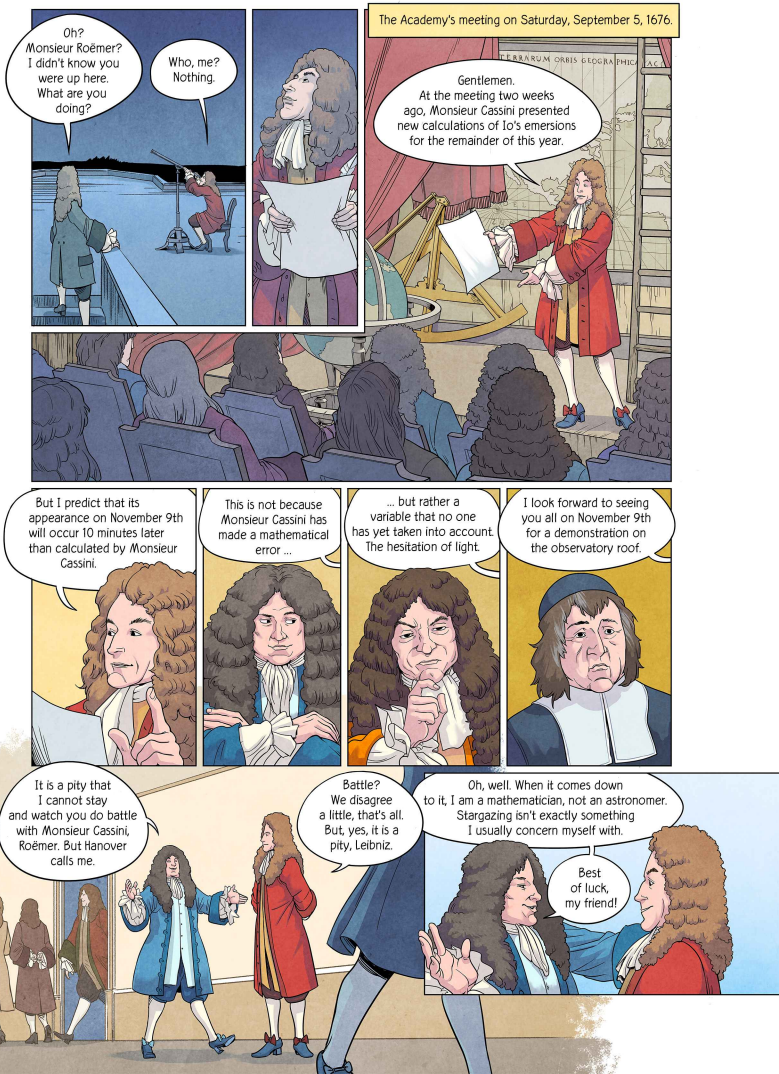
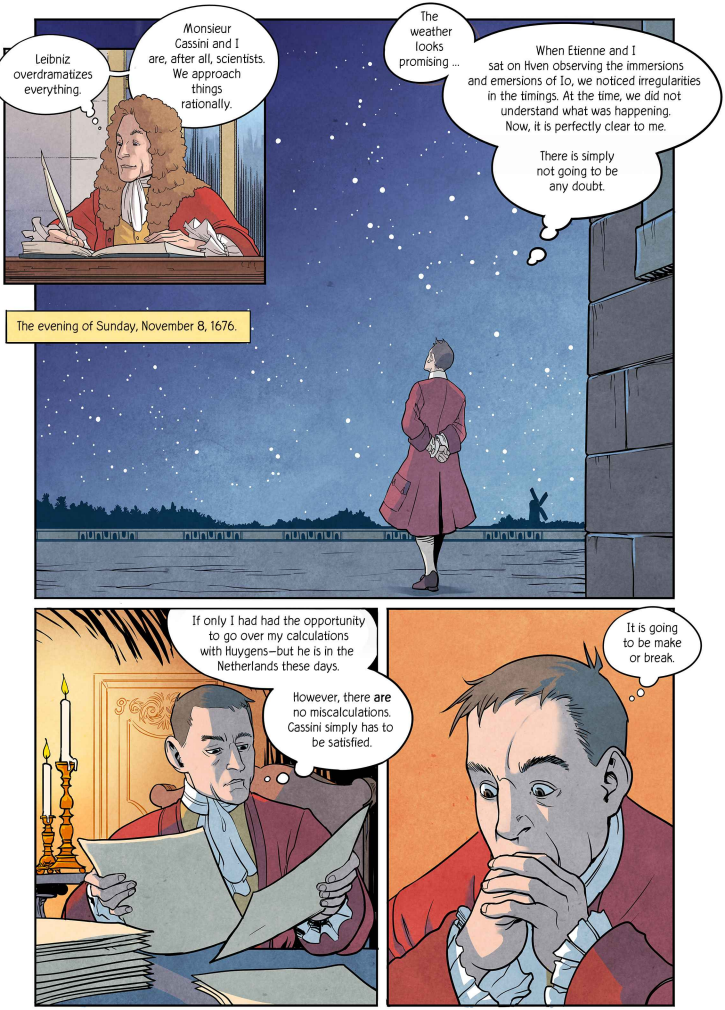
