Logic in the 17th century

Jaap Maat
Core Logic 18 October 2006

17th century:

revolutionary developments in mathematics, philosophy, natural science

logic was ‘asleep’

logic was an integral part of education

several years of training in logic at undergraduate level

logic was generally seen as an art, or ‘instrumental discipline’, as opposed to a science

definitions of logic:

- the art of reason, or an instrumental art directing our mind to knowledge (Sanderson)

- the art (or skill) of reasoning, directing the mind in the use of reason (Wallis)

- an art which teaches us to dispute probably on both sides of any matter that is propounded (Blundeville)

contents of textbooks were often following a standard plan, based on Aristotle’s Organon:

- terms (categories, predicables)
- propositions (opposition, conversion)
- discourse (syllogisms)

- other subjects (fallacies, topics)

Robert Sanderson, Logicae Artis Compendium (1614)

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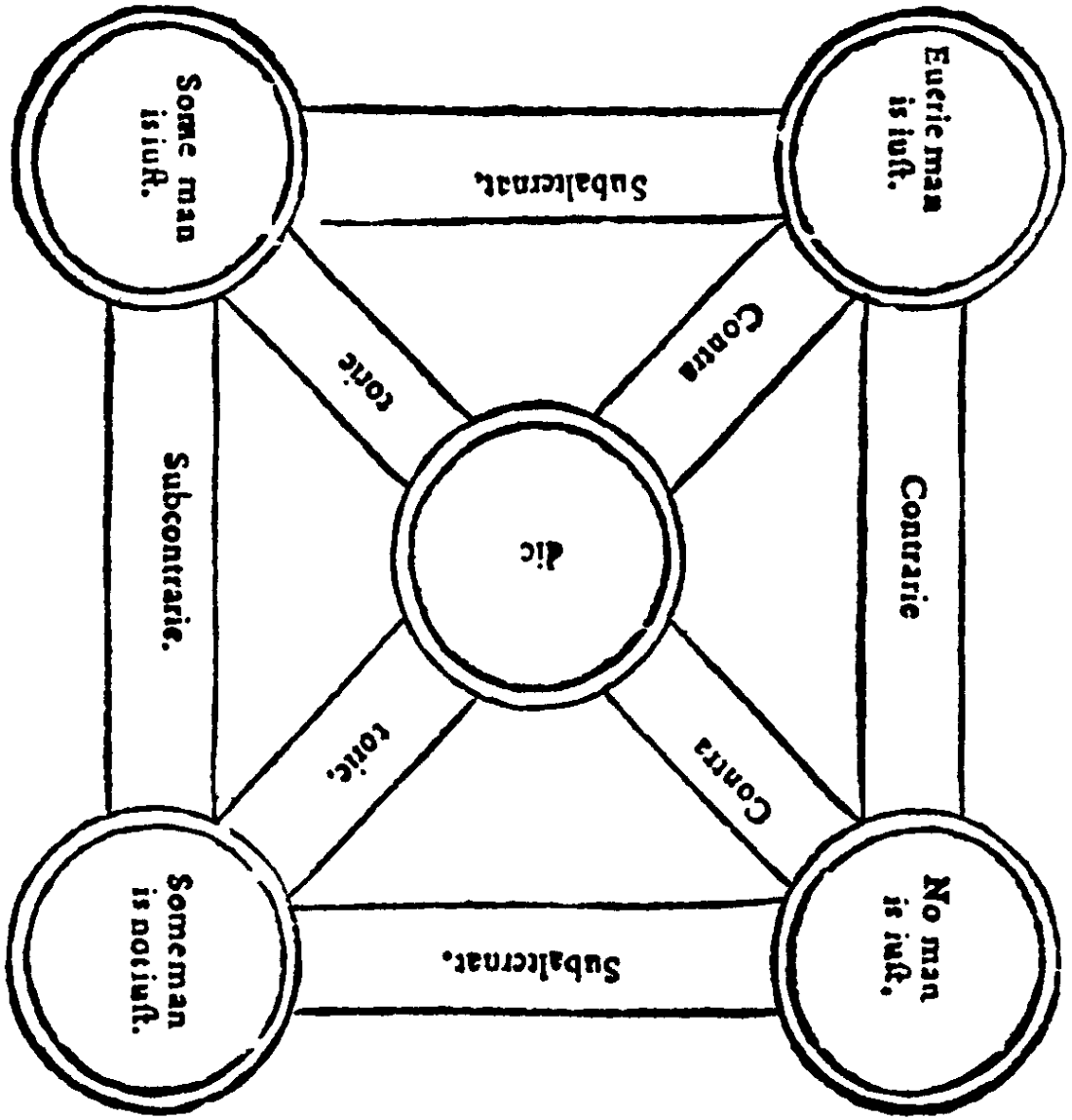
LOGICA

John Wallis, Institutio Logicae (1686)

Blundeville (1599) Porphyrian Tree

Blundeville (1599) Square of opposition



Blundeville (1599)
The four perfect moods in the 1st figure

followyng: the termes whereof bee theſe, ſenſible bodie, ſubſtance, and man placed in this ſort.

