

# Aristotelian temporal logic: the sea battle

According to the square of oppositions, exactly one of “it is the case that  $p$ ” and “it is not the case that  $p$ ” is true.

*Either* “it is the case that there will be a sea battle tomorrow”  
*or* “it is not the case that there will be a sea battle tomorrow”.

Problematic for existence of free will, and for Aristotelian metaphysics.

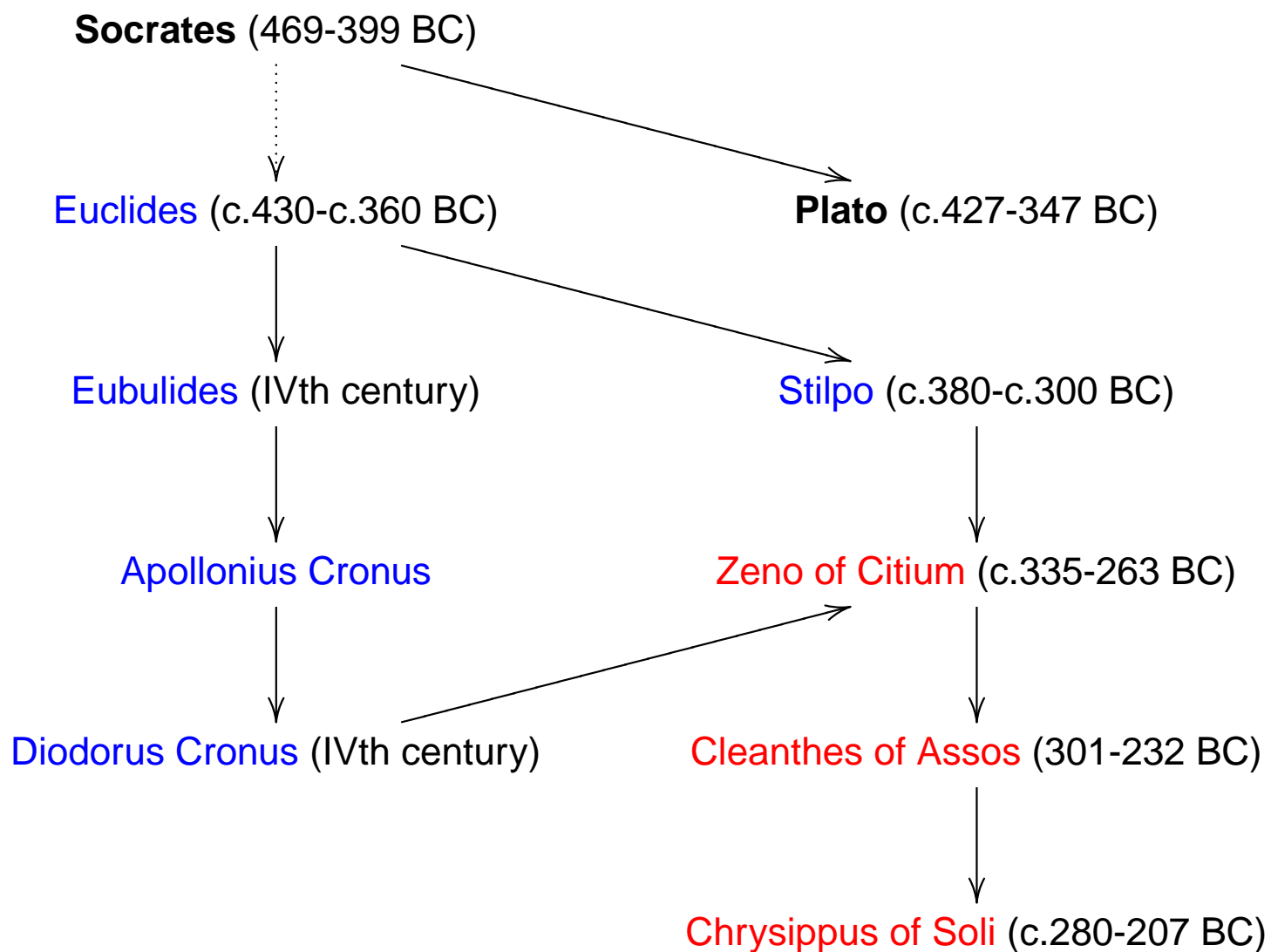
# The Master argument.

Diodorus Cronus (IVth century BC).

- Assume that  $p$  is not the case.
- In the past, “It will be the case that  $p$  is not the case” was true.
- In the past, “It will be the case that  $p$  is not the case” was necessarily true.
- Therefore, in the past, “It will be the case that  $p$ ” was impossible.
- Therefore,  $p$  is not possible.

