Syllogistic Reasoning as a Ground for the Content of Judgment: A Line of Thought from Kant through Hegel to Peirce

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In this paper I develop Paul Redding's suggestion that Peircean abduction and Hegel's discussion of the syllogism can be seen as a working out of Kant's treatment of the reflecting power of judgment, particularly concerning its role in conceptual change. After some historical background I regiment a use of singular terms, kind terms, and predicates across Hegel's three syllogistic figures and reconstruct an account of comprehension and extension for this system suggested by Peirce. In doing so I show that reasoning according to the ampliative syllogistic figures affects the content of these three classes of terms in precise ways. I close with a treatment of inference by analogy (associated by Hegel with the third syllogistic figure) as an exercise of reflection, and I discuss two cases in the history of science, one in astronomy and the other in biology, where a reflective exercise associated with analogical inference revised our understanding of the domain in question.

Keywords: G.W.F. Hegel, C.S. Peirce, Paul Redding, Abduction, Kantian Reflection

I Introduction[1]

In a paper published in this journal Paul Redding (2003) suggests that Kant's notion of the reflecting power of judgment, as a capacity for concept formation, lies at the back of Hegel's third figure syllogism, corresponding to hypothetical inference in Peirce's exposition of the

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syllogistic figures and later traded by Peirce for talk of abduction.[2] In this paper I develop the thought that Peircean abduction and Hegel's discussion of the third syllogistic figure can be seen as a working out of Kant's treatment of the reflecting power of judgment, and in particular a working out of Kant's view that reflection, as an exercise of our rational capacities in operation during inquiry, affects the contents of our concepts. In doing so I lay some groundwork for considering contemporary work in semantics and philosophical logic alongside a tradition that is not well-represented in current debates.

Section II of this paper offers a brief consideration of the extensional and set-theoretical interpretations of formal languages characteristic of contemporary philosophy so as to contrast that view with what will follow. Part II also discusses some of the historical context of the views under consideration. The rest of the paper is directed at a reconstruction, partly exegetical and partly rational, of the critique of and revision to Aristotelian syllogistic that knits together the line of thought from Kant through Hegel to Peirce that is the subject of this paper. Sections III and IV are primarily exegetical, covering Kant's discussion of the reflecting power of judgment and detailing his criticism of Aristotle's division of the syllogism into different figures. I argue that Kant's criticism of the subsentential logical structure that determined the Aristotelian syllogistic figures made it possible to rethink syllogistic inference so as to distinguish deductive from inductive and abductive figures via the role that different concepts play in different figures,

[2] Throughout his career Peirce held that there were three forms of reasoning none of which could be reduced to any combination of the others. The first two forms were labelled 'deduction' and 'induction', but his term for the third varied over the course of his career. In his work on the syllogism he referred to the third form of inference as 'hypothesis' (e.g. in the 1878 paper "Deduction, Induction, and Hypothesis,") though later he came to call his third pole of reasoning 'abduction' (sometimes also 'retroduction'). The interested reader can turn to Anderson (1986), Burks (1946), Douven (2011), Levi (2012), and Psillos (2011) for further discussion of Peirce's views on abduction. Section 2 of Psillos (2011) traces some of the Kantian and Aristotelian sources of Peirce's views on abduction, and Anderson (1986) argues that Peirce's later views on abduction were influenced by changes in his reading of Aristotle. With the exception of a few passing remarks and a brief note on developments in Peirce's account of the logic of inquiry in part VII, I will use the term 'abduction' without commentary.

though it was Hegel (and then Peirce) who made this alternative structure explicit. In section V I canvas some of the commitments that came to dominate Hegel's mature views on logic. Like Kant, Hegel (and Peirce after him) believes that a proper understanding of the contentfulness characteristic of judgments about nature must attend to the processes of conceptual revision through which we come to better represent the world—processes involving the Kantian power of reflection. But I will argue that Hegel and Peirce go farther than Kant in mapping out the structure of these processes of conceptual revision.

Sections VI and VII are focused on rational reconstruction. The dialectically central portion of the paper is section VI. There I regiment a use of singular terms, kind terms, and predicates across Hegel's three syllogistic figures and reconstruct an account of conceptual content for this system suggested by one of Peirce's early papers. Whereas it is common today to interpret the semantic values of subsentential expressions via extensions and functions on extensions, I will appropriate an older distinction between the extension of a term (its referents) and its comprehension (its context-specific implications) as equiprimordial components of conceptual content. I then show that the practice of drawing conclusions across these three syllogistic figures revises the extensions and comprehensions of singular terms, kind terms, and predicates in specific ways according to their occurrences as middle terms in the different figures. Section VII looks at Hegel's association of the third syllogistic figure with inference by analogy and considers his view in light of Peirce's later treatment of abduction. There I argue that in an analogical inference we have a clear case of an exercise of the reflecting power of judgment as Kant introduced that notion, and I give two examples from the history of science (one from astronomy, the other biology) where an exercise of reflection led to an analogical inference that substantially reoriented our understanding of a given domain of inquiry. The

result is a more thorough appreciation of the intellectual genealogy that runs from Kant's notion of the reflecting power of judgment through Hegel's treatment of the syllogism and into Peirce's work on the logic of inquiry.

II Some Remarks on Logic and the History of Philosophy

The views on logic central to this paper can partially be brought into focus by considering them in contrast with model-theoretic interpretations of formal languages. The study of formal systems in which semantic values like meaning and truth are at work generally proceed by interpreting sentences and terms via a model with an antecedently specified domain of objects, properties, relations, and facts. Descended from research into the foundations of mathematics undertaken at the turn of the last century, the model fixes the semantic values of subsentential terms via their *extensions*: given a domain of objects, the model assigns individual objects as the semantic values of singular terms, and n-tuples of objects as the semantic values of n-ary predicates (properties and relations).[3] The truth of an atomic sentence is then determined by the extensions the model assigns to the subsentential terms—a sentence '$Ps_1 \ldots s_n$' is true on a model just in case the ordered set of objects denoted by the n-tuple $<s_1 \ldots s_n>$ in the model is a member of the set of n-tuples the model assigns as the interpretation of the predicate 'P'. In the case of a one-place predicate and a given model, 's is P' is true just in case the object denoted by 's' is a

[3] If kind terms are distinguished from predicates, they are usually formalized as restrictions on quantification (Gupta 1980). For an overview of model-theoretic semantics see Hodges and Scanlon (2013). Some of the development of model theoretic interpretations of logic is traced in van Heijenoort (1967) and Hintikka (1988). Pages 27-29 of the latter place Peirce's views on logic in the context of this development. For a more revisionary perspective, in *Realizing Reason* (2014) Danielle Macbeth gives a protracted argument for the conclusion that nineteenth century philosophy of mathematics is not well represented by the focus on extensionalism that came to dominate twentieth century philosophical logic.

member of the set of objects denoted by 'P'.[4] For languages without intensional operators, the truth-values of logically complex sentences are then interpreted as functions of the truth-values of the sentences occurring within them. There are two features of this approach that I want to highlight as a way of framing the view developed in the rest of the paper.

First, on this way of interpreting a language the implication relations among atomic sentences are explained by set-theoretic relations among the extensions the model gives to the subsentential expressions occurring in those sentences: 's is red' implies 's is colored' just in case the set of objects that the model assigns to 'is red' is a subset of the set of objects that the model assigns to 'is colored'. In this way the extensional resources of the model allow us to recover something like the *meaning* of the terms of the language. This approach cannot distinguish the meanings of co-referential terms, of course. If it happens that every renate is a chordate, so that having a kidney implies having a heart and *vice versa*, then extension alone will not suffice to distinguish the semantic role of these terms.[5] With the development of possible world semantics the extensional interpretation of language was extended to cover some of the distinctions that could not be accounted for by extensions at a single world. Picking up the old contrast between extension and intension (more on which in a moment), on a possible worlds semantics a term's *extension* is defined as its reference at a world, while its *intension* is defined as a function from worlds to extensions (cf. Fitting 2014). These world-varying extensions allow us to distinguish the semantic values of contingently co-referential terms— that 'renate' and 'chordate' differ in meaning, now understood as intension rather than extension, is explained by the fact that at some world(s) there are heart-having animals that do not have kidneys (or *vice*

[4] I am treating the set of sets of one-tuples that interprets 'P' as the unordered set of their union, of course, and I am ignoring the evaluation of quantified sentences.

[5] It is not actually true that every member of the phylum *chordata* has a heart (lancelets, a sort of primitive fish, do not), but the example has become standard and the details are irrelevant.

versa). But notice that extensions are still bearing the explanatory weight here: intensions are *functions* of extensions, as the intension of 'chordate' is not a set of animals but a function from a world to a set of animals. By building possible worlds into the model and allowing terms to vary in their extensions across different worlds, we can use these variations to interpret differences in semantic value without having to give up an extensional model theory (though this approach has problems of its own; notice it cannot distinguish the meaning of terms that are coreferential at every world, e.g., '2' and '1+1').

