

# The 1761's transit of Venus :

an international transfer of mathematical knowledge...

Isabelle Lémonon (EHESS- CAK Paris)

Novembertagung 2015, Turin, November, 26<sup>th</sup>-28th

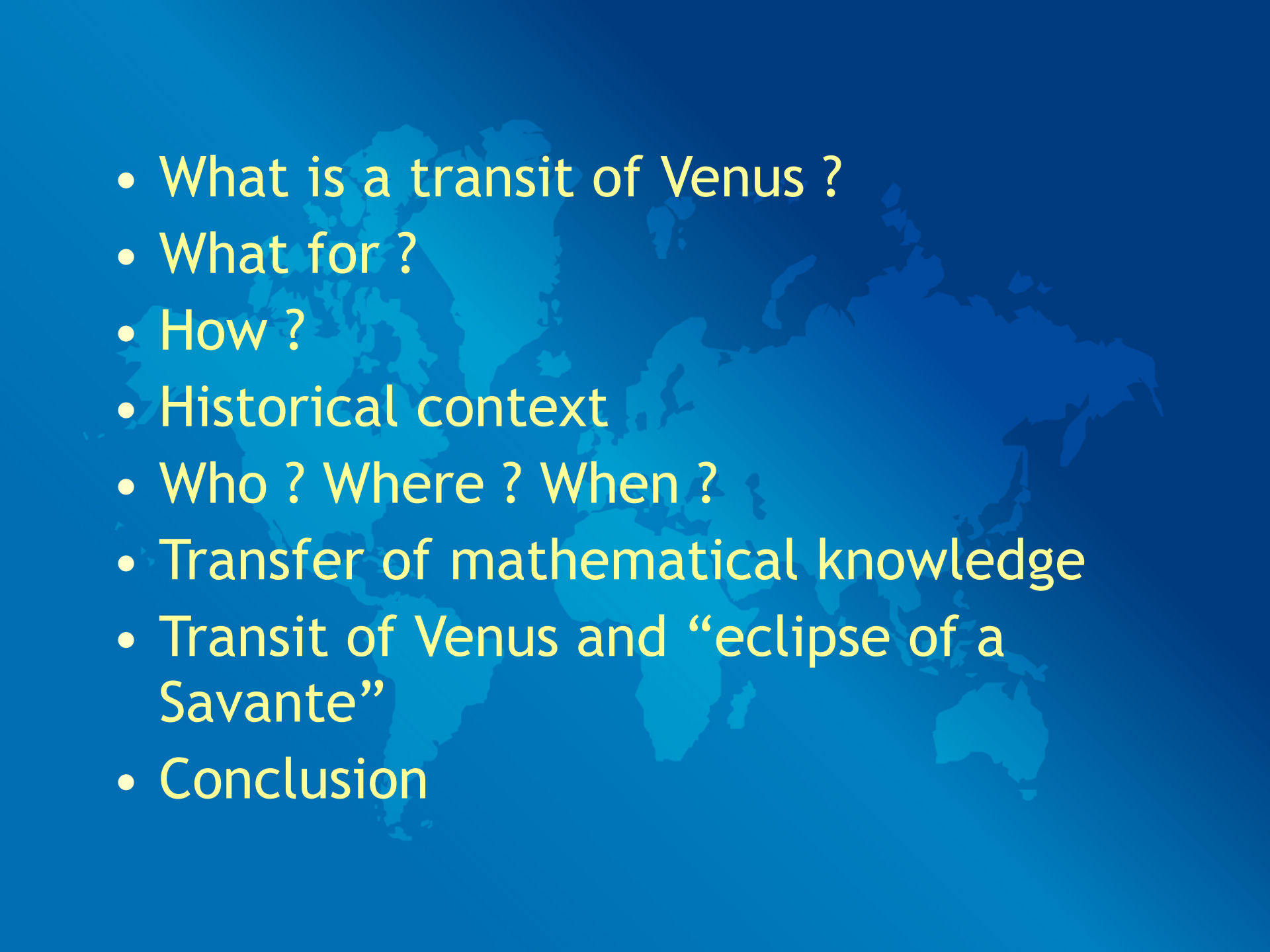
# The 1761's transit of Venus :

an international transfer of mathematical knowledge...