*Ergo:* Everything that is possible is true.

# Megarians and Stoics.



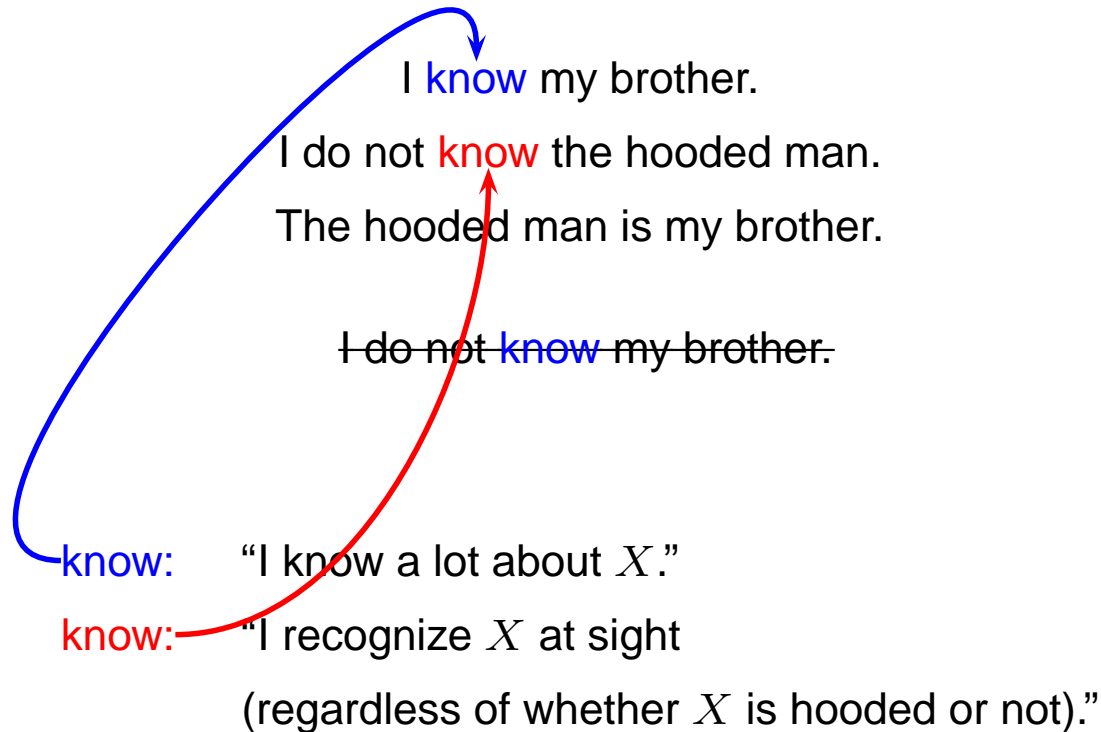
# Eubulides.

- Strongly opposed to Aristotle.
- Source of the “seven Megarian paradoxes”, among them the *Liar*.
  - *The Liar* is attributed to Epimenides the Cretan (VIth century BC); (*Titus 1:12*).
  - **Aulus Gellius**, *Noctes Atticae*.  
Alessandro Garcea, Paradoxes in Aulus Gellius, **Argumentation** 17 (2003), p. 87-98
- Graham Priest, The Hooded Man, **Journal of Philosophical Logic** 31 (2002), p. 445-467

# The seven Megarian paradoxes.

- *The Liar.* “Is the man a liar who says that he tells lies?”
- *The concealed man.* “Do you know this man who is concealed? If you do not, you do not know your own father; for he it is who is concealed.”
- *The hooded man.* “You say that you know your brother. Yet that man who just came in with his head covered is your brother and you did not know him.”
- *Electra.* “Electra sees Orestes : she knows that Orestes is her brother, but does not know that the man she sees is Orestes; therefore she does know, and does not know, her brother at the same time.”
- *The Sorites / the heap.* “One grain of wheat does not make a heap. Adding one grain of wheat doesn’t make a heap.”
- *The bald one.* “Pulling one hair out of a man’s head will not make him bald, nor two, nor three, and so on till every hair in his head is pulled out.”
- *The horned one.* You have what you have not lost. You have not lost horns, therefore you have horns.

# *Quarternio terminorum.*



Every metal is a chemical element.

Brass is a metal.

~~Brass is a chemical element.~~

# More shortcomings of syllogistics.

**Syllogistics** is finitary and cannot deal with very simple propositional connectives:

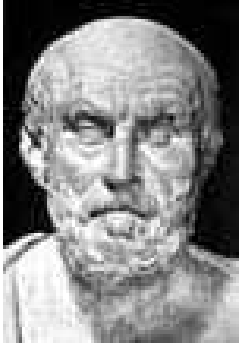
Every human being is a man or a woman.