In this paper I will adapt an earlier view of the content of concepts that marks a substantive distinction between the reference of a term and its conceptual content, and I will do so by distinguishing the extensional and the implicational dimensions of language without trying to reduce the latter to the former. Though there is no univocal characterization of this distinction, it has a storied history. Something like it was marked in late medieval philosophy with the terms '*suppositio*' and '*significatio*', in the *Logic* of Port Royal with '*étendue*' and '*compréhension*', in Kant's logic with '*Extension*' and '*Inhalt*', in Mill's logic with 'denotation' and 'connotation', in De Morgan's work with 'scope' and 'force', in William Hamilton's lectures on logic (and in Peirce's early logic) with 'breadth' and 'depth', and in Frege's philosophy of language with '*Bedeutung*' and '*Sinn*'. While the advent of possible worlds semantics allowed philosophers and linguists to reconstruct more fine-grained dimensions of meaning while remaining in an extensional metalanguage, the contrast between comprehension and extension as traditionally conceived marks an important difference in the sorts of significance a term can have, and in my reconstruction I will interpret a term's comprehension via its implications rather than its extension. No matter how well set-theoretic devices allow the latter to ape the former, there is a distinction here that is worth making. As the Port Royal

Logic's use of 'comprehension' seems to remain free of the possible worlds connotations surrounding 'intension', I will use that term.

The second point to emphasize by way of framing what will follow is that the model-theoretic approach also has the advantage of giving clear conditions of truth and implication for the sentences of the language, though at the cost of abstracting from the processes of conceptual revision that are characteristic of inquiry into the natural and social sciences.[6] The inferences that are underwritten by model-theoretic interpretations of a language are *explicative*—a conclusion follows from a set of premises because the content of that conclusion is already contained in the premises according to the extensions and functions on extensions that the model assigns to the terms, sentences, and operators of the language. What those extensions are, the objects and facts they denote, is irrelevant—all we need to know are the set-theoretic relations that hold among them. By contrast, the syllogistic systems of Hegel and Peirce include *ampliative* inferences, those whose conclusions increase the content of a set of concepts beyond that which was contained in the premises. For this reason they are not deductively valid inferences; their goodness is underwritten by determinate features of the world that are particular to the objects in question (their comprehension) rather than by logical form and set-theoretic extension. And so it will be central to my reconstruction of the line of thought in this paper that the processes of inquiry through which the uses of our terms are revised affect the content of those terms in ways that fall under the purview of philosophical logic.

This raises a more general issue to flag at the outset. Throughout the paper I will be mostly silent concerning the broader historical and intellectual contexts in which the logical

[6] This is not to deny that some contemporary semantic projects have developed mechanisms for revising semantic values in a model—see, e.g., the work surveyed in van Eijck and Visser (2012) and Hansson (2014), or developed in detail in Gupta and Belnap (1993) and Standefer (2013). But my reconstruction of extension and comprehension across the three syllogistic figures will emphasize features of the practice of inquiry that go missing in more formal treatments descended from extensional model theories.

views of Kant, Hegel, and Peirce were developing. These contexts are often important for understanding why a particular batch of commitments, or a position on some issue, were held as they were, and in places I note some of the discussions that surround this material. But for the most part my focus is restricted to the views of Kant, Hegel, and Peirce as I reconstruct them. One issue that I will raise now and set aside almost totally is that of the question of *material* as against *formal* consequence relations. While I will discuss non-deductive ampliative inferences (induction, hypothesis/abduction, inference by analogy) as forms of reasoning that increase the content of our concepts, and while this might quite naturally be spelled out in terms of material inferential relations or the notion of material consequence, for reasons of economy I will refrain from doing so in what follows. But it may be useful to say a few words about the subject now so as to give some idea of this larger context.

It has become common to associate inferentialist positions on language and thought with a commitment to the existence (or usefulness) of material inferential relations—roughly, those that are good in virtue of facts concerning the objects and properties denoted in the sentences constituting the inference rather than by the logical form of the inference. This view is defended in various places by Wilfrid Sellars (1953, 1958) and Robert Brandom (1994, 2000, 2008), and it can with some plausibility be seen in Carnap's (1934) use of P-rules (for physical) in addition to L-rules (logical), together with his contrast between the material and formal modes of discourse (cf. Westphal 2015 §6.3 for a more general statement of Carnap's inferentialism). One might extend this line of geneaology by considering C.I. Lewis' theory of knowledge in his (1929) and (1947), and Sellars' criticism of Lewis' use of the strict conditional to model content-involving inferential relations in Sellars (1948). In its place Sellars (1953), taking himself to be working out ideas from Carnap, argues that the *subjunctive* should be understood as the conditional that

gives expression to material rules of inference. The history of the development of this idea during the middle of the last century is not well understood, but Sellars reading of Carnap, and more generally the readings of the American philosophers at Iowa in the 1940's, look problematic when considered alongside certain plausible reconstructions of Carnap's project (cf. Carus 2003 and Olen 2015; Westphal 2015 offers a contrastive reading of the Carnapian strands in Quine and Sellars, and a criticism of Quine's extensionalist ambitions). At the same time it is clear that the definitive statement of this period of 20th century philosophy has yet to be written. I take nothing I say here to turn on any particular reading of these projects, though I hope that the current discussion will prove useful for sorting out the conceptual space in some of these debates.

The notion that logic should consider material consequences is also associated with Hegel, and quite rightly so.[7] The view that Hegel's logic attends to questions of content as well as form has been worked out in some detail by Robert Brandom (cf. the first three chapters of Brandom 2009). Peckhaus (2009) looks at the influence of Hegel on the development of logic in the 2nd half of the 19th century, focusing on the work of Friedrich Adolf Trendelenburg, Otto Friedrich Gruppe, and Carl von Prantl, and concludes "A main point of criticism held in common by these authors was their rejection of the doctrine that the laws of formal logic are independent of the content of the sentences or judgments involved" (p.15). He also notes that von Prantl's 1886 survey of the burgeoning mathematical logics of that period involved a critique of exclusively extensional interpretations (pp.14-15). It would be easy to see Hegel's position here as a brute denial of Kant's contention that pure general logic was formal.[8] But it had been common for hundreds of years before Hegel to draw a material/formal distinction in the

[7] Early statements of Peirce on the subject can be found in his (1868) and (1869).

[8] While *pure general* logic may be formal for Kant, his theory of inquiry into the natural sciences employs a logic that includes ampliative inferences; see Kitcher (1986).

consequence relation. Buridan, William of Ockham, and Albert of Saxony mark the distinction, for instance. The author of a commentary on Aristotle that was long thought to be Duns Scotus, now known as 'Pseudo-Scotus', puts the contrast as follows:

> Consequences are divided thus: some are material, others are formal. A formal consequence is one which holds in all terms, given similar mutual arrangement and form of the terms….A material consequence is one which does not hold in all terms given similar mutual arrangement and form so that the only variation is in the terms themselves. (quoted in Bochenski 1961, pp.191-2; cf. the discussion of Pseudo-Scotus' account of formal and material consequences in Kneale and Kneale 1962 pp.278-81)

There never existed a universally accepted account of formal and material consequence, however (Kneale and Kneale 1962 p.292-3), and the debate continued into the 18th century. By that time some philosophers (often influenced by the practice of science) were arguing that different domains of inquiry must be formalized according to facts peculiar to those domains. Kant and Hegel would have doubtlessly been aware of at least some of the German writings in this area. Andreas Rüdiger (1673-1731) urged that the perceived 'sterility' of syllogistic inference was owed to a failure to appreciate its character as *inventive*, as capable of arriving at unknown conclusions from given premises (Capozzi and Roncaglia 2009, pp.124-6). Gottfried Ploucquet (1716-1790) thought that logical calculi should be developed according to the demands of specific domains of inquiry: "by nature and according to logical order every calculus comes after the understanding of the matter to which the calculus is applied….He who invents does not begin from a calculus, but from the consideration of things" (quoted in Capozzi and Roncaglia 2009, p.135). And if Hegel had a copy of Humphry Davy's 1812 textbook on chemistry when writing the chapters on syllogism and chemistry (which are separated by a chapter on mechanism) in the larger *Logic* he would have been exposed to the following account of inquiry (itself not too unlike Peirce's view):

> The foundations of chemical philosophy, are observation, experiment, and analogy. By observation, facts are distinctly and minutely impressed on the mind. By analogy, similar facts are connected. By experiment, new facts are discovered; and, in the progression of knowledge, observation, guided by analogy, leads to experiment, and analogy confirmed by experiment becomes scientific truth. (quoted from Hacking 1983, p.152).

