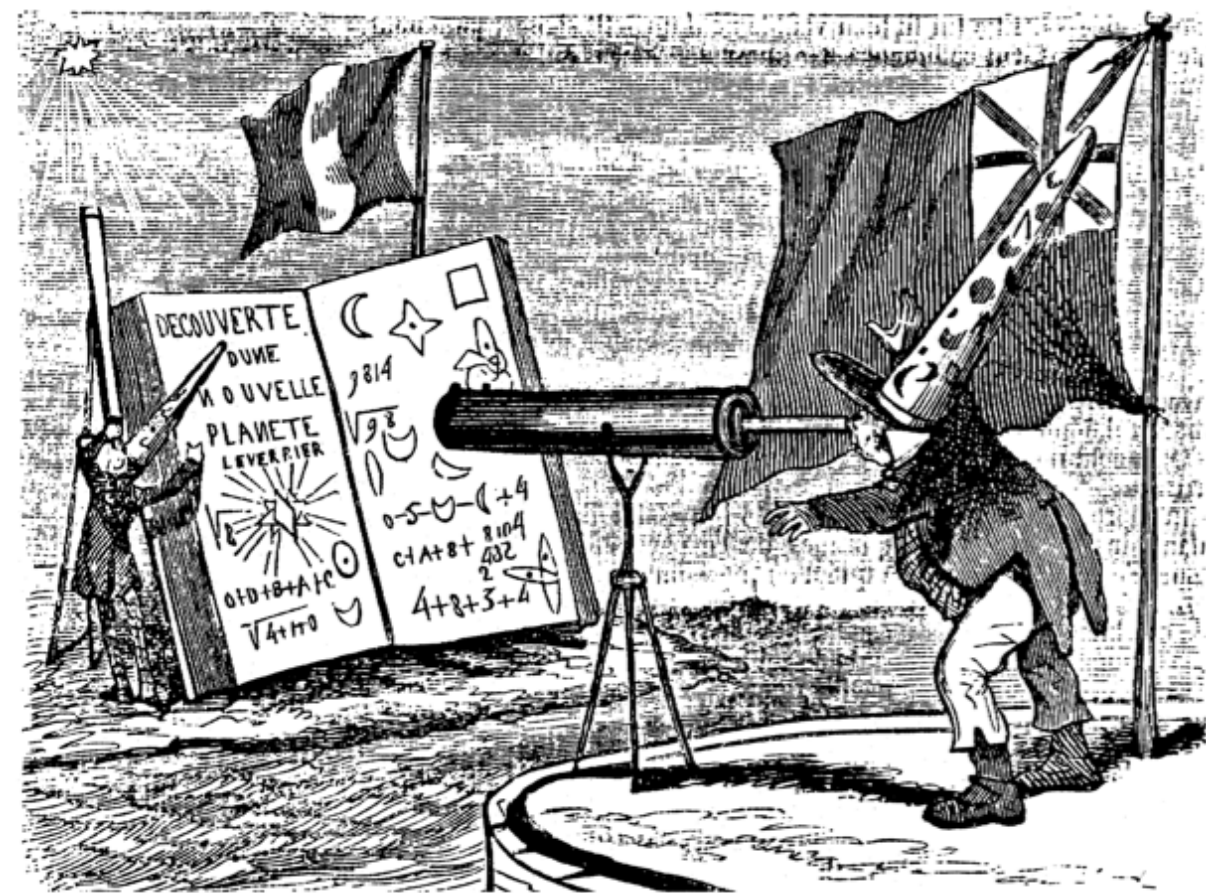
- the French are very upset

“Are we in the Academy of Sciences or in the Chamber of Deputies?” La Sem

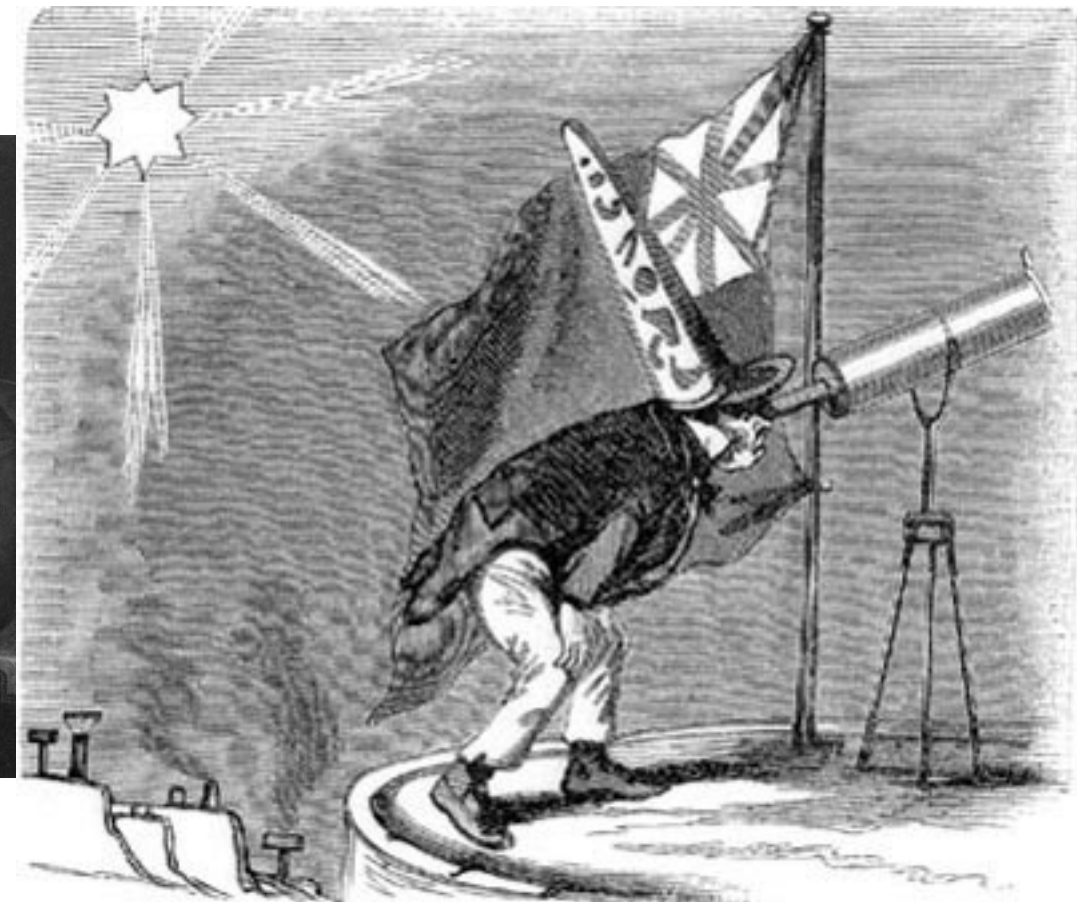
- 19. Oct 1846 - session of the Academy of Sciences
 - Arago took the question of priority very emotionally
 - provides a “refutation” of Adams’ claim: essentially that Adams never published anything about Neptune or Uranus
- press picked it up



Arago



M. Adams discovering the planet in the report of M. Leverrier!



(M. Adams cherchant la planète de M. Leverrier.)

