

Peirce, Logic and Semiotics

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My background and work...

A theory of everything...

A theory of everything (TOE)...

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... a theory of Mind, Agency, Ethics, Science, Logic...

A theory of everything (TOE)...

... a theory of Mind, Agency, Ethics, Science, Logic...

... found in Charles Peirce's pragmatism
from 150 years ago.

What are we looking for?...

Aim

Aim

An explanation of mind and behavior...

Aim

An explanation of mind and behavior...

..... that is scientifically appropriate...

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An explanation of mind and behavior...

..... that is scientifically appropriate...

... and yet is not reductionist/mechanistic,
still preserving features of agency.

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Answer: Active inference and semiotics?

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An explanation of mind and behavior...

..... that is scientifically appropriate...

... and yet is not reductionist/mechanistic,
still preserving features of agency.

Answer: Active inference and semiotics?

...Either way, begins with pragmatism, logic, and a theory of meaning.

Outline

- Part 1: Theory of Inquiry
- Part 2: Concepts in experience
- Part 3: Deduction
- Part 4: Semiotics

- Part 1: Theory of Inquiry

Begin with Peirce's Doubt-Belief model...



... Doubt



Belief ...

ex: lost keys,
laptop battery, rustle
in the woods

Like active inference...



ex: lost keys,
laptop battery, rustle
in the woods

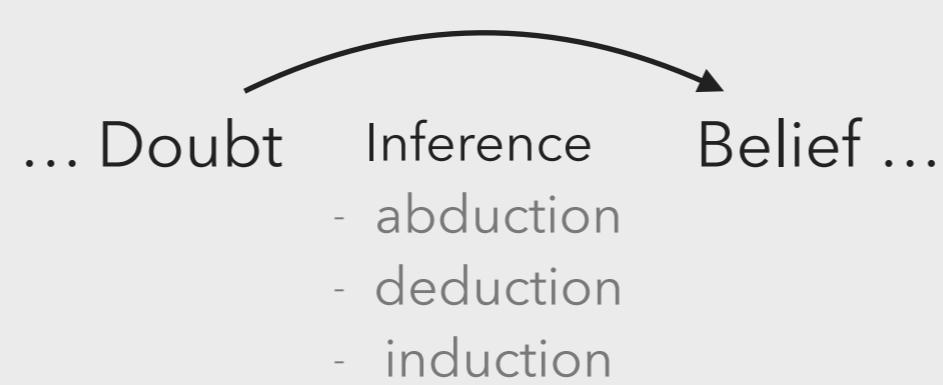
... and add Peirce's theory of inference.

... Doubt



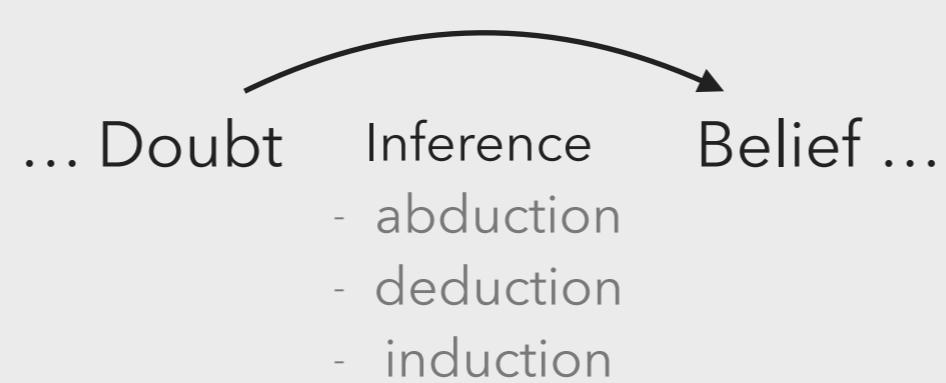
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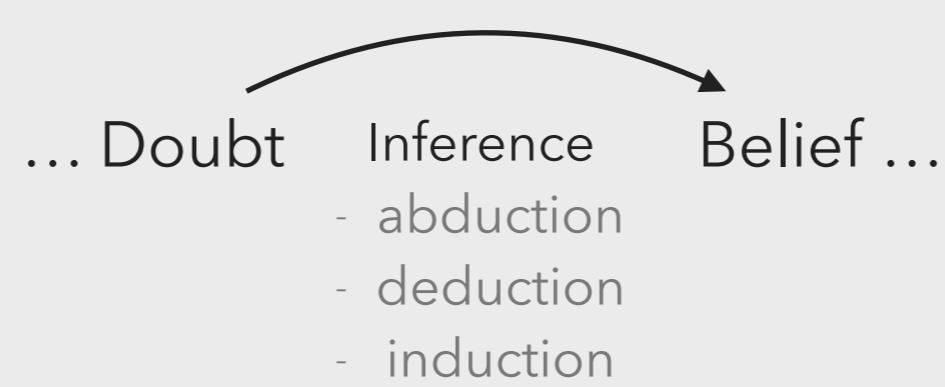


ex: lost keys,
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'the continuity of explanation'

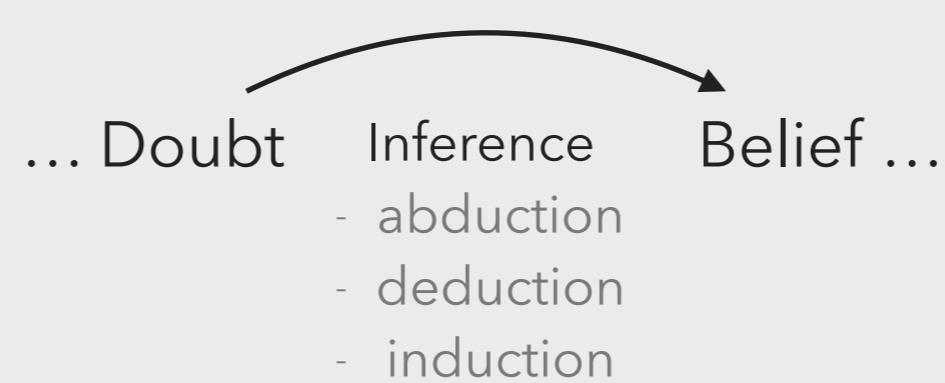


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in the woods

Like active inference(?)...



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Outline

- Part 1: Theory of Inquiry
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- Part 2: Concepts in experience

A 'concept' includes both a 'what to expect' and a 'when to expect it'.

- ex. 'A diamond is hard' means we expect 'hardness' when we encounter objects of type 'diamond'

inspiration for Wille's 'Formal Concept Analysis'...

A 'concept' includes both a 'what to expect' and a 'when to expect it'.

- ex. 'A diamond is hard' means we expect 'hardness' when we encounter objects of type 'diamond'

What do we mean by 'diamond'?...

- The meaning of 'diamond' is the set of objects that – when put to the test – one would identify as a 'diamond' in experience.

What do we mean by 'hardness'?...

- The meaning of 'hardness' is that it 'resists scratching', i.e. the set of expected behaviors when 'hardness' is put to the test.

A 'concept' is 'universal' vs 'particular'...

- ex. 'Horse', 'chair', 'water bottle'

A 'concept' is inferential...

- ex. 'Horse', 'chair', 'water bottle'

inspiration for Brandom's 'Inferentialism'...

A 'concept' is inferential...

- ex. 'Horse', 'chair', 'water bottle'

In summary, a 'concept':

- includes both a 'what to expect' and a 'when to expect it'
- is 'universal' vs 'particular'
- is inferential

In every case, the mind's 'concepts' serve as the building blocks for 'hypothetic' experience...

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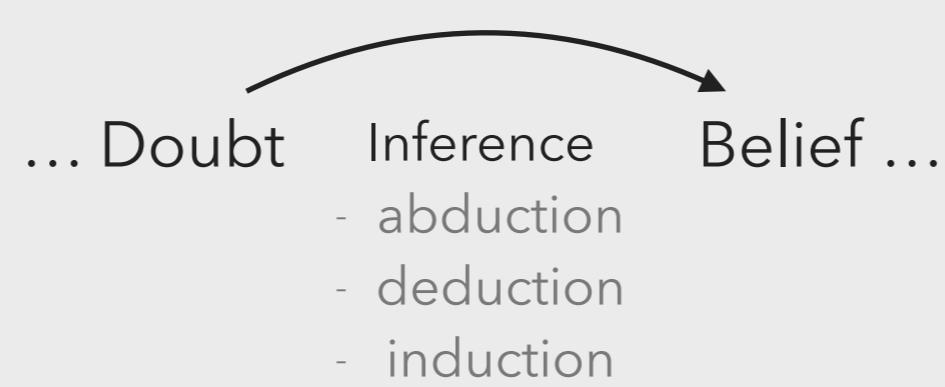
Like active inference...

In every case, the mind's 'concepts' serve as the building blocks for 'hypothetic' experience...