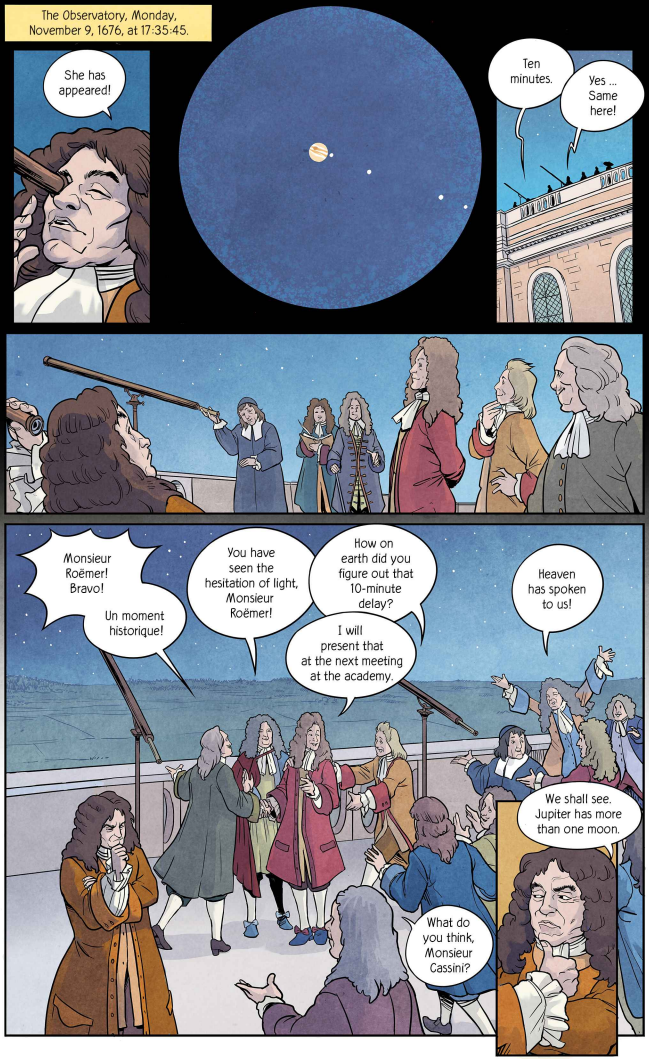