Bar. Euery ſenſible bodie is a ſubſtance,
ba But euery man is a ſenſible body,
ra. Ergo euery man is a ſubſtance.

The name of this moode is called Barbara, diuided into three ſillables, placed in the margent right against the Syllogiſme, to theſe the quantitie and qualitie of euery propoſition, according to the ſignifications of the vowels contayned in euery ſillable: and to all the other names of the moodes hereafter following. The ſecond moode, whereof three termes being giuen, a ſillogiſme is made of an vniuerſall negatiue Maior, and of an vniuerſall affirmatiue Minor, directly concluding an vniuerſall negatiue: As for example let the termes bee theſe: ſenſible body, a man, a ſtone, and the ſillogiſme thus.

Ce. No ſenſible body is a ſtone,
la. But euery man is a ſenſible body,
rent. Ergo no man is a ſtone.

The name of this moode is Celarent.

The third moode is, when three termes being giuen, a ſillogiſme is made of an vniuerſall affirmatiue Maior, and of a particular affirmatiue Minor, directly concluding a particular affirmatiue: As for example let theſe be the termes: ſenſible body, ſubſtance, and man, and the ſillogiſme thus:

Da. Euery ſenſible body is a ſubſtance,
ri. But ſome man is a ſenſible bodie,
i. Ergo ſome man is a ſubſtance.

The name of this moode is Darii.

The fourth moode is, when three termes being giuen, a ſillogiſme is made of an vniuerſall negatiue Maior, and a particular affirmatiue Minor, directly concluding a particular negatiue: As for example, let theſe be the termes, ſenſible body, man, and ſtone: and the Syllogiſme thus.

Fe. No ſenſible bodie is a ſtone,
ri. But ſome man is a ſenſible bodie,
o. Ergo ſome man is a ſtone.

The name of this moode is Ferio.

Examples

Logic was under attack

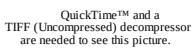
major figures argued (or declared) it was useless:

Bacon, Descartes, Locke

QuickTime™ and a
TIFF (Uncompressed) decompressor
are needed to see this picture.

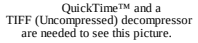
Francis Bacon
Novum Organum, 1620

“As the sciences which we now have do not help us in finding out new works, so neither does the logic which we now have help us in finding out new sciences.
The logic now in use serves rather to fix and give stability to the errors which have their foundation in commonly received notions than to help the search after truth. So it does more harm than good.”

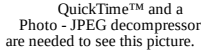


René Descartes
Rules for the Direction of the Mind
1628-1629

“Some will perhaps be surprised that in this context, where we are searching for ways of making ourselves more skilful at deducing some truths on the basis of others, we make no mention of any of the precepts with which dialecticians suppose they govern human reason. They prescribe certain forms of reasoning in which the conclusions follow with such irresistible necessity that if our reason relies on them, even though it takes, as it were, a rest from considering a particular inference clearly and attentively, it can nevertheless draw a conclusion which is certain simply in virtue of the form.”



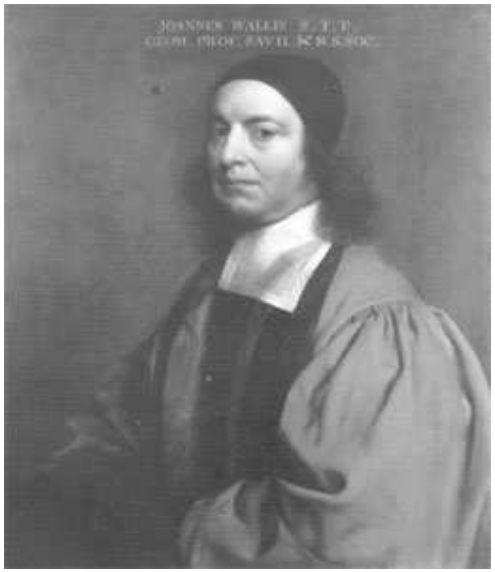
“Our principal concern here is thus to guard against our reason’s taking a holiday while we are investigating the truth about some issue; so we reject the forms of reasoning just described as being inimical to our project. Instead we search carefully for everything which may help our mind to stay alert.”