Press war

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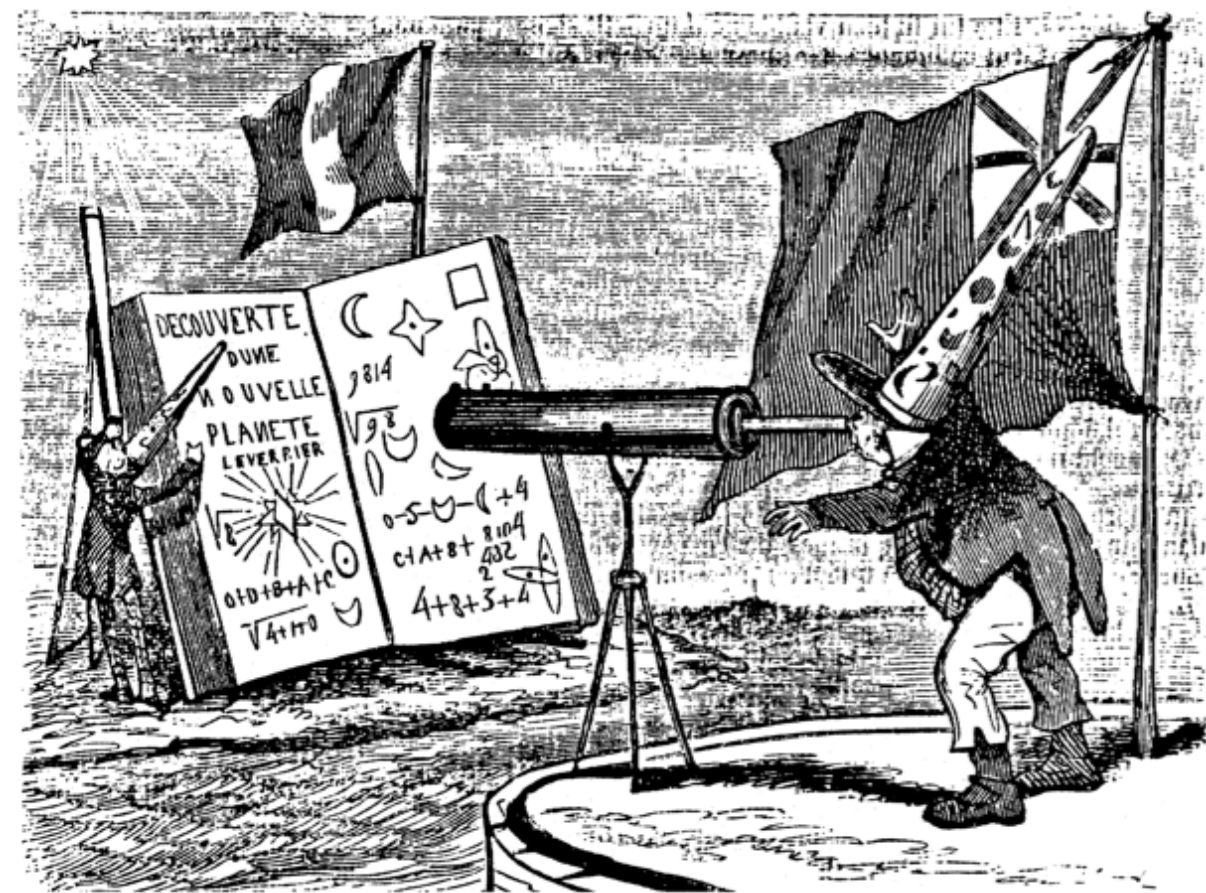
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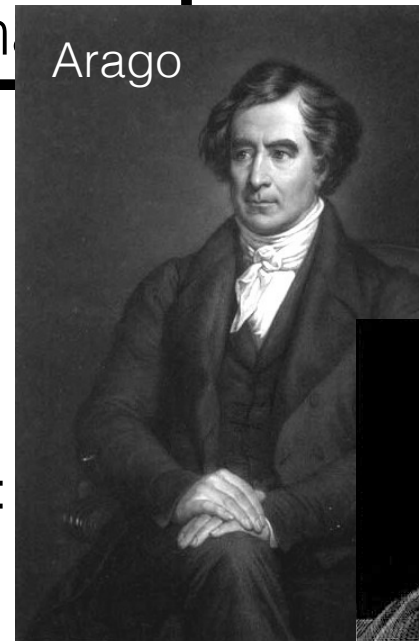
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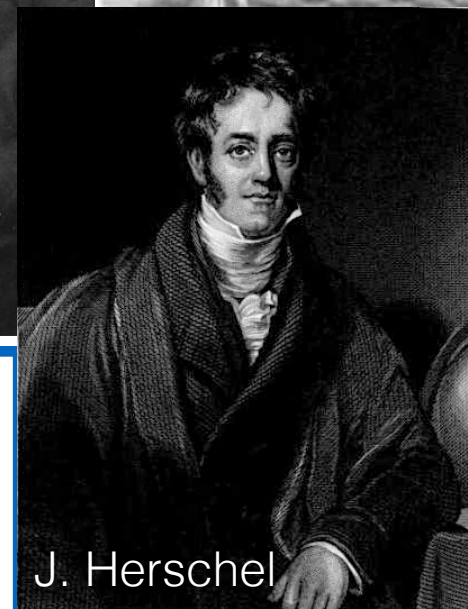
“These French fly at one like wildcats” J. Herschel
(25.10.1846)