Interestingly, in the period between Hegel and Peirce there was an American figure who put forth a theory of inquiry similar to the syllogistic systems that Hegel and Peirce develop, though he makes no reference to Hegel and Peirce makes no reference to him.[9] In September of 1831 (two months before Hegel's death) Francis Wayland, president of Brown University, gave a talk to the Phi Beta Kappa Society of Rhode Island. The talk was entitled "A Discourse on the Philosophy of Analogy" and it was published in pamphlet form in December of that year. Like Hegel and Peirce on the syllogism he divides reasoning into three categories, and like Hegel he thinks they are of deductive, inductive, and analogical forms. His talk was a rallying cry for a concerted study of analogical inference as a basis of scientific progress. Wayland argues that while demonstration (or deduction—see p.21) and induction are widely recognized as the source of our knowledge of the world, these two forms of inquiry operate by presuming laws of nature that they are themselves unable to uncover. A proper account of the growth of scientific knowledge, he argues, must include an understanding of how we come to posit laws of nature, and that understanding will come by way of a theory of analogy.

> Besides skill in interpreting the answer of nature, man must also then acquire skill in asking of her the question. There is needed a science, which, standing on the confines of what is known, shall point out the direction in which truth probably lies, in the

[9] But Wayland had studied in Germany, and at the start of his talk he writes that the subject he settled on is one that, so far as he knows, "has not yet attracted the notice of any writer in our language" (p.4). And it would not be surprising that Peirce might have come across the published version of Wayland's talk, as he was a figure referenced by American academics well into the 20th century. Among other things, Wayland wrote one of the classic series of textbooks covering moral psychology, human faculties, and political systems meant for upper level undergraduates, a research agenda prominent among American philosophers throughout the middle of the 19th century.

> region that is unknown. This, when it has assumed a definite form, will be the *science of analogy*. (P.13; emphasis in the original)

These ideas were in the air for hundreds of years before Kant and they were carried well into the nineteenth century. If the story about the 20th century reception of the notion of a material consequence relation remains to be written, still less has the definitive statement been produced for late medieval, early modern, and enlightenment treatments of these ideas. Finally, it is worth pointing out that a material inferential interpretation of the logic of inquiry remains a going project. In recent work John Norton has defended what he calls a 'material theory of induction'. Norton abdicates a formal treatment of induction in favor of justifying particular cases by recourse to material facts concerning the domain over which the induction is made (2003, 2011, 2014). He is currently working on a manuscript that applies this approach to analogical inference and inference to the best explanation, though Norton's views are not owed to influence by Hegel or Peirce (personal correspondence). Instead they derive from his consideration of the work of practicing scientists.

In future work I hope to say more about the historical connections among these ideas. One way of framing the current paper is as a groundwork for that discussion. But with the exception of a few remarks in passing I will for the most part keep this broader historical and intellectual context at bay so as to focus on the details of the ideas I draw from Kant, Hegel, and Peirce. Though Peirce may be right that in his early work he was "too taken up in considering syllogistic forms and the doctrine of logical extension and comprehension, both of which I made more fundamental than they really are" (*Collected Papers* 2:102), the syllogistic system developed in part VI has the virtue of being simple. And because of this simplicity it establishes a precise sense in which we can say that the inductive and abductive syllogistic figures are ampliative, increasing the extension and comprehension of different classes of concepts. In the

details this will thereby establish that Hegel and Peirce situate Kant's notion of the reflecting power of judgment in the context of inference so as to show that the very idea of a determinate world-representing judgment presupposes a process of reasoning through which that judgment acquires the content it has, so that reasoning shows up as a ground for the content of judgment.[10] My use of a Peircean notion of extension and comprehension as applied to Hegel's syllogistic in section VI of this paper will give a clear (though artificially simple) representation of one sort of process of conceptual development, and by looking at analogical inference as used in the sciences in section VII we can begin to see ways in which the story told here could be brought around to consider the broader context of the development of these ideas. But I leave a more thorough consideration of the pre-Kantian sources for this reconstruction, the influence it had through Hegel and Peirce, and a comparison with more recent projects, for another time.

III The Determining and Reflecting Powers of Judgment

The exercise of reflection is discussed in an appendix to the Analytic of Principles in the first *Critique*, a chapter devoted to the power of judgment. The focus of that chapter lies on the principles of judgment as found in transcendental logic, which unlike formal logic does not abstract away from the content of cognition (A131/B170). Though the discussion of reflection in the appendix to that chapter is one of *transcendental* reflection, which is concerned with the *a priori* content of cognition, Kant also thinks that reflection is at work in revising the content of our concepts of objects in space and time. The employment of the reflecting power of judgment in empirical cognition is discussed in Kant's logic (*Vienna Logic*, 24:909ff; *Jäsche Logic*, 9:94-

[10] This is not to deny that other aspects of the content of judgment might be grounded in, for instance, our physiological responsiveness to and sensory integration of the world. But it is the ground of content in *reasoning* that is of interest to me here.

95; both reprinted in Kant's *Lectures on Logic*).[11] As Kant describes it, this exercise of reflection is one through which our concepts of species and genus are revised; via reflection we compare a set of individuals and endeavor to determine whether there is some concept sufficient to subsume them under a common a kind. In doing so we are sometimes required to form a new concept sufficient to explain what we observe is common among the individuals, and reflection on and comparison of different individuals are stages in this process. But the reflecting power of judgment receives more extensive treatment in the third *Critique*. Whereas the determining power of judgment subsumes an individual given in sensibility under a concept from the understanding so as to result in a judgment that represents things in some way, reflecting judgment is called into operation without a determinate concept sufficient to guide the imagination's synthesizing of the content given in intuition so as to result in a judgment adequate for representing that content. Instead, in an exercise of the reflecting power of judgment the subject is confronted with an object (or a set of objects being compared) and searches for a concept to comprehend it (them). The operation of this power of judgment is paradigmatic of certain sorts of experiences for Kant, including aesthetic judgments of beauty and the sublime, and in attributing purposes to organisms. In the Introduction to the third *Critique* a third exercise of the reflective power of judgment is discussed as well—namely, that of determining particular empirical laws according to the principle that nature is a systematic organized whole (§§IV-VII of the first Introduction and §§IV-V of the published Introduction; see also Guyer's remarks at pp.xxiv-xxv). Though we can know *a priori* that all events in space and time are causally determined by natural laws, to know which *specfic* laws causally determine a given sort of event requires reflection on *a posteriori* content. In all such judgments, Kant thinks, certain

[11] In both the referenced passages a discussion of extension and content (*Inhalt*) in concepts immediately follows Kant's discussion of reflection.

conceptual shortcomings force the mind into a reflective stance, and in some cases that reflection can result in a novel way of relating our concepts together in a system that makes the world intelligible to us.

One question we might have is just how reflecting judgment operates in relation to determining judgment. It is sometimes assumed that one can talk of reflecting judgment and of the reflecting *power* of judgment as if anything said about the one could be put in terms of the other. If one only meant by 'judgment' the *faculty* of that name, then 'reflecting judgment' and 'the reflecting power of judgment' might be nearly synonymous. On the other hand we might speak of reflecting judgment not as a faculty but as an instance of a faculty's activity, as if reflecting judgment and determining judgment were two different switchpoints on a cognitive dial. And now the two terms should not be used interchangeably. For a *power* of judgment is not a judgment *qua* act; the former denotes a capacity and the latter an instance of that which such a capacity issues in when actualized. And if reflection is a power of judgment brought into actualization in the course of observation, comparision, reasoning, etc., while determination is another power able to be actualized under similar conditions, then nothing so far said eliminates the possibility of conceiving of a single judgment *qua* act as a unity whose moments may include both determination and reflection. The advantage of thinking of reflection as a power of judgment, rather than an act that power issues in, is that we are now in a position to conceive of reflection as part of a process that contains determination as well, and so to conceive reflection in terms of its role in this process.

In sections VI and VII I will argue that the form of reasoning associated with Peircean abduction and Hegel's third figure syllogism involves a use of the reflecting power of judgment along these lines, and that its empolyment results both in changes in the content of pre-existing

concepts and, in analogical reasoning, in the generation of new forms of understanding. To set the stage I will discuss Kant's criticism of Aristotelian syllogistic and consider some of Hegel's views on logic. For while Redding associates Hegel's three syllogistic figures with Aristotle's, I think we do better to see Hegel, following Kant, as breaking decisively with the Aristotelian tradition over the logical form of the syllogism. And for that we need to turn to an early work in Kant's logic.