John Locke
An Essay
concerning
Human
Understanding
1689

“To this abuse, and the mischiefs of confounding the Signification of Words, Logick, and the Liberal Sciences, as they have been handled in the Schools, have given Reputation; and the admired Art of Disputing, hath added much to the natural imperfection of Languages, whilst it has been made use of, and fitted, to perplex the signification of Words, more than to discover the Knowledge and Truth of Things”

Logic had its defenders as well (Wallis, Leibniz):



John Wallis

"The precepts of logic are not taught (as many of the young seem to have thought) to supply the means for quarreling and wrangling over sophistical theses for a couple of years (...), being useless in the rest of their lives after they have taken off the academic gown, but to be able, for their whole lives, to set up reasonings well, to form clear concepts for themselves, and to put them forward to others in the right order" (*Institutio Logicae, dedicatory letter, November 1686*)

QuickTime™ and a
Photo - JPEG decompressor
are needed to see this picture.

Gottfried Wilhelm Leibniz
New Essays on Human
Understanding 1702-1704

“As for *logic*: since it is the art which teaches us how to order and connect our thoughts, I see no grounds for laying blame upon it. On the contrary, men’s errors are due rather to their lack of logic.”

Logic as a discipline in the 17th century:

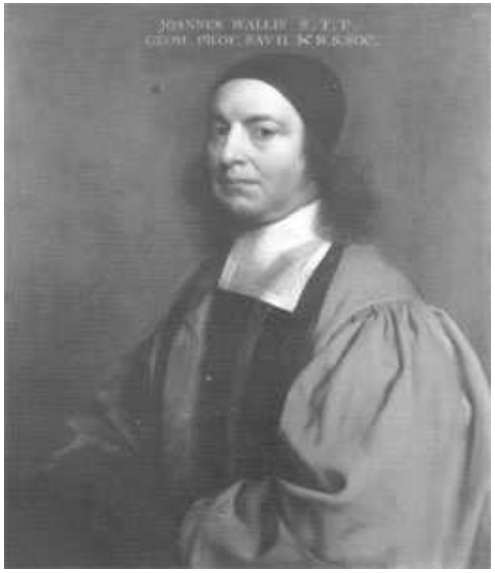
traditional subject
many pupils, many teachers, many textbooks
few researchers
hardly any developments

Possible exceptions:

- *Port Royal logic*

- *Leibniz's logical calculi*

- *John Wallis's thesis about singular propositions.*



John Wallis (1626-1703)

- outstanding mathematician
- the most skilful cryptanalist in the world
- Savilian professor of geometry at Oxford
- prominent as a linguist
- published various theological works
- active as a scientist
- wrote a textbook on logic

Wallis's treatise on singular propositions
(1638)

Propositio Singularis, in dispositione Syllogistica,
semper habet vim Universalis

A singular proposition, in a syllogistic disposition,
always has universal force

Four types of propositions

Universal affirmative: All S are P
Universal negative: No S is P
Particular affirmative: Some S are P
Particular negative: Some S is not P

Singular propositions: the subject term denotes an individual
(proper names, indexical phrases, descriptions)

Socrates is a man
This man is Cicero
The author of the Aeneid is Virgil

Ramus's distinctions (Petrus Ramus 1515-1572)

Axioma simplex:
- generale (universal)
- speciale
  - particulare (particular)
  - proprium (singular)

singular propositions differ from universal ones:

- UA and UN are contrary, not contradictory, whereas SA and SN are contradictory

  All S are P - No S are P vs. Virgil is Roman - Virgil is not Roman

2) Socrates is a Greek — M u P
   Socrates is the teacher of Plato — M u S
   the teacher of Plato is a Greek — S u P
   valid

   All Athenians are Greek — M a P
   All Athenians are democrats — M a S
   All democrats are Greek — S a P
   invalid

3) conversion

From: All S are P it does not follow that All P are S.
But from 'Virgil is the author of the Aeneid' (S u P) it does follow that P u S.

singular propositions differ from universal ones:

was Wallis blind to these facts?

Wallis's main a priori argument:

Singular propositions are to be reduced to universal ones, because
Predication is either *de toto* or *de parte*
In a universal proposition, predication is *de toto*
In a particular proposition, predication is *de parte*
In a singular proposition, predication is *de toto*.

Not properties of the term, but the nature of the connection between subject and predicate determines what type a proposition belongs to

Some a posteriori arguments:

- The major in the 1st and 2nd figure is always *de toto* (universal). But sometimes it is singular. Therefore, the singular is sometimes *de toto* (universal).

  examples:

  Augustus was emperor
  Octavius was Augustus
  Octavius was emperor

This (i.e. replacing a universal proposition with a singular one in a valid syllogism) could be done in any mood of both figures and indeed in any mood of any figure.

2. Nothing can be concluded from pure particulars. But from pure singulars there are things that can be concluded. Therefore, the singular is not particular, and hence universal.