M. Adams discovering the planet in the report of M. Leverrier!



Arago



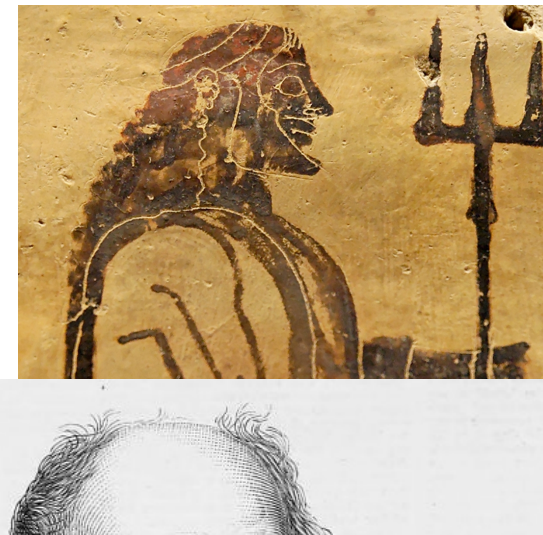
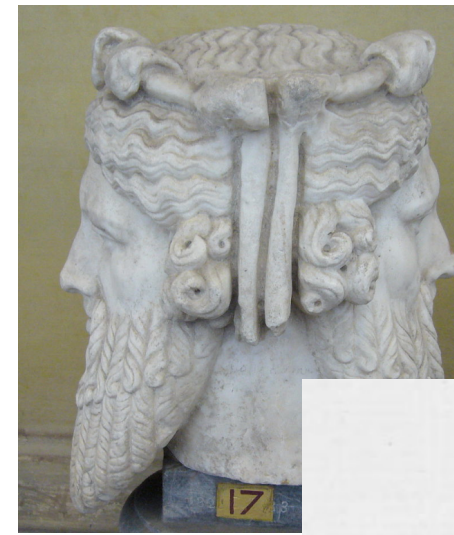
J. Herschel



searching for the planet of Monsieur Le Verrier

The name game

- Galle (25.09.1846) - as one who found it:
 - “Janus”, Roman God of beginning and passage
- Le Verrier (28.09.1846)
 - chooses “Neptune”
 - gives is to the press with the announcement of the discovery
 - writes back to Galle, that Bureau des Longitudes decided that name
—> not true, probably embarrassed to directly (himself) reject Galle
- Challis and Adams (17.10.1846)
 - “Oceanus”
- Arago (19.10.1846)
 - “Le Verrier” (and “Herschel” for Uranus)
 - Le Verrier adopts this name (neglecting his own choice)
- Herschel (January 1847, May 1847)
 - Demogorgon, Minerva and Hyperion
- most continental astronomers choose “Neptune”
- Airy (28.02.1847)
 - adopts “Neptune”
- Bureau des Longitudes (summer 1847)
 - adopts “Neptune”



W.H.Smyth: “I don't quite like this proposed change in the nomenclature of the Planets, for mythology is neutral ground. Herschel is a good name enough. Le Verrier somehow or other suggests the idea of a Fabriquiant & is therefore not so good. But just think how awkward it would be if the next planet should be discovered by a German: by a Bugge, a Funk, or your hirsute friend Boguslawski!”