IV Kant's Response to Aristotle

In "The False Subtlety of the Four Syllogistic Figures", a paper published nearly 20 years before the first *Critique*, Kant argues that the Aristotelian division of the syllogism obscures its underlying logical form. That Aristotelian division was founded on a conception of a syllogism as a two-premise inference and a single conclusion, all of whose sentences are categorical and in subject-predicate form. The major premise is defined as the premise containing the predicate-term (P) of the conclusion, and the minor premise as that containing the subject-term (S) of the conclusion. In the major and minor premises a third term—the middle term (M)—is united with either the major or the minor term. The conclusion is therefore always of S-P form, but there are four different subject/predicate combinations in which the major and minor terms can combine with the middle term, and these combinations give the four figures of the syllogism:[12]

[12] Aristotle expressed the subject-predicate relation "S-P" as "P belongs to S," so his figures would have the order of these letters reversed to "P-S". It was a medieval device to read them as "S is P", and the moderns tended to stick with this transposition.

First Figure:	Second Figure	Third Figure	Fourth Figure
1) M-P	1) P-M	1) M-P	1) P-M
2) S-M	2) S-M	2) M-S	2) M-S
3) S-P	3) S-P	3) S-P	3) S-P

In addition, each sentence is given one of four categorical aspects: universal affirmative or 'A' (all S is P); particular affirmative or 'I' (some S is P); universal negative or 'E' (no S are P); and particular negative or 'O' (some S are not P). Singular categorical sentences, e.g. "the S is P," were excluded from syllogistic consideration by Aristotle, though the medievals treated them in terms of the corresponding universal categoricals—the idea being if there is only one S, then to say that *the* S is P is equivalent to saying that *all* S are P (we will see that Hegel resists this reduction).[13] When these four types of categorical sentence are permuted across the four figures of the syllogism, 256 possible syllogistic forms result. Of these many are invalid. Aristotle recognized 14 inferences across the first 3 figures as valid deductive inferences. The medievals introduced the fourth figure explicitly (Aristotle thought it equivalent to the first) and increased the number of deductively valid instances they recognized to 24—(though 9 of these are invalid if the domain is empty).

Much work was then expended, by Aristotle and later by the medievals, in showing how each admissible 2nd, 3rd, and 4th figure inference could be converted into a first figure inference by various equivalences between different A, I, E, and O sentences. In this way every valid syllogism could be interpreted as a syllogism in the first figure. Kant's contention is that these reductions show that the only genuine figure marked out by this treatment is the first figure, and

[13] Aristotle also recognized indefinite categorical sentences—e.g. "*an* S is P"—though in his syllogistic these were either ignored or treated as particular categoricals.

that for this reason the placement of the conclusion's subject and predicate across the premises does not indicate any logically relevant division of the syllogism into different figures.

Instead, Kant provides his own taxonomy for judgment and its relevance to syllogistic inference. He begins by stipulating that to judge is to "compare something as a characteristic mark with a thing" (2:47, p.89). The 'characteristic mark' and the 'thing' are then identified with the predicate and subject respectively, but in the next paragraph Kant introduces the idea of a *mediate* characteristic mark of a thing, which is defined as the "characteristic mark of a characteristic mark of a thing" (ibid). The characteristic mark of the thing is itself an *immediate* characteristic mark; this immediate mark is therefore *intermediate* between the thing and the mediate mark. Thus, a dog (a thing) might have 'being an elkhound' as an immediate characteristic mark, which is intermediate to the mediate characteristic mark 'being a mammal,' which last is thereby a mark of the mark 'being an elkhound'. This three-sorted schema for concepts sets up the distinction between, to use Frege's terms, the *subsumption* of a singular term by a universal term (for Kant: the use of a characteristic mark to identify a thing) and the *subordination* of a universal term by another universal term (Kant: the use of a characteristic mark to infer another characteristic mark). On the basis of this taxonomy Kant gives the following 'real definition' of the syllogism:

> *every judgment which is made by means of a mediate characteristic mark is a syllogism.* In other words, a syllogism is the comparison of a characteristic mark with a thing by means of an intermediate characteristic mark. (2:48, p.90)

Kant's contention is that once this is recognized as the underlying logical form of the syllogism, the fact that this form can be obscured by various subject/predicate transpositions across the premises is exhibited as a "false subtlety."

Nevertheless, Kant does not use his own division of the syllogism to reconceive its figures. That would fall to Hegel, whose term logic explicitly distinguished concepts for singular things (things), particulars (immediate characteristic marks), and universals (mediate characteristic marks), and who, unlike those who inherited Aristotelian syllogistic, refused to reduce judgments about singular things to universal judgments. For in Hegel's theory of the syllogism, these two sorts of concepts play different roles as middle terms in reasoning. It is perhaps easiest to see Hegel's contribution here if we begin by looking at some of the conclusions Kant draws in the "False Subtlety" essay (conclusions that remained central to Kant's philosophy). At the end of that essay Kant writes

> …*understanding* and *reason*, that is to say, the faculty of cognizing distinctly and the faculty of syllogistic reasoning, are not different *fundamental faculties*. (2:59, p.103)

This claim Hegel could accept, but he disagreed with Kant over which faculty was to be emphasized. For at the start of the next paragraph Kant writes

> …it can also be concluded from the above considerations that the higher faculty of cognition rests absolutely and simply on the capacity to judge.

There is room to debate exactly how to take Kant here, but it is clear that Hegel rejects the sentiment insofar as for Hegel it was syllogistic inference that was supposed to explain the judgment—this was part and parcel of Hegel's effort to get philosophy beyond the standpoint of the understanding (*Verstand*) to reach that of reason (*Vernunft*). Whereas the logical tradition up to and including Kant spoke of singular, particular, and universal *judgments*, Hegel conceives of singulars, particulars, and universals as distinct forms of *concept*, and he argues that to understand these concepts (and thereby the judgments they enter into) we must understand the role they play as middle terms in, respectively, inductive, deductive, and abductive syllogisms.

V From Textual Exegesis to Rational Reconstruction

The path that led Hegel to his mature views on logic is complex. Throughout his time at Jena (1801-1806) he was working on a project in logic, the philosophy of nature, and metaphysics that would eventually crystalize in his thinking in terms of logic, nature, and spirit. With the exception of the 1805/6 winter term Hegel taught a course on Logic and Metaphysics every year he was at Jena (di Giovanni 2010, p.xii). From the beginning an interpretation of the syllogism was central to his views in this vicinity (his Habilitation included a defense of the thesis "*Syllogismus est principium Idealismi*").[14] The project that dates from 1804/05 was ultimately abandoned on the basis of a revolution in his thinking about logic, though we do not have source materials indicating the details of that revolution.[15] The manuscript for his 1805/06 lectures, however, indicates just how central his views on logic were to become. Harris writes of the system from this period (1986: xxi):

> Every stage—from the basic theory of space and time onwards—is conceived as an evolution from "concept" through "judgment" to "syllogism."

Despite the fact that the syllogism was a focal point in Hegel's philosophical thinking from the early stages of his development, it is not clear when he first hit upon the interpretation of the syllogism that is given in Volume 2 of *The Science of Logic* (1816) the Subjective Logic of the Concept (the division of the *Logic* that we today would think of as logic proper, as opposed to more metaphysical discussions in the Objective Logic of Being and Essence in Volume 1). But once developed there, this view of the syllogism would remain constant throughout his later work. And it is clear that by 1816 Hegel is convinced that logic needs to be conceived so as to

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[14] Harris (1983: 18, footnote). On the importance of a speculative theory of the syllogism in Hegel's thinking, see Harris (1983: 43-52) and the discussion of the "triangle of triangles" at pp.157ff. On the revolution in Hegel's logic that occurred in 1806, see Harris (1983: 410ff). For an overview of the development of Hegel's views on logic, see di Giovanni (2010).

[15] Harris (1986: xiv, footnote).

foreground the relationship between the content of concepts and the role of those concepts in inference.[16] Determinately contentful concepts are not given to us in judgments partitioned out atomically, with their inferential roles computed on the basis of merely formal relations of truth-preservation among those judgments. Instead, our ability to apprehend a judgment's content without pausing over its meaning—it's 'immediate' presentation in thought—is an artifact of our ability to use that content in reasoning, to mediate inferences with it. For this reason the inferential content of concepts needs to be at the center of a theory of meaning, with an account of judgment understood on this basis:

> ...to regard the syllogism as merely consisting of *three judgments* is a formalistic view that ignores the relation of determinations which alone is at issue in the inference. It is altogether a merely subjective reflection that splits the connection of the terms into isolated premises and a conclusion distinct from them…It is mostly because of this subjective attire that the inference appears as a subjective *expedient* in which reason or understanding take refuge when they are incapable of *immediate* cognition…This syllogistic inference from one separate proposition to another is nothing but a subjective form; the nature of the fact is that its various determinations are united in a unity of essence [*die Natur der Sache ist, dass die unterschiedenen Begriffs-bestimmungen der Sache in der wesentlichen Einheit vereinigt sind*]. This rationality is not an expedient; on the contrary, in contrast to the *immediacy* of the connection that still obtains in *judgment*, it is the *objective* element; it is the prior immediacy of cognition that rather is mere subjectivity, in contrast to the syllogistic inference which is the truth of the judgment.[17] (*Science of Logic* 12:94-5, p.592-3)

[16] From the start of his lectures on Logic and Metaphysics, in 1801/02, Hegel was interested in getting beyond the merely formal understanding of logic that abstracted away from the content of judgments (di Giovanni 2010, p.xvii).