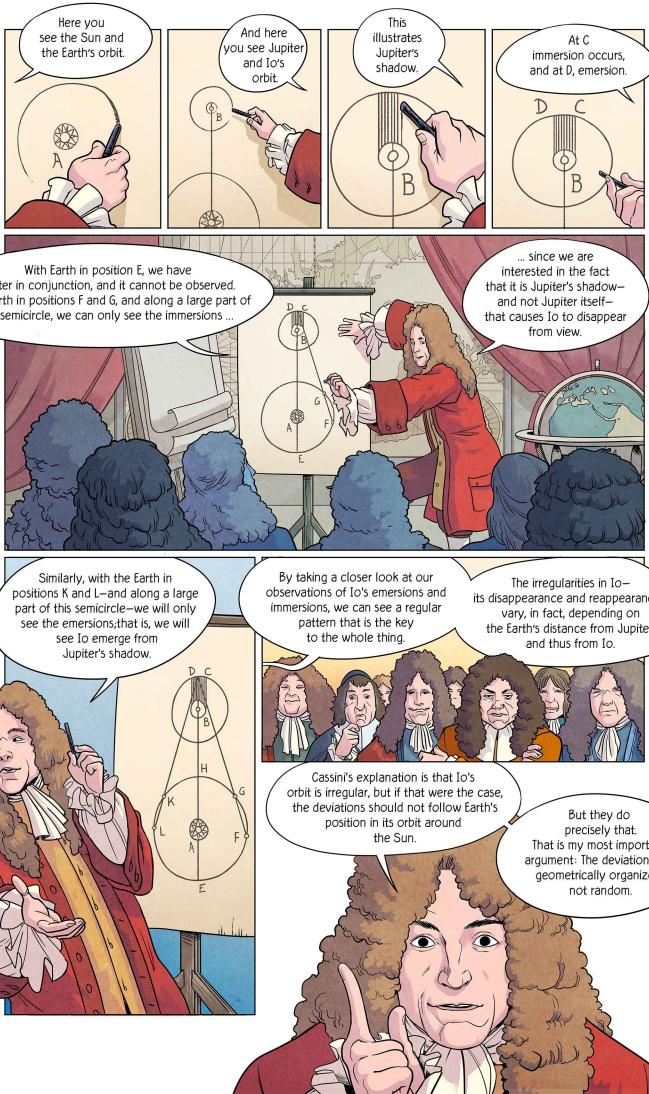
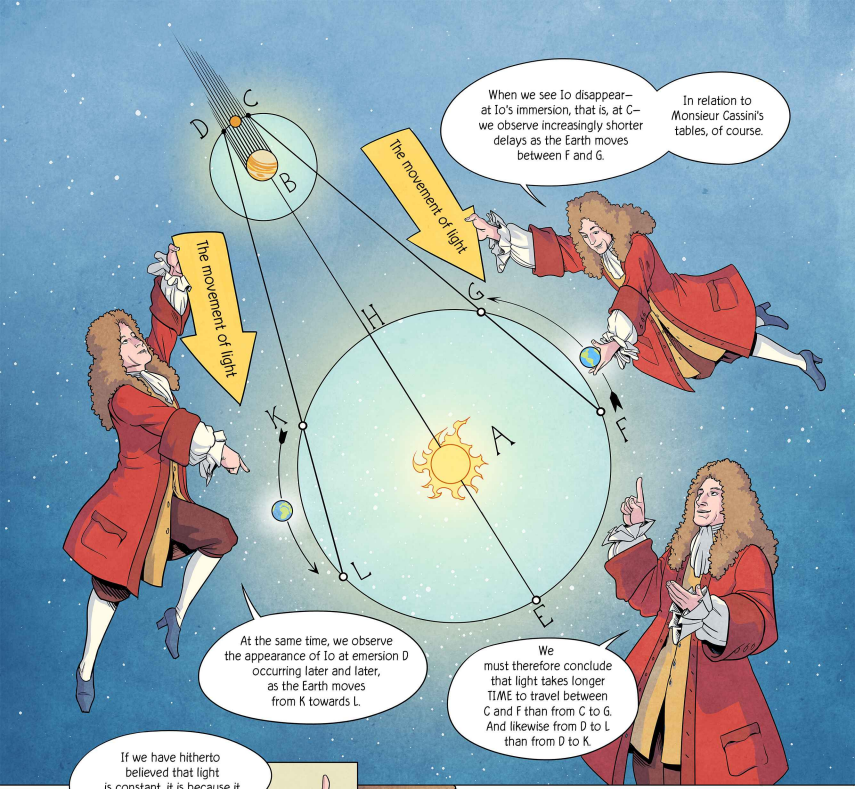

