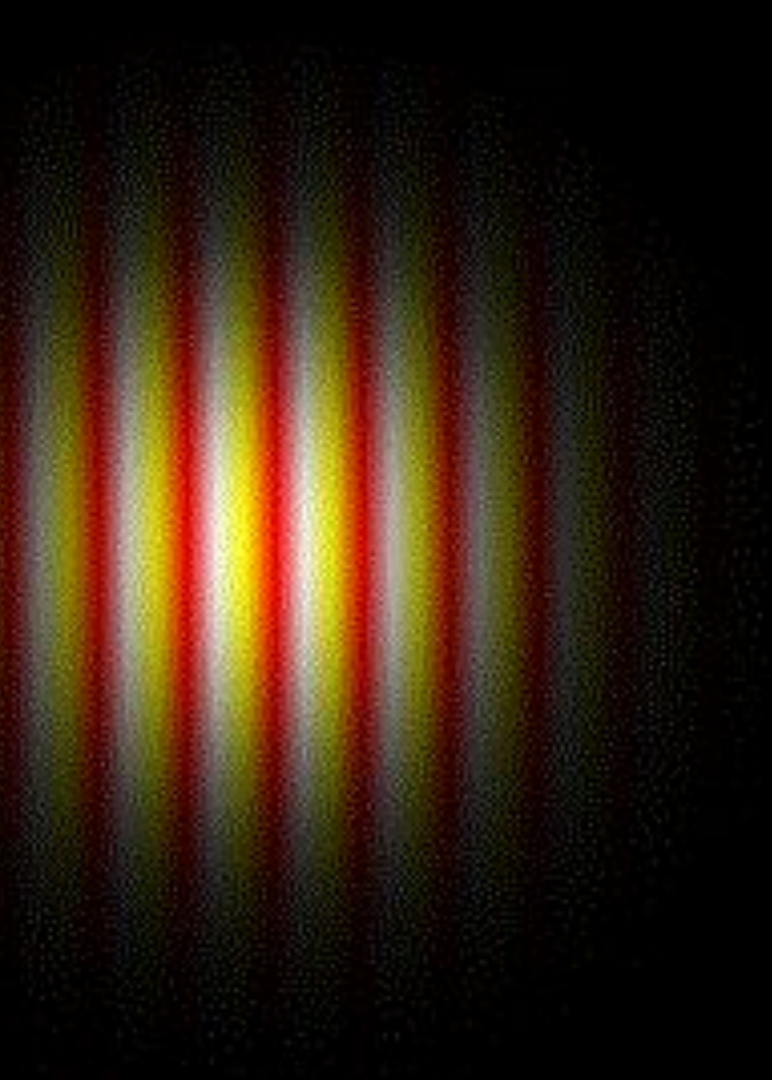


2 + 2 = 4 (?)

Itala nam tellus
GRAECIA MAIOR
erat. Ouid. 4. Fast.
CL. V. DNO D. IOACHIMO CAMERARIO, R.P. NVRENBERG. MEDICO CELEBERRIMO, VERO ET VETERI SVO AMICO, ABRAHAMVS ORTELIVS DEDICAB.
MARIS SICVLI, SIVE AVSONII PARS.
SEPTEMTRIO.
MERIDIES.
Frons Italiae
Apuli Daunij.
Silbiani.
Diomedis campus.
Vrias sinus.
REGIO QVARTA.
LVCANI.
Andragathia regio.
Hirpini.
DELMATIA.
Mamertini.
TRINACRIAE sive SICILIAE PARS.
MARIS TVRRHENI
Hanc Italiae partem exteriorem sic describere conabar Abrahamus Ortelius.

400 BCE

Myths attributed to Pythagoras:

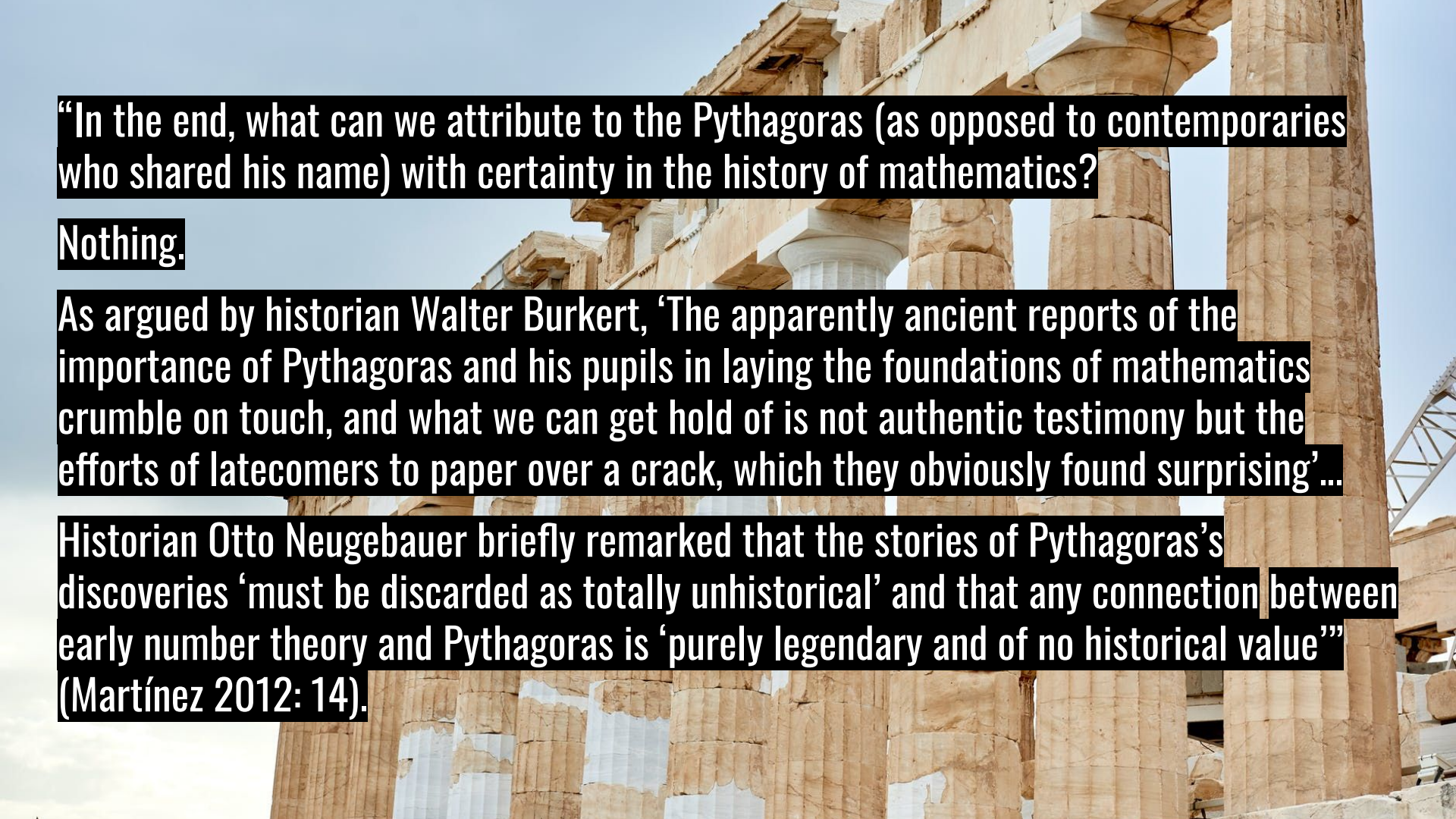
“That Pythagoras never laughed.

That he infallibly predicted earthquakes, storms, and plagues...

Also, that ‘there was such persuasion and charm in his words that every day almost the entire city turned to him, as to a god present among them, and all men ran in crowds to hear him.’

And, that when he and his associates once crossed the river Nessus, Pythagoras spoke to the river, and it loudly replied: ‘Hail, Pythagoras!’

One ancient poem says that Pythagoras was the son of the god Apollo” (Martínez 2012: 2).

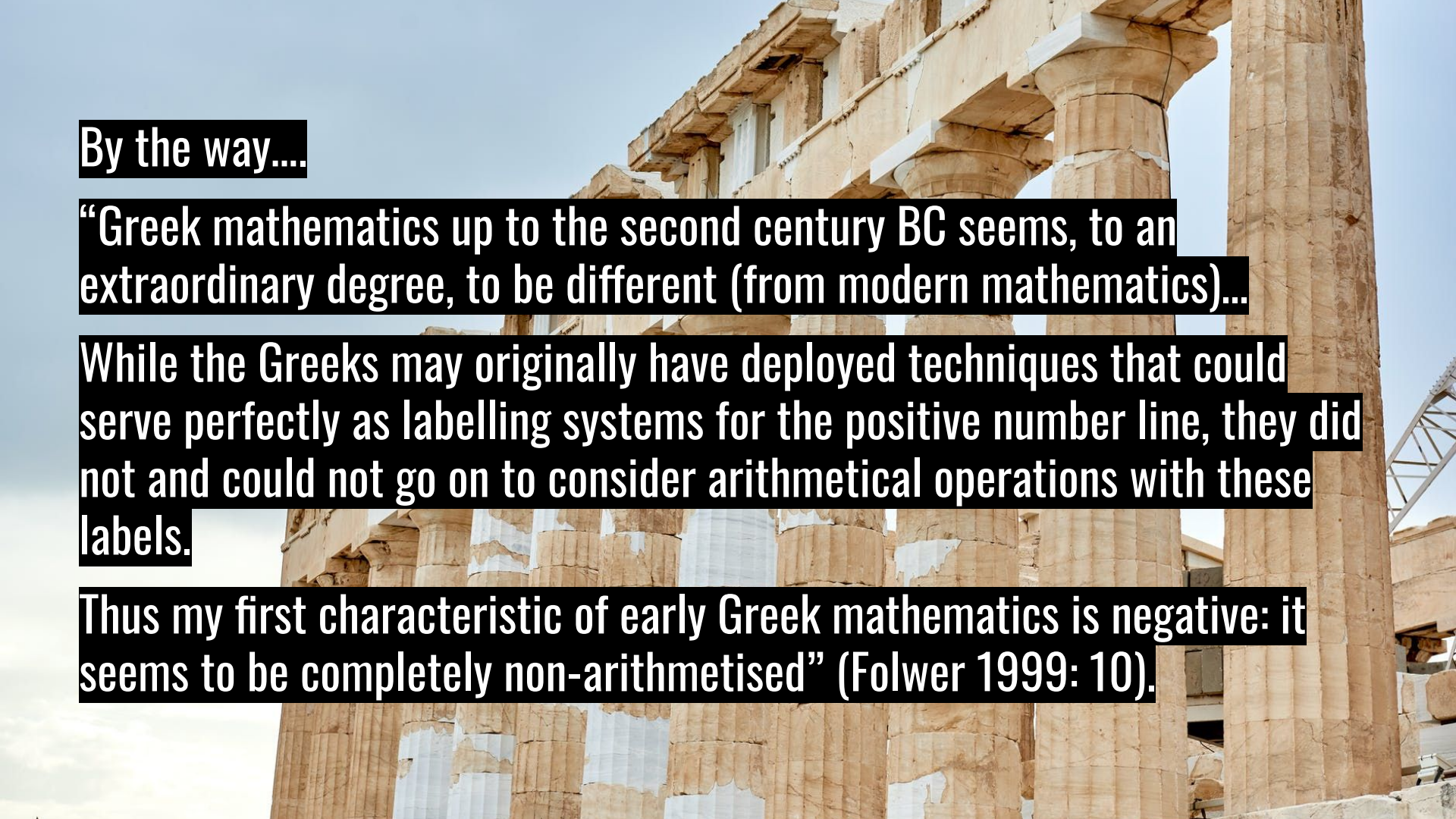


“In the end, what can we attribute to the Pythagoras (as opposed to contemporaries who shared his name) with certainty in the history of mathematics?

Nothing.

As argued by historian Walter Burkert, ‘The apparently ancient reports of the importance of Pythagoras and his pupils in laying the foundations of mathematics crumble on touch, and what we can get hold of is not authentic testimony but the efforts of latecomers to paper over a crack, which they obviously found surprising’...

Historian Otto Neugebauer briefly remarked that the stories of Pythagoras’s discoveries ‘must be discarded as totally unhistorical’ and that any connection between early number theory and Pythagoras is ‘purely legendary and of no historical value’” (Martínez 2012: 14).