[17] At 12:57, p.554, in the opening discussion of the Judgment chapter, having just finished the chapter on the concepts of singularity, particularity, and universality, Hegel characterizes the judgment as the "*true significance* of the previous forms of transition"—e.g., of the discussion of singular things, particularity and universality in the Concept chapter. Hegel's is a nonstandard notion of truth, but it seems clear that these two claims—the judgment is the truth of the concept and the syllogism is the truth of the judgment—place inference at the center of Hegel's theory of conceptual content. Similar remarks are made in the Jena System of 1804-5: "The judgment is not as such on its own account, but is returned into the concept and subsumed under it. The determinate concept obtains its reality in the syllogism" (7:94-5, p.99 of Hegel 1986). And Hegel opens Essence in *The Science of Logic* with "The *truth* of *being* is *essence*" (11:241, p.337).

Rather than thinking of logic as a merely formal science whose job it is to plot rational relations among sentences regardless of their content, Hegel's is a view of logic on which (at least some of) the rational relations among sentences are intelligible only insofar as the content of those sentences, the determinate understanding of some bit of the world they afford, is part of what explains those relations. At the opening to The Subjective Logic of *The Science of Logic* Hegel writes (12:27, p.524):

> This formal discipline must therefore be thought of as inherently much richer in determinations and content, and also of infinitely greater efficacy over the concrete, than it is normally taken to be.[18]

At the end of this section (12:28, p.525) Hegel explicitly contrasts his understanding of logic with both the Kantian and the Aristotelian:

> Just as the Kantian philosophy did not consider the categories in and for themselves…still less did it subject to criticism the forms of the concepts that make up the content of ordinary logic.…It is an infinite merit of Aristotle, one that must fill us with the highest admiration for the power of his genius, that he was the first to [provide a natural description of the phenomena of thought as they simply occur]. But it is necessary to go further and determine both the systematic connection of these forms and their value.

VI A Peircean Interpretation of Hegel's Syllogistic Figures

Kant's distinction between a thing's falling under an immediate/intermediate concept and an immediate/intermediate concept falling under a mediate concept requires, at a minimum, a three-sorted logic of terms. Hegel marked this sorting by talk of singular things (S), particularity (P), and universality (U). In the section headings of the chapter on the Concept Hegel speaks of universality and particularity in adjectival terms as '*der allgemeine Begriff* ' and '*der besondere Begriff* ,' while speaking of singular things with the noun '*das Einzelne*.' But this usage is not

[18] See also 12:19 (p.517) and the discussion in chapters 22 and 23 in Winfield (2012).

standard and he is also willing to talk in terms of 'universality' (*Allgemeinheit*), 'particularity' (*Besonderheit*), and 'singularity' (*Einzelheit*), e.g. in the characterization of the logical form of the syllogism at 12:92 (p.590) and in terms of 'the universal' (*das Allgemeine*), 'the particular' (*das Besondere*) and 'the singular thing' (*das Einzelne*) at 12:50 (p.547). In what follows I will primarily speak in terms of 'universality', 'particularity', and 'singular things' so as to avoid talking of universals and particulars. I do so for two reasons. First, 'particular' tends to be interchangeable with 'singular thing' in English, and this distinction needs marked here. Particularity for Hegel (as with an intermediate mark for Kant) is a characteristic of singular things that marks them off as a subset of some larger totality (represented by a mediate mark for Kant and universality for Hegel). Second, use of the term 'universal' tends to invoke platonic considerations that are not relevant for what follows, and my hope is that talk of 'universality' will avoid this.[19] It is also worth noting that Hegel distinguishes singular things (*Einzelnen*) from individuals (*Individuen*), the latter being singular things that have the teleological unity characteristic of organisms and persons. It has been customary to translate '*Enzelne*' as 'individual', though di Giovanni prefers 'singular thing' so as to preserve 'individual' for '*Indivduum*'. Though that distinction is not at issue here, I follow di Giovanni's notation.

In his discussion of the syllogistic figures Hegel applies the categories for singular things, particularity, and universality to a range of cases. He discusses both non-constitutive subject/predicate relations (like the color of a rose), and relations holding between natural kinds and the properties that are constitutive of them as members of those kinds. He also treats of particularity and universality as the species/genus relation. For the purposes of rational reconstruction with an aim toward exhibiting a clear case in which the use of these inferences affects the content of the concepts contained within them, I will mark talk of singular things with

[19] My thanks to a reviewer for suggesting this treatment.

sortally-restricted demonstratives, particularity with kind terms (common nouns), and universality with predicates; on the side of metaphysics these logical categories show up as objects, kinds, and properties respectively. But I want to emphasize that I am reconstructing an idealized regimentation of the these three syllogistic figures in order to show how, on this basis, we can plot definite processes of conceptual development over the course of inquiry. All that is necessary for demarcating these figures is that the three classes of concepts be ordered from less to more general and capable of forming judgments of the forms listed below.[20] While I focus on regimenting Hegel's talk of particularity and universality in terms of kinds and their constitutive properties, I am not claiming, for instance, that Hegel supposed particularity was co-extensional (still less co-*in*tensional) with kind classification. I will also occasionally slide between the formal and the material modes of discourse, trading talk of conceptual relations for talk of the objects and facts those relations purport to represent.

Hegel's reconceptualization of the subsentential structure of the judgments occurring in a syllogism affords a rethinking of the inferential relations within which these terms play their roles, and so a rethinking of the syllogism itself.[21] Each concept will play a role as a middle term in a different syllogistic figure, so that a division of the syllogism into three figures is at the same time a division of concepts into singular things, particularity, and universality. To understand

[20] Peirce's examples, for instance, are meant to illustrate statistical generalizations about the contingent properties of objects:

Deduction	Induction	Abduction
1) This ball is from the urn.	1) This ball is from the urn.	1) This ball is red.
2) All the balls in the urn are red.	2) This ball is red.	2) All the balls in the urn are red.
3) This ball is red.	3) All the balls in the urn are red.	3) This ball is from the urn.

A story much like the one I tell concerning kinds and constitutive properties could be told concerning the effect of reasoning with terms that do not purport to represent lawlike relations between kinds and their properties, as in Peirce's examples. But the effect of inductive and abductive reasoning will increase the extension and comprehension of these terms in ways that are more context-sensitive.

[21] Cf. Harris' (1983) discussion of this sorting as part of Hegel's speculative theory of the syllogism during his early development, pp.157ff.

this syllogistic system is to understand how to use these three kinds of concept in mediating different inferences. With a case of a singular thing instanced by 'this rod', particularity with the kind term 'metal', and universality with the predicate 'conducts electricity', the three syllogistic figures take the following forms:

Hegel's First Figure: SPU (Deduction)

1) SP	1) This rod is made of metal.
2) PU	2) Metal things conduct electricity.
3) SU	3) This rod conducts electricity.

Hegel's Second Figure: PSU (Induction)

1) SP	1) This rod is made of metal.
2) SU	2) This rod conducts electricity.
3) PU	3) Metal things conduct electricity.

Hegel's Third Figure: SUP (Abduction)

1) SU	1) This rod conducts electricity.
2) UP	2) Metal things conduct electricity.
3) SP	3) This rod is made of metal.

In a deductive syllogism the particularity of a concept—its subordination under a universality—allows it to be a middle term that mediates in inference attributing that universality to a singular thing. The conclusion (SU) is the judgment that results from that mediation of particularity (P). Here we have a case of kind-membership mediating a relation between an object and a property. Because the second premise tells us that the kind term 'metal' implicates the predicate 'conducts electricity,' we know that we are entitled to attribute the corresponding property to anything subsumed under that kind term—kind terms underwrite deductive implications between singular terms and predicates. With induction, by contrast, being a singular thing mediates a relation of subordination between a case of particularity (a kind-identity) and a case of universality (a property that the members of those kinds bear), in virtue of

the observation that a member of the kind (or a set of them) is subsumed by both the particularity and the universality.[22] Finally, taking a universal concept as the middle term yields the third figure. Here one posits that a thing falls under a particularity in virtue of the fact that this would explain why the thing falls under a universality, in the context of a commitment that the universality in question subordinates that particularity. As reconstructed, in this form of reasoning we use a property as the basis through which to infer that some singular thing is a member of some kind.

