“Should Kant have thought that logic was complete since Aristotle?”

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14 April 2012
“[S]ince the time of Aristotle [logic] has not had to go a single step backwards, unless we count the abolition of a few dispensable subtleties or the more distinct determination of its presentation, which improvements belong more to the elegance than to the security of that science. What is further remarkable about logic is that until now it has also been unable to take a single step forward, and therefore seems to all appearance to be finished and complete.” (Bviii)

Couturat calls Kant’s attitude "ultraconservative," and “almost reactionary" (Philosophical Principles of Mathematics, 320-1)
What must strike a person with modern training most frequently in considering Kant’s outlook on logic is the limitation of his knowledge of and conception of it. Kant learned and taught the established logical lore at a very uncreative time in the history of the subject…Kant not only had very limited technical resources at his command; what is more striking and more damaging to his standing as a philosopher, he was largely satisfied with logic as he found it. Technically he could hardly in any case have gone far beyond the state of the science in his own time, and he was not a creative mathematician. But what would have been needed for Kant to be dissatisfied with ‘traditional logic’ might only have been more insight into his own discoveries. (“Kant’s Philosophy of Arithmetic,” 17)

But what does Parsons mean?
Ernst Cassirer ("Kant und die moderne Mathematik" 1907, 35-6):

[T]he critical doctrine recognizes the forms of pure intellectual synthesis, which in fact must be related to the intuition of space and time in order to make experience possible, but which nevertheless owe their truth and validity to the ‘pure understanding.’ And if one considers the system of ‘Logistic’ as it is presented by Russell and Couturat, one sees that it is nothing other than a sum total of such fundamental synthetic forms. ...
If we understand, in accordance with Kant’s explanation, by synthesis “in its most general meaning the action [Handlung] of putting together various representations and comprehending their manifoldness in one cognition” [A77/B103], then one can see this conceptual determination directly as an outline of the procedure for which the logical calculus above all gives a foundation. In fact – what else does the calculus of classes or of relations designate than that we combine into a cognitive unity a plurality of elements through the common relation to the concept of class or to the relation whose field they represent?

Synthesis is an act of the understanding, and relational. So the appropriate logic of synthesis is relational logic, not syllogistic.
At least one contemporary Kantian agrees with Cassirer

In 1910 the neo-Kantian philosopher Ernst Cassirer argued that the traditional theory of the concept, as represented by the relations of subordination and superordination characteristic of Aristotelian logic, is responsible for both the errors of traditional rational metaphysics and those of traditional empiricism. [...] Cassirer's main point is that the traditional theory of the concept must now be completely overturned, so that, in particular, the fundamental mode of concept formation is rather represented by the essentially relational or 'functional' conceptual structures characteristic of modern mathematical science. [...]
From this point of view, then, there is a deep and pervasive tension between the theory of the concept in traditional logic and the conceptualization of nature provided by modern mathematical science [...] [T]he very same tension is reflected in Kant's metaphysical deduction of the categories, as Kant struggles to forge a synthesis of rationalism and empiricism that can do justice to the Newtonian mathematical science of nature he takes as his model. (Michael Friedman, "Logical Form and the Order of Nature," 214-5)
An immediate objection: the doctrine of synthesis belongs in transcendental, not formal, logic

“General logic abstracts, as we have seen, from all content of cognition, i.e. from any relation of it to the objects, and considers only the logical form in the relation of cognitions to one another, i.e. the form of thinking in general. But now since there are pure as well as empirical intuitions (as the Transcendental Aesthetic proved), a distinction between pure and empirical thinking of objects could also well be found. In this case, there would be a logic in which one did not abstract from all content of cognition [...] It would therefore concern the origin of our cognition of objects insofar as that cannot be ascribed to the objects.” (A55-6/B79-80)
Cassirer, like other Neo-Kantians, did not distinguish formal and transcendental logic.

But Cassirer and other Neo-Kantians reject the distinction between the form of thinking and the form of intuition: the “functions” of the understanding are “preconditions for ‘sensibility’” (35).

“This special position [Sonderstellung], which [Kant] claimed for space and time, as forms of intuition, prompted him to make that mistaken separation [Trennung] of general from transcendental logic; there is only one, comprehensive logic, which has to do with the possibility of experience: transcendental logic.” (Walter Kinkel, *Immanuel Kants Logik* (1904), xvi)
Kant strongly distinguishes intuitive relations from conceptual relations

Metaphysical Exposition of the Concept of Space, arguments 3 and 4

• The intuitions of particular spaces are intuitively contained in the intuition of space, but the concept <space> would be logically contained in the concepts of particular spaces.