Oh? Monsieur Roëmer? I didn't know you were up here. What are you doing?
Who, me? Nothing.
The Academy's meeting on Saturday, September 5, 1676.
Gentlemen. At the meeting two weeks ago, Monsieur Cassini presented new calculations of Io's emersions for the remainder of this year.
But I predict that its appearance on November 9th will occur 10 minutes later than calculated by Monsieur Cassini.
This is not because Monsieur Cassini has made a mathematical error ...
... but rather a variable that no one has yet taken into account. The hesitation of light.
I look forward to seeing you all on November 9th for a demonstration on the observatory roof.
It is a pity that I cannot stay and watch you do battle with Monsieur Cassini, Roëmer. But Hanover calls me.
Battle? We disagree a little, that's all. But, yes, it is a pity, Leibniz.
Oh, well. When it comes down to it, I am a mathematician, not an astronomer. Stargazing isn't exactly something I usually concern myself with.
Best of luck, my friend!


Leibniz overdramatizes everything.
Monsieur Cassini and I are, after all, scientists. We approach things rationally.
The weather looks promising ...
When Etienne and I sat on Hven observing the immersions and emersions of Io, we noticed irregularities in the timings. At the time, we did not understand what was happening. Now, it is perfectly clear to me.
There is simply not going to be any doubt.
The evening of Sunday, November 8, 1676.
If only I had had the opportunity to go over my calculations with Huygens—but he is in the Netherlands these days.
However, there are no miscalculations. Cassini simply has to be satisfied.
It is going to be make or break.