Whereas a deductive syllogism is warranted simply on account of its form, and so regardless of the content of the terms occurring within it, inductive and abductive syllogisms are not justified in this way. Just so, whereas the first figure inference is *explicative* of a pre-existing content contained in the premises, the second and third figures are not. This point can be made by considering the extensional interpretations of these figures. In the deductive syllogism the premises state that the rod is a member of the set of metal things, and that the set of metal things is a subset of the set of things that conduct electricity. It follows by elementary set theory that the rod is a member of the set of things that conduct electricity. But in the abductive syllogism the truth of the premises do not ensure the truth of the conclusion, for the rod might fall outside the set of metal things and still be a member of the set of things that conducts electricity.[23] To understand what it is to reason according to inductive and abductive syllogistic figures we must look beyond the extensional forms of these figures. Though the lack of deductive validity for inductive and abductive inference raises questions concerning the conditions under which these inferences are warranted, I bracket those questions in what follows. For my purposes it is

[22] The propriety of the kind and property inference turns on an acceptance of an underlying natural law; the propriety of Peirce's inference turns on an acceptance of the law of averages. It is a complicated matter determining when such an inference is warranted, and I suppress these considerations in what follows.

[23] A standard formal representation of a third figure syllogism turns the second premise into a conditional, and now the inference is a a case of the fallacy of affirming the consequent.

enough to note that we do reason in these ways, as my aim is to elucidate what these practices commit us to by way of revising our concepts within this syllogistic system rather than to give an account of when such commitments are justified.

Though Hegel is interested in how conceptual content develops over the course of inquiry, he does not treat these figures as case-studies for how that process occurs. Peirce, by contrast, works up a set of distinctions with which to track changes in conceptual content, though he does not apply it to this syllogistic game either. In a paper presented to the American Academy of Arts and Sciences in 1867 entitled "Upon Logical Comprehension and Extension," Peirce appropriates the distinction between extension and comprehension toward the end of making sense of changes in content over the process of inquiry. Of particular relevance is Peirce's distinction between the *informed* extension and comprehension of a term and its *substantial* extension and comprehension. The former is meant to capture the referents and implications of a set of terms at a particular time, and the latter represents an ideal state at the end of inquiry "in which the information would amount to an absolute intuition of all there is, so that the things we should know would be the vey substances themselves, and the qualities we should know would be the very concrete forms themselves" (p.426).

Applying the distinction between informed and substantial extension and comprehension to these three figures, we can see that the processes of reasoning according to these figures has the effect of transitioning our concepts from less to more informed stages of their extension and comprehension. Call the 'extension' of a term the objects it refers to at a context. Call its 'comprehension' the concepts that are implicated by the use of the term at a context. Let 'content' be the genus of which extension and comprehension are species. As reconstructed above the use of a deductive syllogism, whose conclusion is a judgment subsuming a singular

term under a predicate on the basis of the use of a kind term as a middle term in mediating that inference, has the role of making explicit certain features of the pre-existing relations of extension and comprehension that the terms stand in. On the side of *extension* the conclusion that the rod is a member of the set of conductive things is an explication of the facts that 1) the set of metal things is a subset of the set of conductive things and 2) the rod is a member of the set of metal things. On the side of *comprehension* the conclusion of the deductive syllogism explicates that the predicate 'conducts electricity' is part of the comprehension of the singular term on account of the fact that (as the premises assert) the kind term is part of the comprehension of the singular term and the predicate is part of the comprehension of the kind term. Deductive inference does not change the content of our concepts but rather makes explicit what was implicit in a set of judgments.

The second and third figures are ampliative rather than explicative; to draw these conclusions is to change the content of some of the terms occurring within them. To accept the conclusion of the inductive inference above is to endorse increasing the informed comprehension of the kind term 'metal', transitioning the language from a less to a more informed stage concerning the implications consequent on the application of that kind term. At the same time to draw this inference is to endorse increasing the informed extension of the predicate 'conducts electricity' by all of the objects one has already included under the extension 'metal'. It may be a risky use of induction to accept this inference, of course, particularly if one's sample size is small or one lacks an explanation concerning why metal things conduct electricity. Induction forecasts future experience without certifying that it will conform to our expectations. But the point at issue is that, in practice, the drawing of this inference affects one's commitments concerning the content of some of the terms occurring within it. For once one has accepted the

inductive conclusion that metal things conduct electricity, subsequent subsumptions of singular terms under that kind term will implicate the predicate added to the comprehension of that kind term on the basis of that inductive inference. The comprehension of every singular term falling under that kind term will therefore, in practice, be increased by the addition of the predicate in question, and so that predicate's extension will be increased as well, now coming to include all members of the kind denoted by that kind term. We can represent this increase in content by drawing the deductive inferences that are licensed by the rule engendered in the conclusion of the induction—anything that was classified under the term 'metal' will now be understood to conduct electricity.

An abductive conclusion, by contrast, increases both the extension of a kind term and the comprehension of a singular term. To classify this rod as metal on the basis of its disposition to conduct electricity is to commit to increasing the extension of the kind term 'metal' while increasing the comprehension of the singular term by the predicates included in the comprehension of that kind term. Such an inference does not change the comprehension of the kind term, but it does change the informed comprehension associated with the singular term (and so changes our understanding of what it is to be that singular thing). To say that the comprehension of the singular term is increased by the kind term 'metal' is to say that we who use that term after having accepted this inference are now in a position to draw new implications with that singular term. And a new round of deductive inference will make these implications explicit.

Modified slightly, use of this system of reasoning over the course of inquiry can account for successive transitions from less to more informed extensions and comprehensions for any term in a (certain class of) language(s). On my reconstruction terms standing for singular things,

particularity, and universality each have an informed extension and an informed comprehension. We have seen that the employment of an inductive syllogism increases the informed extension of a term for universality and the informed comprehension of a term for particularity, and that abductive syllogisms increase the informed extensions of terms for particularity and the informed comprehensions of terms for singular things. We do not have methods for increasing the informed extensions of terms for singular things nor the informed comprehensions of terms for universality, however. Notice that terms for singular things cannot increase their extensions, as they denote only one object. Instead the problem here is determining how to fix the extensions of singular terms. An observational language offers a way forward, for in a language with observation sentences singular things can be labelled with singular terms in virtue of the apparatus associated with individual reference—e.g. contexts of utterance, demonstratives, definite descriptions, names, etc. (this is not to say that such labelling is intelligible independent of classification under a kind, of course). If we situate this syllogistic system in a community that employs observation sentences then we can explain how at least some of the singular terms of the language acquire their extensions (we may want to account for the extensions of mathematical objects in some other manner, of course). To find a practice of inquiry sufficient to explain changes in the comprehension of terms for universality, notice that in some cases we can produce a more general term that subsumes a given universality as a case of particularity relative to this more general universality. And considered *qua* particularity a given universality may have its comprehension increased by employment in the inductive syllogistic figure, for that is the form of reasoning that (within this game) increases a general term's comprehension. To pick an example that will concern us in more detail in the next section, while from some context we might view the property denoted by the predicate 'either orbits the sun or orbits a body

orbiting the sun' as something that singular things bear via different particularities (e.g. one being a planet, another a moon), and so which property is a universality considered at that context relative to the corresponding particularities, from another context we can see that the property of 'orbiting' that these bodies share is one that, we have discovered, is particularized under the more universal category denoted by the term 'massive body' or some cognate. Now the rules of gravitation through which we understand what it is to be a massive body subordinate this universality *cum* particularity ('orbits the sun or orbits a body orbiting the sun') together with other particularities heretofore not thought to be species of this new genus ('is a star'), with the result that we have a new more universal concept. But this means that a given universality may be a particularity under a higher genus. Now the subordinated universality (e.g. 'orbiting'), considered *qua* particularity relative to this more general term, can have its comprehension increased on the basis of the drawing of an inductive syllogism. If this syllogistic system were integrated with an account of observation that fixes the extensions of terms and an account of a process of searching for more universal concepts to subordinate successive levels of particularity then it would mark out a domain of inquiry in which it is possible to account for the transition of less to more informed extensions and comprehensions for each of these three classes of term. In that sense, integrating this system with an account of observation and of the use of observation in constructing more general concepts in the development of a comprehensive worldview suffices to determine, in principle, how the members of any class of terms in that fragment of the language aquire the contents they do (I am of course bracketing thorny questions about the existence and nature of an Absolute Idea). Given the way object-language talk of grounding is warranted on the basis of explanation, this is just to say that the use of this syllogistic system within a particular domain of inquiry, the practice of drawing these inferences against the

variegated backdrop of observation, reflection, hypothesis, experiment, etc., is a ground for the conceptual contents that the terms in that fragment of the language come to have—for it is this very practice that explains why the concepts in question have the content they do.[24]

VII Inference by Analogy as an Exercise of the Reflecting Power of Judgment

One might worry that the syllogistic system of section VI is too baroque to be more than a historical oddity—after all, when has an advance in our understanding of the world taken place strictly within those strictures? But Hegel associates the third syllogistic figure with inference by analogy, and by considering analogical inference in the context of the work of practicing scientists we can see concrete cases where capacities for reflection and conceptual change are operative over the course of inquiry. Inference by analogy is a form of reasoning that involves comparing two different things (objects, relations, domains, etc.) and using some understanding of one of them to try to make sense of the other. And like the inductive and abductive syllogisms, an analogical inference is ampliative and underwritten by material facts concerning the objects, relations, etc. adverted to in the inference. In both the *Science of Logic* and the *Encyclopedia* Hegel gives the following as an example of analogical inference:

> The earth has inhabitants;
> The moon is an earth;
> Therefore the moon has inhabitants.