...out of women's reach ?

Isabelle Lémonon (EHESS- CAK Paris)

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- 
- What is a transit of Venus ?
  - What for ?
  - How ?
  - Historical context
  - Who ? Where ? When ?
  - Transfer of mathematical knowledge
  - Transit of Venus and “eclipse of a Savante”
  - Conclusion

# What is a transit of Venus ?

- Transit = one celestial body appears to move across the face of another celestial body (different apparent diameter)
- Conjunction= apparent close approach between the objects as seen on the sky

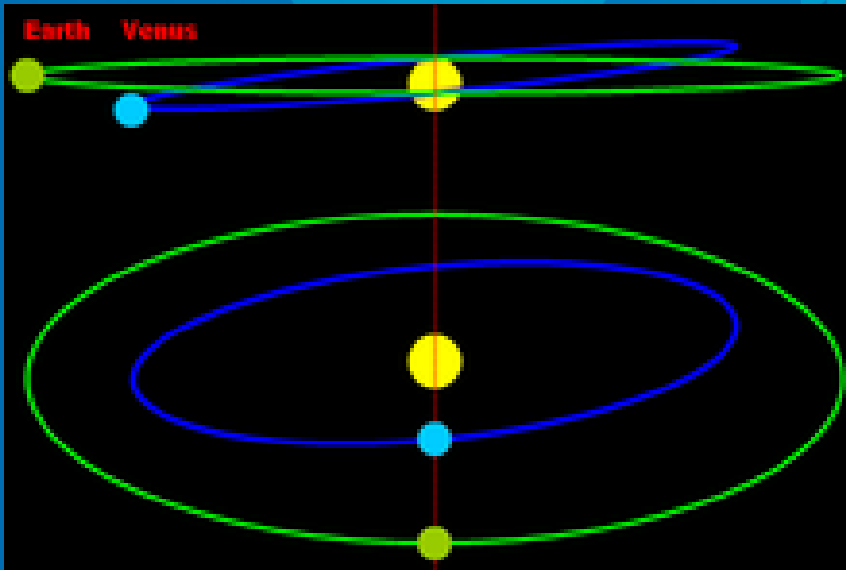


Diagram of transit of Venus  
3,4°



Image of the 2012 transit taken by NASA's  
Solar Dynamics Observatory spacecraft

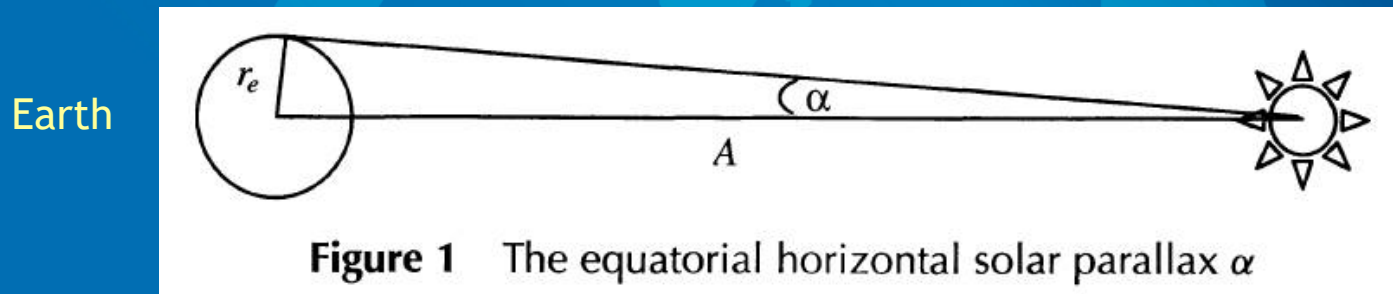
# What is a transit of Venus ?