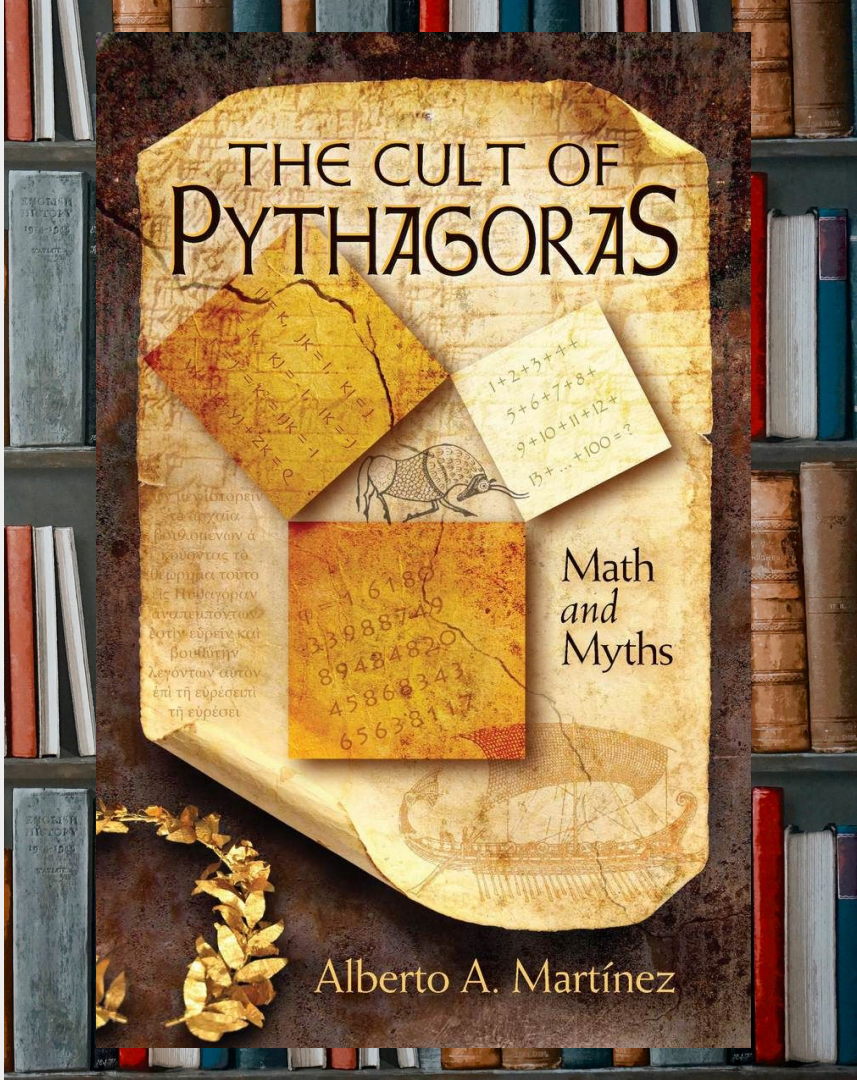
By the way....

“Greek mathematics up to the second century BC seems, to an extraordinary degree, to be different (from modern mathematics)...

While the Greeks may originally have deployed techniques that could serve perfectly as labelling systems for the positive number line, they did not and could not go on to consider arithmetical operations with these labels.

Thus my first characteristic of early Greek mathematics is negative: it seems to be completely non-arithmetised” (Folwer 1999: 10).

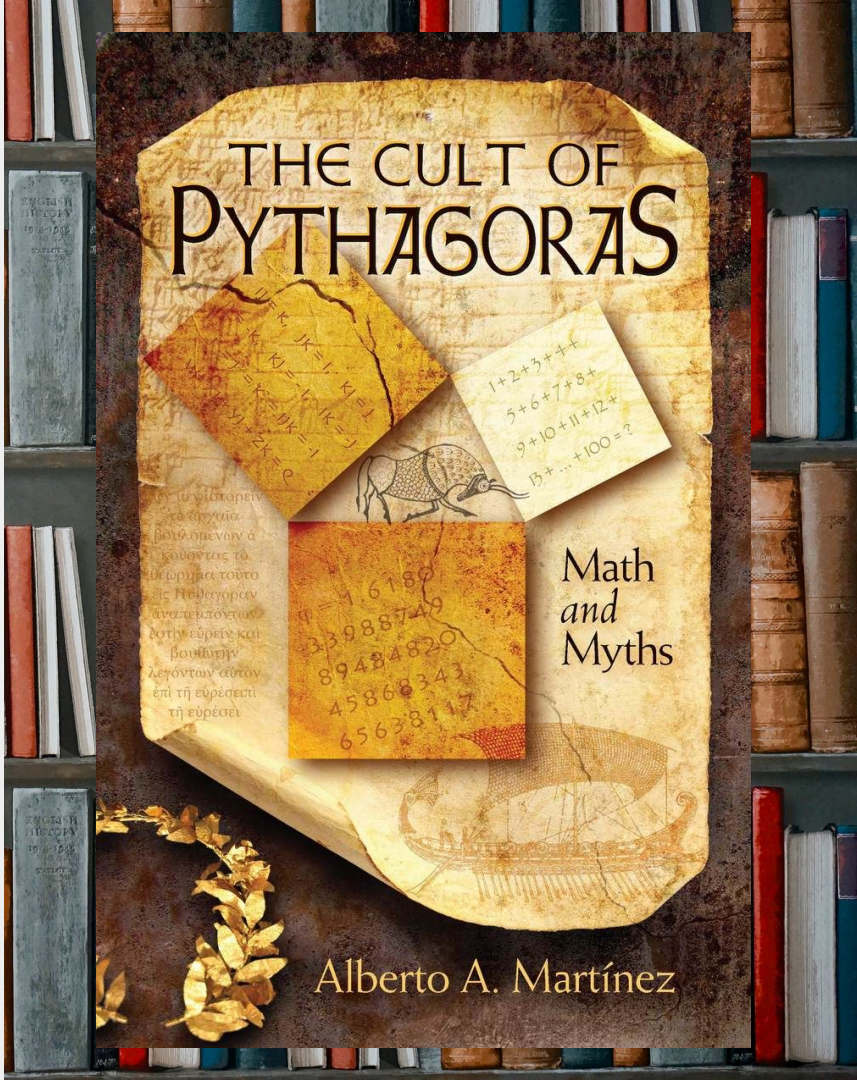
For more, see Martínez (2012).



Note:

Even though his book is only partially about Pythagoras, Martínez still named the book *The Cult of Pythagoras*.

This is because Martínez claims that mathematicians (like himself) have a quasi-divinical approach to mathematics, are guilty of embellishing their own history, and (like some religions) have a track-record of brushing their past conflicts under the rug.



In 2001, the magazine Physics World ran a poll on the philosophical view of physicists.

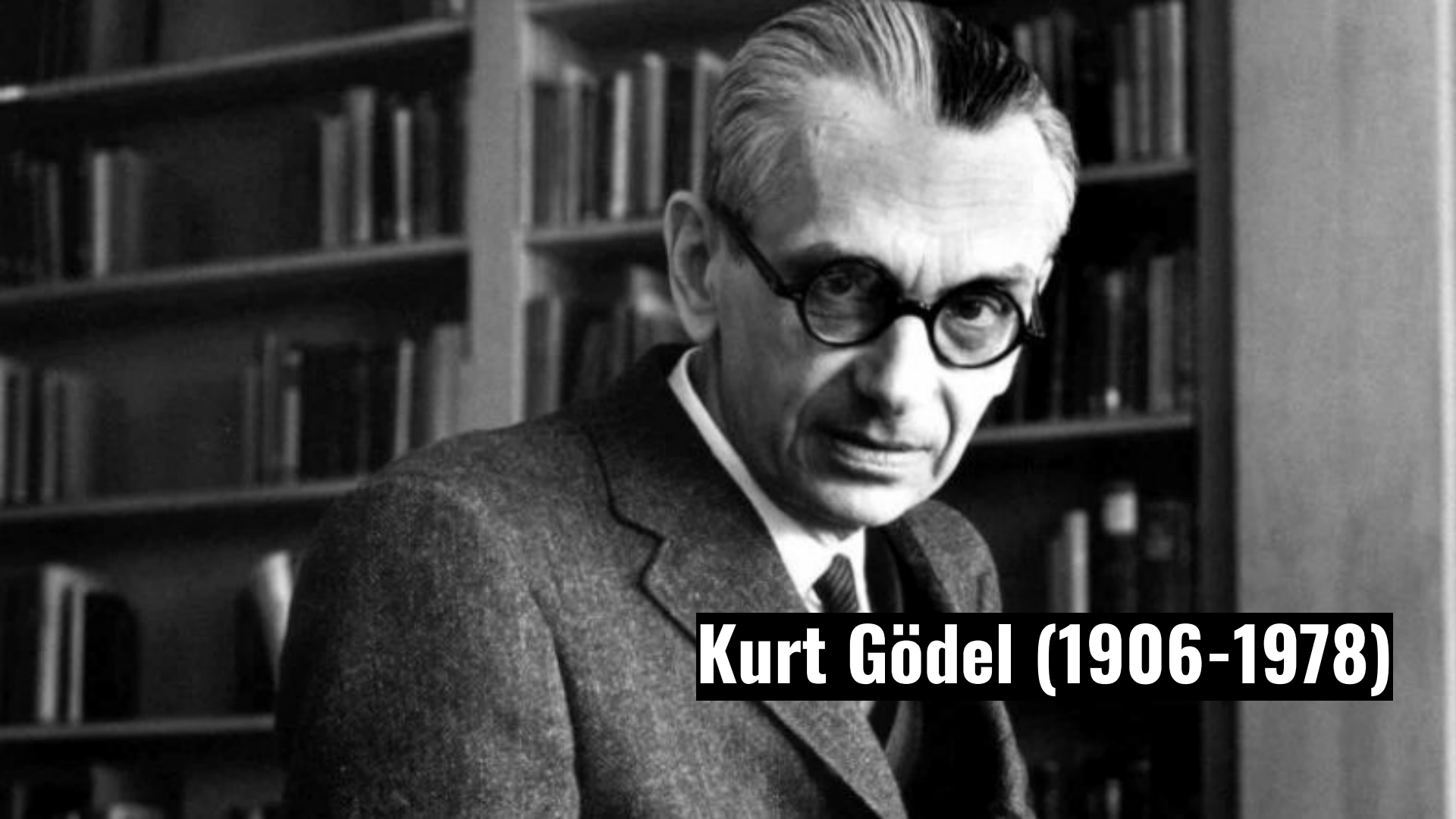
Among various questions, about the reality of electrons, genes, atoms, emotions, and lightwaves, the survey also asked about beliefs regarding numbers...

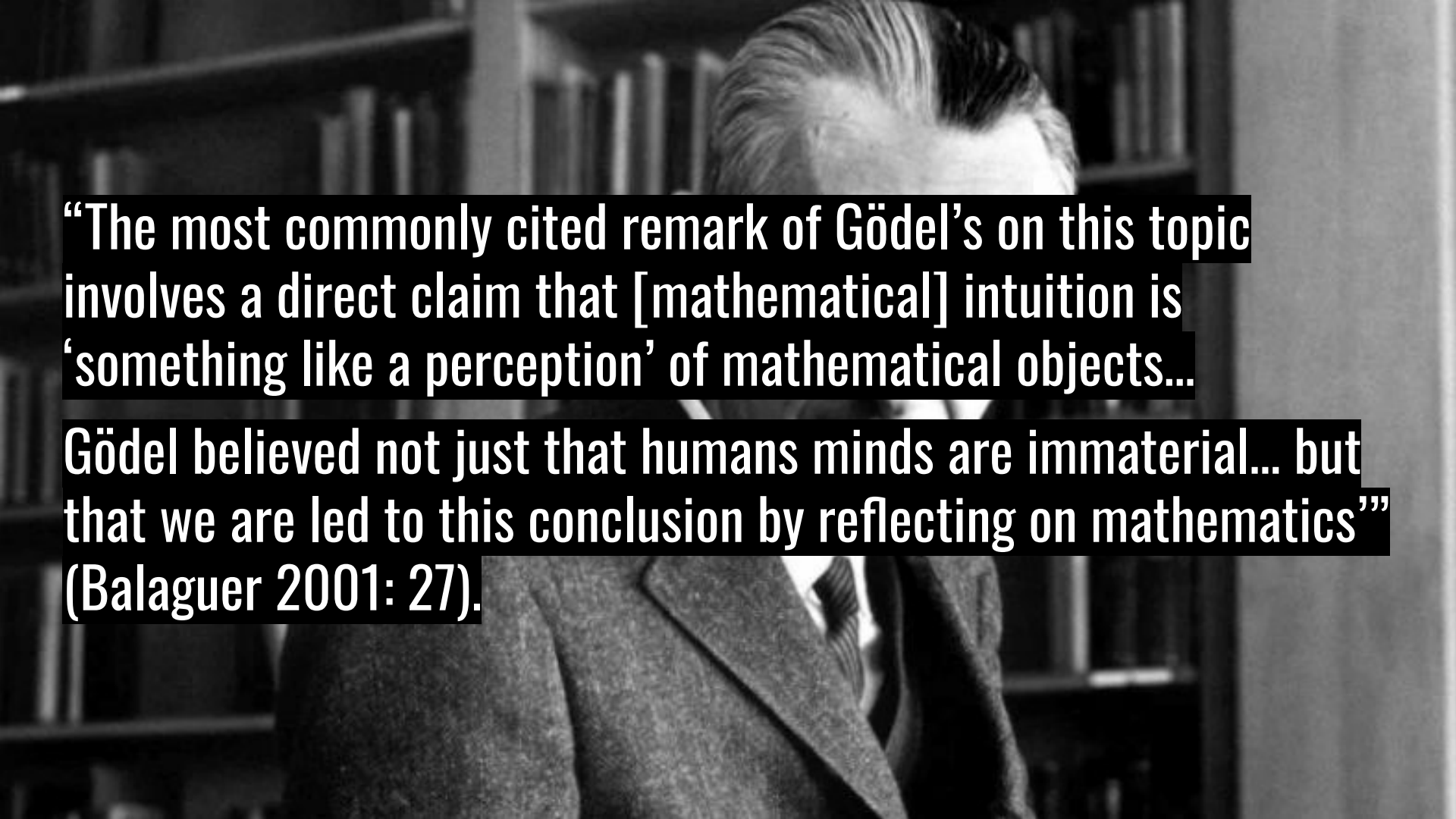
	Real	Not Real	Not Sure
The Earth	93%	3%	4%
Stones	93%	3%	4%
Genes	83%	8%	9%
Electrons	84%	9%	7%
Light Waves	68%	20%	12%
Real Numbers	66%	26%	8%
Imaginary Numbers	43%	44%	13%