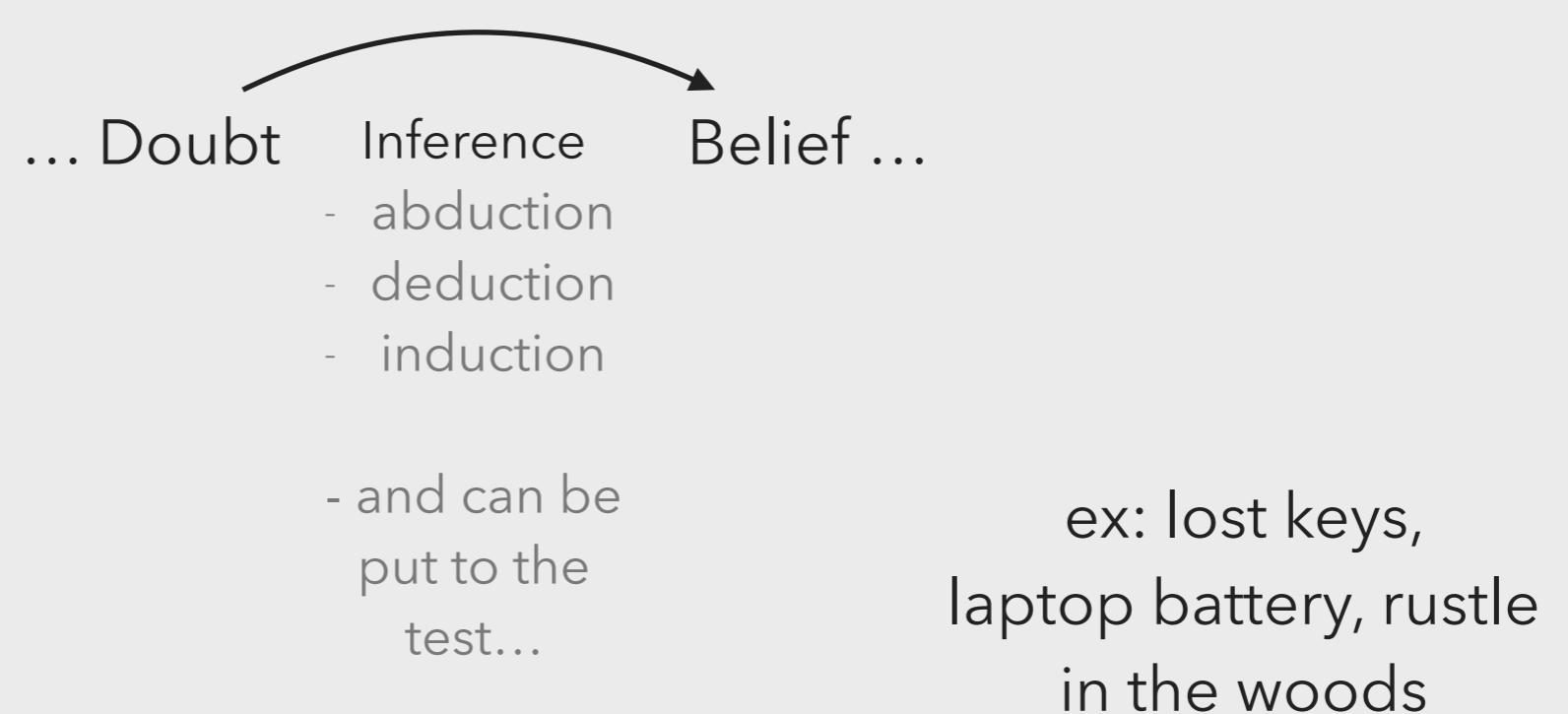
... which can be put to the test in scientific practice...

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Returning to inquiry...



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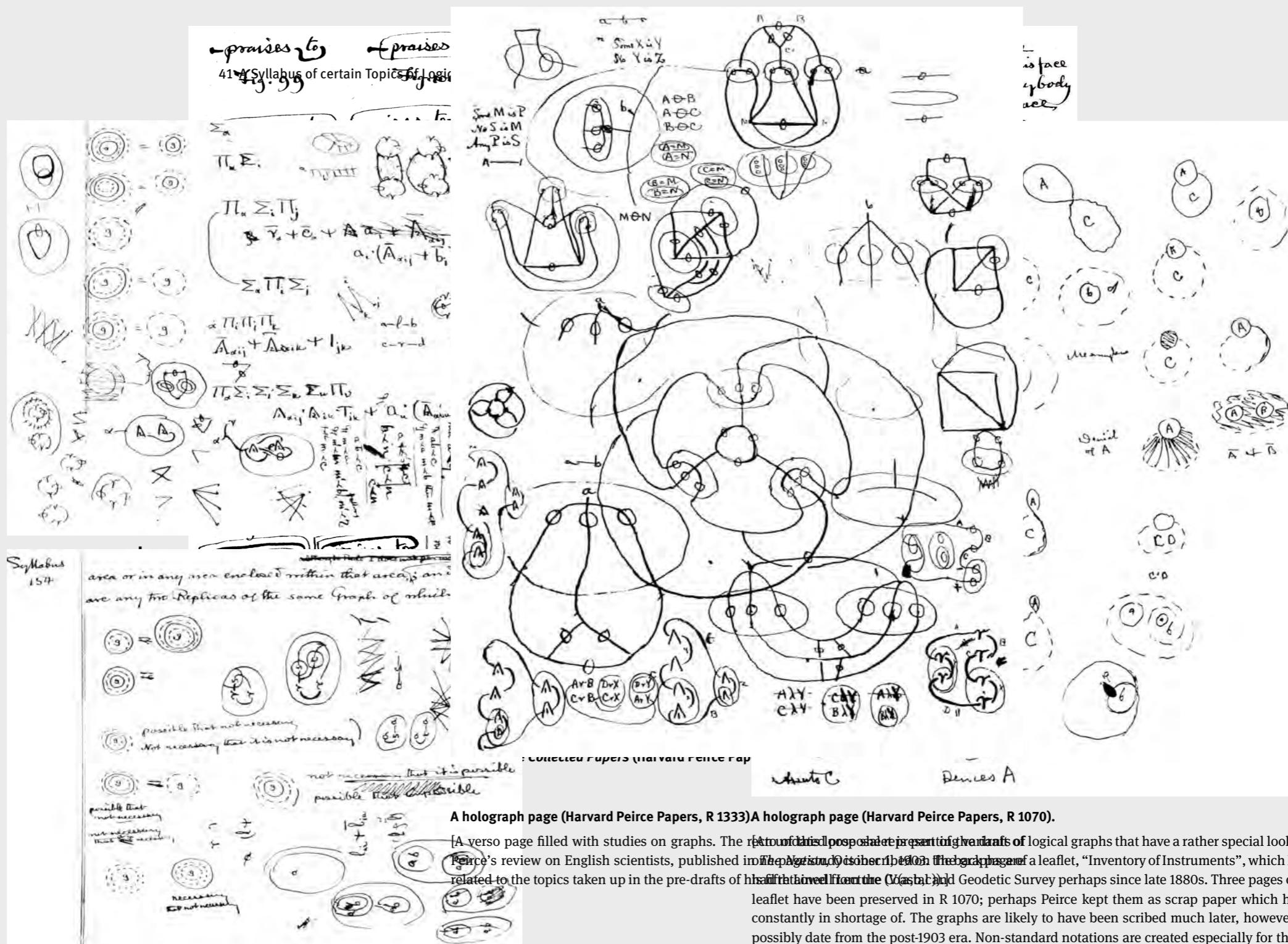


Outline

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- Part 3: Deduction

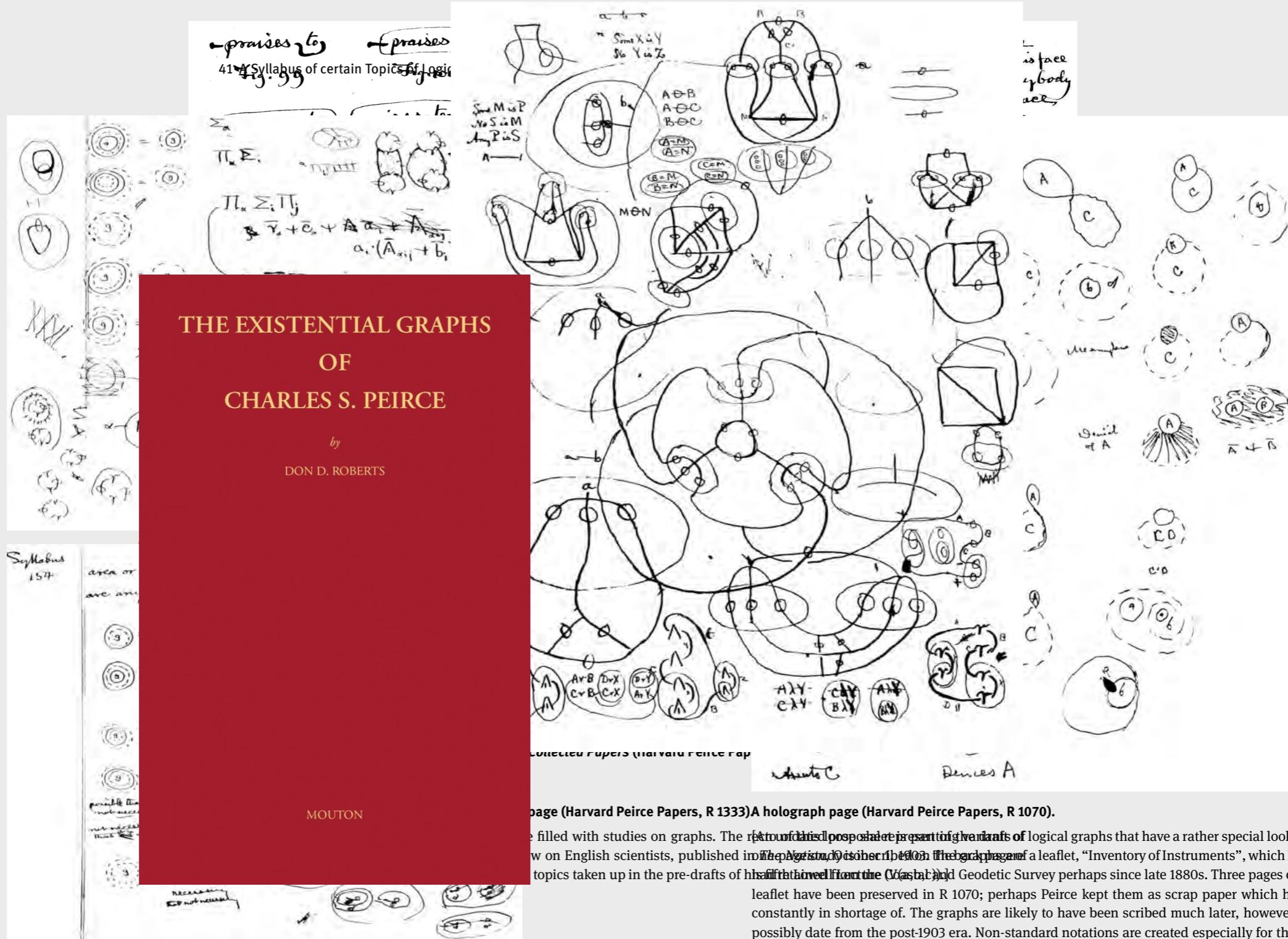
An alternate calculus for the logic of relations...



[Two holograph images (Harvard Peirce Papers, R 478(s)): a reversed verso of an abandoned ms draft page 137 (above) and an abandoned ms draft page 154 (below).]

A holograph page (Harvard Peirce Papers, R 1333) A holograph page (Harvard Peirce Papers, R 1070).