- Predictable astronomical phenomenon
- One of the rarest of these phenomena
- Every 243 years, with pairs of transits eight years apart separated by long gaps of 121,5 years and 105,5 years (orbital periods of Earth and Venus are close to 8:13 and 243:395 commensurabilities)

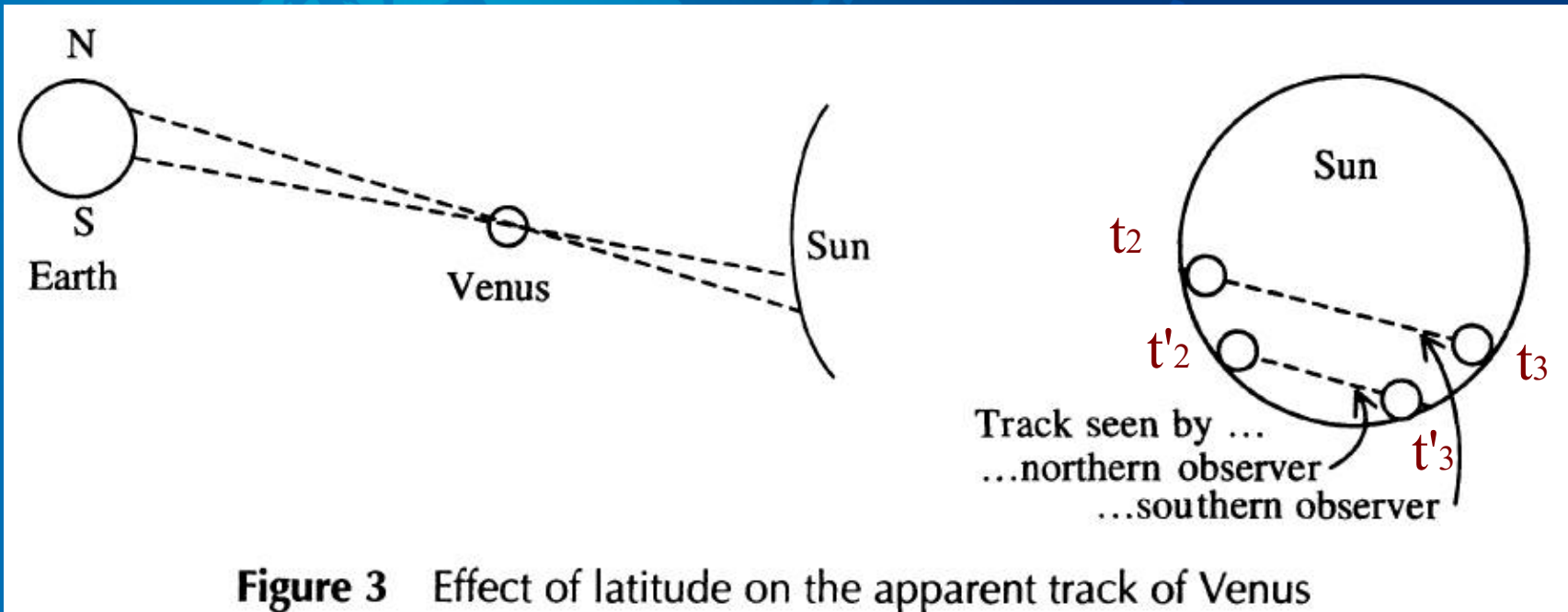
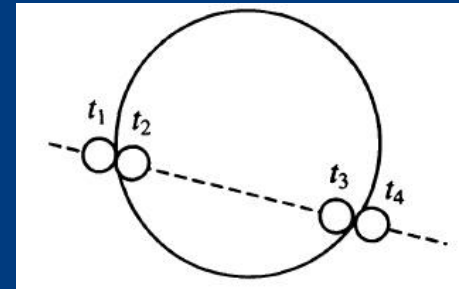
# What for ?