The name game

Cher, respectable collègue
M. J. Le Verrier
Logez-attendez bon pour m'écrire rue
St. Thomas d'Enfer n° 5. Je vous ai apporté
par à l'Observatoire, où vous avez adressé
votre lettre
Le Bureau des longitudes s'est
prononcé ici pour Neptune.
Le signe un trident. Le nom de

Announcement of the new name for Neptune in AN, 1846

BEILAGE

ZU N^o 581. DER ASTRONOMISCHEN NACHRICHTEN.

Name des neuen Planeten.

Nach einem unter dem 6^{ten} October von Herrn *Arago* erhaltenen Briefe, hat Herr *Le Verrier* sein unbestreitbares Recht, dem von ihm entdeckten Planeten einen Namen zu geben, an Herrn *Arago* übertragen. Zufolge dieses ihm übertragenen Rechtes giebt Herr *Arago* dem neuen Planeten den Namen des Entdeckers **LEVERRIER**, und hat für ihn das Zeichen



gewählt.

S.

Eggen did steal files

- Olin Jeuck Eggen (1919 - 1998)
- during WWII served in Office of Strategic Service (predecessor of CIA) as a spy in Austria and Balkans (Suntzeff 1998)
- worked at Royal Greenwich Observatory (1956-1961) helped restructured the archives and the library of RGO
- in 1962 “borrowed” all Neptune correspondence to write a biography of Airy and Challis
- never returned it (moved to Mt. Stromlo, to Chile), and openly denied he had them
- they were found among his papers in Chile