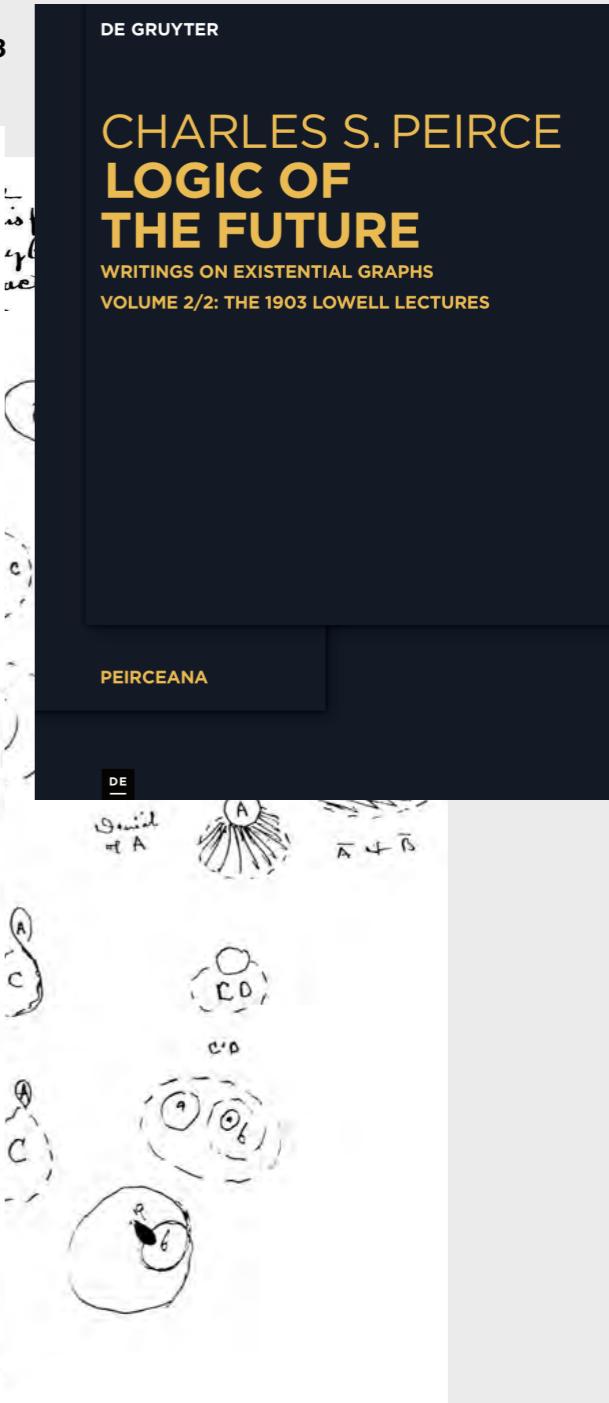
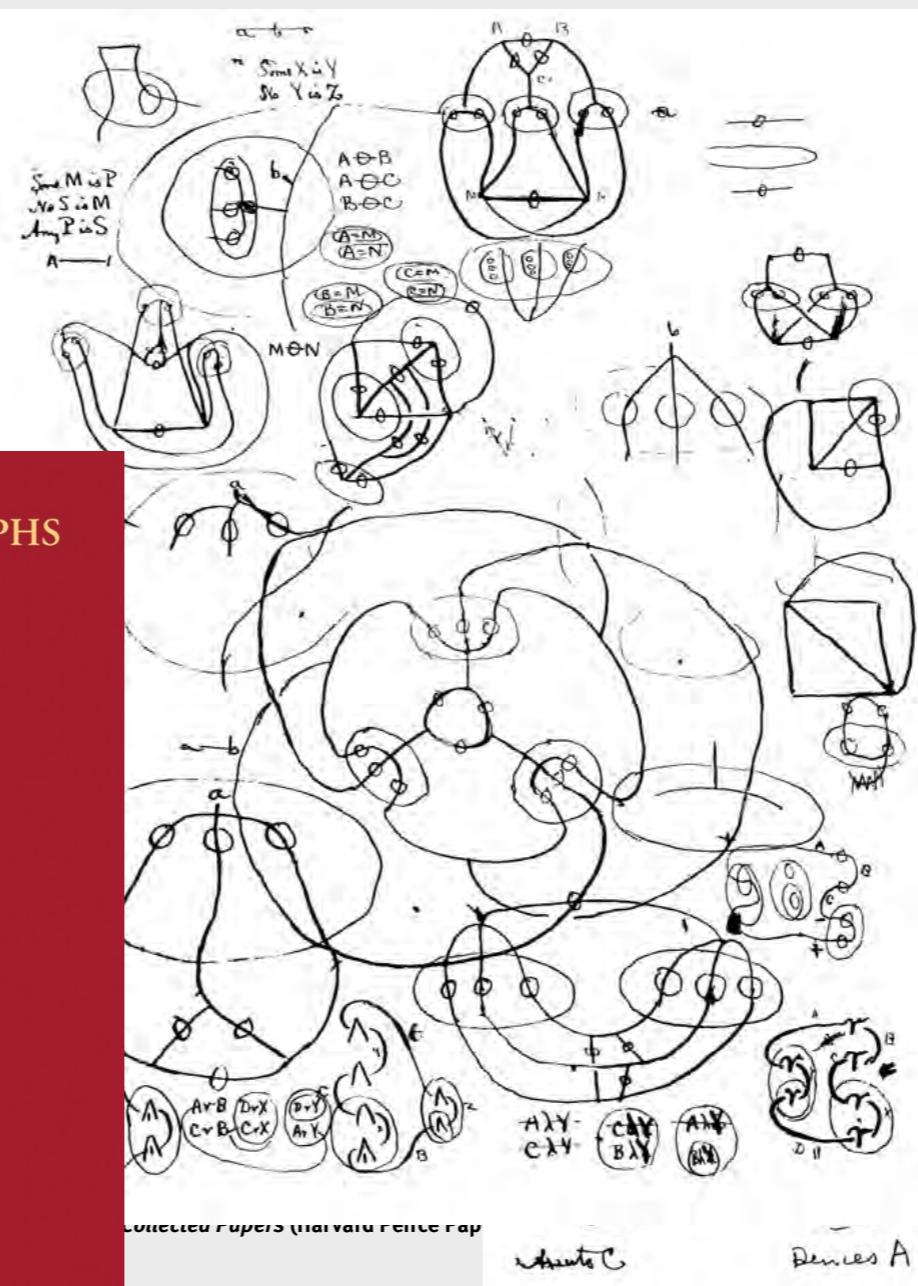
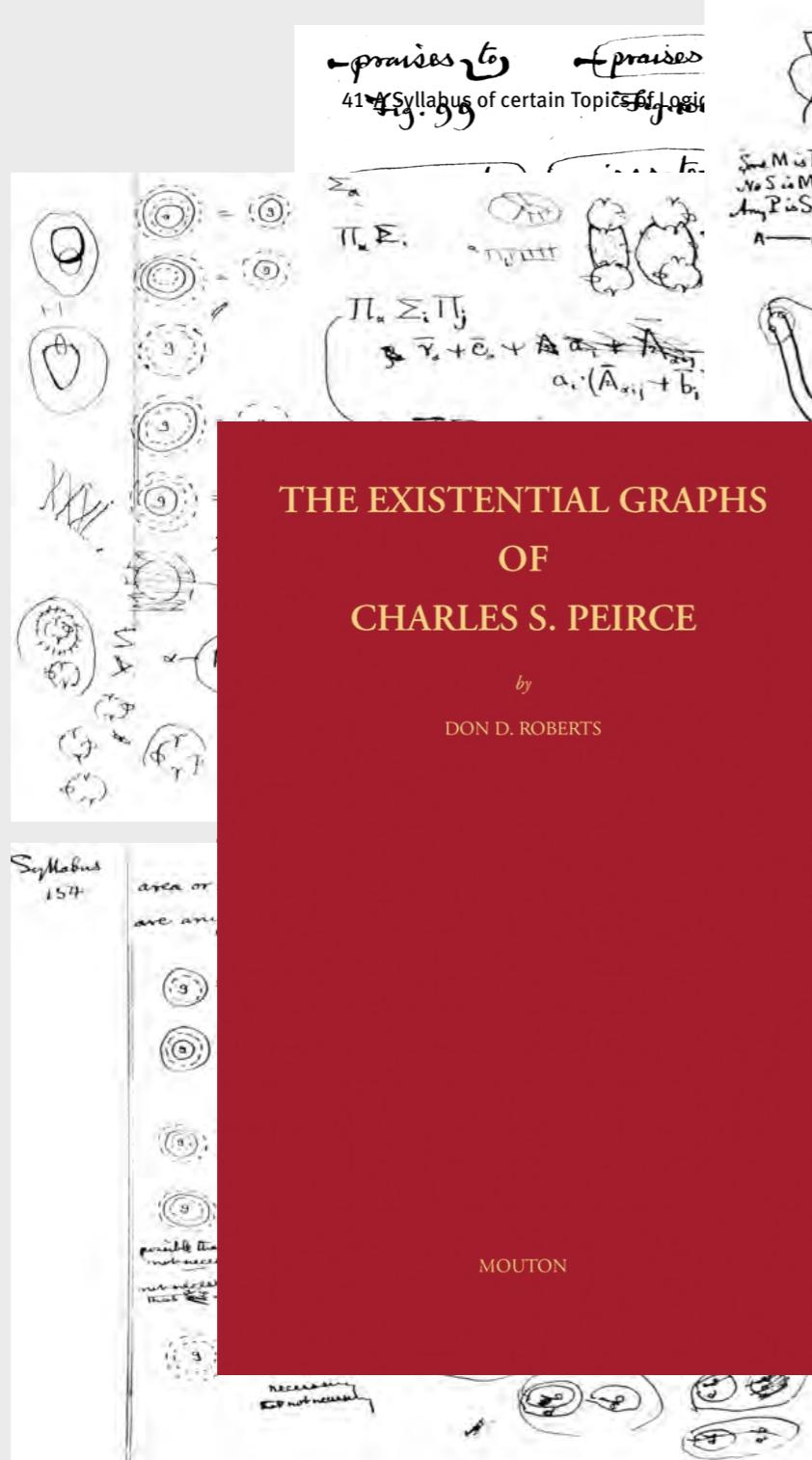
A verso page filled with studies on graphs. The ~~retired and postulate presenting of~~ ~~and~~ ~~of~~ logical graphs that have a rather special look. This Peirce's review on English scientists, published in ~~the~~ ~~and~~ ~~described on the back page~~ ~~of a leaflet, "Inventory of Instruments", which Peirce related to the topics taken up in the pre-drafts of his ~~that~~ ~~and~~ ~~the~~ ~~and~~ Geodetic Survey perhaps since late 1880s. Three pages of that leaflet have been preserved in R 1070; perhaps Peirce kept them as scrap paper which he was constantly in shortage of. The graphs are likely to have been scribed much later, however, and possibly date from the post-1903 era. Non-standard notations are created especially for the blot, thus effecting contradictions ("meaningless") and denials of an assertion, as well as for the scroll, in which the inloops are pulled out from the outloop to form these 8-shapes distinguished from the latter by dashed boundaries. Rules for inserting on the antecedent and erasing from the consequent appear near the bottom left of the page.]~~



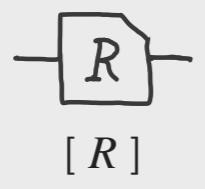
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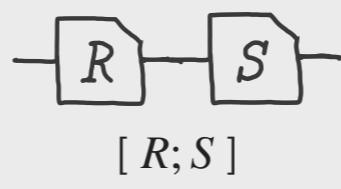
are filled with studies on graphs. The *retrouvez des postes de présentation de graphes logiques* that have a rather special look. This is a page from an English scientist, published in the *Journal des Sciences Physiques et Naturelles* in 1880. The graphs are taken up in the pre-drafts of *Harvard Peirce Papers* (R 1070) and *Geodetic Survey* perhaps since late 1880s. Three pages of that leaflet have been preserved in R 1070; perhaps Peirce kept them as scrap paper which he was constantly in shortage of. The graphs are likely to have been scribed much later, however, and possibly date from the post-1903 era. Non-standard notations are created especially for the blot, thus effecting contradictions ("meaningless") and denials of an assertion, as well as for the scroll, in which the inloops are pulled out from the outloop to form these 8-shapes distinguished from the latter by dashed boundaries. Rules for inserting on the antecedent and erasing from the consequent appear near the bottom left of the page.]