Martinez also surveyed his students each semester from 2005 to 2010.

“Out of 245 majors in mathematics and the sciences over those five years, 77 percent of the students wrote that triangles existed before humans and will continue to exist forever.

Almost 22 percent disagreed, and only 3 students chose not to reply and wrote instead ‘maybe,’ ‘neither,’ or ‘no idea’” (Martinez 2012: xx).


Kurt Gödel (1906-1978)

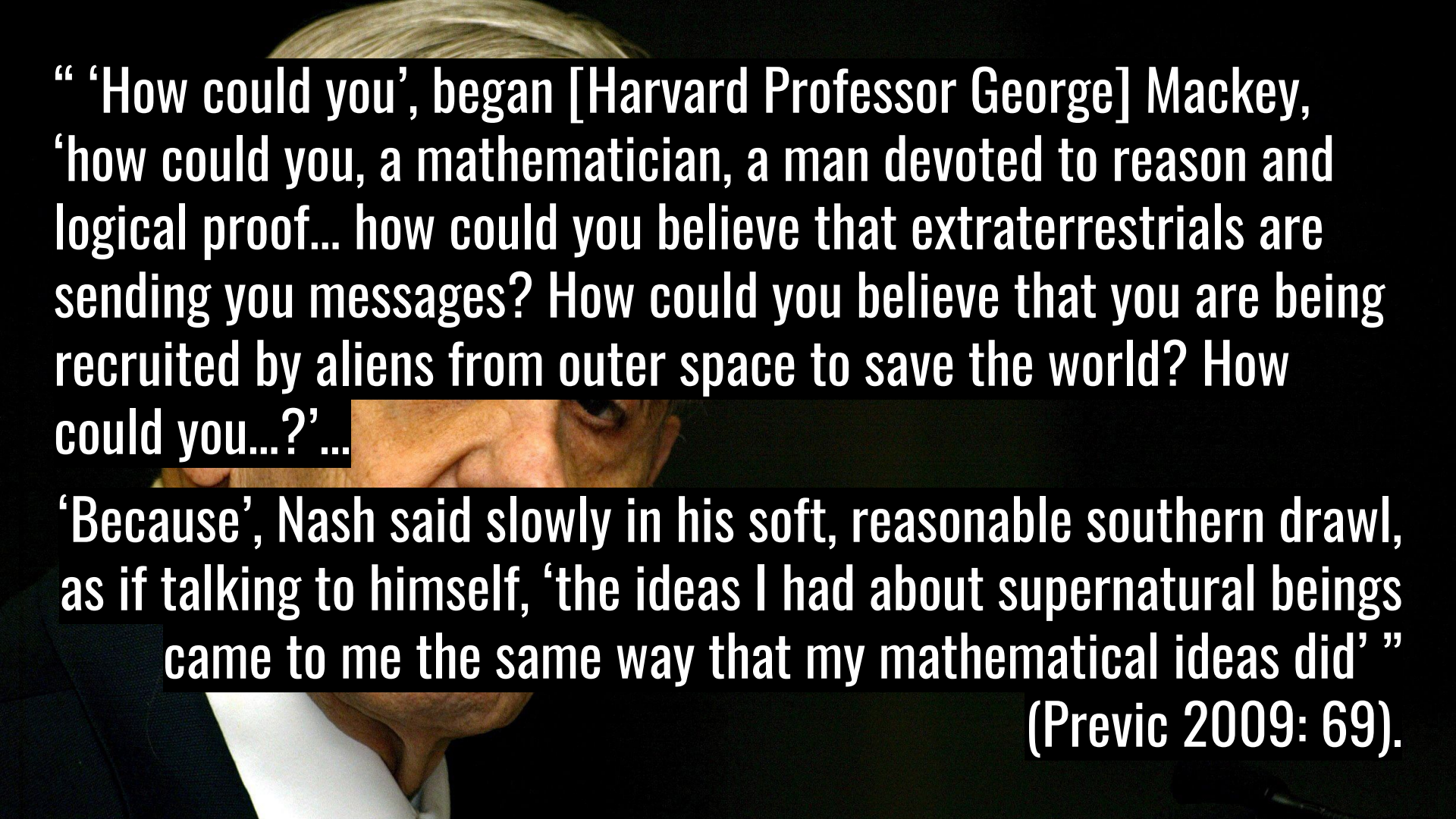


“The most commonly cited remark of Gödel’s on this topic involves a direct claim that [mathematical] intuition is ‘something like a perception’ of mathematical objects...

Gödel believed not just that humans minds are immaterial... but that we are led to this conclusion by reflecting on mathematics’” (Balaguer 2001: 27).

John Nash (1928-2015)

A BEAUTIFUL
MIND

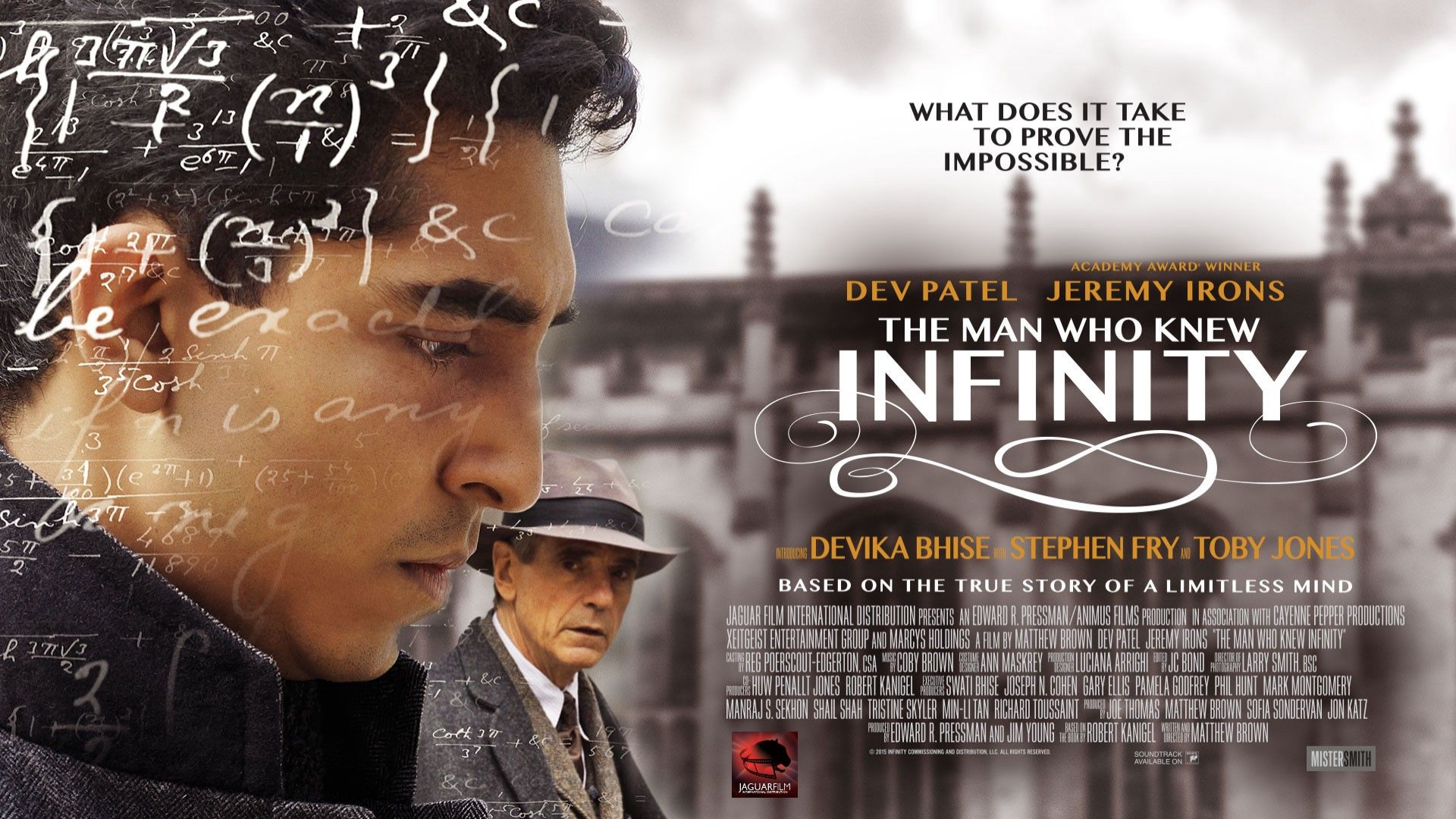


“ ‘How could you’, began [Harvard Professor George] Mackey, ‘how could you, a mathematician, a man devoted to reason and logical proof… how could you believe that extraterrestrials are sending you messages? How could you believe that you are being recruited by aliens from outer space to save the world? How could you…?’…

‘Because’, Nash said slowly in his soft, reasonable southern drawl, as if talking to himself, ‘the ideas I had about supernatural beings came to me the same way that my mathematical ideas did’ ”

(Previc 2009: 69).