**EVIDENCE FROM THE MOTIONS OF OLD STARS
THAT THE GALAXY COLLAPSED**

O. J. EGGEN, D. LYNDEN-BELL,* AND A. R. SANDAGE

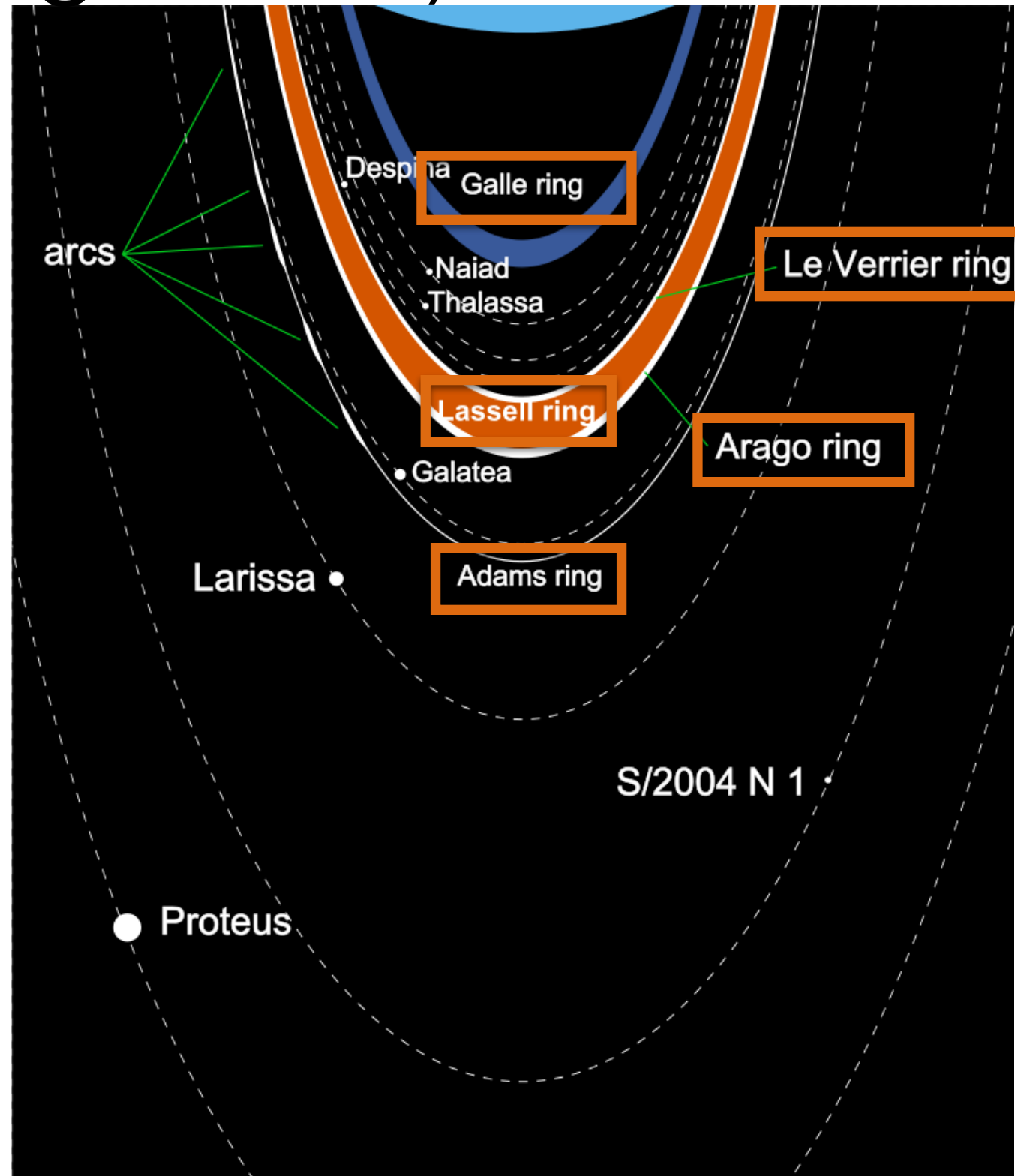
Mount Wilson and Palomar Observatories

Carnegie Institution of Washington, California Institute of Technology

Received May 17, 1962

Who gets the credit? (according to DK)