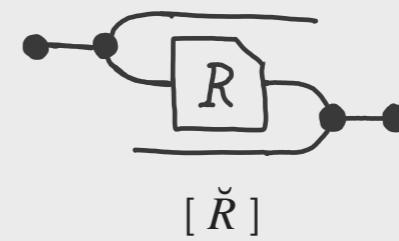
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$[R]$



$[R; S]$

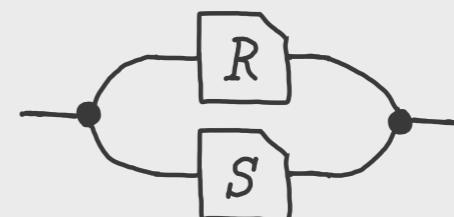


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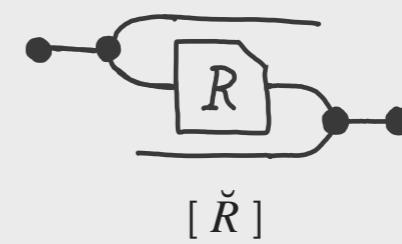
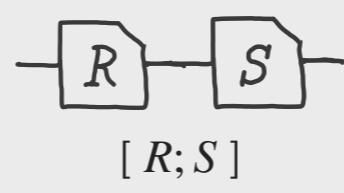
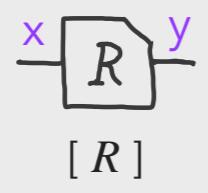
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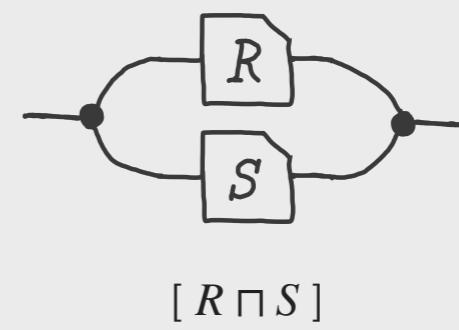
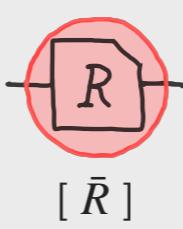
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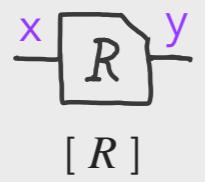
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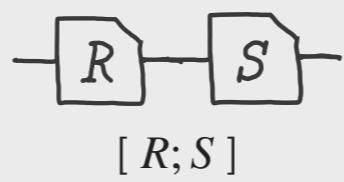
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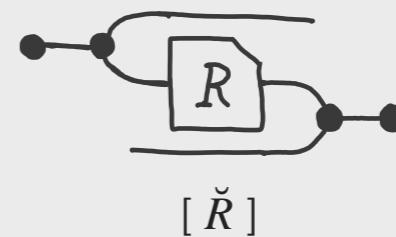
Also: think matrices...



$[R]$

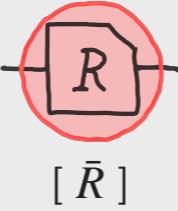


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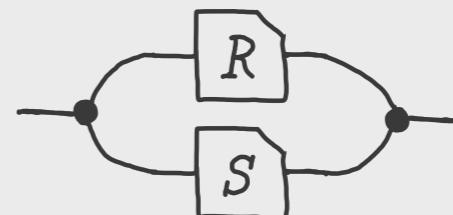


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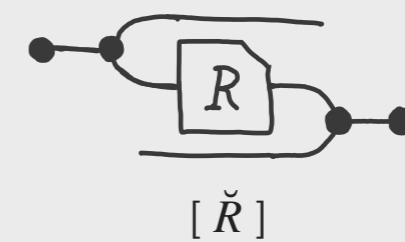
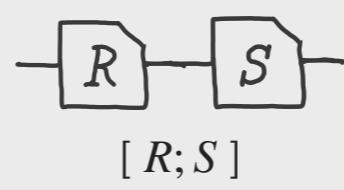
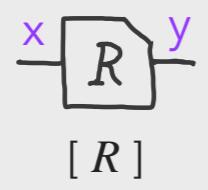
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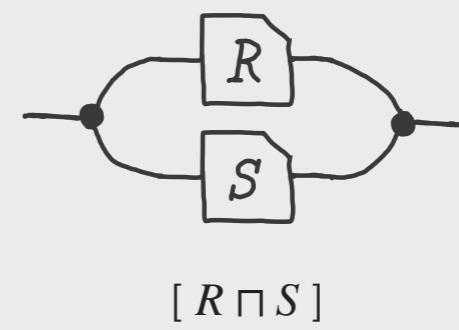
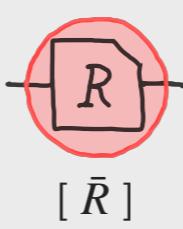
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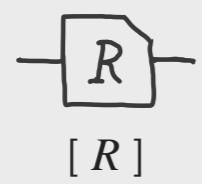


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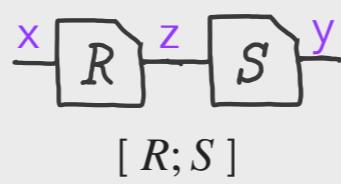


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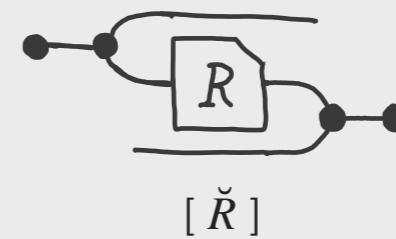




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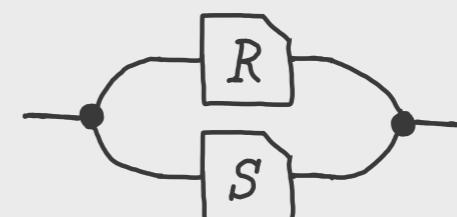


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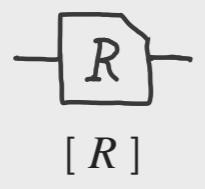
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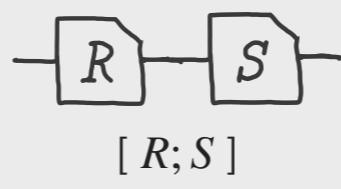
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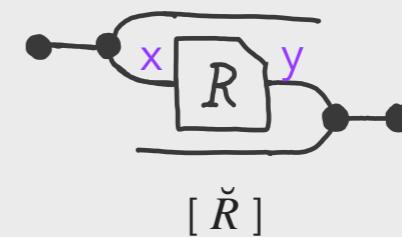
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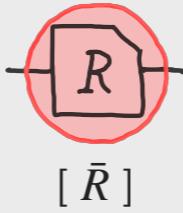


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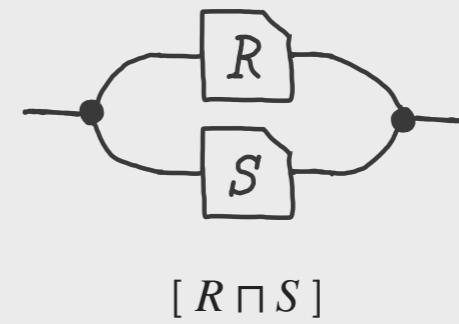


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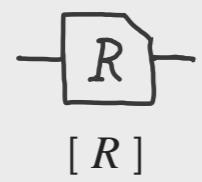
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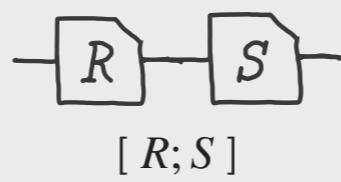
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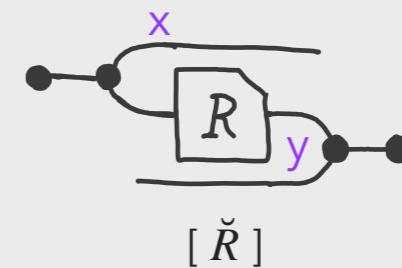
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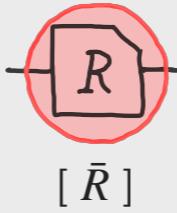


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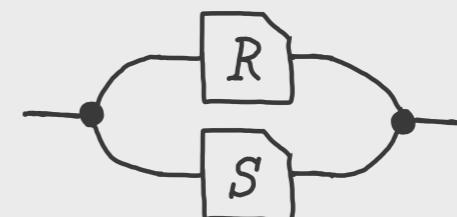


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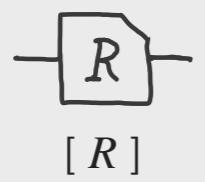
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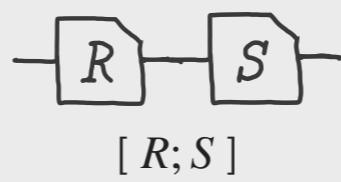
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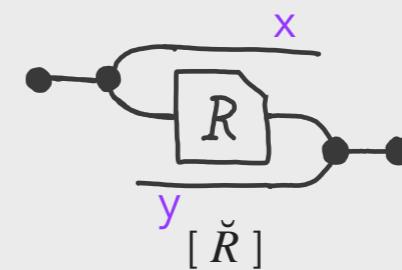
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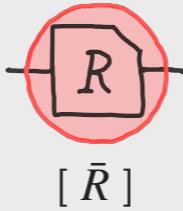