Srinivasa Ramanujan (1887-1920)


WHAT DOES IT TAKE
TO PROVE THE
IMPOSSIBLE?
ACADEMY AWARD® WINNER
DEV PATEL JEREMY IRONS
THE MAN WHO KNEW
INFINITY
INTRODUCING DEVIKA BHISE WITH STEPHEN FRY AND TOBY JONES
BASED ON THE TRUE STORY OF A LIMITLESS MIND
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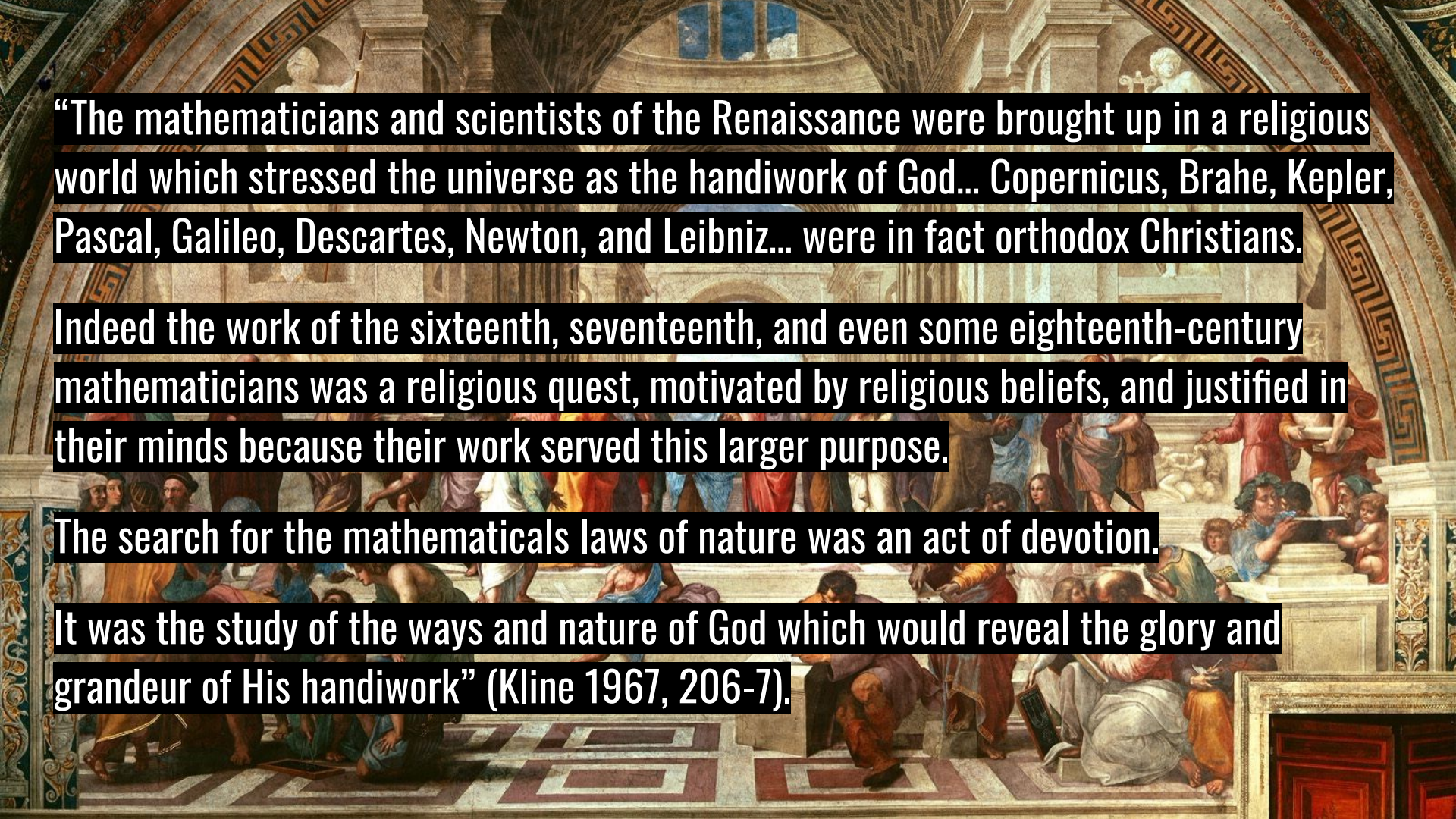


“The mathematicians and scientists of the Renaissance were brought up in a religious world which stressed the universe as the handiwork of God... Copernicus, Brahe, Kepler, Pascal, Galileo, Descartes, Newton, and Leibniz... were in fact orthodox Christians.

Indeed the work of the sixteenth, seventeenth, and even some eighteenth-century mathematicians was a religious quest, motivated by religious beliefs, and justified in their minds because their work served this larger purpose.

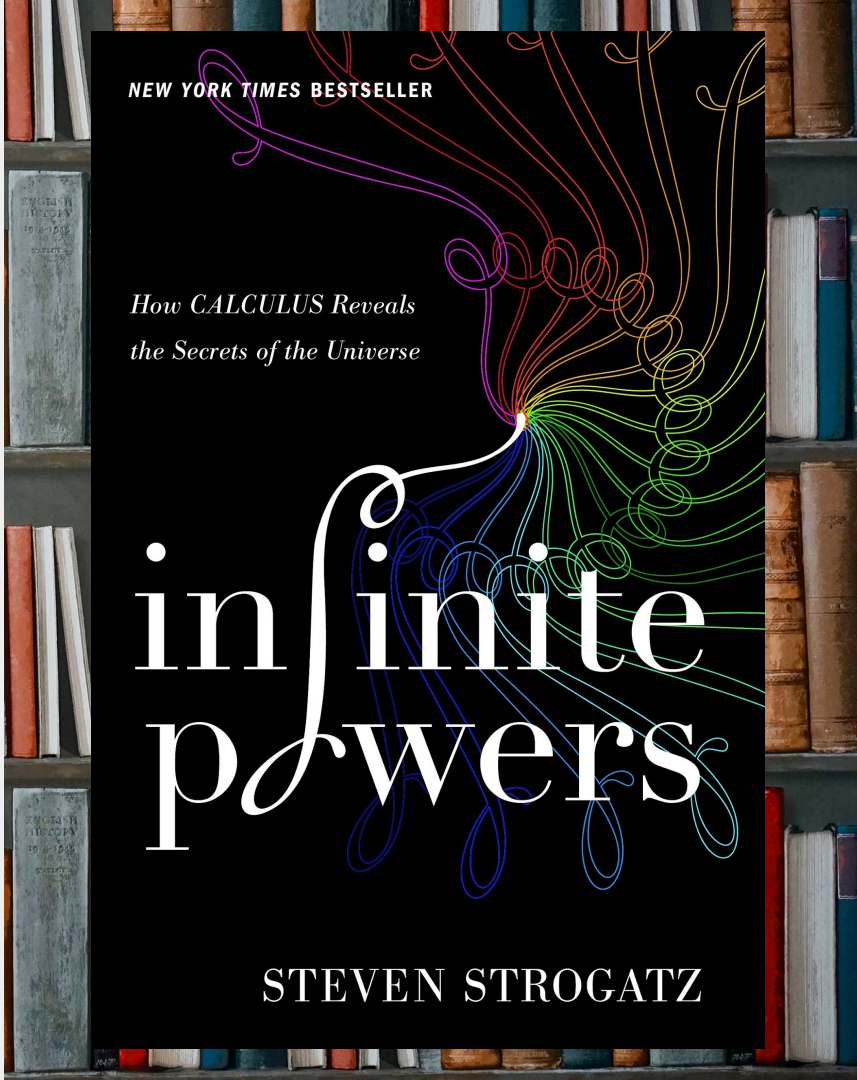
The search for the mathematicals laws of nature was an act of devotion.

It was the study of the ways and nature of God which would reveal the glory and grandeur of His handiwork” (Kline 1967, 206-7).

It's Calculus
Mo' Fucka!
PUTNAM
Party - Friday
H ≤ R
12/16 1:30pm Fefferman Math-BD
12/3 O'Roark 12pm
12/6 Rosenbaum 4pm
12/6 Dupont, 1:30pm
12/7 1pm Area 15
12/11 Ina A'M'L
CHALK
TIZA
CRAIE

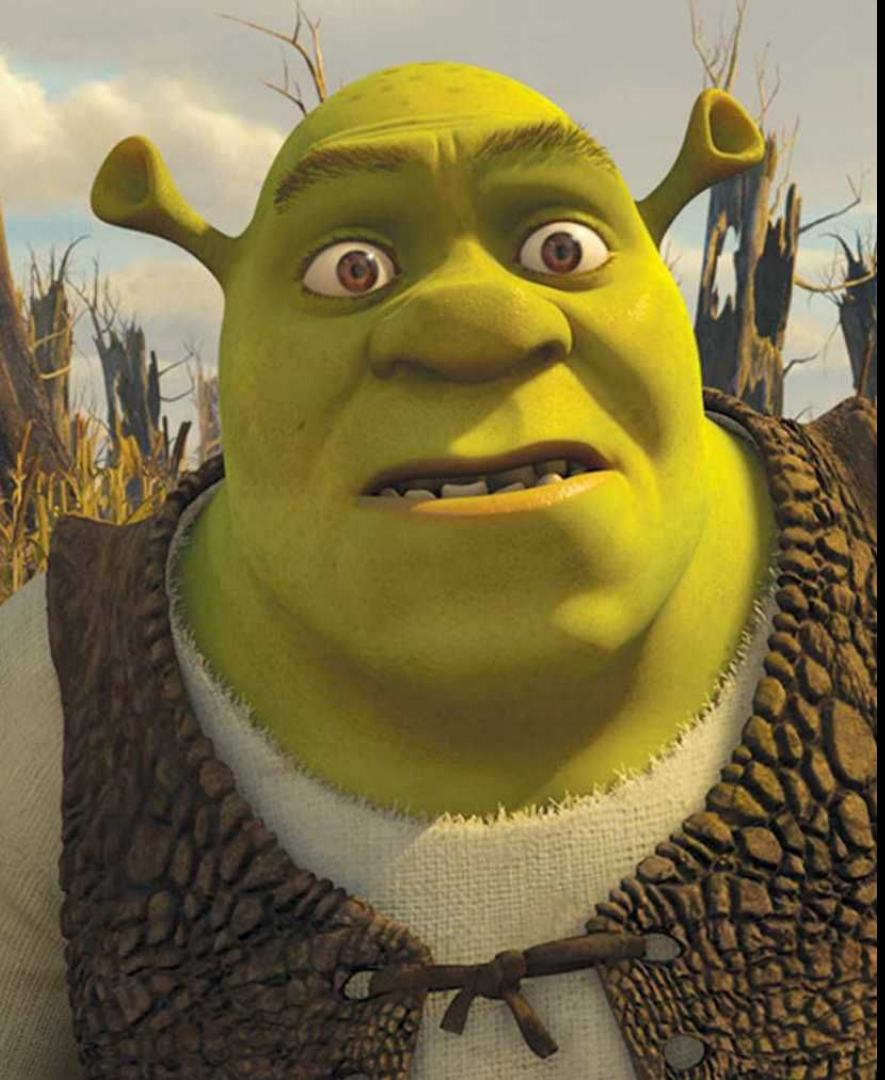
Food for thought...

In *Infinite Powers*, Strogatz (2019) reminds us of all the technology that math and in particular the calculus, enables us to enjoy.



The study of mathematics has, directly or indirectly, led to the development of:

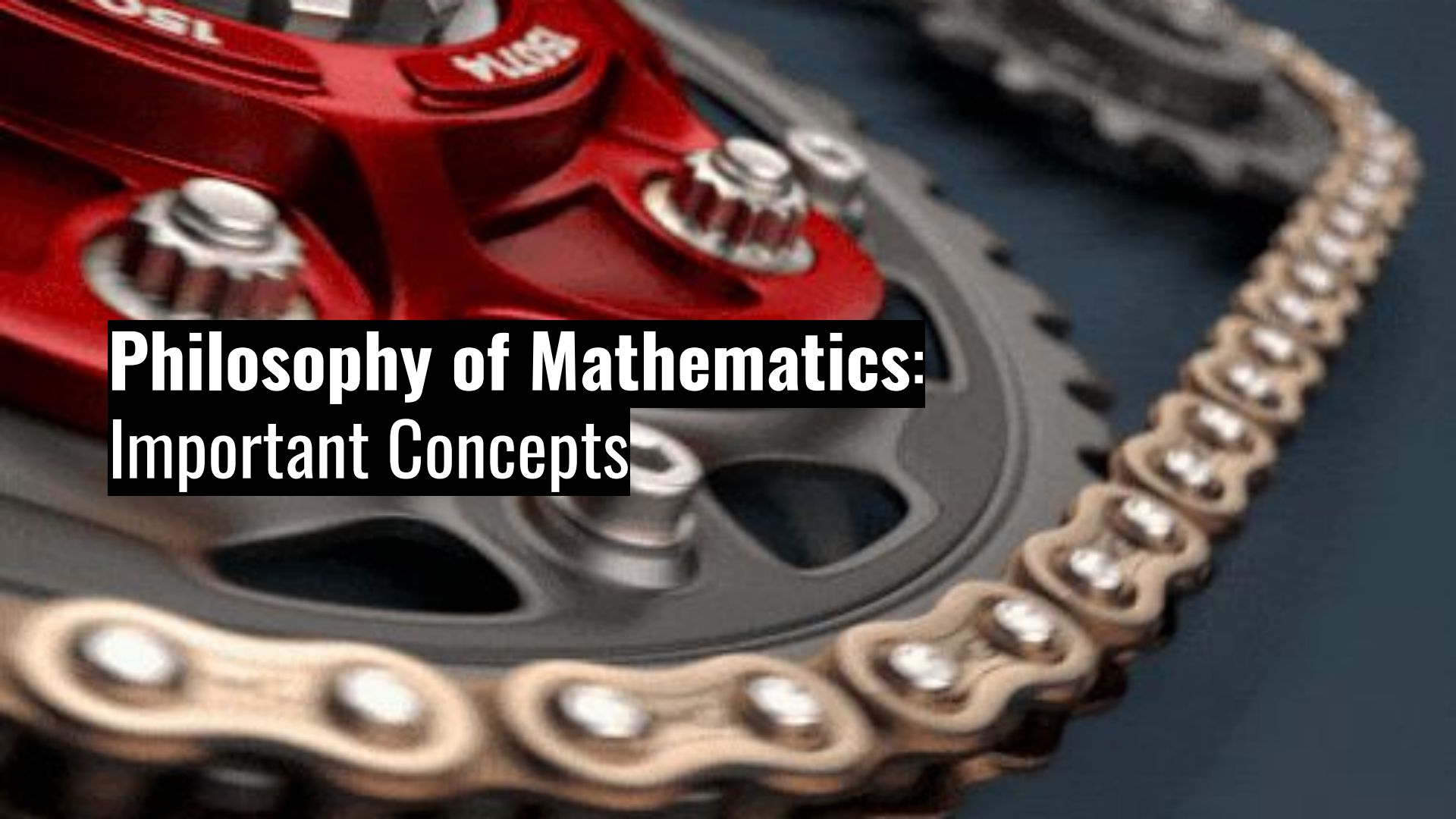
- cell phones
- GPS
- television
- ultrasound



Insights by Archimedes are used in both computer-generated imagery (CGI) and software that aids doctors in facial surgery (Strogatz 20190: 51-57).