• An intuition of space contains an infinite number of intuitions of spaces within it, but the concept <space> contains an infinite number of concepts under it.
Kant strongly distinguishes intuitive relations from conceptual relations

The part/whole relations among intuitions thus differ structurally from part/whole relations among concepts.

<animal>

<not rational + animal> = <brute>

<rational + animal> = <human>
Can Cassirer’s claim be salvaged?

Kant would not have been moved to question Aristotelian logic by pointing out that there are purely intuitive relations not capturable in Aristotelian formal logic. That was his point!

Cassirer, in eliding the difference between formal and transcendental logic (and thus also between purely conceptual and purely intuitive relations), risks trivializing his claim that Aristotelian logic is not an appropriate logic for the (transcendental!) notion of synthesis.

Can we do better?
To find the strongest and most plausible version of Cassirer's claim that Kant, if he had reflected on his own doctrine of synthesis, should have questioned the adequacy of Aristotelian logic even for formal logic.

- most plausible, not necessarily plausible
- I don’t deny that questioning the adequacy of Aristotelian logic would have done damage elsewhere in Kant’s philosophy.
My argument will have two parts

1. Kant is actually committed to there being three distinct kinds of part/whole structures: of intuitions, of concepts, and of syntheses of intuitive manifolds. I’ll call these “intuitive structure,” “discursive structure,” and “schematic structure.”

2. Inasmuch as schemata (as rules for the synthesis of intuitive manifolds) serve various roles in his philosophy as intermediaries between concepts and intuitions, the structural features of schemata have to be reflected in the structural features of concepts. And this is impossible without a logic stronger than Aristotle’s.
Outline of the argument

I’ll make the argument in three ways.

§I. Real Definitions in Geometry.

(§II. The intuitive marks of empirical intuitions.)

((§III. The formation of concepts by the comparison, reflection, and abstraction of intuitions.))
§1. Real Definitions in Geometry

“The definition, as always in geometry, is at the same time the construction of the concept” (19 May 1789 Letter Reinhold, Ak 11:42).

To construct a concept: “to exhibit a priori the intuition corresponding to it” (A713/B741).

They are therefore genetic definitions: they “exhibit the object of the concept a priori and in concreto” (JL, §106).

They are real definitions: they “present the possibility of the object from inner marks” (JL, §106).
Two Features of Real Definitions in Geometry

It is an immediate consequence of the definition that the defined concept has an instance.

Grasping the definition is sufficient for knowing how to construct instances of the concept.
Kant’s example of a real definition: <circle>

A line every point of which is the same distance from a single one.

“The possibility of a circle is ... given in the definition of the circle, since the circle is actually constructed by means of the definition, that is, it is exhibited in intuition [...] For I may always draw a circle free hand on the board and put a point in it, and I can demonstrate all the properties of a circle just as well on it, presupposing the (so-called nominal) definition, which is in fact a real definition, even if this circle is not at all like one drawn by rotating a straight line attached to a point. I assume that the points of the circumference are equidistant from the center point. The proposition “to inscribe a circle” is a practical corollary of the definition (or so-called postulate), which could not be demanded at all if the possibility – yes, the very sort of possibility of the figure – were not already given in the definition.” (Letter to Herz, 26 May 1789; Ak 11:53, emph. added)
Kant v Wolff on Real Definitions in Geometry

But why does Kant call Euclid’s definition the “(so-called nominal) definition”?

Kant is clearly alluding to Wolff on <circle>:

“If circle is defined through a plane figure returning to itself, the single points of whose perimeter are equally distant from a certain intermediate point; the definition is nominal: for it is not apparent from the definition, whether a plane figure of this kind is possible, consequently whether some notion answers to the definitum, or whether it is actually a sound without meaning [mens]. For truly if the circle is defined through a figure, described by the motion of straight line around a fixed point in a plane, then from the definition it is patent [patet], that a figure of this kind is possible: this definition is real.” (Philosophia Rationalis, §191)
Kant v Wolff on Real Definitions in Geometry

Kant’s divergence from Wolff over <circle> stems from a more fundamental divergence over the nature of concepts: for Kant, concepts "rest on functions," or constitutively include abilities to do certain things (A68/B93).