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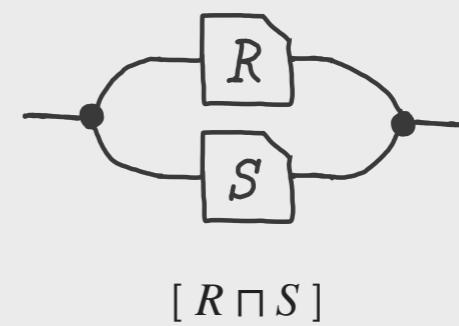


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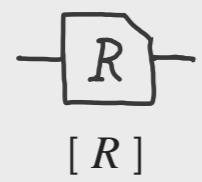
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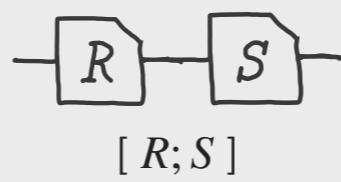
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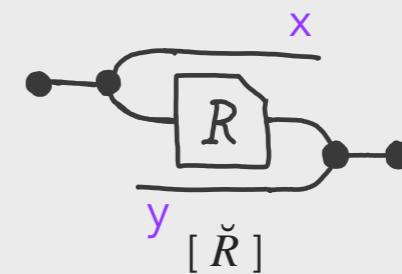
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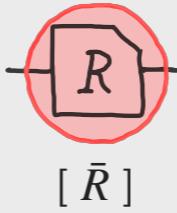
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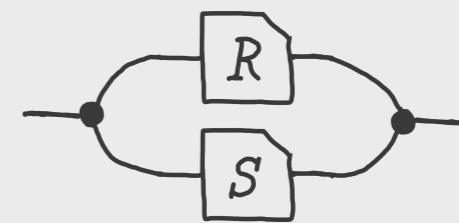
$[R; S]$



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[Identity]



$[\bar{R}]$



$[R \sqcap S]$

[The History of Logic in the 20th century]

[First-Order Logic]

[The History of Logic in the 20th century]

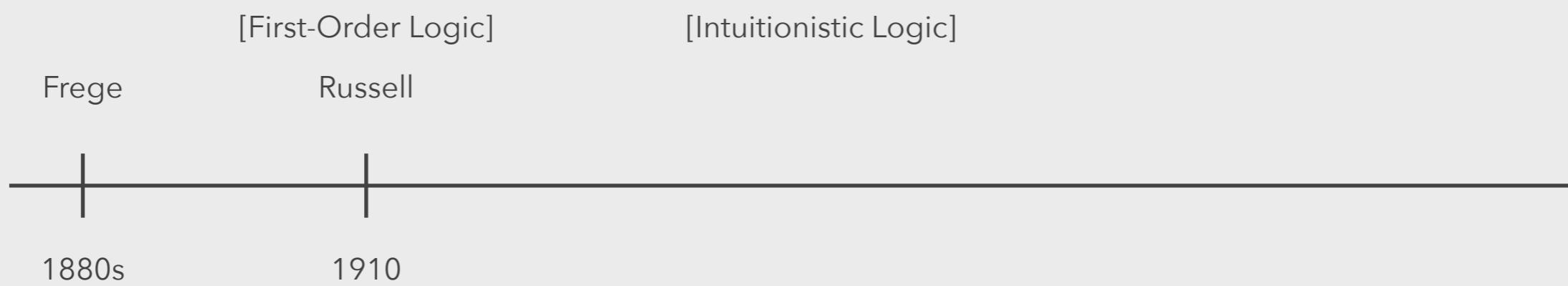
[First-Order Logic]

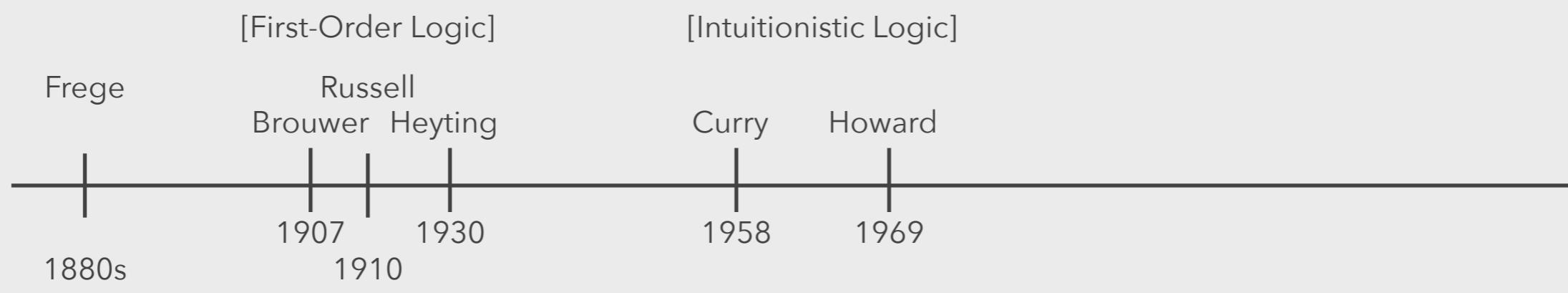
Frege

Russell

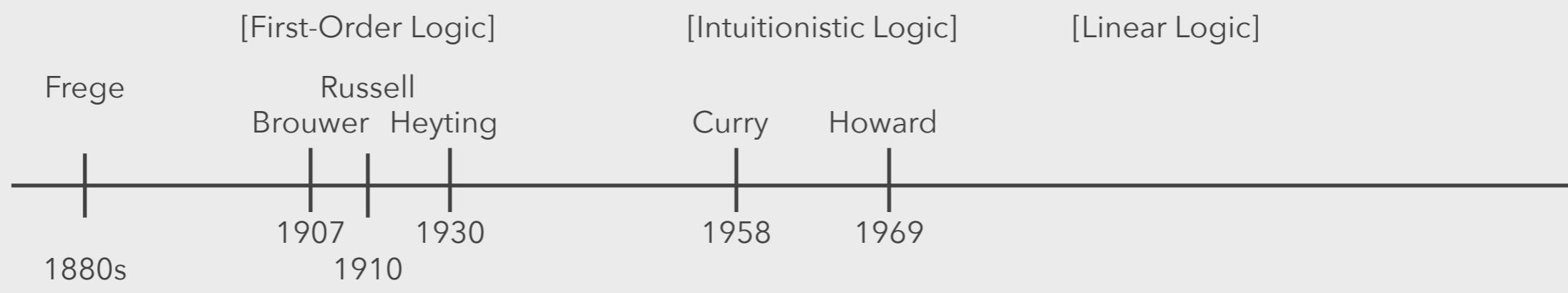


[The History of Logic in the 20th century]