The legacy of Pierre Fermat's work on optimization is used today in both data-compression algorithms (for audio and visual files) and FBI fingerprint databases (ibid., 107).

Calculus is used in developing treatment techniques for HIV (ibid., 224), when modeling new jet engines (ibid., 246), and (of course) a lot more.



Philosophy of Mathematics: Important Concepts

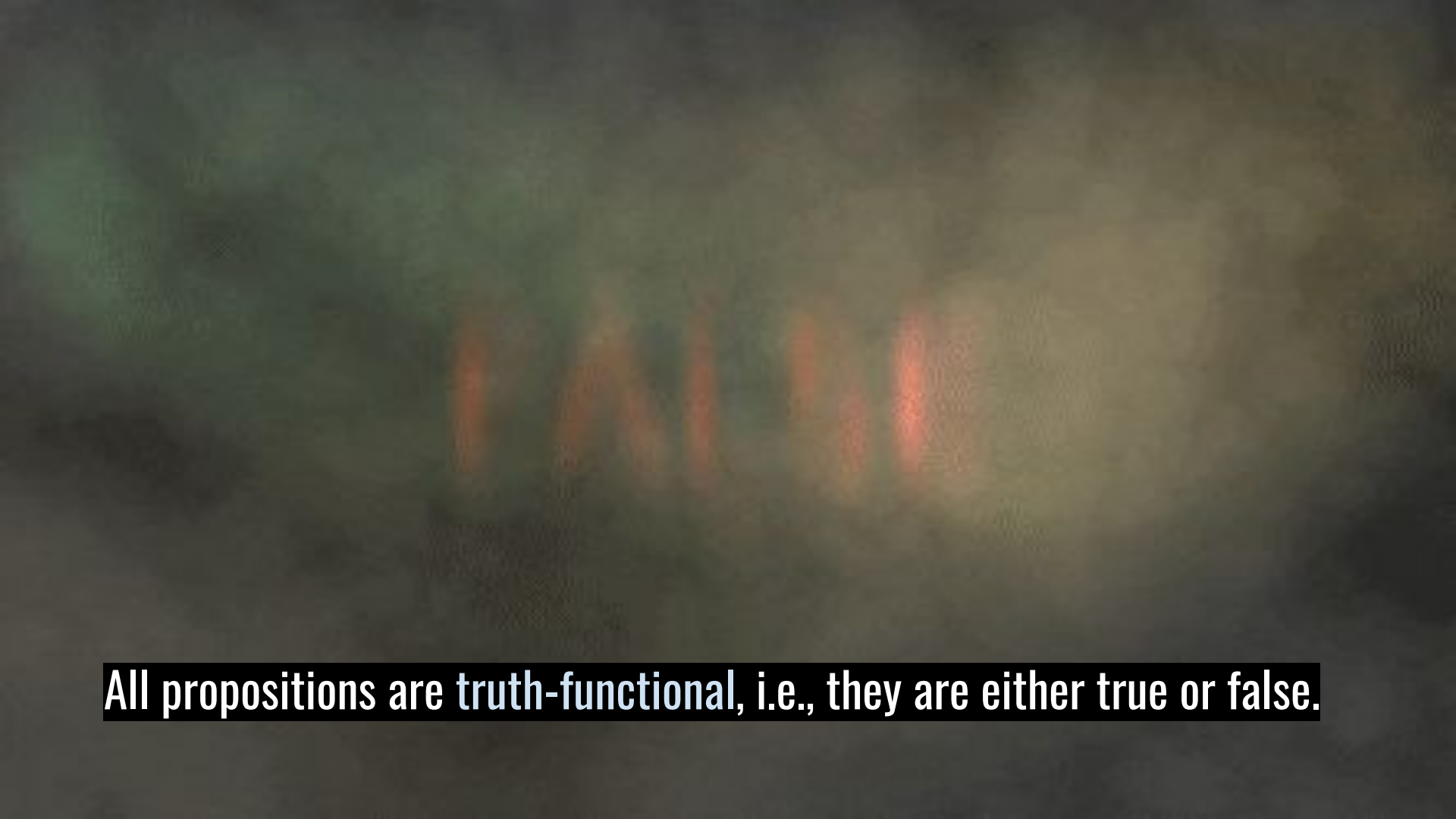
Question:
What is truth?

A view that became popular in Philosophy is to view the truth not as an object, i.e., the whole truth or one big truth, but instead as a property. Truth (in this theory) is a property of sentences, or propositions.

Background Concepts

A proposition is the thought that is expressed by a sentence which can be either true or false, i.e., a declarative sentence.

E.g., “Snow is white.”


All propositions are truth-functional, i.e., they are either true or false.

E.g. of non-propositions:

“What’s a pizookie?”

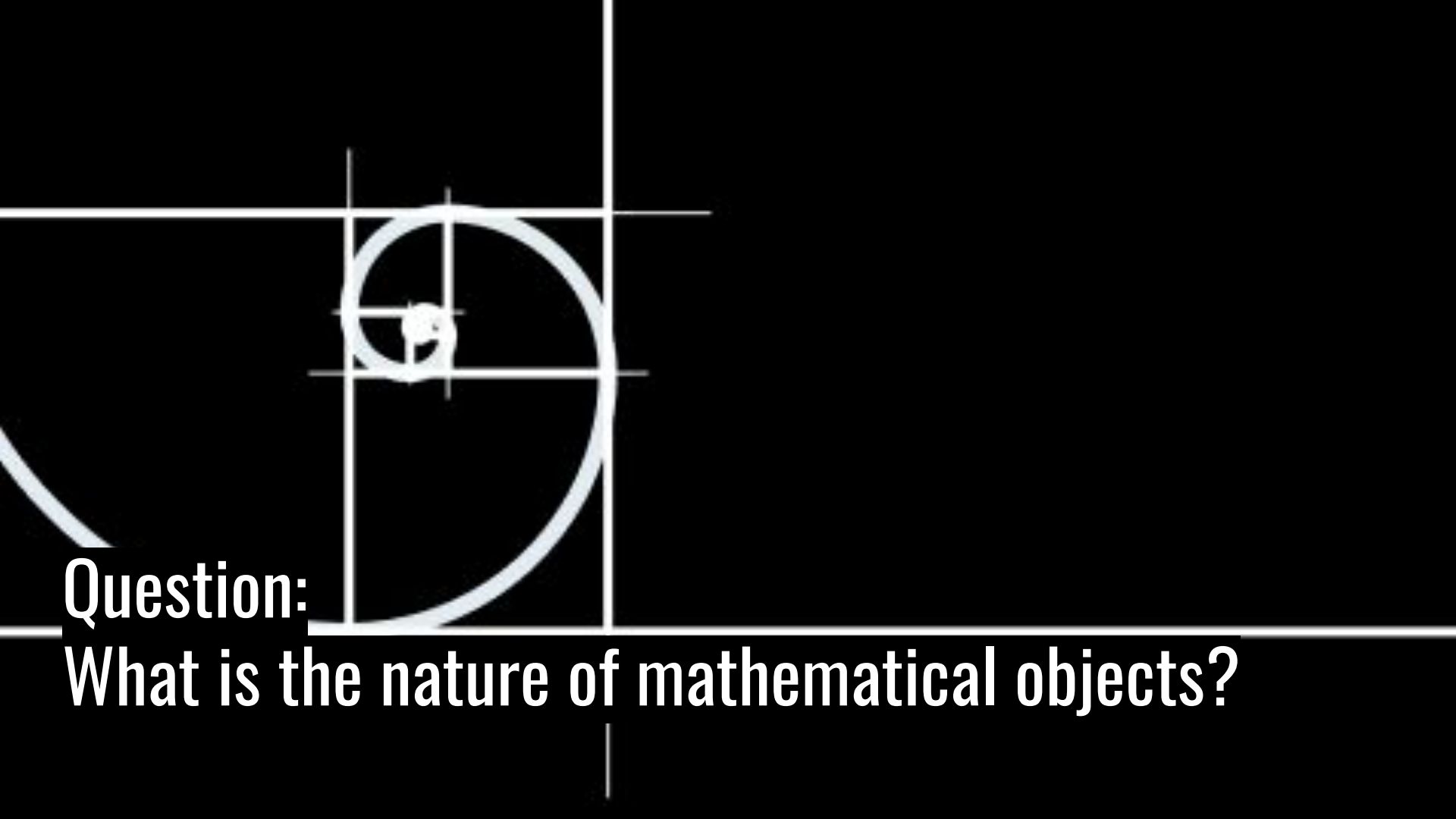
“Please stop talking.”

“AHHHH!”

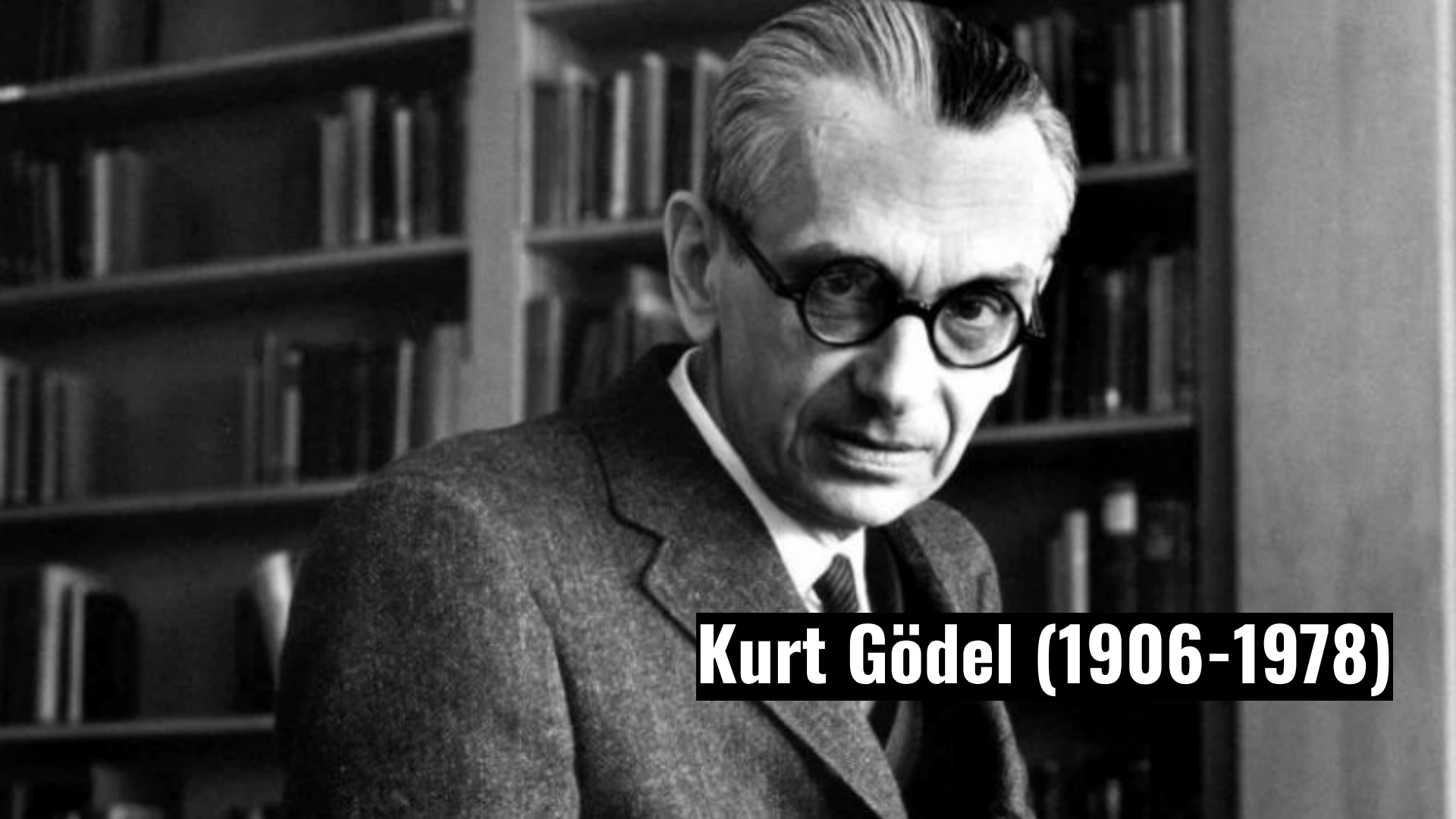
Under this way of thinking, all propositions need a truthmaker, i.e., something that makes the statement true.