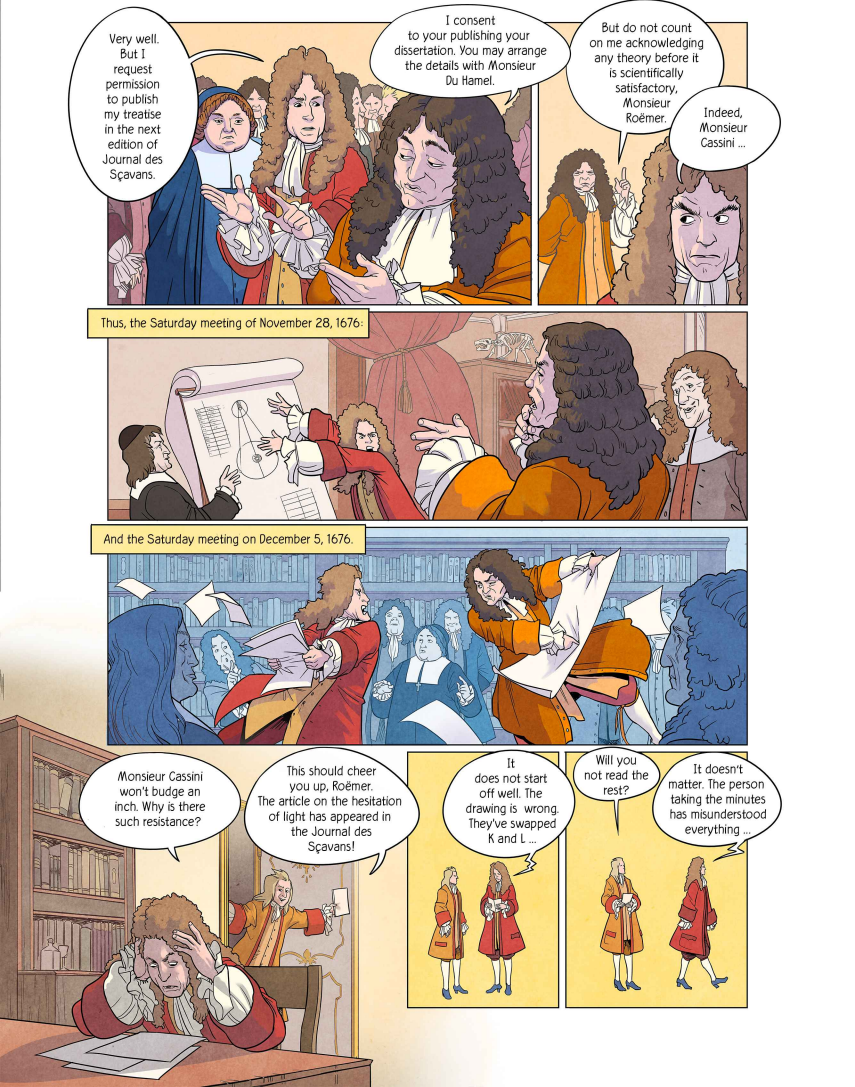

The Observatory, Monday, November 9, 1676, at 17:35:45.
She has appeared!
Ten minutes.
Yes ... Same here!
Monsieur Roëmer! Bravo!
Un moment historique!
You have seen the hesitation of light, Monsieur Roëmer!
How on earth did you figure out that 10-minute delay?
I will present that at the next meeting at the academy.
Heaven has spoken to us!
We shall see. Jupiter has more than one moon.
What do you think, Monsieur Cassini?

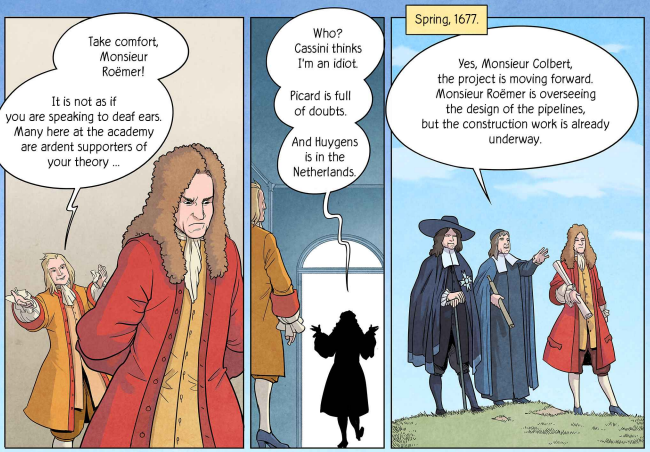

Here you see the Sun and the Earth's orbit.
A
And here you see Jupiter and Io's orbit.
B
This illustrates Jupiter's shadow.
B
At C immersion occurs, and at D, emersion.
D C
B
With Earth in position E, we have Jupiter in conjunction, and it cannot be observed. With Earth in positions F and G, and along a large part of this semicircle, we can only see the immersions ...
... since we are interested in the fact that it is Jupiter's shadow– and not Jupiter itself– that causes Io to disappear from view.
D C
B
G
A
F
E
Similarly, with the Earth in positions K and L–and along a large part of this semicircle–we will only see the emersions;that is, we will see Io emerge from Jupiter's shadow.
D C
B
H
K
G
L
A
F
E
By taking a closer look at our observations of Io's emersions and immersions, we can see a regular pattern that is the key to the whole thing.
The irregularities in Io– its disappearance and reappearance– vary, in fact, depending on the Earth's distance from Jupiter, and thus from Io.
Cassini's explanation is that Io's orbit is irregular, but if that were the case, the deviations should not follow Earth's position in its orbit around the Sun.
But they do precisely that. That is my most important argument: The deviations are geometrically organized, not random.