- Measurement of the distance Sun/Earth  $A$  (E.Halley 1716, Royal Society) : solar parallax  $\alpha$

“a clarion call for scientists everywhere to prepare for the rare opportunity presented by the forthcoming transits of 1761 and 1769. [...] I recommend it to the curious strenuously to apply themselves to this observation. By this means, the Sun's parallax may be discovered”



# How ?



$t_3 - t'_3 = 1\text{h}20'50''$  Cape Town / Greenwich  
 Difference local times (longitude effect) =  $1\text{h}13'35''$   
 Remaining time difference  $\Delta t = 7'15''$  (latitude effect)

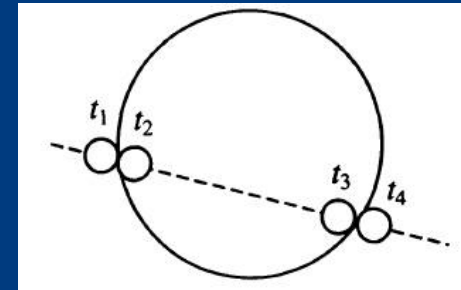
## How ?

- Halley's method

- measure  $t_3 - t_2$
- two observations in one place
- knowledge of longitude and Kepler's law

- Delisle & Short's method

- measure  $t_3$
- one observation in two places
- accuracy of clocks
- knowledge of longitude



Network of observers



# Historical context ?

- First observation (telescope) : 1639



Crabtree watching the transit of Venus 1639  
by Ford Madox Brown, Manchester Murals  
19<sup>th</sup> century



The Founder of English Astronomy by Eyre Crowe, 1891  
Jeremiah Horrocks observing the 1639 transit of Venus  
ESO

## Historical context ?

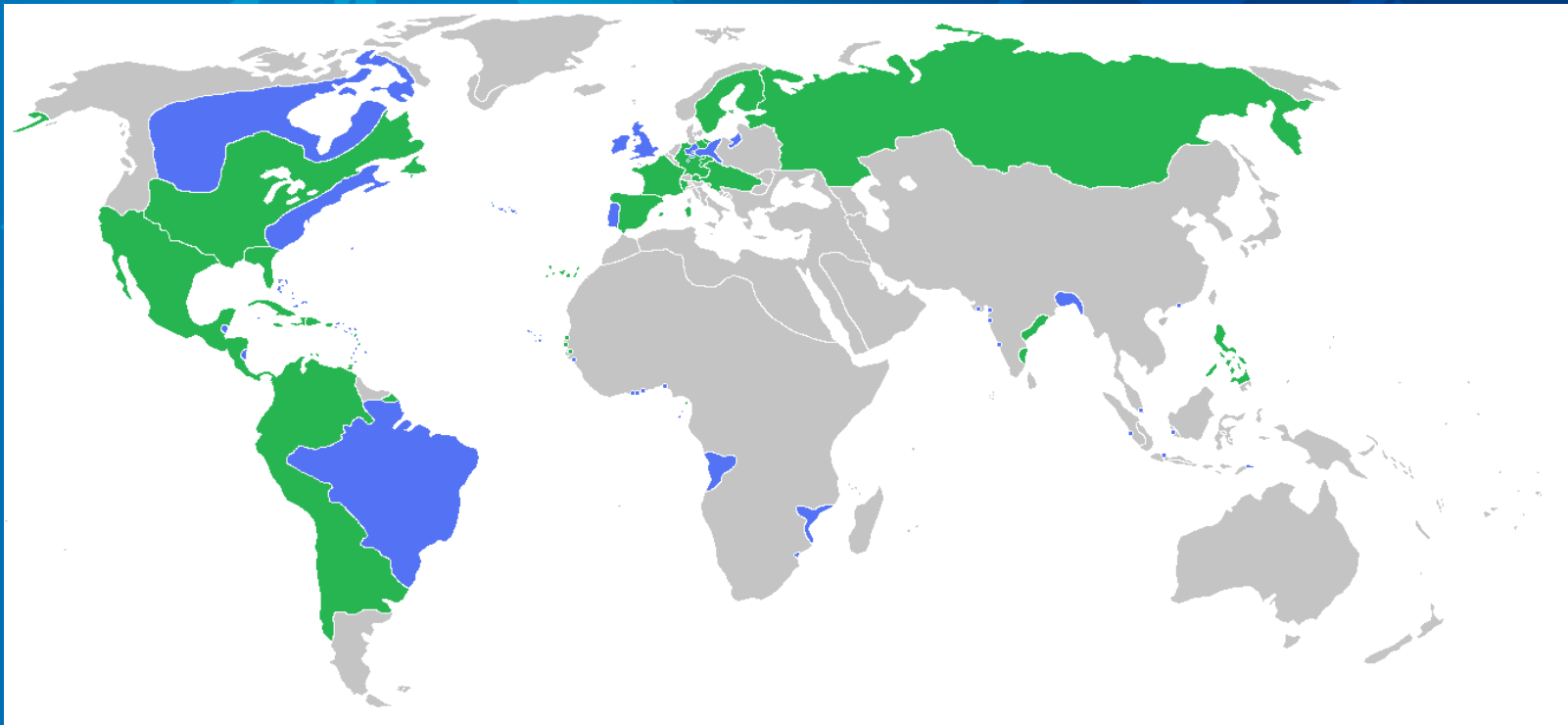
- 1677 : Observation of Mercure's transit by Halley  
First idea of measuring time instead of angle
- 1716 : Discourse at the Royal Society proposing to use the transit of Venus to measure the solar parallax  
The “two observations in one place” way of measuring time
- 1747 : Delisle proposes the “one observation in two places” way of measuring time