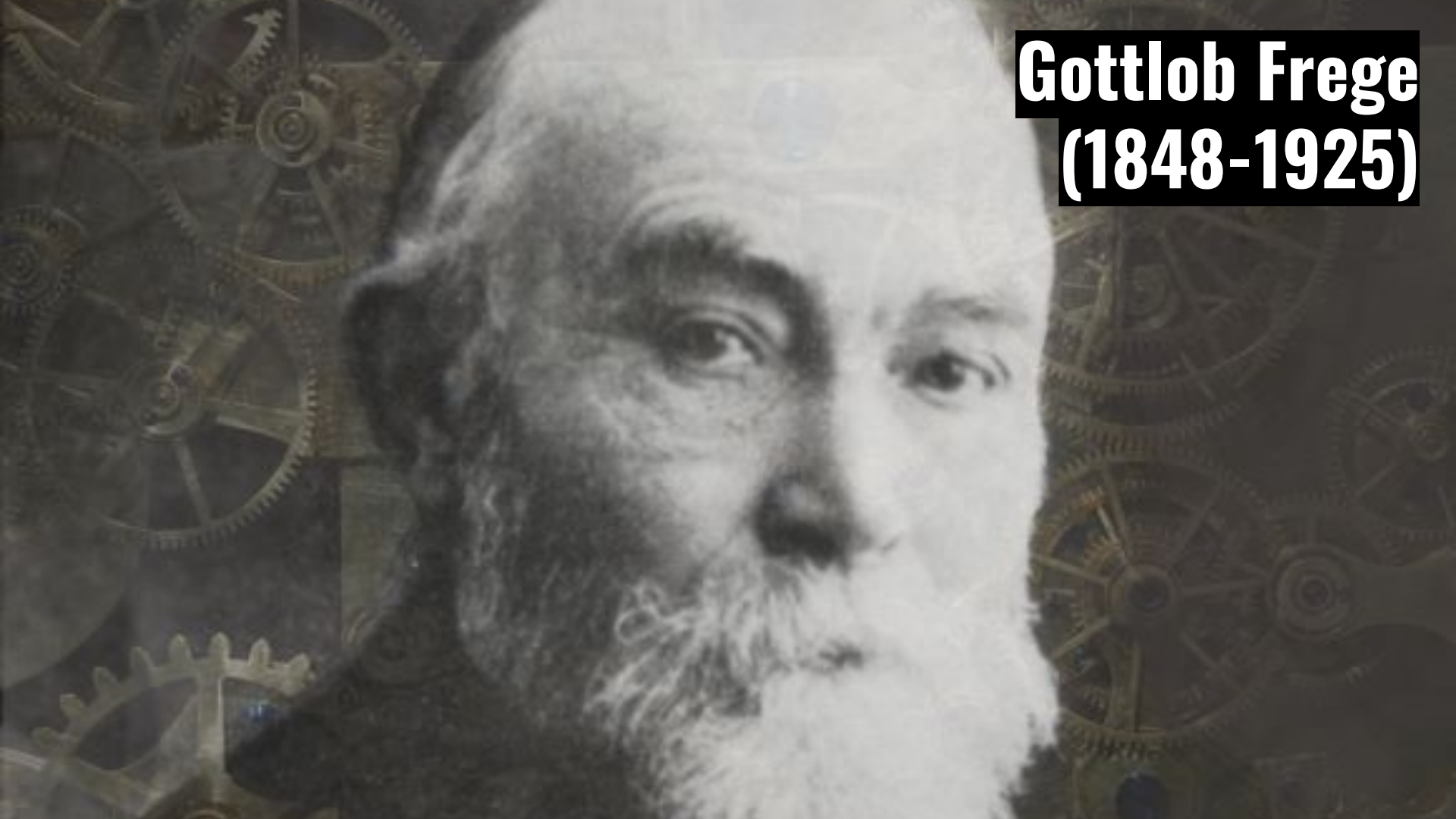
E.g., “The cat is on the mat.”

Question:
What makes “2 + 2 = 4” true?

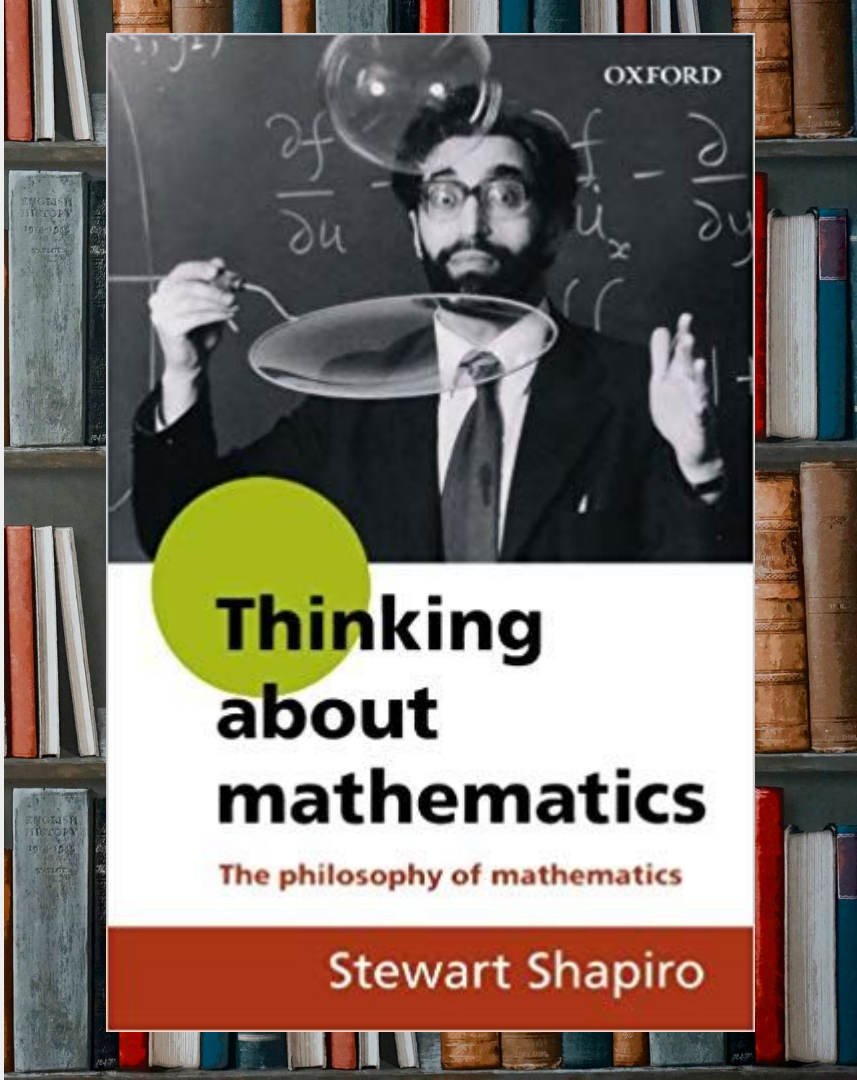


Question:
What is the nature of mathematical objects?


Kurt Gödel (1906-1978)


Gottlob Frege
(1848-1925)

A complete survey of this debate (plus a whole lot more) can be found in Shapiro (2002).



Possible Positions

Physicalism is the view that:

a. mathematical objects exist, and
b. they are ultimately physical.

I.e., mathematical objects are just piles of physical stuff.

Name: _____

Pictures Addition With Sum to 10.

Count, sum and circle the correct number.

	+		=	2 3 4
	+		=	2 3 4
	+		=	4 5 6
	+		=	7 8 9
	+		=	7 8 9
	+		=	4 5 6

Objection

Argument Against Physicalism

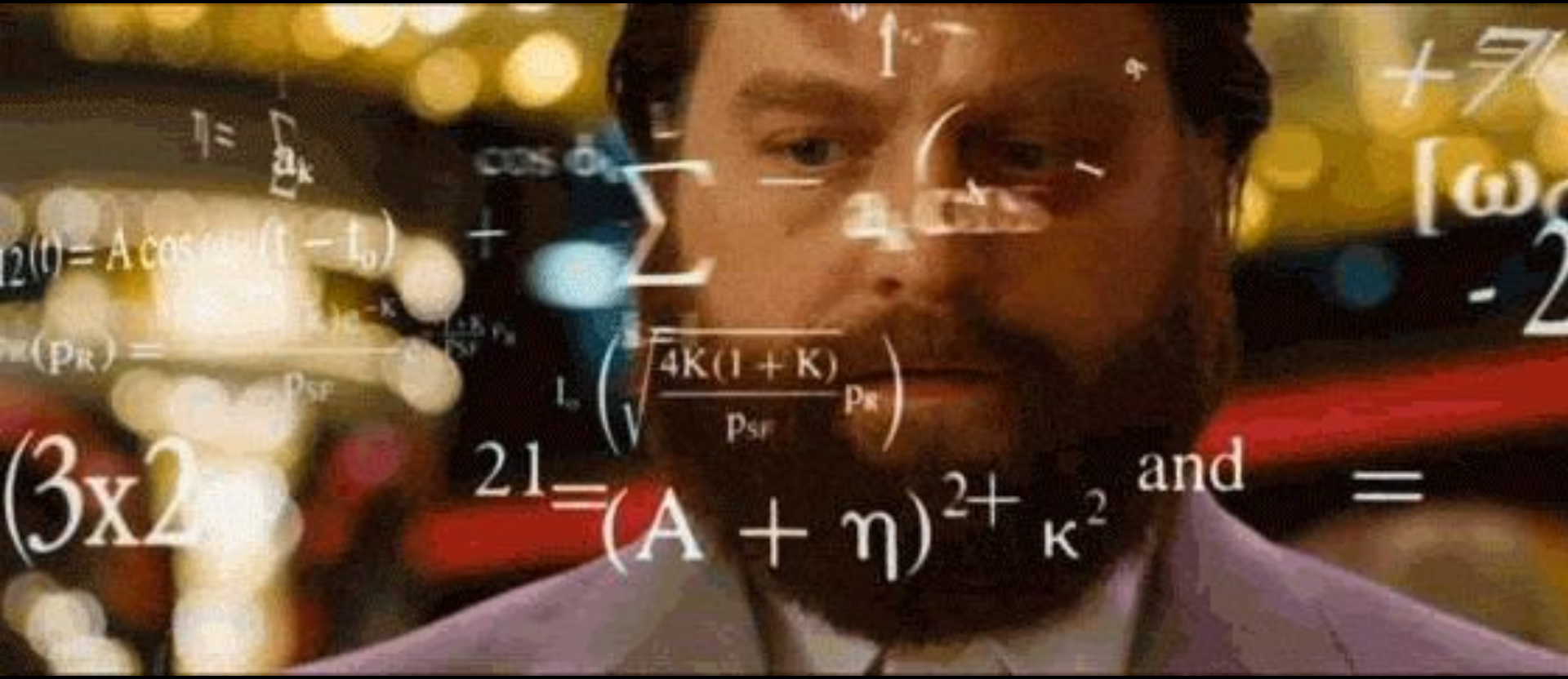
There is an infinite amount of numbers, but there is not an infinite amount of physical stuff.
That means there is not enough physical stuff to serve as a truthmaker for all mathematical objects.
Physicalism must be false.

Possible Positions

Conceptualism (a.k.a. psychologism) is the view that:

a. mathematical objects exist, and
b. they are ultimately mental objects.

I.e., mathematical objects are just ideas subjectively constructed in our minds.


$\sum$
$\sqrt{\frac{4K(1+K)}{P_{SF}}P_R}$
$(A+\eta)^2+\kappa^2$
and
=

Objection

Argument Against Conceptualism

The Subjectivity Problem

1. Conceptualism would make mathematical errors impossible.

4

Tanner, can you please state a prime number for me?