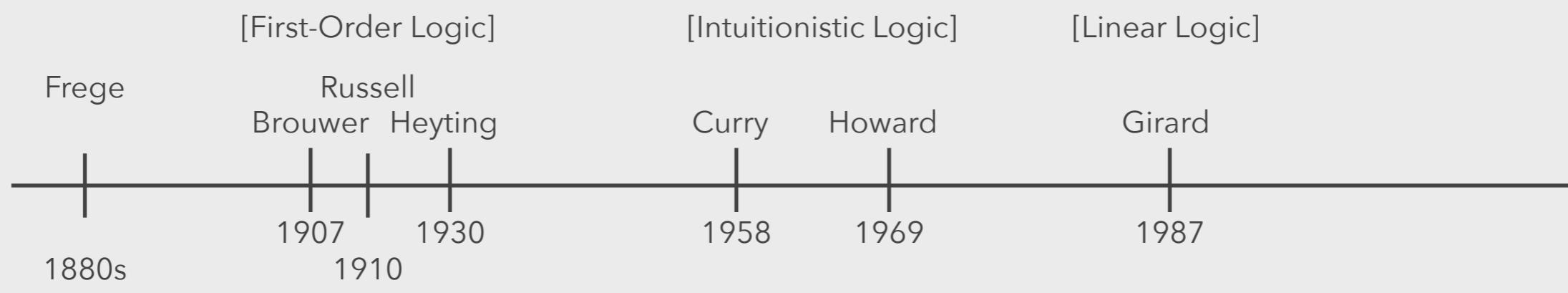




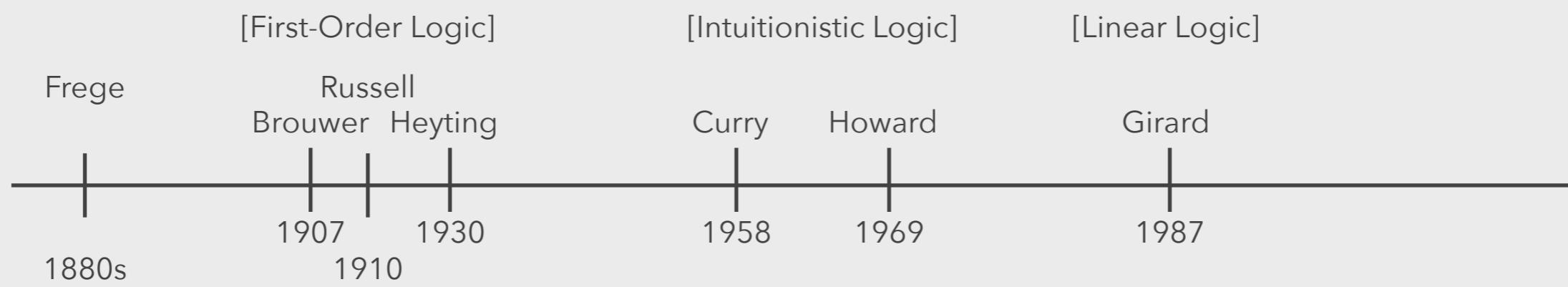
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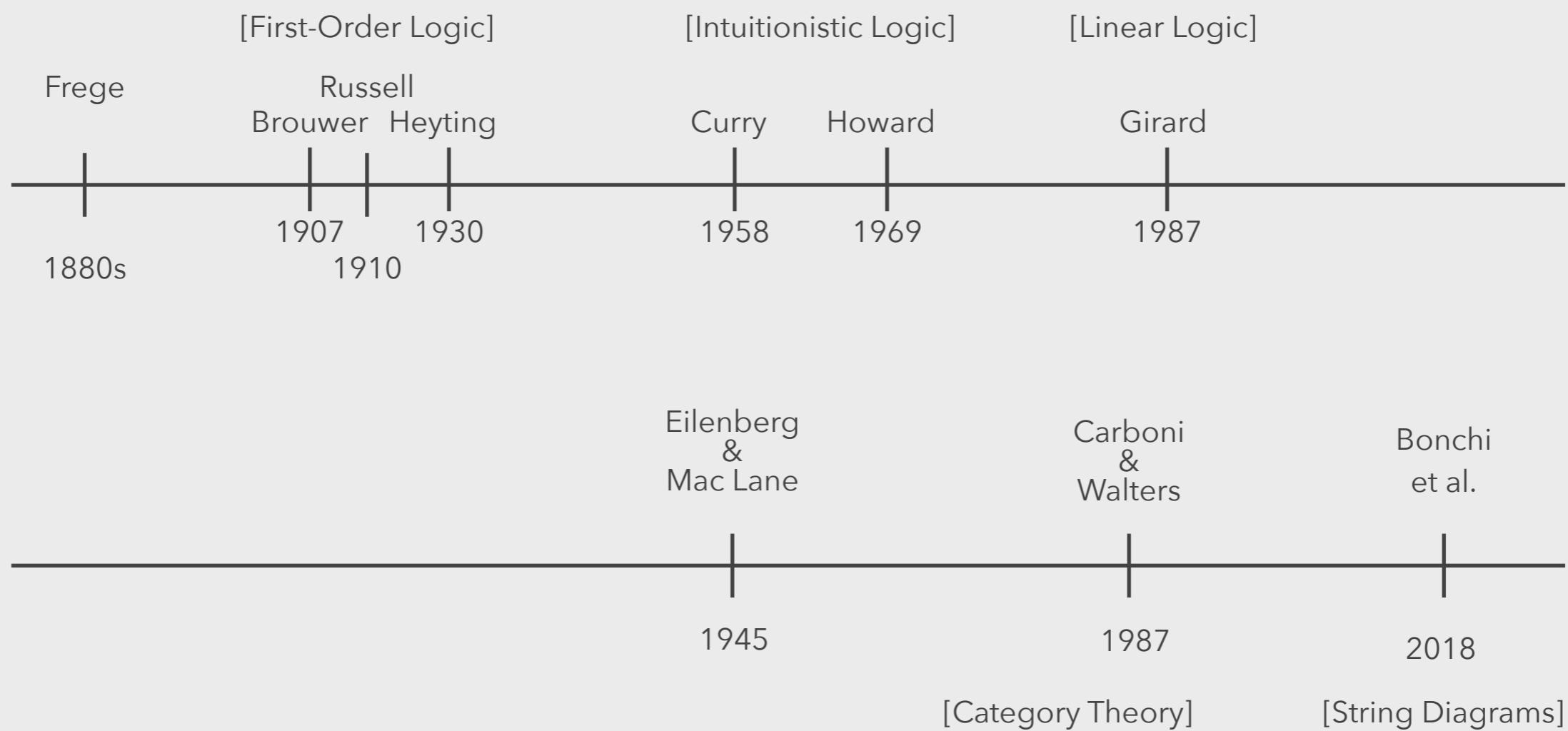


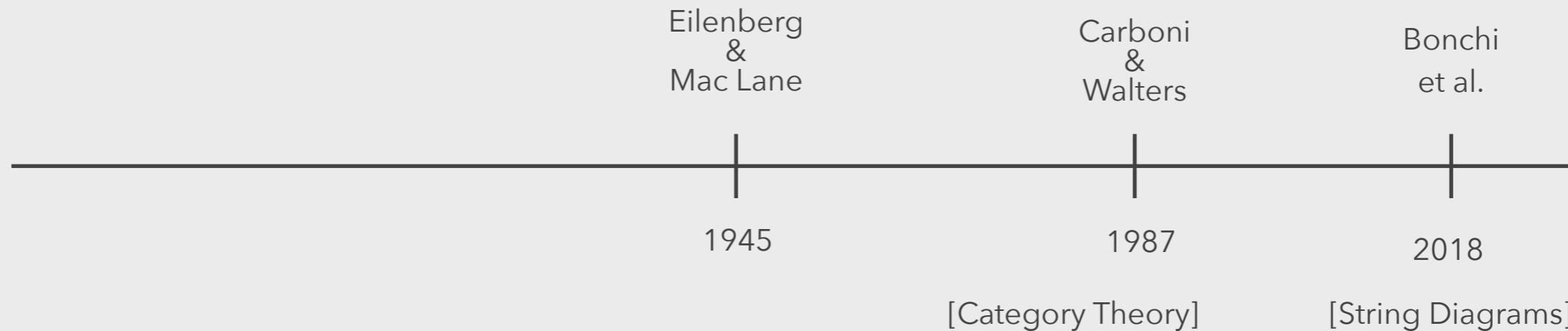
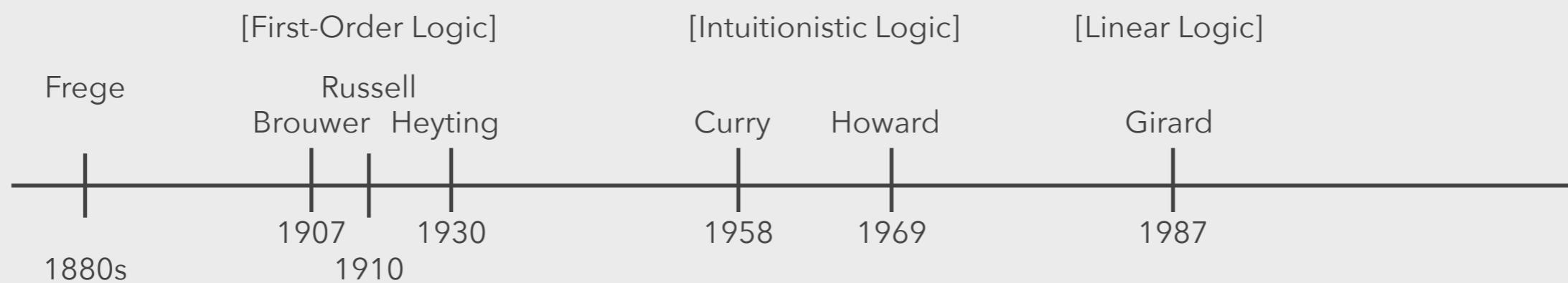
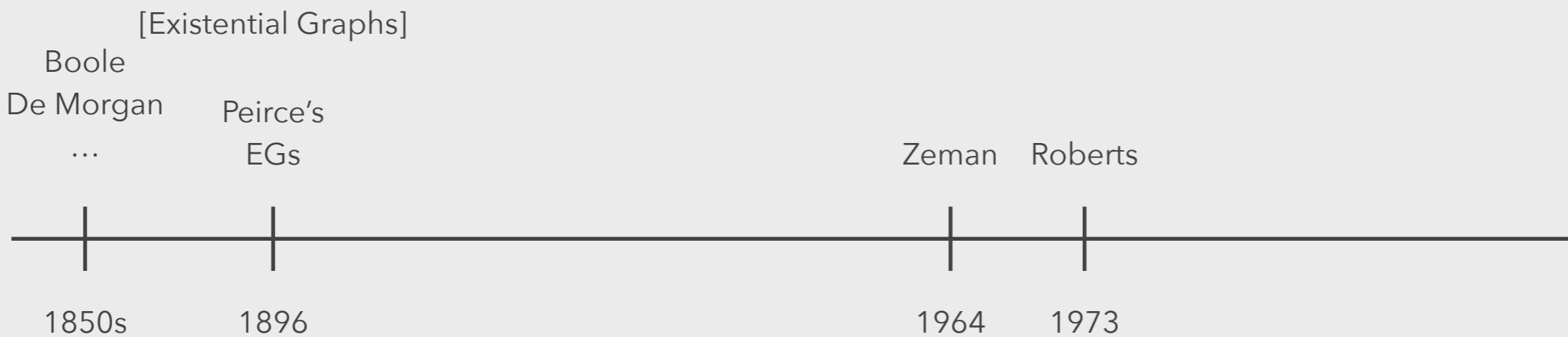
[The History of Logic in the 20th century]

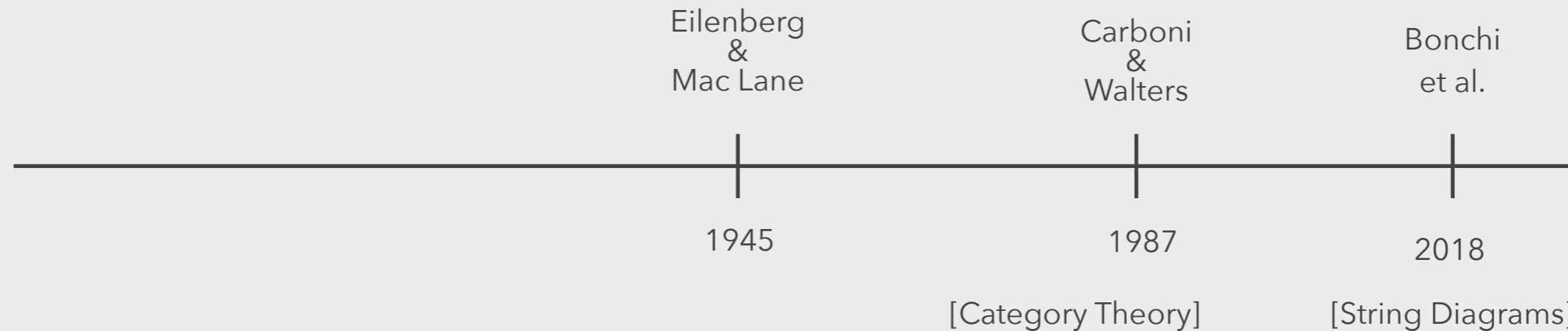
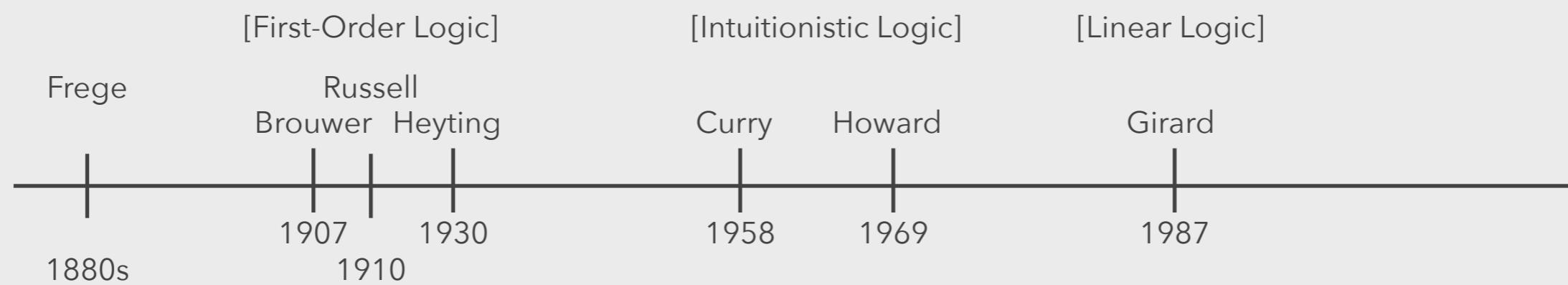


[The History of Logic in the 20th century]









[Algebraic Logic Tradition]

[Existential Graphs]

Boole

De Morgan

Peirce's

...