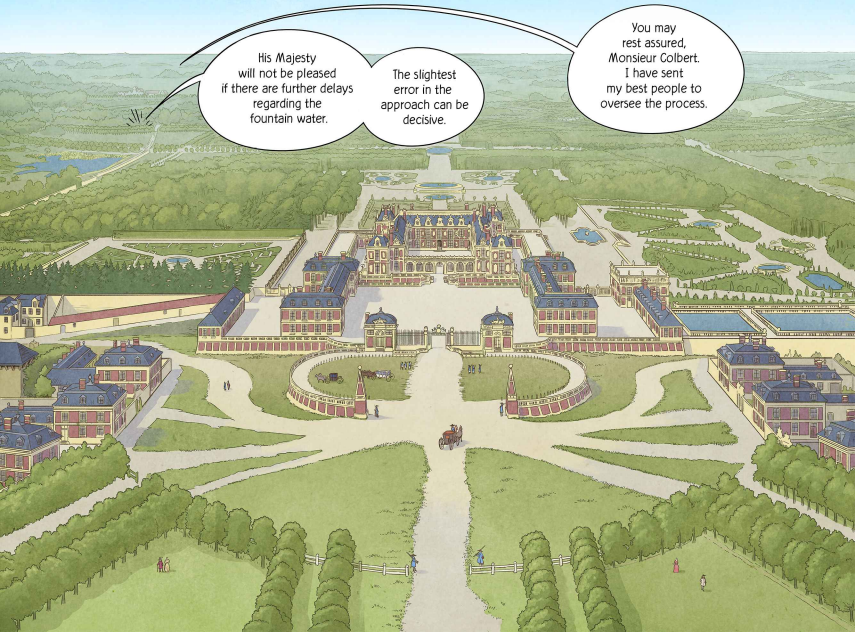

C
D
B
The movement of light
When we see Io disappear— at Io's immersion, that is, at C— we observe increasingly shorter delays as the Earth moves between F and G.
In relation to Monsieur Cassini's tables, of course.
G
H
F
The movement of light
K
A
L
At the same time, we observe the appearance of Io at emersion D occurring later and later, as the Earth moves from K towards L.
We must therefore conclude that light takes longer TIME to travel between C and F than from C to G. And likewise from D to L than from D to K.


If we have hitherto believed that light is constant, it is because it moves incredibly fast.
But now we can speak of a non-infinite, but finite speed.
Assuming that light takes time— that is, that light travels at a finite speed— I have determined, through careful calculations, that it takes between 10 and 11 minutes for light to travel from the Sun to the Earth.
I will now present my calculations ...


Truly remarkable!
Yes, but look at Cassini. Monsieur Leibniz was right; he is not pleased.
I protest!
If you are right, these effects should also be seen in the immersions and emersions of the other Jovian moons.
You are correct. The effect can also be observed in the immersions and emersionsof another of Jupiter's moons, Europa; however, since its orbital period is twice as long as Io's, these events occur less frequently and are difficult to time precisely.
The third moon of Jupiter, Ganymede, has an orbital period four times that of Io, and the observations become even more difficult.It is my firm conviction that my theory regarding the delay of light is correct.
I maintain my opposition to your theory.
The explanation for the regularities in the immersions and emersions of Io and the other satellites could also be that they do not move at a steady pace in their orbits around Jupiter– in a way that we do not currently understand.
My God. Here it comes.
But all calculations are correct, if one takes into account the hesitation of light, Monsieur Cassini!
That is irrelevant! You must first demonstrate that your theory applies to all the moons!
Gentlemen. It is late, and we must adjourn the meeting.
The discussion can continue at the next meeting.

