Logic in the 17th century

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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)
INDEX CAPITUM.

PARS PRIMA.
De Apprehensione Simplici.

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III. De Poëibus Commonibus, seu Universalibus.
IV. De Predicabilibus tribus primoribus; Genere, Species, & Differentia.
V. De duobus profermis Predicabilibus; Proprio, & Accidente.
VII. De Substantiis, Accidentiis, & olim Pracdicamentis.
VIII. De Prædicamentis Quantitatis.
IX. De Prædicamentis Qualitatis.
XI. De Prædicamentis Relationis.
XII. De Prædicamentis Additionibus & Subtractionibus.
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XVI. De Oppositione Simplicium Terminorum.
XVII. De Modis Præcis & Simul.
XVIII. De Modis & Habitus.
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XX. De Subiecta, Objecta, Adiuncta.
XXII. De Poëbo & Partibus, Divisione & Distributione.
XXII. De Eodem & Diverso.
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De Secunda operatione Intellecuis.

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VIII. De Converse Propositionum.
IX. De Propositionibus Modalius.
X. De Modis & Habitus, Exceptiones, Reduplicativa & variis Proprietatibus Propositionum Suppositiunis.

PARS TERTIA.
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tibus.
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XIX. De Modis Di & Omne, seu Syllogismos Difusorius.
XX. De Fallaciis.
XXI. De Matera Syllogismorum.
XXII. De Demonstratione.
XXIII. De Syllogismo Topico.
XXIV. De Methodo.

THESES TRES.
I. Propositio Singularis, in Propositione Syllogistica, semper habeat vixim Universalis.
II. Syllogismi hypothetici, quibus Compositi, referentes sint omnes ad Aristotelicos Categoriorum Modos.
III. Quantitates non differt Realiter a Re Quanta.

LOGICA
The Table of Substance

Substance is either

1. Simple, if it be simple, it is either

2. or elemental as fire, air, earth, water.

3. or with body, if it be with body, it is either

4. or composed if it be composed, it is either

5. or sensual if it be sensual, it is either

6. or visible as a tree, an ocean plant, which is either

7. or invisible as a shrub, a broom, &c.

8. or perishable, if it be perishable, it is either

9. or sensible if it be sensible, it is either

10. or mental, as the human soul, &c.

11. or physical, as the physical body.

12. or elemental, as the celestial, terrestrial, &c.

13. or mental, as the mental soul, &c.

14. or physical, as the physical body.

15. or elemental, as the celestial, terrestrial, &c.

16. or mental, as the mental soul, &c.

17. or physical, as the physical body.

18. or elemental, as the celestial, terrestrial, &c.

19. or mental, as the mental soul, &c.

20. or physical, as the physical body.

21. or elemental, as the celestial, terrestrial, &c.

22. or mental, as the mental soul, &c.

23. or physical, as the physical body.
Blundeville (1599)
Square of opposition
The Fift Booke of Logike.

124. The four perfect moods in the 1st figure

The name of this mood is called Barbara, divided into three figures, placed in the margin right against the Silogisme, to show the quantity and quality of every proposition, according to the significations of the vowels contained in every syllogism: and to name all the other names of the moods hereafter following. The seconde mood is, when three terms being given, a silogisme is made of an universal affirmative, and of an universal affirmative, directly concluding an universal affirmative. As for example, let these be the terms: sensible body, man, and stone, and the silogisme thus:

Ce. No sensible body is a stone.
Ia. But every man is a sensible body.

Then.
Ergo no man is a stone.

The name of this mode is Celarent.

The third mode is, when three terms being given, a silogisme is made of an universal affirmative, and of a particular affirmative, directly concluding a particular affirmative. As for example, let these be the terms: sensible body, substance, and man, and the silogisme thus:

Da. Every sensible body is a substance.
Ra. But some man is a sensible body.

Then.
Ergo some man is a substance.

The name of this mode is Darapti.

The fourth mode is, when three terms being given, a silogisme is made of an universal negative, and of a particular affirmative, directly concluding a particular negative. As for example, let these be the terms: sensible body, man, and stone: and the silogisme thus:

Fe. No sensible body is a stone.
Te. But some man is a sensible body.

Then.
Ergo some man is a stone.

The name of this mode is Ferio.
Logic was under attack
major figures argued (or declared) it was useless:
Bacon, Descartes, Locke
“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.”

Francis Bacon
Novum Organum, 1620
“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.”
“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):

"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)
“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.”

Gottfried Wilhelm Leibniz
New Essays on Human Understanding 1702-1704
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 cryptanalyst 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: \[
\begin{aligned}
&\text{generale (universal)} \\
&\text{speciale} \\
&\quad \begin{aligned}
&\text{particolare (particular)} \\
&\text{proprium (singular)}
\end{aligned}
\end{aligned}
\]
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 \( M \cup P \)
   Socrates is the teacher of Plato \( M \cup S \)
   the teacher of Plato is a Greek \( S \cup P \)
   valid

   All Athenians are Greek \( M \cap P \)
   All Athenians are democrats \( M \cap S \)
   All democrats are Greek \( S \cap P \)
   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’ \( S \cup P \) it does follow that \( P \cup S \).
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 Socrates 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 \[ \text{M} \text{u} \text{P} \]
The author of the Aeneid is Virgil \[ \text{M} \text{u} \text{S} \]
Therefore, Virgil is Roman (valid) \[ \text{S} \text{u} \text{P} \]

All Athenians are Greek \[ \text{M} \text{a} \text{P} \]
All Athenians are democrats \[ \text{M} \text{a} \text{S} \]
All democrats are Greek (invalid) \[ \text{S} \text{a} \text{P} \]

All Athenians are Greek \[ \text{M} \text{a} \text{P} \]
All Athenians are democrats \[ \text{M} \text{a} \text{S} \]
Some democrats are Greek (valid, Darapti) \[ \text{S} \text{i} \text{P} \]
"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 singuliére soit différente de l'universelle en ce que son sujet n'est pas commun, elle s'y doit néanmoins plutôt rapporter qu'à la particulière; 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 particulière" (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
- 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)