EGs

[First-Order Logic]

Zeman Roberts



[First-Order Logic]

Frege

Russell

Brouwer Heyting

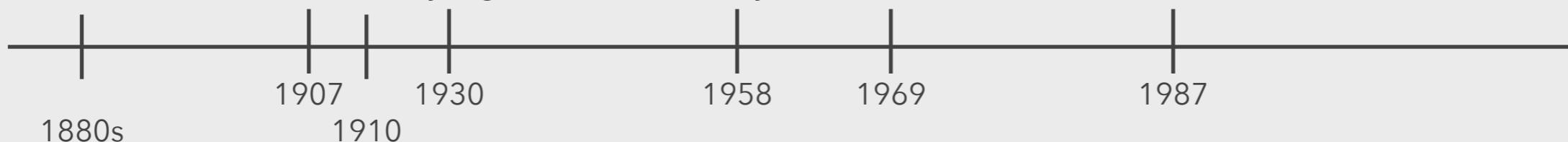
[Intuitionistic Logic]

Curry

Howard

[Linear Logic]

Girard



Eilenberg
&
Mac Lane

Carboni
&
Walters

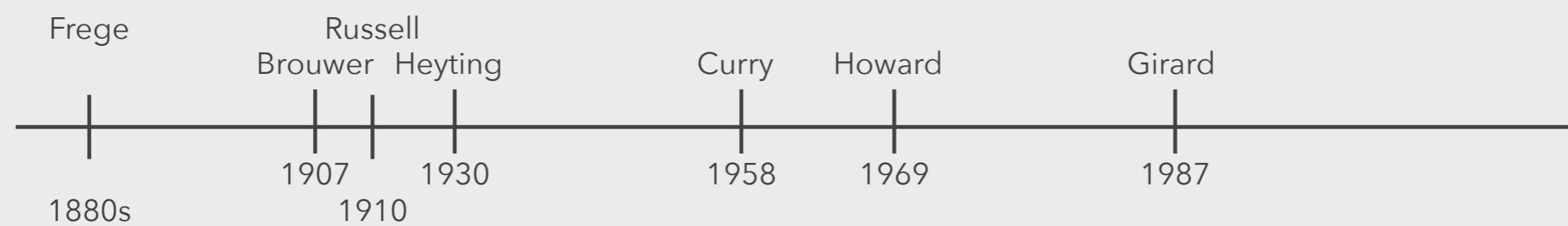
Bonchi
et al.



[Existential Graphs]



[First-Order Logic]



Eilenberg
&
Mac Lane

Carboni
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1945

1987

2018

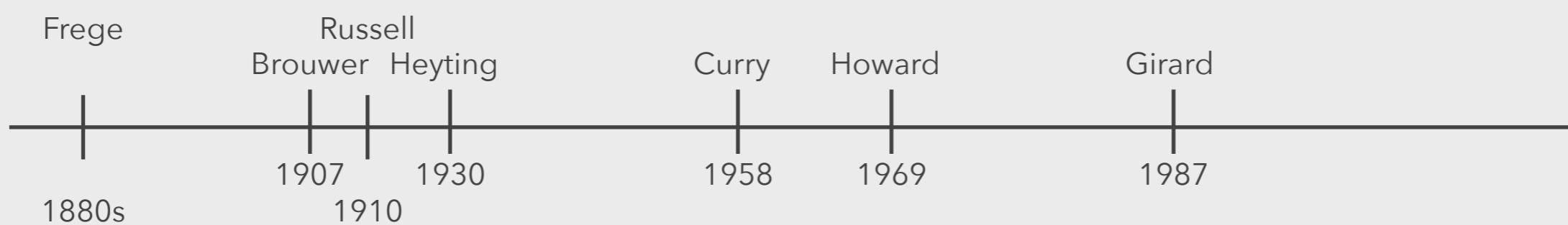
[Category Theory]

[String Diagrams]