# Historical context ?

- Sailing development : control of the oceans
  - colonies
  - economy
  - policy
- Competition for this control (England, France, Spain)
  - wars
  - privateering
  - technology
  - longitude

# Historical context ? 1761

- Seven Year's war (1755-1764) : two coalition (Great Britain / France)

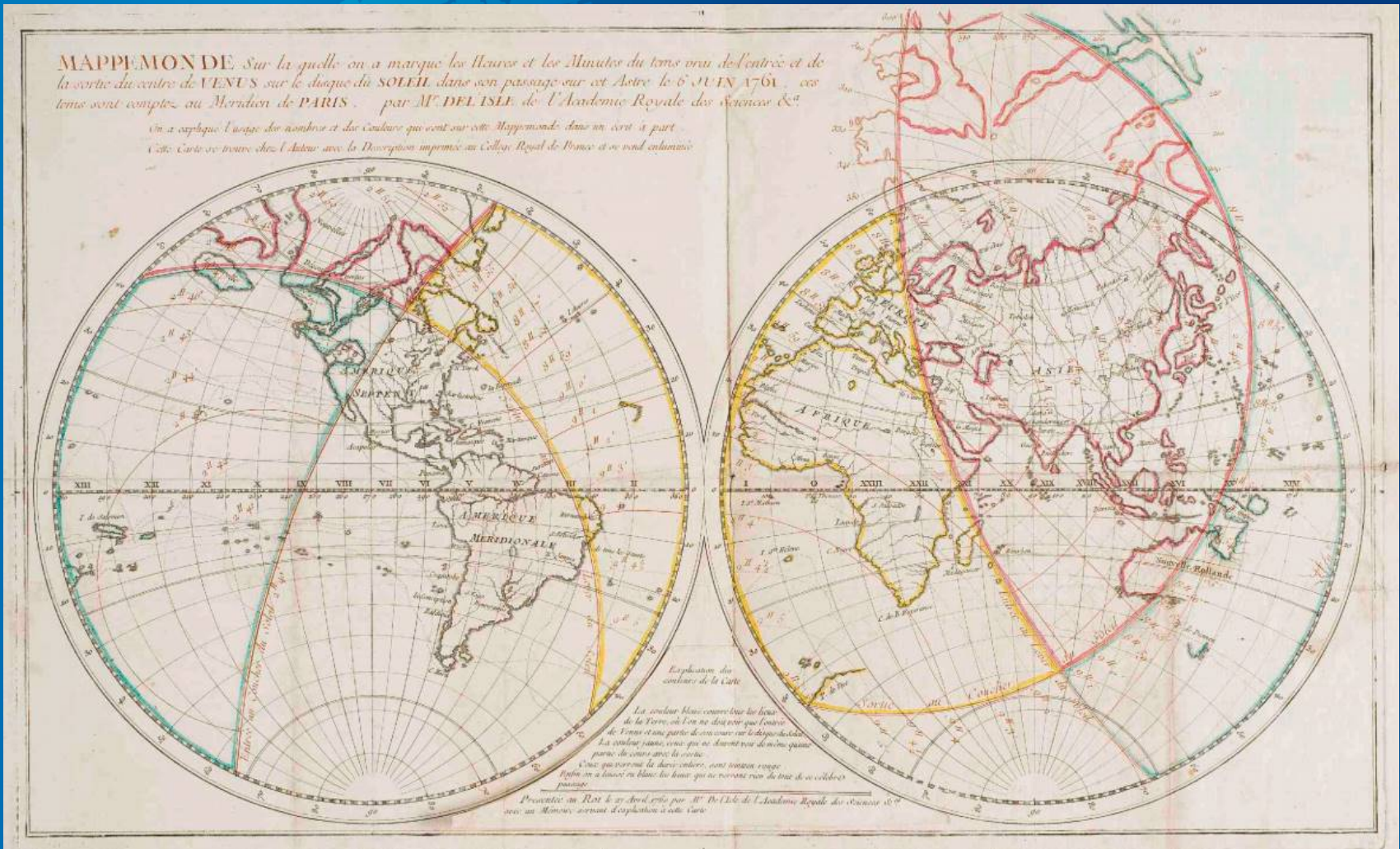


All the participants of the Seven Years' War.

- Great Britain, Prussia, Portugal, with allies
- France, Spain, Austria, Russia, Sweden with allies

# Who ? Where ? When ?

200 copies (correspondences, academies)



Mappemonde présentée au Roi le 27 avril 1760 avec sujet du passage de Vénus sur le Soleil, que l'on attend le 6 juin 1761, Paris, Blue 2<sup>nd</sup> contact, Yellow 3<sup>rd</sup> contact, Red all the contacts, White no observation possible