Every man is mortal.

Every woman is mortal.

*Ergo...* every human being is mortal.

# Stoic Logic (1).



**Chrysippus of Soli** (c.280-207 BC)

- 118 works on logic,
- seven books on *the Liar*,
- inventor of propositional logic,
- nonstandard view of modal logic (“the impossible can follow from the possible”).

Harry Ide, Chrysippus’s response to Diodorus’s master argument, **History and Philosophy of Logic** 13 (1992), p. 133-148.



# Stoic Logic (2).

## Chrysippus' Principles of Propositional Logic.

- If  $p$ , then  $q$ . But  $p$ , therefore  $q$ .
- If  $p$ , then  $q$ , But not  $q$ , therefore not  $p$ .
- Not both  $p$  and  $q$ . But  $p$ , therefore not  $q$ .
- Exactly one of  $p$  and  $q$ . But  $p$ , therefore not  $q$ .
- Either  $p$  or  $q$ . But not  $q$ , therefore  $p$ .

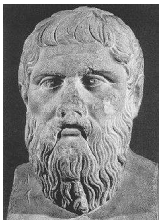
# Hypothetical Syllogisms (1).

Categorical propositions (“Every  $B$  is an  $A$ ”) are very special propositions.



“Socrates is bald”

**Attempt 1.** “Every **socratizing animal** is bald.”



“If Socrates is bald, then Plato is bald.”

**Attempt 2.** Define predicates “**a Socrates-is-bald-situation**” and “**a Plato-is-bald-situation.**”

Every **Socrates-is-bald-situation** is a **Plato-is-bald-situation.**

# Hypothetical Syllogisms (2).

**Barbara** becomes:

$$\begin{array}{c} AaB \\ BaC \\ \hline AaC \end{array}$$

Every **Socrates-is-bald-situation** is a **Plato-is-bald-situation**

Every **Plato-is-bald-situation** is a **Aristotle-is-bald-situation**

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Every **Socrates-is-bald-situation** is a **Aristotle-is-bald-situation**

If Socrates is bald, then so is Plato.

If Plato is bald, then so is Aristotle.

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If Socrates is bald, then so is Aristotle.

**Tempting:**  $(p \rightarrow q \ \& \ q \rightarrow r) \rightarrow (p \rightarrow r)$ .

# Hypothetical Syllogisms (3).

A **disjunction** can be expressed by

Every **not- $p$ -situation** is a  **$q$ -situation**.

Socrates is either a woman or a man.

Every **Socrates-is-not-a-woman-situation** is a **Socrates-is-a-man-situation**.

A **negation** can be expressed by

Some **not- $p$ -situation** is a **not- $p$ -situation**.

Socrates is not a woman.

Some **Socrates-is-not-a-woman-situation** is a **Socrates-is-not-a-woman-situation**.

# Hypothetical Syllogisms (4).

Socrates is either a woman or a man.

Socrates is not a woman.

Socrates is a man.

Every Socrates-is-not-a-woman-situation is a Socrates-is-a-man-situation.

Some Socrates-is-not-a-woman-situation is a Socrates-is-not-a-woman-situation.

Some Socrates-is-not-a-woman-situation is a Socrates-is-a-man-situation.

AaB

BiC

AiC.

Tempting:  $p \vee q \ \& \ \neg p \rightarrow q$ .

# Hypothetical Syllogisms (5).

We have to be careful, as Boethius claims:

If  $p$ , then 'if  $q$ , then  $r$ '