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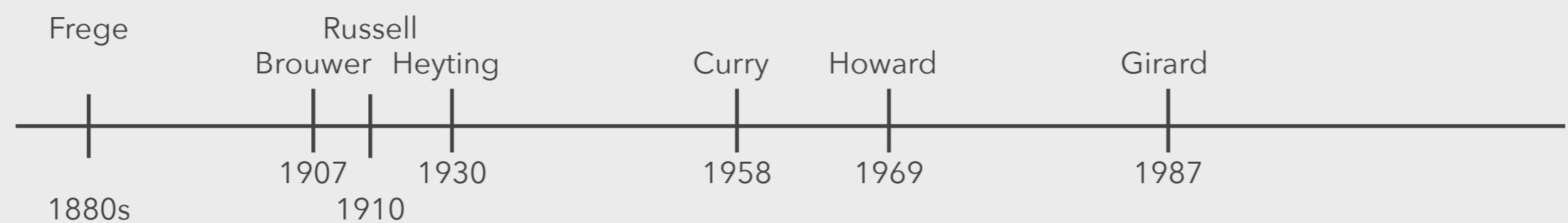
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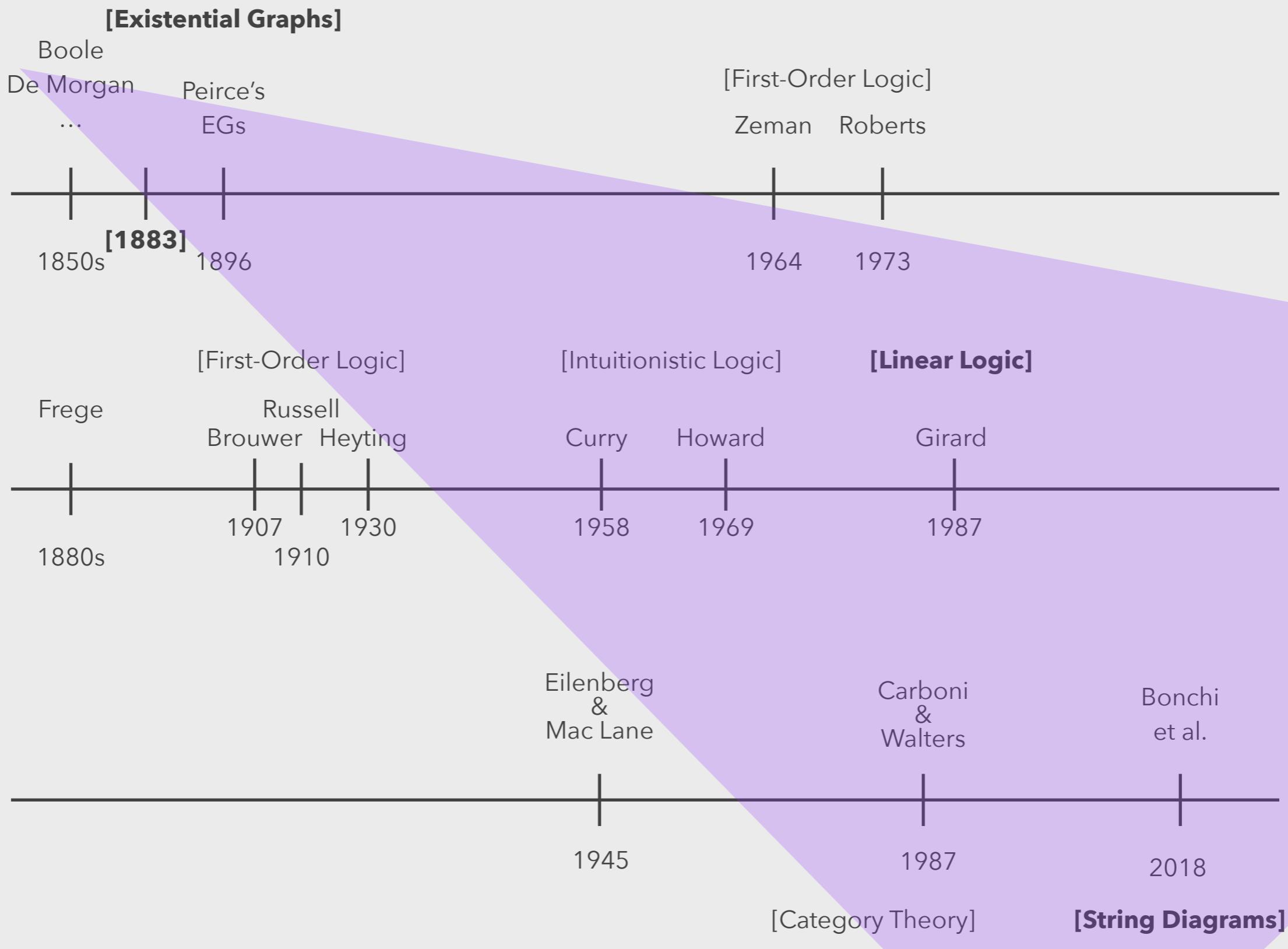
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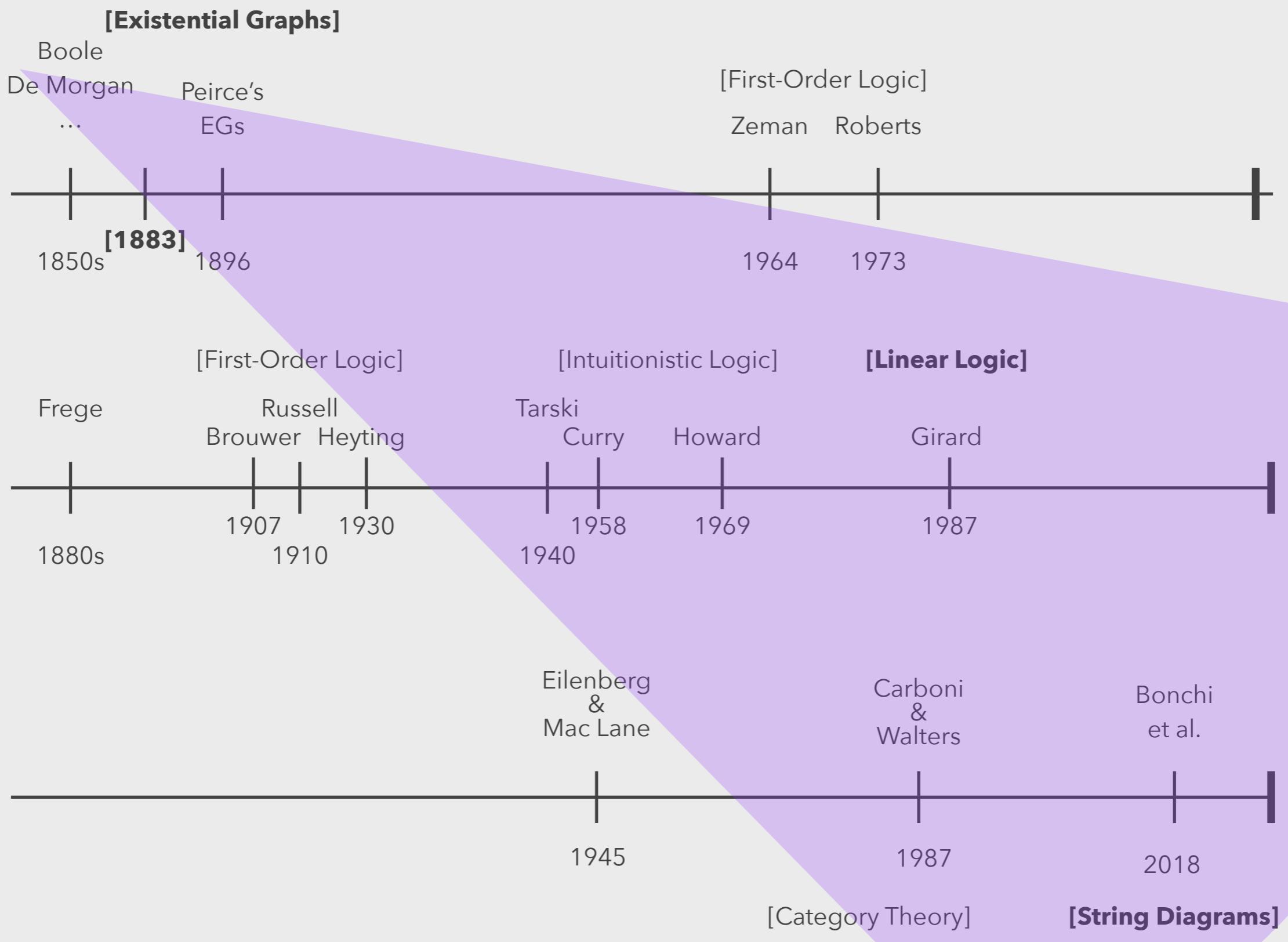
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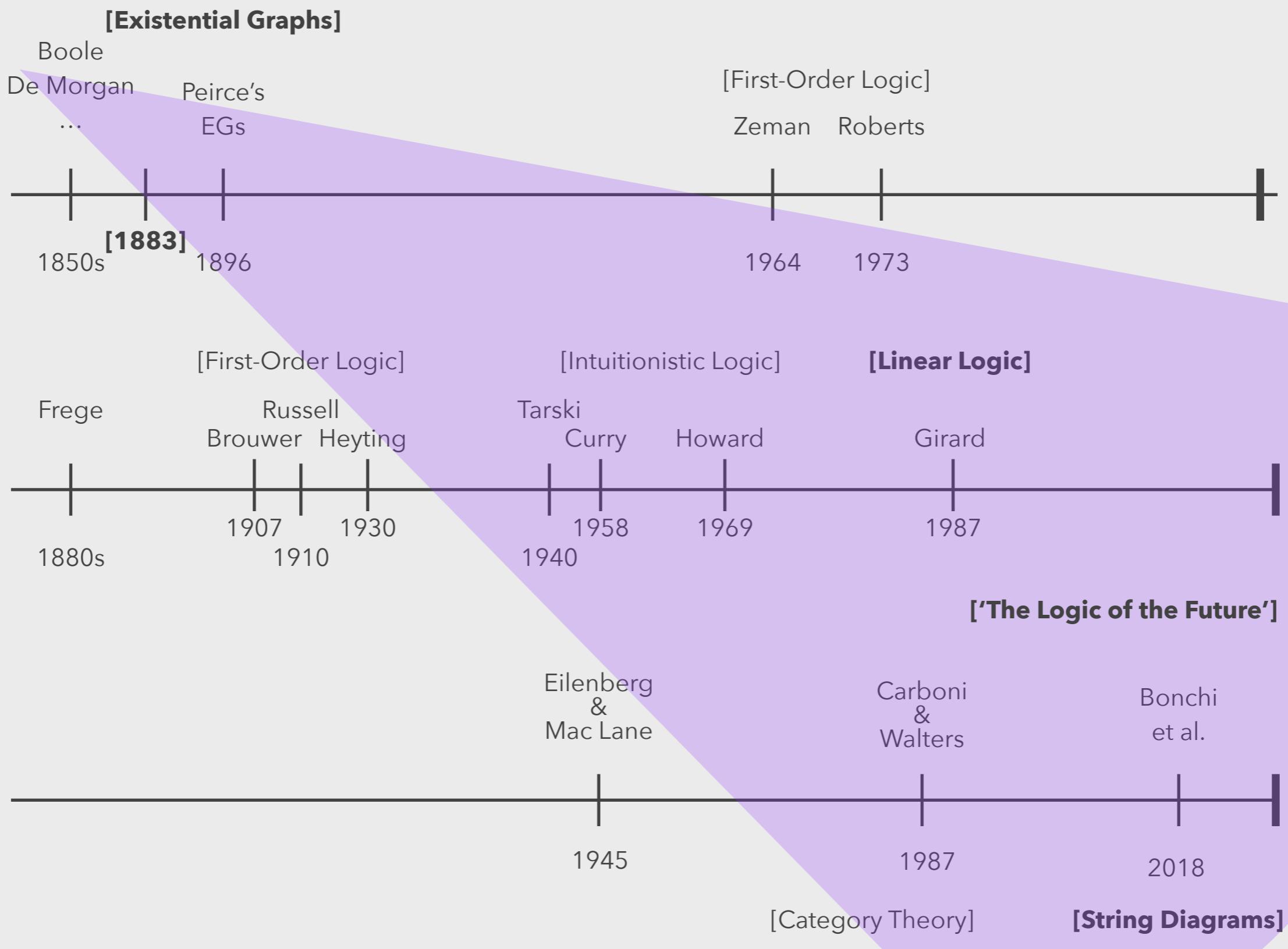
2018

[Category Theory]

[String Diagrams]







Advantages:

- first fully compositional, finite axiomization of first-order logic (FOL),
- fully diagrammatic syntax and inference rules: no complex rules for treating variables, quantifier-free,
- sufficient for foundation of mathematics,
- comes with encodings into Tarski's relation algebra, queries in relational databases...

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While the calculus is sufficient for classical FOL, its building blocks are not!

The closest extant theory is *classical (cyclic) bilinear logic*.

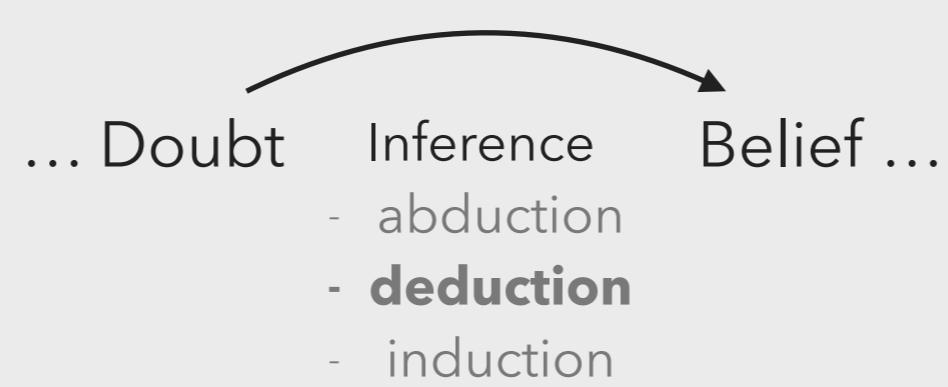
This setting is significant to the evolution of quantum systems, causality, and natural language.

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Outline

- Part 1: Theory of Inquiry
- Part 2: Concepts in experience
- Part 3: Deduction
- Part 4: Semiotics

- Part 4: Semiotics

We eventually want to discuss 'icon', 'index', and 'symbol'...

... but I want to begin elsewhere...

... with you daydreaming at your desk.

Peirce's 'What is a Sign?'

... with you daydreaming at your desk.

(Unmediated)
Experience

Stream of Feeling

Stream of Behavior

Stream of Thought

Daydreaming...

(Unmediated) Experience	(Unmediated) Reaction <i>[surprise: horn]</i>	
Stream of Feeling	compulsive Feeling	
Stream of Behavior	compulsive Behavior	
Stream of Thought	compulsive Thought	

Daydreaming...

(Unmediated) Experience	(Unmediated) Reaction [surprise: horn]	
Stream of Feeling	compulsive Feeling [loud]	
Stream of Behavior	compulsive Behavior [cover ears]	
Stream of Thought	compulsive Thought [close window]	

Daydreaming...

(Unmediated) Experience	(Unmediated) Reaction [surprise: horn]	(Unmediated) Thought [surprise: 'horn']
Stream of Feeling	compulsive Feeling [loud]	Likeness to...
Stream of Behavior	compulsive Behavior [cover ears]	Indication of...
Stream of Thought	compulsive Thought [close window]	Symbol for...

Daydreaming...

(Unmediated) Experience	(Unmediated) Reaction [surprise: horn]	(Unmediated) Thought [surprise: 'horn']
Stream of Feeling	compulsive Feeling [loud]	Likeness to... ['car horn']
Stream of Behavior	compulsive Behavior [cover ears]	Indication of... ['traffic', 'road work']
Stream of Thought	compulsive Thought [close window]	Symbol for... ['construction tax', 'danger']

Daydreaming...

... could leave it here.