Since <distance between two points> = <straight line between two points>, and we cannot think a line without drawing it in thought (B138), then to think Euclid’s definition just is to rotate a straight line around a fixed point in a plane.

So for Kant, Euclid’s definition contains Wolff’s.
There was a wide-ranging debate in the 17th-18th centuries over the reality of Euclid’s definitions.

Refl 5-11 (1778-89, 1790)

A circle: “a line (on a plane) such that every possible line drawn on that plane from a determinate point is perpendicular to it."

Kant asks: “How much can be inferred from this definition of a circle?” And he replies:

“I think, from a definition that does not at the same time contain in itself the construction of the concept, nothing can be inferred (which would be a synthetic predicate).”
Kant on Geometrical Definitions that Fail to be Real: <circle>

Granted:
• This definition is true of all and only circles,
• it is provably equivalent to Euclid’s, and
• it can be proved that it has instances.

But:
• that it has an instance is not an immediate consequence of the definition, and
• the definition gives no guidance in how to construct those instances.

So the definition is not real.
Kant on Geometrical Definitions that Fail to be Real: <parallel lines>

Kant continues Refl 6: “from a definition that does not at the same time contain in itself the construction of the concept, nothing can be inferred (which would be a synthetic predicate)… Euclid's definition of parallel lines is of this kind.”

Euclid’s definition of <parallel lines>: straight lines which, being in the same plane and being produced indefinitely in both directions, do not meet one another in either direction.

Euclid can prove that there are instances of this definition. But the definition does not contain in itself its definition, and so Kant (unlike Lambert, Saccheri) rejects this definition.
A subject could:
• grasp the marks <straight line>, <coplanar>, and <intersecting>
• know how to construct each of these partial concepts
• understand fully how these marks are put together to form the concept <parallel line>
and yet still have no idea how to construct parallel lines.
A Successful Real Definition: Borelli’s Definition of <parallel lines>

Borelli: parallel lines are straight lines with a mutual perpendicular.

This definition **does** contain its own construction. Anyone who:
• understands <straight line> and <perpendicular straight line>
• knows how to construct these component concepts
• understand fully how these marks are put together to form the concept <parallel line>
will understand fully how to construct parallel lines.

Indeed, on Kant’s view, to think this definition just is to construct parallel lines.
Two lines are parallel if they have a mutual perpendicular.
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Two lines are parallel if they have a mutual perpendicular.
Schematic v Discursive Structure

The difference between successful and faulty mathematical definitions shows the difference between schematic and discursive structure

Discursive structure is described by pure general logic, and representable in a Porphyrian tree (ultimately bottoming out in simple concepts).

To know a concept, considered purely discursively, only requires knowing the component marks and how they composed:

\(<\text{parallel lines} >\)

\[= <\text{straight line}> + <\text{coplanar}> + \text{not} <\text{intersecting} >.\]

\[= <\text{straight lines}> + <\text{with a mutual perpendicular} >\]
Schematic v Discursive Structure

Schematic structure is described by geometry, and representable in the step by step construction procedures laid out in geometrical problems (ultimately bottoming out in simple constructions).

To know a concept, in this distinctly geometrical way, requires knowing the construction procedures for its component concepts and the very specific way in which these component constructions combine to produce a compound construction procedure.

Real definitions are the very special cases where these two structures mirror each other.
Schematic v Discursive Structure

1. From a concept F we can form its contrary non-F, and place it on the Porphyrian tree. But though there is a mathematical concept \(<\text{circle}> = \langle\text{curve all of whose points are equidistant from a given point}\rangle\), there is no mathematical concept \(<\text{curve not all of whose points are equidistant from a given point}\rangle\). (As in Euclid’s definition.)

2. The component marks of a concept are coordinated in an order invariant way. \(<\text{Rational animal being}> = \langle\text{animal rational being.}\rangle\) But the order matters in constructive procedures. To draw a circle, we first draw a line AB from a point A, and then construct a curve all of whose points are of distance AB from A. We cannot first draw a curve through some point B, and then construct a point A that is equidistant from that curve. In geometry, order matters.
3. Constructive procedures iterate. Iterating the procedure to construct a perpendicular produces two parallels. But determining a concept by the same mark twice just gives you back the same result: $<A> = <A> + <A>$. (Sutherland, Friedman)
3 kinds of part/whole structures

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<tbody>
<tr>
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The Key Idea

The schema is then a mediating representation between the intuition and the concept, and its structure is partially like an intuition and partially like the concept.