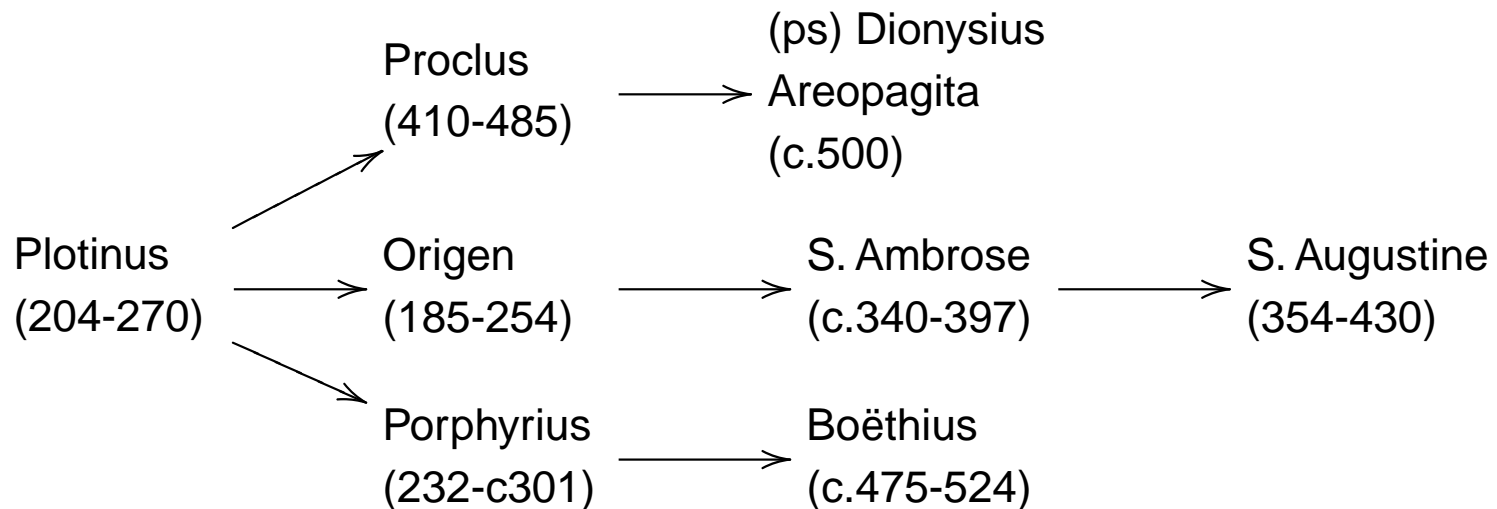
If  $q$ , then not  $r$ .

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Not  $p$ .

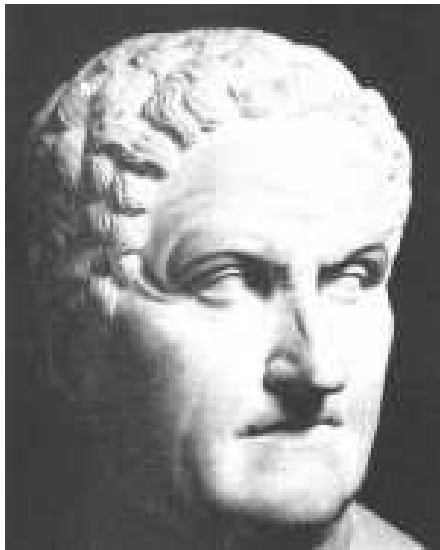
# Neoplatonism.

- *(Really old-fashioned) received opinion.* The middle ages were Aristotelian, the rediscovery of Plato's works marked the beginnings of the Renaissance.
- *But:* until the XIIth century, Aristotle was only known via neoplatonistic scholars.
- **Sources of neoplatonism.**



# Late antiquity.

- Galen (129-216)



*Galen of Pergamum*

(129-216)

Court Physician to Marc Aurel

*Introduction to Dialectics*

(rediscovered in XIXth century)



# Late antiquity.

- Galen (129-216)
- Augustine (354-430)



*(Sanctus) Aurelius Augustinus*  
(354-430)  
*doctor ecclesiae*

# Late antiquity.

- Galen (129-216)
- Augustine (354-430)
- Boëthius (c.475-524)
- Cassiodorus (c.490-c.585)



*Flavius Magnus Aurelius Cassiodorus Senator*  
(c.490-c.585)

**Main work:** *Institutiones*

# Late antiquity.

- Galen (129-216)
- Augustine (354-430)
- Boëthius (c.475-524)
- Cassiodorus (c.490-c.585)
- Isidore of Seville (c.560-636)



*(Sanctus) Isidorus Hispalensis*  
(c.560-636)

**Main work:** *Etymologiae*

Patron Saint of the Internet

# Boëthius.



*Anicius Manlius Severinus Boëthius*  
(c.475-524)

“The last of the Roman philosophers, and the first of the scholastic theologians” (Martin Grabmann)

# Logic in the Middle Ages.

- *Peripatetic position:* Logic is a preliminary to scientific inquiry.
- *Stoic position:* Logic is part of philosophy.

## In the Middle Ages:

- Logic as *ars sermocinalis*. (Part of the preliminary studies of the *trivium*.)
- Logic (in a broader sense) as central to important questions of philosophy, metaphysics and theology.



Kurt **Flasch**, Das philosophische Denken im Mittelalter, Von Augustin zu Machiavelli, Reclam, Ditzingen 1986 [Universal-Bibliothek 8342]

<http://www.amazon.de>: € 16.10.

# Theological Questions.

**Theological questions connected with the set-up of logic.**

- **The Immortality of the Soul.**
- **The Eucharist.**
- **The Trinity and the ontological status of Father, Son and Holy Spirit.**
- **Free will and responsibility for one's actions.**