Diálogos, 91 (2008) | pp. 59-82

ELEMENTS OF GÖDEL'S TURN TO TRANSCENDENTAL PHENOMENOLOGY[1]

RICHARD TIESZEN

> *Mathematical logic should be used by more nonpositivistic philosophers. The positivists have a tendency to represent their philosophy as a consequence of logic -- to give it scientific dignity. Other philosophers think that positivism is identical with mathematical logic, which they consequently avoid. (Kurt Gödel, as reported by Hao Wang, Wang 1996, p. 174)*

The logician who conducted and recorded the most extensive philosophical discussions with Kurt Gödel during Gödel's later years was Hao Wang. We know from the work of Wang and others that Gödel's favorite philosophers were Plato, Leibniz, Kant, and Husserl. Let me quote some passages from Wang that are, I think, important for indicating, if only very generally, how ideas in the work of Plato, Leibniz, Kant, and Husserl, were related in Gödel's thinking:

> Before 1959 Gödel had studied Plato, Leibniz, and Kant with care: his sympathies were with Plato and Leibniz. Yet he felt he needed to take Kant's critique of Leibniz seriously and find a way to meet Kant's objections to rationalism. He was not satisfied with Kant's dualism or with his restriction of intuition to sense intuition, which ruled out the possibility of intellectual or categorial intuition. It seems likely that, in the process of working on his Carnap paper in the 1950s, Gödel had realized that his realism about the conceptual world called for a more solid foundation than he then possessed. At this juncture it was not surprising

---

[1] A shorter version of this paper was presented in the *Semana de la Fenomenología* held at the Universidad de Puerto Rico in October 2008 and in the California Phenomenology Circle (CPC) in April 2008. I thank Professor Guillermo Rosado-Haddock for the invitation to lecture in Puerto Rico, and Professors Jeffrey Yoshimi and Joe Schear for the invitation to lecture at the CPC meeting. Thanks also to the members of both audiences for helpful comments. The paper is excepted from my book manuscript *After Gödel: Platonism and Reason in Mathematics and Logic.*

> for him to turn to Husserl's phenomenology, which promises a general framework for justifying certain fundamental beliefs that Gödel shared: realism about the conceptual world, the analogy of concepts and mathematical objects to physical objects, the possibility and importance of categorial intuition or immediate conceptual knowledge, and the one-sidedness of what Husserl call "the naive or natural standpoint". (Wang 1996, p. 164)
>
> In his philosophy Gödel tried to combine and go beyond the main contributions of his three heroes: Plato, Leibniz and Husserl. Leibniz had defined the ideal by giving a preliminary formulation of monadology. Husserl had supplied the method for attaining this ideal. Plato had proposed, in his rudimentary objectivism in mathematics, an approach that could serve as foundation for Husserl's method and, at the same time, make plausible for Gödel the crucial belief that we are indeed capable of perceiving the primitive concepts of metaphysics clearly enough to set up the axioms. (Wang 1996, p. 289)
>
> Gödel uses Plato, Leibniz and Husserl in a positive way, Kant and Hegel in a mixed way, and positivism and Wittgenstein negatively. (Wang 1996, p. 327)

Husserl is the most recent philosopher on Gödel's list of favorites, and it is to Gödel's interest in Husserl that I will especially turn in this paper. Reports of Gödel's interest in Husserl have surfaced in many places over the years. Gian-Carlo Rota has written that Gödel believed Husserl to be the greatest philosopher since Leibniz (Kac, Rota, and Schwartz 1986, p. 177). Heinz Pagels has written that "During his later years he [Gödel] continued to pursue foundational questions and his vision of philosophy as an exact science. He became engaged in the philosophy of Edmund Husserl, an outlook that maintained that there is a first philosophy that could be grasped by introspective intuition into the transcendental structure of consciousness—the very ground of being" (Pagels 1988, p. 293). As part of his description, Pagels mentions how Gödel thought it meaningful to ask questions about the truth of axioms, and to consider their philosophical foundations, and he then mentions Gödel's view on mathematical intuition. Georg Kreisel has also noted Gödel's interest in Husserl in his article on Gödel in the *Biographical Memoirs of Fellows of the Royal Society* (Kreisel 1980, pp. 218-219). Hao Wang has remarked, in connection with Gödel's views in "What is Cantor's Continuum Problem?", that "presumably Husserl's elaborate analysis of our perception of a physical object can … be viewed as supporting G[ödel]'s conclusion" (Wang 1987, p. 303) about the objective existence of mathematical objects and about mathematical intuition. He comments in another place that "perhaps Husserl's considerations of *Wesensschau* can be borrowed to support G[ödel]'s belief in the objective existence of mathematical objects" (Wang 1987, p. 304). Also, Charles Parsons has conjectured that Husserl's conception of intuition is Gödel's model in "What is Cantor's Continuum Problem?" (Parsons 1983, p. 24).