It is a procedure for synthesizing an intuition according to a concept.

Schematic structure is the “logic of synthesis.”

But if the discursive structure of a real definition is to mirror its schematic structure, then discursive structure must be richer than Aristotelian structure.
## Schematic and Conceptual Structure Should Mirror Each Other

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§II. Intuitive Marks

Some commentators have noticed that Kant’s definition of “mark” [Merkmal], does not require that they be concepts. Kant makes this explicit in his logic lectures:

Refl 2286 (1780-89): “The mark is a partial representation, (which) as such (is a ground of cognition). It is either intuitive (synthetic part): a part of the intuition, or discursive: a part of the concept, which is an analytic ground of cognition. Either [partial] intuition or partial concept.”

Dohna-Wundlacken Logic 725 (early 1790s): “A mark is a partial representation insofar as it is the ground of cognition of the whole representation. […] Partial representations as grounds of cognition can be partial concepts and partial intuitions. The latter do not occur in logic.”
What are intuitive marks?

Refl 2282 (1780-89? 76-9??):

“A mark is not always a concept of a thing, but rather often only of a part of the thing. E.g. the hand is a mark of the human; but only having hands is the mark as concept of the human. In this way the partial concept serves through its generality to bring the thing even without comparison under a distinguishing ground.

A partial representation as ground of cognition of the whole representation is a mark.”

• <Having hands> is a conceptual mark of <human>.
• The hand is a mark (though not as concept) of human. (A spatial part!)
• <Hand> is the concept of a part of a human. (A spatial part!)
What are intuitive marks?

An intuitive mark is an intuition that is a (spatio-temporal) part of a whole intuition, where the partial intuition is a ground of cognition for the whole.

In this note, Kant recognizes that the intuitive structure and the discursive structure can come apart: the hand is a part of the human, but <hand> is not a part of <human>.

Kant is here struggling to think through the consequences of his distinguishing between intuitive and discursive structures and he is struggling to understand how they interrelate. But what is this *having* in *<having hands>*?
Kant calls these intuitive marks “synthetic parts”: the whole intuition is composed from intuitive marks by an act of synthesis.

Kant’s model for how intuitive parts are combined to form a whole intuition is provided by geometry.

So we should expect to find the same three kinds of structures for empirical representations.
Empirical Schemata

In fact it is not images of objects but schemata that ground our pure sensible concepts. No image of a triangle would ever be adequate to the concept of it. For it would not attain the generality of the concept, which makes this valid for all triangles, right or acute, etc., but would always be limited to one part of this sphere. The schema of the triangle can never exist anywhere but in thought, and signifies a rule of the synthesis of imagination with regard to pure shapes in space. Even less does an object of experience or an image of it ever reach the empirical concept, rather the latter is always related immediately to the schema of the imagination, as a rule for the determinatin of our intuition of our intuition in accordance with a certain general concept. The concept of a dog signifies a rule in accordance with which my imagination can specify the shape of a four-footed animal in general, without being restricted to any particular shape that experience offers me or any possible image that I can exhibit in concreto. (A140-1/ B180)
### 3 kinds of part/whole structures

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The Key Idea

The schema is then a procedure for synthesizing an intuition that falls under the concept.

Suppose Kant wants the discursive structure of an empirical concept to mirror its schematic structure (and I think he does!).

Then discursive structure must be richer than Aristotelian structure.
3 kinds of part/whole structures

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The End.
To form <tree>, with the distinctive discursive structure that it has, from the schema and its schematic structure, by comparison, reflection, and abstraction, there must be some way of capturing discursively the relation between *to draw a leaf* and *to draw a tree* -- namely, a relational concept such as *<_____ with ______>*.

But this picture would require a richer logic than Aristotelian logic: a relational logic!

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<tr>
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<th>Intuition of a willow</th>
<th><em>To draw a trunk with branches on the trunk and leaves on the branches</em></th>
<th><em>&lt;tree&gt; = &lt;living thing&gt; + &lt;with leaves&gt; + &lt;with branches&gt; + &lt;with trunk&gt;</em></th>
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