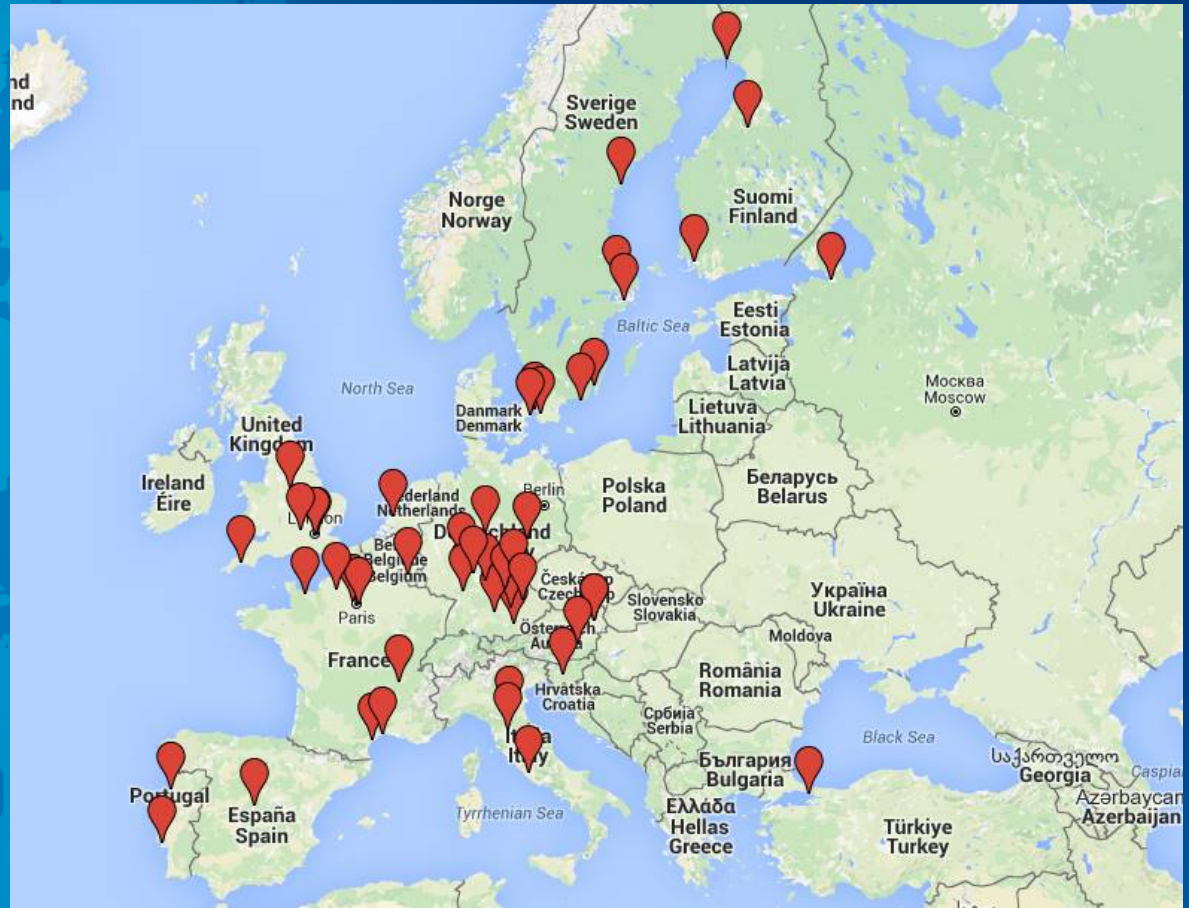
# Who ? Where ? When ?

- 1761, june 6th
- 176 observers from 10 countries at least (astronomers, academicians, savants, sailors...)
- 120 observation places (46)



Map drawn from *Les passages de Vénus devant le disque solaire*, Dubois, 1873

# Who ? Where ? When ?



Map drawn from *Les passages de Vénus devant le disque solaire*, Dubois, 1873

Pingré, Dixon, Mason, Wargentín, Mayer (T. & C.), Chappe, Short, Blair, Maraldi, Messier, Lalande, La Caille, Le Monnier, Cassini...

# Transfer of mathematical knowledge

- Philosophical Transactions (England)
  - 12 articles in 1761 (prior, later...>10)
  - From England, France, India, Constantinople, Sweden
  - Ambassador, East India Company members, Chaplain, Astronomers
- Mémoires de l'académie royale des sciences (France)
  - 21 articles in 1761 (prior, later...> 8)
  - From France, Austria, Russia, Mauritius, England
  - Cardinal, Astronomers



# Transfer of mathematical knowledge

- Journal des savants (France)
  - 4 articles (prior, later...>6)
  - from France, Austria, Portugal
  - Astronomers
- Journal des associés étrangers (AcadS France)
- Mémoire de l'académie de Haarlem (Netherlands)
- Allgemeine geographische Ephemeriden (Germany)
- Nova acta eruditorum (Ac Uppsala Sweden) N>3
- Academiens handlingar (Ac Stockholm, Sweden) N>2
- Ephemerides astronomicae ad meridianum vindobonensem (Austria, Hell)

At least 75 articles in journals

# Transfer of mathematical knowledge

- Many monographs all around the countries
    - France (>4)
    - England (>6)
    - Germany (>4)
    - Netherlands (>3)
    - Austria (>1)
    - Italy (>11)
    - Sweden (>1)
    - Russia (>6)
    - Spain (>2)
- N > 38 from 9 countries

126 publications (1758-1768)

International collaboration ?  
International competition ?