Example

Virgil was learned
Some poet was Virgil
Some poet was learned

- *Socrates non est equus* is a negative proposition; it is either universal or particular. But it is not particular. Therefore it is universal. It is not particular because negative particulars cannot be converted as the singular negative can: both *nullus equus est Socrate*s and *aliquis equus non est Socrates* follow from *Socrates non est equus*. And only the universal negative is converted in this way.

cf. the affirmative case: ‘some S is P’ converts simply into ‘some P is S’

Corollaries; it follows from the main thesis, that

a. affirmative and negative singular propositions are contradictories

Socrates is a man - Socrates is not a man
Cf. All men are generous - No man is generous

Corollaries; it follows from the main thesis, that

b. when the predicate is an individual, universal propositions can be simply converted

The author of the Aeneid is Virgil - Virgil is the author of the Aeneid
Cf. All Greeks are Europeans - All Europeans are Greeks

Corollaries; it follows from the main thesis, that

c. when the minor term is an individual, the conclusion in the third figure is universal (contrary to what logicians teach)

The author of the Aeneid is Roman	M u P	
The author of the Aeneid is Virgil		M u S
Therefore, Virgil is Roman (valid)		S u P

All Athenians are Greek		M a P
All Athenians are democrats		M a S
All democrats are Greek (invalid)		S a P

All Athenians are Greek		M a P
All Athenians are democrats		M a S
Some democrats are Greek (valid, Darapti)	S i P	

"It must however be noted that there is a slight difference between the singular proposition and other universal propositions (as can be seen from the corollaries), but not such that it would banish the singular propositions from the rank of universal ones" (p. 228-229).

Wallis's argument was widely accepted

"Mais quoique cette proposition singuliere soit différente de l'universelle en ce que son sujet n'est pas commun, elle s'y doit néanmoins plutôt rapporter qu'à la particuliere; parce que son sujet, par cela même qu'il est singulier, est nécessairement pris dans toute son étendue, ce qui fait l'essence d'une proposition universelle, & qui la distingue de la particuliere" (Arnauld & Nicole*, La Logique ou l'Art de Penser, 1662, II, 3)*

How is it that opposition is valid in the case of singular propositions? Should we say that a singular proposition is equivalent to a particular and to a universal proposition? Yes, we should. So also when it is objected that a singular proposition is equivalent to a particular proposition, since the conclusion in the third figure must be particular, and can nevertheless be singular; e.g. ‘Every writer is a man, some writer is the Apostle Peter, therefore the Apostle Peter is a man’. I reply that here also the conclusion is really particular, and it is as if we had drawn the conclusion ‘Some Apostle Peter is a man’. For ‘some Apostle Peter’ and ‘every Apostle Peter’ coincide, since the term is singular.

G.W. Leibniz, ‘some logical difficulties’ (after 1690).

Logic was instrumental in new developments after all:

1. some elements of logical theory became ever more prominent in grammatical theory

2. newly developed philosophical languages were based on ‘philosophical’ grammar

Examples of logical elements in grammar:

1. logical analysis of the proposition becomes important

For example: Vossius analyses the verb as copula + predicate.

Peter writes = Peter is writing

Examples of logical elements in grammar:

2. logical distinction between categorematic / syncategorematic terms becomes important in grammatical theory

For example: Port Royal grammar divides all words into
words signifying the objects of thoughts

nouns, articles, pronouns, participles, prepositions, adverbs

and

words signifying the form and manner of our thoughts

verbs, conjunctions, interjections

Examples of logical elements in grammar:

3. distinction between logical form / linguistic form is often made

The Art of Signs
OR
A UNIVERSAL CHARACTER
AND
PHILOSOPHICAL LANGUAGE

By means of which speakers of the most diverse languages will in the space of two weeks be able to communicate to each other all the notions of the mind (in everyday matters), whether in writing or in speech, no less intelligibly than in their own mother tongues. Furthermore, by this means also the young will be able to imbibe the principles of philosophy and the true practice of logic far more quickly and easily than from the common writings of philosophers.

George Dalgarno, Ars Signorum 1661

Dalgarno:

logic and grammar are one and the same art

radicals vs. particles

radicals are building blocks, particles are the cement of speech

logical form on the linguistic surface:

to affirm - tim

to deny - trim

all particles are expressed by radicals

Gottfried Wilhelm Leibniz
rational grammar

- binary division between words and particles (signs of concepts versus signs of modes of conceiving) “words constitute the matter, particles the form of discourse”
- analysis of the verb: noun plus the verb ‘is’, which signifies some sort of judgment
- analysis of particles is important, as all relations between concepts are expressed by particles

Leibniz’s rational grammar

aim is to expand logic in such a way that it encompasses inferences that depend on the meaning of grammatical particles

“very frequently there occur inferences in logic, that are to be proved not on the basis of logical principles, but on the basis of grammatical principles, that is, on the basis of the signification of inflections and particles” (A 6 4 344)