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INQUIRY AND SCIENTIFIC METHOD IN PEIRCE'S PHILOSOPHY

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SCIENCE AS A NATURAL OBJECT

Teleological definition (*definitio in fine*) *c.* 1902:

"A science is defined by its problem; and its problem is clearly formulated on the basis of abstracter science. This is all I intended to say here concerning classification, in general."

The only way to classify sciences is by examining how they can mutually generate one another. So, we can explain their *ends*: which problems are to be resolved, i.e., what problem is aimed at in *practice*, and not only *in theory.*

PEIRCE'S CLASSIFICATION OF THEORETIC SCIENCES

A. ***branch***: theoretic science

A.1. ***Sub-branch***: science of discovery, or *heuretic science*

A.1.1. ***Class***: mathematics

A.1.1.i. ***Subclass***: mathematics of logic

A.1.1.ii. ***Subclass***: mathematics of discrete series

A.1.1.iii. ***Subclass***: mathematics of *continua* and *pseudocontinua*

A.1.2. ***Class***: philosophy, or *cenoscopy*

A.1.2.i. ***Subclass***: categorics, phenomenology or *phaneroscopy*

A.1.2.ii. ***Subclass***: normative sciences

A.1.2.ii.a. ***Order***: esthetics

A.1.2.ii.b. ***Order***: ethics

A.1.2.ii.c. Order: logic or semeiotic

A.1.2.iii. ***Subclass***: metaphysics

A.1.3. ***Class***: special science, or *idioscopy*

LOGIC AS SEMEIOTIC

Logic, in its general sense, is, as I believe I have shown, only another name for *semiotic* (*semeiotikê*), the *quasi*-necessary, or formal, doctrine of signs. By describing the doctrine as "quasi-necessary," or formal, I mean that we observe the characters of such signs as we know, and from such an observation, by a process which I will not object to naming Abstraction, we are led to statements, eminently fallible, and therefore in one sense by no means necessary, as to what *must be* the characters of all signs used by a "scientific" intelligence, that is to say, by an intelligence capable of learning by experience.

CP 2.227, c. 1897.

The science of *semeiotic* is the cenoscopic science of signs, that is, the science that aims at examining how can signs have meaning, how meaning can be true, and how can signs produce interpretations – *in general*.

PARTS OF SEMIOTIC

Speculative or **pure grammar**: studies the general conditions of signs having a significant character, or the relations of signs to themselves (*how* does a sign signify?; “syntax”; purely formal conditions of meaning).

Logic proper or **specific** or **critical logic**: the theory of truth conditions, studies the sign-object relation (*what* does a sign signify?; “semantics”).

Speculative or **pure rhetoric**: studies relations of interpretation among signs (how can a sign *generate* another?; “pragmatics”; effective use of signs)

WHAT IS A *SIGN*?

This is the question answered by *Speculative Grammar.*

"I define a *Sign* as anything which on the one hand is so determined by an Object and on the other hand so determines an idea in a person's mind, that this latter determination, which I term the *Interpretant* of the Sign, is thereby mediately determined by that Object. A Sign, therefore, has a triadic relation to its Object and to its Interpretant."

Letter to Lady Welby, 24-28 Dec 1908,
EP 2: 482.

HOW DO WE THINK WITH SIGNS? THIS IS THE OBJECT OF *CRITICAL LOGIC*: BY REASONING IN CERTAIN WAYS.

Deduction: to infer a *result* from a *rule* and a specific *case*.	**Induction: to infer a general *rule* from a specific *case* and a *result*.**	**Hypothesis: to infer a specific *case* from a *result* and a *rule*.**
Rule: All men are mortal.	Case: Peirce is a man.	Result: Peirce is mortal.
Case: Peirce is a man.	Result: Peirce is mortal.	Rule: If all men are mortal, then Peirce is a man.
Result: Peirce is mortal.	Rule: All men are mortal.	Case: Peirce is a man.

HOW DO WE USE REASONINGS TO DEAL WITH THE WORLD?

This is the question of *methodeutics*, or *pure rhetorics*: by applying forms of reasonings as a map to guide us among facts.

“Why do we want to be logical? Because we want our thoughts to be representations of facts.”

W 1: 166, 1865.

THE "PRAGMATIC MAXIM"

"Consider what effects, that might conceivably have practical bearings, we conceive the object of our conception to have. Then, our conception of these effects is the whole of our conception of the object."

"How to make our ideas clear", 1878 [W 3: 266].

"… Pragmatism whatever it may be is nothing else than the true Logic of Abduction."

"The nature of meaning", 1903 [EP 2: 224].

DEDUCTION

Deduction: form of reasoning that passes from contingency to necessity; not ampliative, it only draws necessary conclusions from premises. NOTA BENE: the *universe of discourse* in the conclusion is smaller than in the premises, according to the Law of Contradiction.

There are two forms of deduction:

- ***Probable deduction*** is necessary reasoning with probabilities. Nothing new is established.
- ***Necessary deduction*** establishes necessary conclusions without working with probabilities.

Relative to the formation of hypotheses, deduction caracterizes the ***second stage*** of scientific inquiry, that of tracing out the consequences of our guesses.

INDUCTION

Induction: form of reasoning that *defines* the domain of objective validity of our terms. Peirce links it with "verification", "testing", "validation", etc. The aim of inductive reasoning in science is to determine the degree of validity of hypotheses or theories by successive applications in the long run. So, it is a *self-corrective* method. Inductions do not *amplify* the universe of discourse. So, as deductions, inductions also do not possess heuretic power.