# Transfer of mathematical knowledge

- 1618 : Kepler's laws (Poland)
- 1677 : E.Halley's observation of the transit of Mercury
- 1716 : Call by Halley for an international observation of the transit of Venus in 1761
- 1750s : English map of the possible observation's location all around the world (english plan of trips)
- 1760 : Delisle's map of other possible locations (french plan of trips)
- 1760 : Change in the english plan of trips
- 1761 : observation and transfer of the results **inside** and **between** the 2 coalitions (ex : Portugal)

# Transit of Venus and “eclipse of a Savante”



Painting by Voiriot, Private collection,  
by courtesy of J.Dennaud

- **Nicole Reine Lepaute (1723-1788)**
  - wife of the king's clockmaker
  - met J.Lalande in 1755
  - first astronomical calculations mentioned in 1757 (Lalande & Clairaut)
  - Associate member of the Academie of Béziers (1761)
  - astronomical calculations for the *Connaissance des Temps* (1759-1774)
  - astronomical calculations for the *Ephémérides des mouvemens célestes* (1774-1785)

# Transit of Venus and “eclipse of Savante”

“ [...] vous trouverez dans cette enveloppe les savants calculs de Mme Le Paute, femme d'un habile horloger et digne écolière en astronomie de M. de Lalande sur le fameux passage de Vénus sous le soleil. Elle me les apporta il y a quelques jours pour vous les envoyer, et je m'en acquitte avec plaisir.”

1761/09/19 Letter by Dortous de Mairan to Bouillet

“ [...] you will find in this envelope “savant” calculations by Mrs. Le Paute, the wife of a skillful clockmaker and clever schoolgirl in astronomy worthy of M. de Lalande on the famous passage of Venus in the sun. She brought me these the last few days to send them to you, and I fulfill this duty with pleasure. “

# Transit of Venus and “eclipse of a Savante”

“Mme Lepaute fit plusieurs mémoires pour l'académie de Béziers dont elle était associée, entre autres le calcul de toutes les observations qu'on y avaient faites lors du passage de Vénus sur le soleil en 1761.”

J.Lalande, *Bibliographie astronomique*, 1803, p.678

•  
"Mrs. Lepaute wrote several memoirs to the Academy of Béziers of which she was associated, including the calculation of all the observations that were made there during the transit of Venus on the Sun in 1761."

# Transit of Venus and “eclipse of a Savante”

- No traces in “savant” journals
- No traces in french journals
- Not any remaining archives for this period in the Academy of Béziers
- Invisibility

“ [...] les organisateurs ont cru bien faire en associant Mme Lepaute au passage de Vénus, ce qui est historiquement non fondé et donc erroné.”

Guy Boistel, Cahiers Clairaut 108, Hiver 2004

Exhibit about the Transit of Venus, Paris Observatory

# Conclusion

- International scientific collaboration/competition
- Not any probative results (savants)
- First draft for the Transit of 1769 (77 locations)
- Even at war, transfer of mathematical knowledge :
  - Halley's idea of using Venus transit spread through Europe
  - Delisle method of measure and map of visibility spread through Europe (trips)



## Conclusion

- Observations results transferred inside each coalition (journals, books, memoirs, translations...)
- Observations results transferred between coalitions (journals, books, memoirs, translations...)
- Role of academies (technical devices, gathering savant teams, relay of the importance of the observation to the King, setting up the trip with the royal navy)
- Perspective : network analysis

# Conclusion

- No transfer of mathematical knowledge through /to/from Women ?
  - no women ?
  - calculations not reliable ?
  - gender effect ?
  - institutional knowledge ?
  - excluded ? Included ?



THANK YOU FOR  
YOUR ATTENTION !