[24] My use of 'ground' here is meant to be noncommittal both on its formal properties as a logical notion, and on the model that interprets it (e.g. causal, metaphysical, conceptual, logical, etc.). By using this apparently representational object-language locution I intend only to mark the point that in order to give an explanation for the contents of different terms on a system such as this, both concerning *what* that content is and *how* these terms came to have that content, one makes recourse to material details of the practice of inquiry that have resulted in those terms having just that content. Whether this explanatory connection, expressed in the material mode with talk of 'grounding' and the like, is to be construed as metaphysical, causal, conceptual or what-have-you is immaterial at present, as are the particular formal properties of this operator. For conventional discussion of issues of the form and matter of grounding vocabulary see Correia (2008), deRosset (2013), Fine (2012), Nolan (2011), Paul (2012) and the essays in Correia and Schnieder (2012) and Chalmers, Manley, and Wasserman (2009).

Such an inference is warranted only when the property inferred across the individuals is something possessed by them in virtue of some relevant connection between the kind and the property, however. In criticizing the analogy above, which Hegel recognizes as defective, he says in the Addition to §190 of the *Encyclopedia Logic* (p.266):

> That the earth has inhabitants does not rest merely on the fact that it is a heavenly body; on the contrary, some further conditions are necessary, especially that of being surrounded with an atmosphere, the related presence of water, and so on; and it is precisely these conditions which, as far as we know, the moon lacks.

An inference by analogy, like the inductive and abductive syllogisms, is good not because of the mere *form* of the inference, but instead in virtue of something about the *content* of the terms occurring within it. One must have some (perhaps context-sensitive) understanding of what it is to be a member of the kind in question if one is to analogically infer a property across those kinds. From a little earlier in that Addition (p.266):

> In the syllogism of analogy it is concluded that because things of a certain kind have a certain property, therefore other things of the same kind have the same property, too….[Analogy] is the instinct of reason which surmises that this or that empircically discovered determination is grounded in an object's inner nature or kind, and which proceeds on that basis.

On my reconstruction to reason with a third figure syllogism is to use an instance of universality (the instantiation of a property) as a middle term in concluding that some object is a member of a particular kind. But Hegel's discussion of analogical inference at 12:115-118 (pp.614-7) of the *Science of Logic* and §190 of the *Encyclopedia Logic* is a case of an inference where the middle term refers to a singular thing considered in terms of a universal characteristic; the object is "taken as something concrete which, in truth, is just as much a universal nature or genus as it is a singular [thing]" (*Science of Logic* 12:117, p.615; cf. *Encyclopedia Logic* §190). Whereas third-figure inference as reconstructed above uses the possession of a property

(conducting electricity) to infer membership in a kind (being made of metal), in an analogical inference of the form above individual membership in a kind (being a planet; an 'earth') is used to infer (to mediate a conclusion) that some one thing of that kind has some property (being inhabited) had by another thing of kind.

Staying within the orbit of the resources already in play, these two forms of reasoning can be seen to affect the content of the concepts occurring within them in different ways. With the inference of a kind on the basis of a property (as in the third syllogistic figure) the result is that a kind term's extension is increased by the singular term subsumed under it, while the singular term's comprehension is increased by the kind term. But this inference does not establish a new inferential connection between the kind term and the property-denoting predicate (we do not change our understanding of what it is to be metal simply in virtue of classifying something as metal—though of course in context a discovery of this sort can *confirm* some other hypothesis in play). Instead, a pre-existing connection between the kind term and the predicate make the inference possible. By contrast, the analogical inference of a property on the basis of a kind is a hypothesis that, were enough instances found in which the connection between the kind and the property held (or were the right story in place connecting that property and kind), one would be in a position to draw an induction over those cases to a conclusion that the property in question is part of the comprehension of the kind. And this would be to establish a new rule linking the corresponding kind term and predicate. Whereas to infer membership in a kind on the basis of the exhibition of a property, as in SUP above, does not affect the comprehension of the kind term used in that inference, to draw an analogical inference of a property on the basis of a kind is to employ a form of reasoning that, over the course of subsequent inquiry, can lead to the institution of a rule linking a kind term with a new predicate so as to increase that kind term's

comprehension.[25] This process of reasoning by analogy bears some relation to Peirce's later views on abduction. In his later work Peirce came to see abduction as a form of nondeductive ampliative inference that must be more sharply distinguished from induction than was permitted by the syllogistic individuation of these forms of reasoning. Ultimately Peirce believed that while abduction was like induction in being ampliative of the content of concepts rather than merely explicative, abduction was unlike induction in that it was the only form of reasoning that was responsible for the generation of new concepts (cf. Levi 2012 pp.76-9, Anderson 1986 pp.147-8, Psillos 2011 §§3-5). I am now in a position to argue that inference by analogy is an ampliative form of reasoning, involving the generation of new concepts, of the sort that Peirce in his later work associates with a revised understanding of abduction, and that this form of reasoning involves an exercise of the reflecting power of judgment as discussed in section III.[26]

Recall that for Kant the reflecting power of judgment is operative when we are given an individual thing and search for a concept with which to understand it. In the toy example of third figure syllogism as SUP we discover that an individual exhibits some property and we cast about for a kind-classification that would explain the exhibition of that property. This sort of activity does not by itself commit us to changing our understanding of the kind—in inferring that the rod

[25] This is not to deny that one can also *deduce* a kind on the basis of a property (only mammals produce milk; this animal produces milk; therefore this animal is a mammal) or a property on the basis of a kind (that this is copper means that it conducts electricity). But these deductions depend upon already having the rule or generalization linking the property and kind in question, and the point of these nondeductive inferences is that they have the effect of establishing new rules rather than relying on them in drawing the inference.

[26] Two other points of convergence worth mentioning. Just as Hegel thinks analogical inference involves the "instinct of reason", so does Peirce think that abduction is in part instinctive—cf. Anderson (1986) pp.155ff. and Psillos (2011) §6. And just as analogical inference can involve an induction over an observation that many members of a kind exhibit an analogically inferred property to the conclusion that all of the members of the kind do, Peirce's later views on abduction give inductive inference a similar role. Peirce came to believe that inquiry begins with an abductive inference that would explain some surprising datum, that we proceed to draw deductive consequences implied by this abduction, and then investigate whether these consequences hold with the result that, if they do, we draw an induction over the results to the conclusion that the abduction is warranted (cf. Peirce 1901, especially pp.94-7, and Levi 2012 pp.76-7).

is metal so as to explain its electrical conductivity I am not coming to some new understanding of what it is to be metal. But there are at least two ways in which analogical inference can involve the conceptual revision of kinds and their properties. In the analogical inference considered above we were faced with two individuals as members of a common kind (the earth and the moon as celestial bodies) and infer that they share some property (being inhabited). Should we come to conclude that having the property in question is part of what it is to be of that kind, perhaps by making an induction over the cases in which the analogy was born out, perhaps by some underlying mechanism able to explain the possession of the property by members of that kind, we come to change our conception of the kind. But more radical conceptual changes are possible with analogical inference, for this mode of reasoning can be operative when comparing individuals classified under *different* kinds. Here it is possible to use an antecedent understanding of one kind of object so as to reorient the categorial frame of one's understanding of another kind, thereby coming to conceive of that latter kind in new ways guided by our conception of the former. This sort of reasoning is not uncommon in the history of science.[27] I will discuss two examples—one concerning Galileo's observations of Jupiter, another concerning natural selection as a basis for rethinking the order of explanation between agency and natural purposes—as cases where reflection on data that we did not have a concept sufficient to synthesize led to analogical reasoning that resulted to an exercise of the determining power of judgment and the formation of a different understanding of the domain in question.