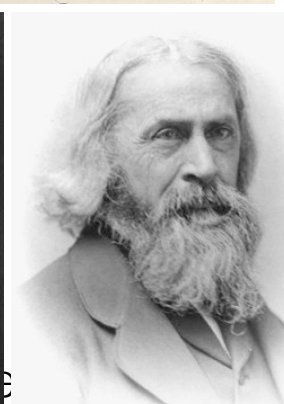
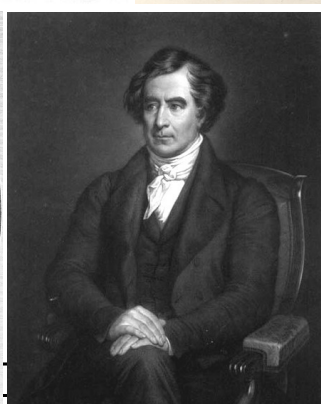
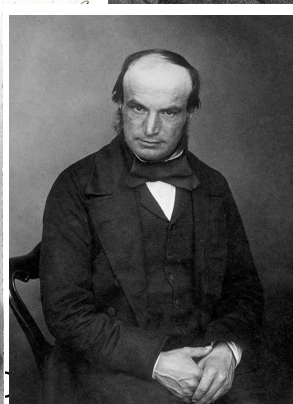
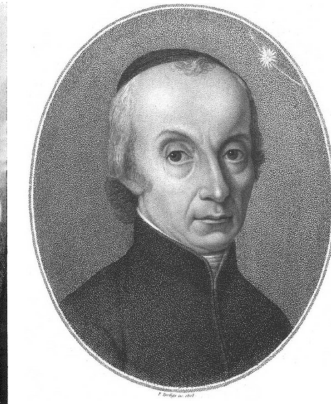
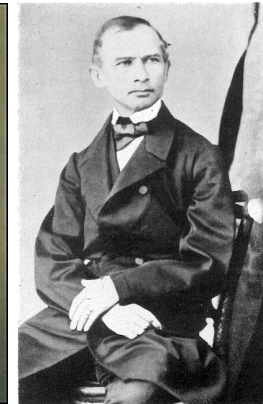
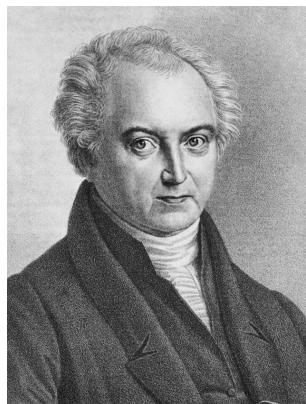
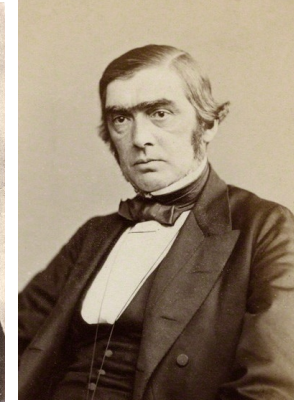
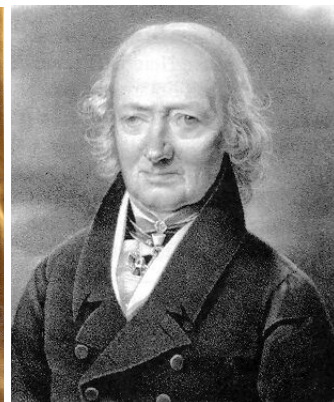
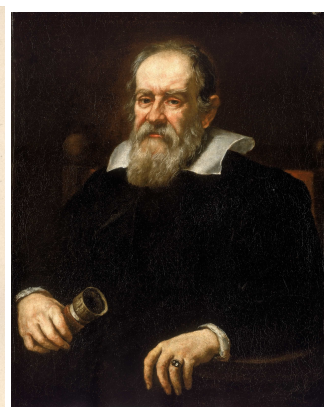
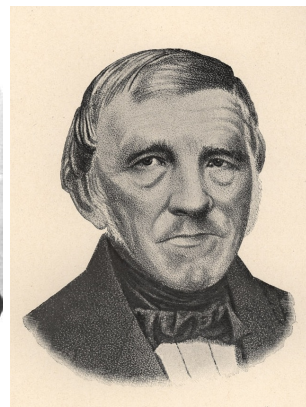
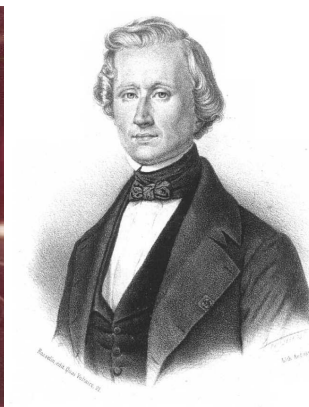
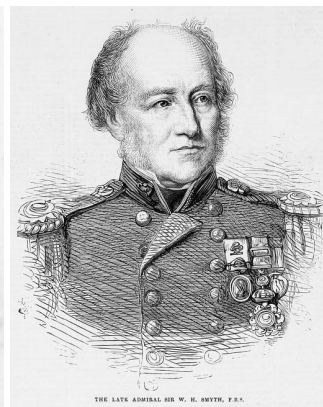
- Le Verrier - for (an amazing) prediction
- Galle and d'Arrest - for discovery (or sighting)
- Adams - for the calculation of the first reasonably correct distance to Neptune, position of its nodes and orbital inclination
- Sears Cook Walker - for eccentricity of Neptune's orbit
- Benjamin Price - for mass of Neptune (based on William Lassell observation of Neptune's moon Triton)



What can we learn

- preprints are faster than publications (it took 1 month for a paper read in Paris to reach London), but less than 5 days for a letter from Paris to Berlin, which is better than 11 days to St. Petersburg!
- “Science knows no nationality, only scientists do”
+ scientific results are clammed by nation, university, institute, funding body
- discovery requires deep knowledge, bold action and some luck

Dramatis personae



Acknowledgments

- pictures of protagonists were mostly taken from wikipedia
- figures are taken from scientific literature (or) as quoted from the literature below (sorry for the small font); cartoons from the French press are from Barbara J. Becker website (<http://faculty.humanities.uci.edu/bjbecker/index.html>); an image of one of the documents from the RGO Neptune Files was taken from <http://dioi.org/kn/neptune/index.htm>
- I am indebted to the AIP librarians: Regina von Berlepsch and Marcel Thies, as well to the librarian of the Royal Astronomical Society Sian Prosser

- Literature:

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