In this paper I present an overview of central themes in Gödel's study of Husserl's phenomenology, culled from the books of Hao Wang (Wang 1974, 1987, 1996), my discussions in the nineteen eighties with Hao Wang about Gödel's philosophical interests, and some items from the Gödel *Nachlass* (see also Tieszen 1992, 1998, 2002, 2006). Many of the items from the *Nachlass* that I will cite are not widely known. It is not my intention to be exhaustive in describing Gödel's study of Husserl, or his views on Plato, Leibniz, and Kant. There are entries in the philosophical notebooks in Gödel's *Nachlass* that will probably be of interest in this connection but they are still awaiting transcription from the Gabelsberger shorthand used by Gödel. What I will do is to sketch how some of the central ideas in the work of Plato, Leibniz, Kant, and Husserl coalesce in Gödel's philosophical remarks.

Gödel (1906-1978) is known to have studied philosophy seriously from the early 1940s until the end of his life. He was first exposed to the work of Plato and Kant fairly early in his studies, and we know that he continued to think about Kant's work off and on over many years. Wang tells us that Gödel studied Leibniz intensively from 1943 to 1946. Gödel's work on Leibniz thus antedated his study of Husserl. Gödel started to study Husserl's philosophy in 1959 and he continued this study through the 1970s. As Wang notes, Gödel's library includes all of Husserl's major writings, many marked with underlinings and marginal comments and accompanied by inserted pages written mostly in Gabelsberger shorthand. "The Modern Development of Mathematics in the Light of Philosophy" (Gödel *1961/?) is the only text we have thus far in which Gödel explicitly discusses Husserl's philosophy at any length. It is a very interesting text for the manner in which it connects certain ideas in Husserl's transcendental phenomenology to various central theses in Gödel's philosophical views on logic and mathematics.

The following themes in Husserl's work, which overlap to some extent with ideas in either Plato, Leibniz, or Kant, were clearly of interest to Gödel:

1. the idea that philosophy can be a rigorous, universal, a priori science (which is related especially to Gödel's interest in Leibniz),
2. transcendental idealism, and the use of the phenomenological method (*epochê*), to develop a new kind of monadology, a monadology that would be aided by phenomenology, but would be combined with

3. a type of platonism that recognizes the objectivity of ideal or abstract objects and concepts of mathematics, logic, and philosophy, and
4. that acknowledges and seeks to cultivate categorial or eidetic intuition of such objects
5. in order to clarify the meaning of primitive concepts of logic and mathematics
6. to ideally be used, in connection with Gödel's technical results, in deciding open problems in the foundations of mathematics and logic, including higher set theory, and also in providing a foundation for the sciences and for philosophy itself.

Gödel opposes logical positivism, naturalism, conventionalism, nominalism, and empiricism about logic, mathematics, and philosophy. He argues in detail against Carnap's view of mathematics as syntax of language, and against certain aspects of Hilbert's formalism about the foundations of mathematics. He argues against the mechanist conception of the human mind as a Turing machine. We will see below how Gödel connects this last point directly with his study of Husserl's phenomenology. Gödel also argues against subjectivism, psychologism, and Aristotelian realism about the concepts and objects of logic and mathematics.

§ 1. Gödel on Leibniz, Kant and Husserl

I would now like to present and discuss some of Gödel's remarks on Leibniz, Kant, and Husserl.