When Galileo observed Jupiter over the course of a few days in January of 1610 he noticed what appeared to be three stars near the planet. Interestingly, they were arrayed around

[27] The 2nd half of the 20th century saw inference by analogy come to prominence first in the philosophy of science and then in artificial intelligence and cognitive science. Work by Mary Hesse (1952, 1964, 1966, 1974) and Paul Bartha (2010) discuss the former. The anthologies of Helman (1988) and Gentner, Holyoak, and Kokinov (2001) consider the latter. Hesse (1966, 1974), and Bartha (2010) hold that analogical reasoning is essential to scientific theorizing.

Jupiter parallel to the plane of the ecliptic, the plane that stretches across the solar system and is formed by the gravitational force of the sun. As we now understand, the planets orbit the sun and the moons of the planets orbit their planets roughly along the ecliptic (if one looks up at the sky and imagines the heavens revolving around the earth, the ecliptic is the line on the sky along which the sun, moon, and planets are roughly situated as they move across the dome of the sky). Over the next few days Galileo noticed that the 'stars' around Jupiter were changing position, moving toward the planet in one direction until they were moving away from it in the other before reversing course and moving in the opposite direction and beginning the cycle again, all the while remaining along the ecliptic. These 'stars' were moving toward and away from Jupiter along the same plane on which the planets orbit the sun and the moon orbits the earth. When one brings to mind, as Galileo surely did, the Copernican view that the planets were revolving around the sun just as the moon revolves around the earth, the observation that these bodies were moving around Jupiter along a course defined by the orbital plane of the solar system would impel one to reconceive these bodies as moons that were orbiting Jupiter just as Jupiter orbits the sun. From Galileo's published remarks in March of 1610:

> … I noticed a circumstance which I had never been able to notice before, namely that three little stars, small but very bright, were near the planet; and although I believed them to belong to a number of the fixed stars, yet they made me somewhat wonder, because they seemed to be arranged exactly in a straight line, parallel to the ecliptic, and to be brighter than the rest of the stars, equal to them in magnitude . . .When on January 8th, led by some fatality, I turned again to look at the same part of the heavens, I found a very different state of things, for there were three little stars all west of Jupiter, and nearer together than on the previous night.
>
> I therefore concluded, and decided unhesitatingly, that there are three stars in the heavens moving about Jupiter, as Venus and Mercury around the Sun; which was at length established as clear as daylight by numerous other subsequent observations.[28]

[28] Quoted at http://solarsystem.nasa.gov/scitech/display.cfm?ST_ID=2283.

In a context in which the planets are beginning to be conceived as orbiting the sun, the observed similarity concerning the spatial relationship between the sun and the planets on the one hand, and the spatial relationship between Jupiter and the observed bodies surrounding it on the other, supported an inference to the conclusion that these bodies are moons that orbit Jupiter just as our moon orbits the earth, or the planets orbit the sun. The inferential connections licensed by this analogy must be localized, of course, so that, e.g., the relationship between the life-supporting forces that obtain between the sun and its planets are not inferred to obtain between Jupiter and its moons. It takes some work to determine which of the inferences that are good in the one domain can be used as an analogical guide in drawing inferences within the other. But the result of this process was, over the course in which it was developing, a contribution toward a new understanding concerning what it was to be a celestial body—now the planets, their moons, and the sun are understood according to a different set of relationships that unified them as instances of a more general kind (cf. the discussion of Kant's account of comparison and reflection in the formation of general concepts at the start of section III).

A second case where analogical inference was employed in developing the content of a set of concepts, determining our understanding of some bit of the world, can be found in the research leading up to and in the reception of Darwin's *Origin.* In order to, *inter alia*, make sense of various observations concerning apparent similarities between different species, to explain why processes of gestation for complex species appear to proceed through stages of complexity that are characteristic of simpler species, to account for the wide variety of species found in the geological record (many of which no longer exist), and to synthesize the projects in natural taxonomy according to some unifying principle, Darwin supposed that random heritable variation and a competition for survival would, over time, tend toward the emergence of novel

species and the extinction of others. These explanatory resources made available a new sort of understanding not only of organic purposes but also of intentional agency. For whereas pre-Darwinian accounts of natural purposiveness were founded on a view that took intentional agency as a domain through which to build an analogical understanding of organic purposes (e.g. in Kant's discussion of natural teleology in the third *Critique***)**, Darwin's hypothesis posited novel conceptual resources that were put to use in reconceiving what it was to be a naturally purposive thing, and these resources were then used by American philosophers in the second half of the 19th century.[29] Whereas for Kant natural purposes are understood by analogy with the conceptual resources of intentional agency, Darwin's work gave us an independent understanding of natural purpose. Those concepts could then be used to reorient the analogical relationship between mind and natural purpose so as to think about intentional agency by analogy with this reconceived notion of natural purpose:

> To this task the new biology brought excellent instruments of analysis: "adaptation to the environment," "spontaneous variation," "struggle for existence," "survival value," these were concepts, at once both physical and teleological, which could readily be applied to all phases of culture and to the criticism of all institutions. (Schneider 1963, p.337)

Seen in this light, Darwin's *Origin* was the culmination of an extended exercise of the reflecting power of judgment that culminated in a hypothesis positing processes of natural selection that were then able to be used in a framework for reconceiving, by analogy, the place of mind and society in nature.[30]

In its general character analogical inference involves identifying hallmark structures in two (or more) different domains that bear some similarities and setting up a mapping of

[29] For helpful introductions to this period see Fisch (1947), Wiener (1949), chapters 30-33 of Schneider (1963), chapters 6,8, and 9 of Kuklick (2001), and chapters 6 through 9 of Menand (2001).

[30] I defend this claim in more detail in my (Forthcoming), which is something of a companion piece to the current paper.

categorial resources from one domain into the other (situated initially on the hallmarks) so that the forms of understanding employed in reasoning and explanation in the first domain can, with a proper commentary on that mapping, be used to interpret the target domain. And this whole process, from the comparison of objects under different kinds (e.g. planets and the sun; moons and planets), to the recognition of the underlying similarities the members of these kinds share in their hallmarks (spatial relationships between heavenly bodies and their satellites), to the transposition of one kind's categories onto the other (using the sun/planet relationship to understand Jupiter and its moons), to the commentary on that transposition through which we specify which similarities to rely on and which to ignore (spatial relationships versus life-supporting effects), to the gradual process of attending to the commentary and extending the application of the categories out away from the hallmarks of the interpreted domain and revising the model as it is put to use, is a process shot-through with reflection. And this is a process of that, when successful, results in the formation of a new understanding of some domain of inquiry. In this way the reflecting power of judgment, as it is understood in the context of Hegel's consideration of analogical inference and what Peirce will call 'abduction', is a power whose exercise can result in new concepts, new forms of understanding, with which to reason about and make judgments of the world.

VIII Conclusion

While neither Hegel nor Peirce systematically employ syllogistic inference as a way of developing the Kantian idea that relations of conceptual content will sometimes change over the course of inquiry, their syllogistic system permits just such a systematic treatment. Though simplistic to the point of being near to a limit-case of an actual process of inquiry, the advantage

of the *Schlusspiel* reconstructed in section VI is that it provides us with a clear-cut case in which the practices of reasoning associated with inquiry affect the contents of the judgments made in that inquiry. And inference by analogy, as a process of reasoning that involves a reflective stance on our current understanding of different domains in the interest of constructing a novel perspective, provides a further point of orientation for this rational reconstruction. By working through this line of thought we deepen our appreciation of Redding's observation that abductive inference in Peirce and third figure inference in Hegel deserve to be seen as descendants of Kant's notion of a reflecting power of judgment. And though contemporary logicians tend to focus on formal treatments that reconstruct implication relations among sentences via deductive set-theoretic relations among the extensions of subsentential terms and the truth-conditional relations of logical operators, we have seen that a distinction between extension and comprehension as applied to the three syllogistic figures affords a way of explicating the claim that for Kant, Hegel, and Peirce the logic of inquiry is not to be understood in merely formal terms that abstract away from the nonextensional relations of implication that underwrite ampliative inferences. Aristotelian syllogistic dominated treatments of logic for two thousand years, and though the formal systems descending from programs in the foundations of mathematics at the turn of the 20th century mark a decisive break with that tradition, Kant's criticism of the logical relations that determine the Aristotelian syllogistic figures enabled a reconceptualization of syllogistic inference that Hegel and Peirce each undertook. This moment in the history of logic deserves to be seen both as a substantive break with Arisotelian logic that predates the turn toward the formal logical systems that came to prominence in the 20th century, and as a view of logic that affords a perspective on inquiry that the extensional formalism characteristic of these latter systems has tended to occlude.

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