THREE KINDS OF INDUCTION

- ***Crude***: the weakest and simplest kind, called *inductio per semplice enumerationem* (Bacon's and Hume's models, strongly based upon past experience);
- ***Quantitative***: or statistical inference, according to which the value of a sample is approximately the value of the whole class, or the real probability in question;
- ***Qualitative***: or *adduction*, "it tests a hypothesis by sampling the possible predictions that can be based upon it". Thereby, it *adduces* evidence to strengthen hypothesis.

THE DIFFERENCE BETWEEN THE THREE KINDS OF INDUCTION IS ONLY IN *METHOD*, NOT IN LOGICAL FORM

• In *crude* induction, we begin with what we have in experience, so the selected samples are not totally random.
• In *quantitative* induction, we begin with a previous hypothesis, proceeding next to random selection. The nature of the predicted class in submitted to inquiry for some hypothetical reason.
•In *qualitative* induction, we do not rely upon past experience, nor upon the experience of a definite collection of enumerable cases of equal evidential value, rather we rely upon a *stream of experience* of different parts, whose evidential value has to be estimated.

Compare:

LOGICAL FORMS OF *NECESSARY DEDUCTION* AND *CRUDE INDUCTION*

Necessary deduction	Crude induction
I. All A are B.	III. *x*, *y*, *z* are B.
II. *x*, *y*, *z* (etc.) are A.	II. *x*, *y*, *z* (etc.) are A.
∴ III. *x*, *y*, *z* are B.	∴ I. All A are B.

PROBABLE DEDUCTION **AND** *QUANTITATIVE INDUCTION*

Probable deduction	Quantitative induction
I. n% of A are B.	III. n% of *x*, *y*, *z* are B.
II. *x*, *y*, *z* (etc.) are A.	II. *x*, *y*, *z* (etc.) are A.
∴ III. n% of *x*, *y*, *z* are B.	∴ I. . n% of A are B.

NECESSARY DEDUCTION **AND** *QUALITATIVE INDUCTION*

Necessary deduction Qualitative induction

I. All A are B.

II. *x*, *y*, *z* (etc.) are A.

∴ III. *x*, *y*, *z* are B.

I. . All A are B.

III. *x*, *y*, *z* are B.

∴ II. *x*, *y*, *z* (etc.) are A.

INDUCTION AS SELF-CORRECTIVE AND FALLIBILISM

Self-correction of possible errors in inductive processes mean that in the long run a genuine representative relation would be established between sample and universe of sampling.

Peirce was a *fallibilist* and an *ontological indeterminist*: absolute exactness and final truths are unjustified in science. Pure chance is objectively real. So, considering what can be called *vector of approximation to truth* – something that manifests itself in an evolutive process of theories and is correlate to the idea of a *final semiotic interpretant* – the process of correcting errors is never totally complete.

INDUCTION LEADS TO OTHER PHASES OF INQUIRY

Induction is experimental substantiation of theories, the means by which we test what we know. In general, inductive experimentation can lead to three situations:

"… the hypothesis is sensibly correct, or requires some inessential modification, or must be entirely rejected."

"A Neglected Argument for the Reality of God", 1908 [EP 2: 442].

Induction characterizes the ***third stage*** of scientific inquiry. Through induction theories are confronted with experience. Inductive reasoning is crucial for the parametric acceptance, correction or rejection of the semiotic system of our model for predictive representation of phenomena.

BUT ONLY *ABDUCTION* LEADS TO DISCOVERY

Observe that neither Deduction nor Induction contributes the smallest positive item to the final conclusion of the inquiry. They render the indefinite definite; Deduction explicates; Induction evaluates: that is all.

"A Neglected Argument for the Reality of God", 1908 [EP 2: 442].

HARVARD LECTURES ON PRAGMATISM (1903)

Long before I first classed abduction as an inference it was recognized by logicians that the operation of adopting an explanatory hypothesis - which is just what abduction is - was subject to certain conditions. Namely, the hypothesis cannot be admitted, even as a hypothesis, unless it be supposed that it would account for the facts or some of them. The form of inference, therefore, is this:

The surprising fact, C, is observed;
But if A were true, C would be a matter of course.
Hence, there is reason to suspect that A is true.

Thus, A cannot be abductively inferred, or if you prefer the expression, cannot be abductively conjectured until its entire content is already present in the premiss [*sic*], 'If A were true, C would be a matter of course.'

"Pragmatism as the logic of abduction", 1903 [EP 2: 231].

AFFIRMING THE CONSEQUENT IS VALID IN INQUIRY

Abduction has the form of a deductive fallacy – affirming the consequent. Thus, it is the most fallible form of reasoning, possessing no logical validity, but plenty of heuristic power.

$$\frac{A \rightarrow C \quad C}{A}$$

The suggestion of the explanatory power of the hypothesis compels us to believe or at least to consider its truth. The hypothesis explains phenomena otherwise incomprehensible by relating them with already known facts. It introduces a *counterfactual*, thereby making it possible to *predict* similar events. Therefore, abduction characterizes the ***first stage*** of scientific inquiry.

THE THREE KINDS OF REASONING TOGETHER

Abduction is the process of forming an explanatory hypothesis. It is the only logical operation which introduces any new idea; for induction does nothing but determine a value, and deduction merely evolves the necessary consequences of a pure hypothesis.

"The nature of meaning", 1903 [EP 2: 216].

OBRIGADO!

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