Maybe your 4 isn't prime, but mine is...

That's not a prime...

Argument Against Conceptualism

The Subjectivity Problem

1. Conceptualism would make mathematical errors impossible.
2. But mathematical errors are possible.
3. So, conceptualism is false.

___

Kent Richards

Skill: Multiplying 2-digit by 2-digit num...
Regrouping

Score ___ / 15

Solve by multiplying

67
x 32
134
2010
2,144

A. 31
x 23
93
+620
713

B. 90
x 58
720
+4547
5267

C. 53
x 20
50
+10 59

D. 71
x 46

E. 52
x 44
208
+208

F. 82
x 64
328
+492
5348

G. 68
x 70
60
+406
5120

K. 25
x 18

59

Name: EMMA
Date:

F

MATHS PAPER 1

Part I: (1 hour 45 Minutes)

1. find x

$$\frac{(3x^2-27)(8x^2)\,6}{4(9-3x)\,(x^2+3x)} = \frac{\tan(x+4)}{\log(x+1/4)}$$

(10 mks)

ghetto redhot

T.C. Hale

Math Test

1. Bob has 36 candy bars. He eats 29. What does he have now?

Diabetes.

Bob has diabetes.

2. Two trains left Kalamazoo, one heading
the other heading south. The
the second

Possible Positions

Nominalism (+ fictionalism) (a.k.a. anti-realism) is the view that:

a. mathematical objects don't exist;
b. mathematical propositions are strictly-speaking false.

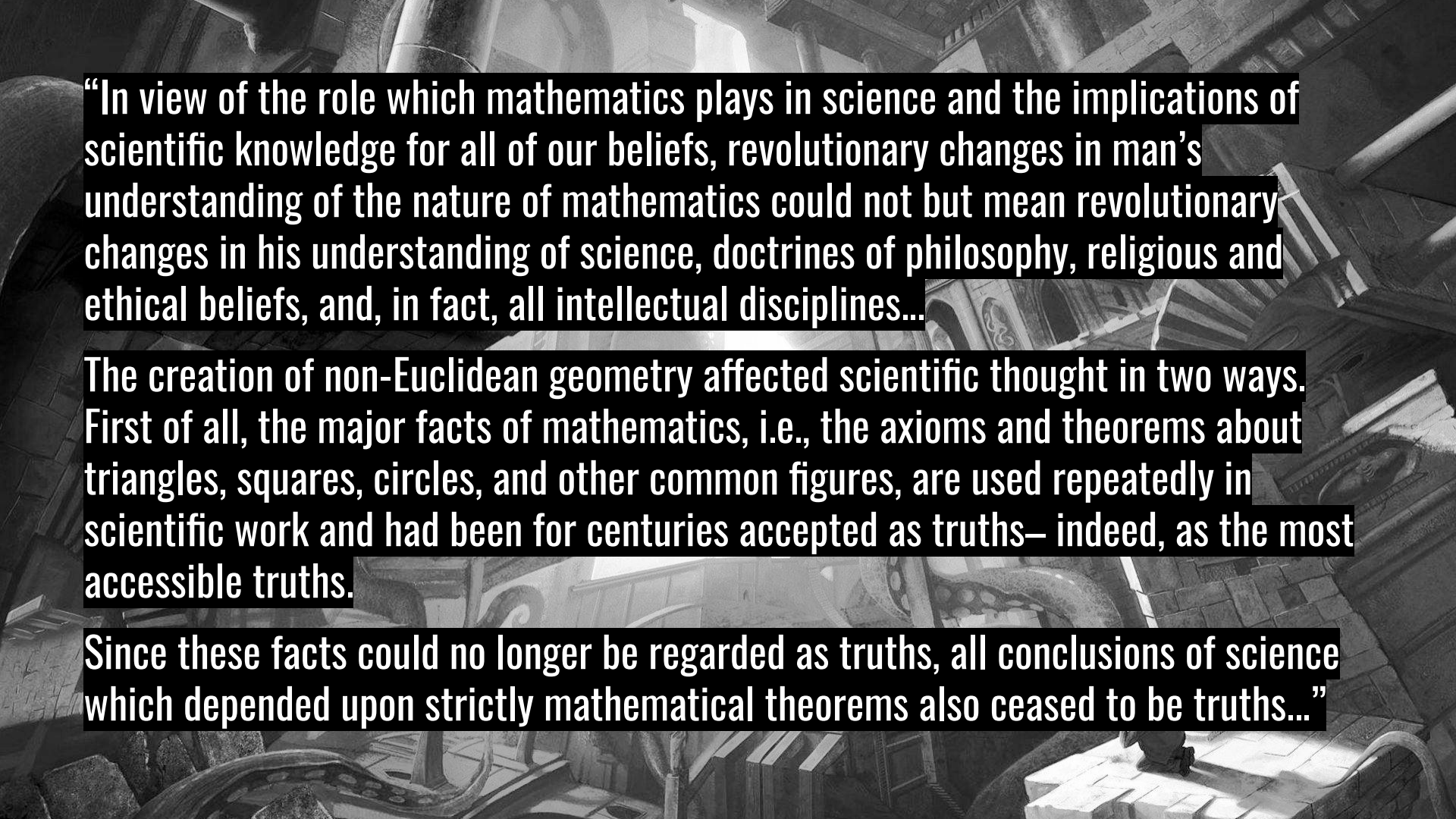
Mathematical statements are technically false since numbers don't exist, but are true in a weak sense, i.e. true in the fiction of mathematics.

Objection

Argument Against Nominalism/ Fictionalism

Fictionalism makes it so that propositions we know(?) are true, eg “2+2=4”, are strictly-speaking false, which is extremely counterintuitive.

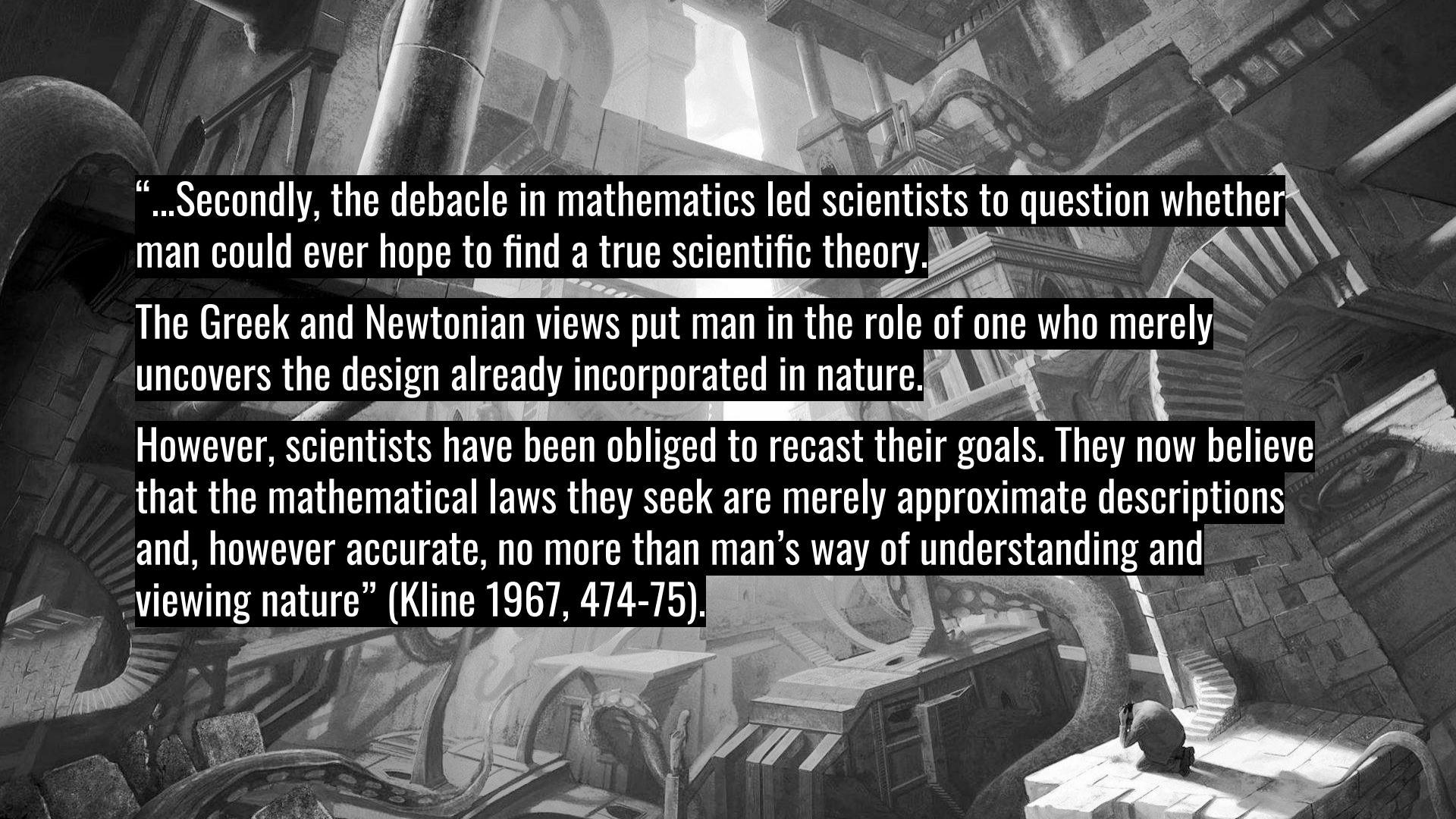
Yet, some mathematicians accepted this result with the dawn of non-Euclidean geometries...



“In view of the role which mathematics plays in science and the implications of scientific knowledge for all of our beliefs, revolutionary changes in man’s understanding of the nature of mathematics could not but mean revolutionary changes in his understanding of science, doctrines of philosophy, religious and ethical beliefs, and, in fact, all intellectual disciplines...

The creation of non-Euclidean geometry affected scientific thought in two ways. First of all, the major facts of mathematics, i.e., the axioms and theorems about triangles, squares, circles, and other common figures, are used repeatedly in scientific work and had been for centuries accepted as truths– indeed, as the most accessible truths.

Since these facts could no longer be regarded as truths, all conclusions of science which depended upon strictly mathematical theorems also ceased to be truths...”

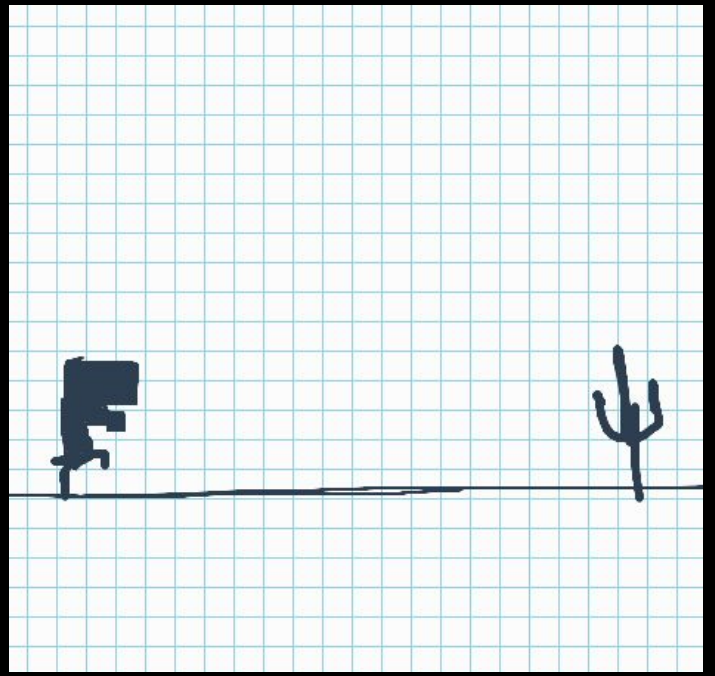


“...Secondly, the debacle in mathematics led scientists to question whether man could ever hope to find a true scientific theory.

The Greek and Newtonian views put man in the role of one who merely uncovers the design already incorporated in nature.