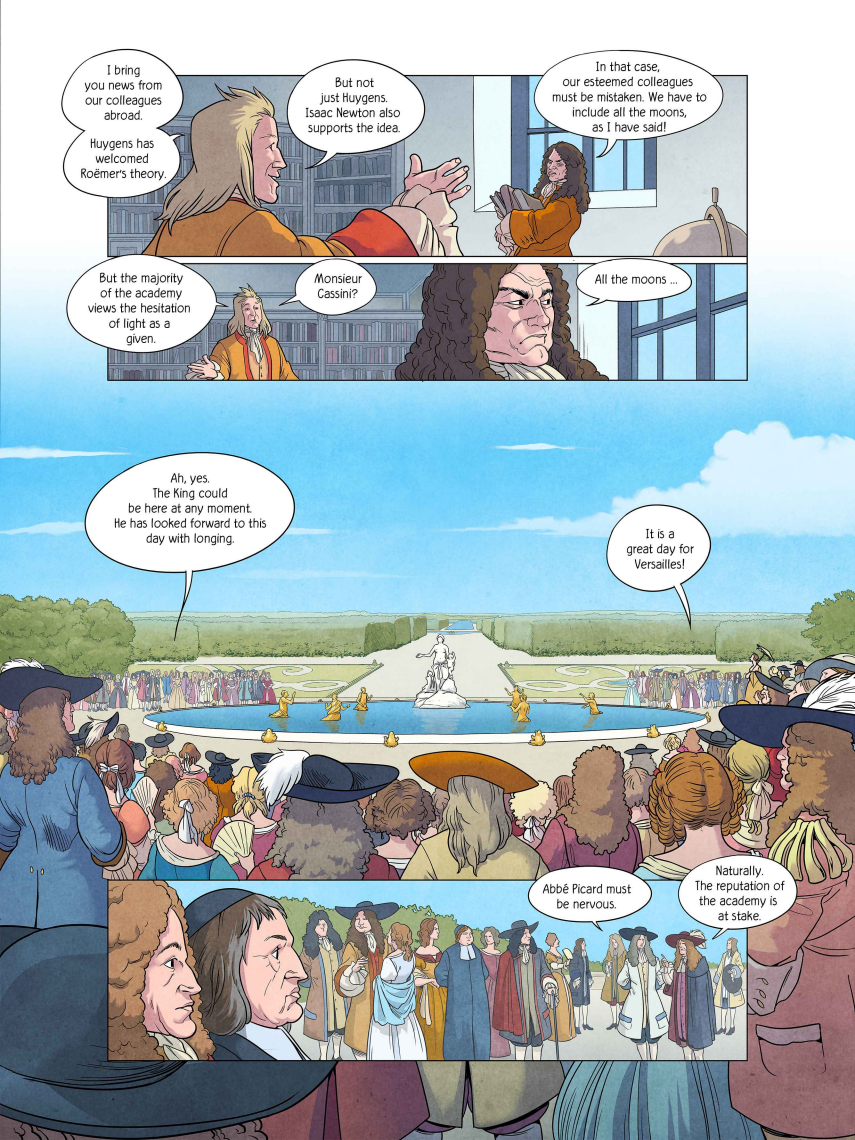

Very well. But I request permission to publish my treatise in the next edition of Journal des Sçavans.
I consent to your publishing your dissertation. You may arrange the details with Monsieur Du Hamel.
But do not count on me acknowledging any theory before it is scientifically satisfactory, Monsieur Roëmer.
Indeed, Monsieur Cassini ...
Thus, the Saturday meeting of November 28, 1676:
And the Saturday meeting on December 5, 1676.
Monsieur Cassini won't budge an inch. Why is there such resistance?
This should cheer you up, Roëmer. The article on the hesitation of light has appeared in the Journal des Sçavans!
It does not start off well. The drawing is wrong. They've swapped K and L ...
Will you not read the rest?
It doesn't matter. The person taking the minutes has misunderstood everything ...


Take comfort, Monsieur Roëmer!
It is not as if you are speaking to deaf ears. Many here at the academy are ardent supporters of your theory ...
Who? Cassini thinks I'm an idiot.
Picard is full of doubts.
And Huygens is in the Netherlands.
Spring, 1677.
Yes, Monsieur Colbert, the project is moving forward. Monsieur Roëmer is overseeing the design of the pipelines, but the construction work is already underway.


His Majesty will not be pleased if there are further delays regarding the fountain water.
The slightest error in the approach can be decisive.
You may rest assured, Monsieur Colbert. I have sent my best people to oversee the process.