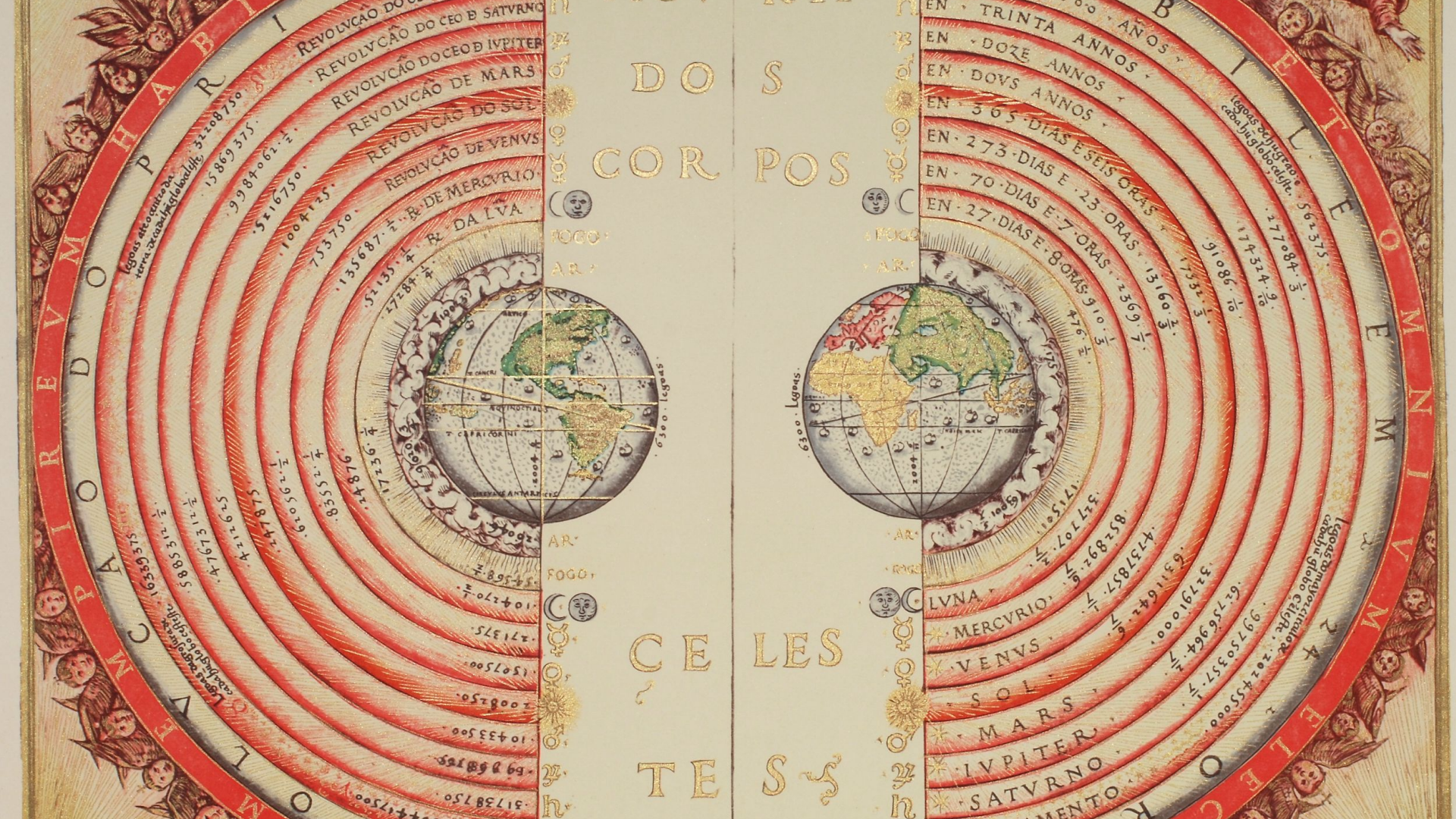
However, scientists have been obliged to recast their goals. They now believe that the mathematical laws they seek are merely approximate descriptions and, however accurate, no more than man’s way of understanding and viewing nature” (Kline 1967, 474-75).

INFORMAL FALLACY OF THE DAY



Argumentum Ad Populum

This is a fallacy in which an arguer lends support to his/her conclusion by claiming that a majority of people endorse the same conclusion.



DOS CORPOS CELESTES
REVOLVÇÃO DO CEO D SATVRNO
REVOLVÇÃO DO CEO D IVPITER
REVOLVÇÃO DE MARS
REVOLVÇÃO DO SOL
REVOLVÇÃO DE VENVS
R. DE MERCVRIO
R. DA LVA
EN TRINTA ANNOS
EN DOZE ANNOS
EN DOVS ANNOS
EN 365 DIAS E SEIS ORAS
EN 273 DIAS E 23 ORAS
EN 70 DIAS E 7 ORAS
EN 27 DIAS E 8 ORAS
LVNA
MERCVRIO
VENVS
SOL
MARS
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AR
6300 legoas

Standard Form(?)

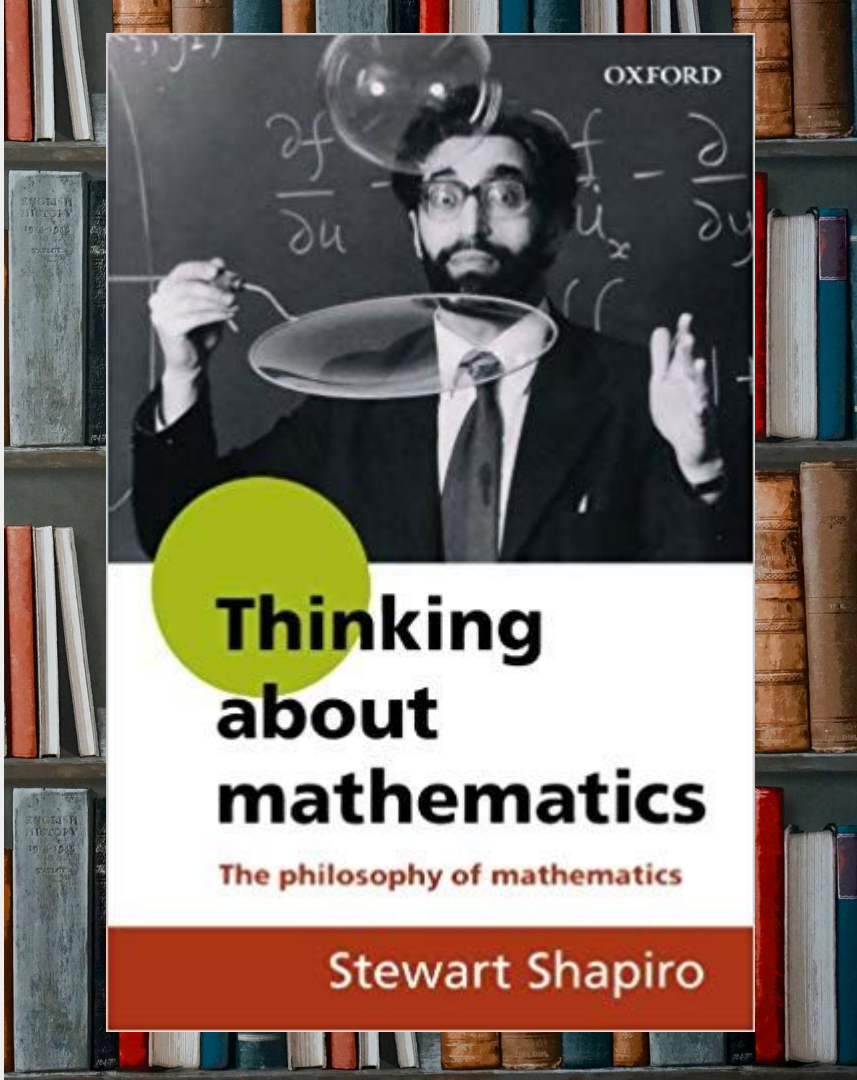
1. Most of the world agrees with me.
2. Therefore, I am right.

In other words, either way the issue of how many physicists or mathematicians believe that numbers are real is orthogonal (or philosophically independent) of whether or not numbers really are real...

SIDEBAR

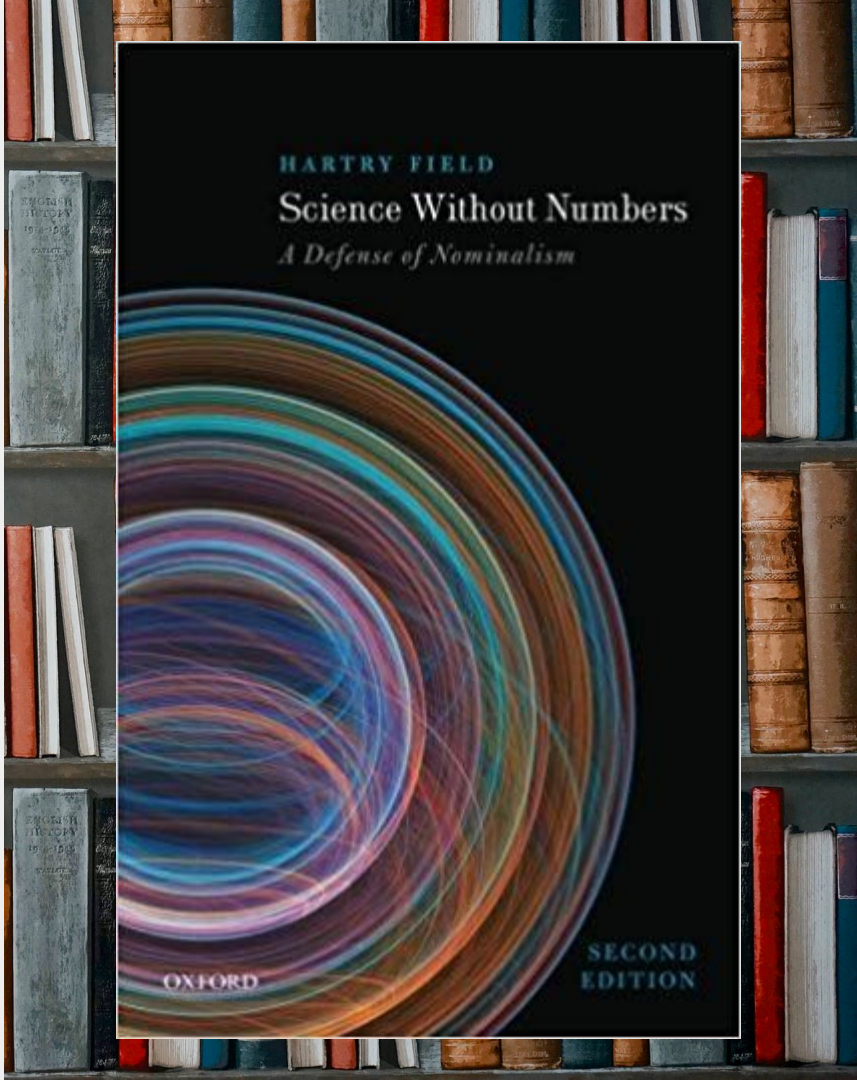
Shapiro (2002: 174) reminds us that the most common argument against **logical intuitionists**, who also do not believe that mathematical objects exist (or make no assumption that they do), was that this approach "cripples the mathematician."

Surely, metaphysical speculation should not impede the practice of mathematics.



$$p \vee \sim p$$

For a powerful formal development of nominalism, see Field (2016).



Possible Positions

- ☒ Physicalism
- ☒ Conceptualism
- ❑ Nominalism (+ fictionalism) ?

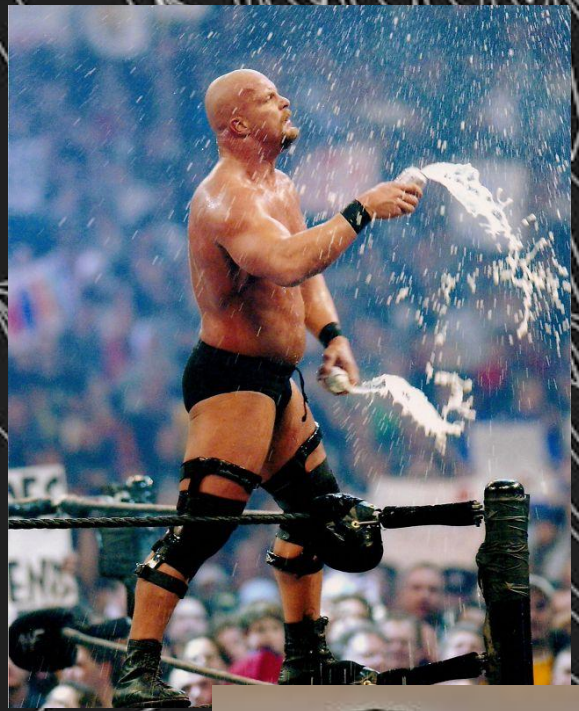
There is another view...

Possible Positions

Some argue that:

a. mathematical objects exist;
b. they are non-physical, abstract objects that exist independently of the mind.

We can access these abstract objects through the use of reason.



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7

π

This view is called Platonism since it's the view of Plato...

"I know that a neutral carbon atom has four valence electrons."

- ☑ Is P true?
- ☑ Does S believe P?
- ☑ Is S justified in believing P?