And the water comes from two artificial ponds, if I understand correctly?
Yes, one at Trappes and one at Bois-d'Arcy. They are both about 19 toises above the water surface of the Grotto of Thetis.
BOIS D'ARCY
VERSAILLES
TRAPPES
And the pressure?
Alas, an eternal concern, Monsieur Colbert. But we have used wide pipes, so the pressure at the palace is as high as possible.
And Monsieur Roëmer has a solution regarding the distribution of pressure across several fountains, is this not true, Monsieur Roëmer?
Monsieur Roëmer?
Uh, yes, Abbé Picard, Please give me a moment!
Listen here, my dear Roëmer, you don't seem to be quite well. Perhaps you should take a few days at home?
Very conscientious, this Roëmer. But sometimes I worry that he will work himself half to death.
Well, in our line of work, it's a risk we all take.
Cassini will likely not be convinced by anything other than a full account of all my calculations and observations ...
... but right now these are just one hodgepodge.
BANK! BANK!
What a year. Leveling with Picard and stargazing with Cassini – who, by the way, still doesn't believe in my theory ...
Picard allowed himself to be convinced, but his acceptance alone moves no mountains ...


A letter for Monsieur Roëmer!
Only quite recently, through The Philosophical Journal from London, have I learned of your outstanding discovery, which represents a significant step toward making the infinite speed of light a measurable quantity.
I am very eager to hear whether the esteemed gentlemen Cassini and Picard readily agree with you, and how the former will adapt his theory regarding Jupiter's moons to this new discovery. ...
To the highly esteemed Christiaan Huygens ...
DRIP DRIP
I cannot hide that I feel a very deep joy, and that I kiss your letter as the greatest fruit of the discovery that I could possibly hope for. I ask you to take on the role of my defender in this matter; if you deem it worthy, it shall with the greatest pleasure be dedicated and consecrated to you. If I prove myself deserving of it, I shall be proud to have won the support of all right-thinking people.
Christiaan Huygens sends his kindest regards to the famous Ole Rømer.
In my last letter to the distinguished Colbert, I wrote what I think of your discovery, and that I was all the more pleased because I know that by accepting what you have demonstrated – namely, that the propagation of light takes time – one could best explain all its phenomena, including the remarkable refraction in Icelandic crystal.
Ehm, Monsieur Cassini?
TOK TOK


I bring you news from our colleagues abroad.
Huygens has welcomed Roëmer's theory.
But not just Huygens. Isaac Newton also supports the idea.
In that case, our esteemed colleagues must be mistaken. We have to include all the moons, as I have said!
But the majority of the academy views the hesitation of light as a given.
Monsieur Cassini?
All the moons ...
Ah, yes. The King could be here at any moment. He has looked forward to this day with longing.
It is a great day for Versailles!
Abbé Picard must be nervous.
Naturally. The reputation of the academy is at stake.


Mon Dieu! The King!
Long live His Majesty!
Monsieur Colbert. S'il vous plaît.
Naturellement, votre majesté.
Attention!
Now.
C'est maintenant, s'il vous plait.
Voila ...!
Ah ... !
Ooooh ... !
Parfait!
Praise the Lord – it works!
Of course it works. We tried it this morning.
Gentlemen! The King is very pleased! We are now moving toward the next fountain.
Thank you for the warning.
And as the party travels on, we are slowly turning off the water here ...
And three, two, one ...
Voila ... !
Ah ... !
Ooooh ... !
Parfait!


Monsieur Roëmer, astronomer at your Royal Academy, Your Majesty.
Step closer, step closer.
We have been told that Monsieur Picard has an assistant in this whole affair, whom it would be absurd to overlook.
That, within our academy, the light of the sun god Apollo has been captured, is a source of great satisfaction to us.
Your Majesty is far too kind.
You have our favor, Monsieur Roëmer.
Tell him the rest, my good Colbert.
It would please His Majesty if you would accept the position of teacher to His Royal Highness, Le Grand Dauphin.
A ... A great honor for me, Your Majesty.
May I congratulate, Monsieur Roëmer. What a gesture.
Although the Dauphin is, after all, known for being difficult to teach ...
Very difficult. No patience on him.
But you must not disappoint His Majesty.
True, that I must not ...
March 1679.
Hahaha! Good doggy!
Please stop that, Your Royal Highness.
Let us review the orbits of Jupiter's moons again, hmm?
But I am tired of reading.
"Le Grand Dauphin". Louis, son of Louis XIV.