Let us start with a few of Gödel's comments about Leibniz. In remarks related to his discussions with Gödel in the 1970s Wang (Wang 1996, p. 166) says that "Gödel's own main aim in philosophy was to develop metaphysics -- specifically, something like the monadology of Leibniz transformed into exact theory -- with the help of phenomenology". Gödel told Wang (Wang 1996, pp. 55, 288, 309) that he considered Leibniz's monadology close to his own philosophy. We know that there are notes on Leibniz in Gabelsberger shorthand in the Gödel *Nachlass* but what we do not know is exactly which parts of Leibniz's monadology Gödel would or would not have accepted. Was he prepared, for example, to accept Leibniz's view that there are many different kinds of monads? It is worth noting that Gödel read and evidently appreciated the essay *Eine neue Monadologie* (1917) by one of Husserl's students, Dietrich Mahnke (van Atten and Kennedy 2003, p. 457). Mahnke obtained his doctoral degree with Husserl in 1922, writing a thesis entitled *Leibnizens Synthese von Universalmathematik und Individualmetaphysik*. This thesis was published in Husserl's *Jahrbuch für Philosophie und phänomenologische Forschung* in 1925.

Although Gödel was quite interested in some updated version of a monadology that used the methodology of transcendental phenomenology, he thought his own work in the foundations of mathematics (the incompleteness theorems in particular) showed that a mechanist view of reason or of the mind of the kind found in Leibniz's work on logic would have to be abandoned. In his 1939 lectures on logic at Notre Dame, which are in the *Nachlass* but not published, he says about Leibniz's Program that the rules of logic can be applied in a purely mechanical way and therefore it is possible

> to construct a machine that would do the following thing: The supposed machine is to have a crank and whenever you turn the crank once around the machine would write down a tautology of the calculus of predicates and it would write down every existing tautology...if you turn the crank sufficiently often. So the machine would really replace thinking completely as far as deriving formulas of the calculus of predicates is concerned. It would be a thinking machine in the literal sense of the word. For the calculus of propositions you can do even more. You could construct a machine in the form of a typewriter such that if you type down a formula of the calculus of propositions then the machine would ring a bell [if the formula is a tautology] and if it is not it would not. You could do the same thing for the calculus of monadic predicates.

Gödel then says that "it is impossible to construct a machine which would do the same thing for the whole calculus of predicates".

> So here already one can prove that Leibniz's program of the 'calculemus' cannot be carried through, i.e., one knows that the human mind will never be able to be replaced by a machine already for this comparatively simple question to decide whether a formula is a tautology or not. (see citation in Sieg 2006, pp. 197-198)

In another note in the *Nachlass* (see van Atten and Kennedy 2003, p. 433) he says that "The universal characteristic claimed by Leibniz (1677) does not exist. Any systematic procedure for solving problems of all kinds would have to be non-mechanical". Gödel amended the first sentence of this note to read: "The universal characteristic claimed by Leibniz (1677) if interpreted as a formal system does not exist". For Gödel, however, this did not mean abandoning a rationalistic optimism about solving open problems in mathematics and logic. At the end of his 1944 paper on Russell he says that

> It seems reasonable to suspect that it is this incomplete understanding of the foundations which is responsible for the fact that mathematical logic has up to now remained so far behind the high expectations of Peano and others who (in accordance with Leibniz's claims) had hoped that it would facilitate theoretical mathematics to the same extent as the decimal system of numbers has facilitated

> numerical computations. For how can one expect to solve problems systematically by mere analysis of the concepts occurring if our analysis so far does not even suffice to set up the axioms? But there is no need to give up hope. Leibniz did not in his writings about the *Characteristica universalis* speak of a utopian project; if we are to believe his words he had developed this calculus of reasoning to a large extent, but was waiting for its publication till the seed could fall on fertile ground. He went even so far as to estimate the time which would be necessary for his calculus to be developed by a few select scientists to such an extent "that humanity would have a new kind of an instrument increasing the powers of reason more than any optical instrument has ever aided the power of vision". (Gödel 1944, pp. 140 -141)

In fact, Gödel retained a rationalistic optimism about mathematical problem-solving on the basis of analyses of concepts but later he shifted the philosophical foundation for his optimism from Leibniz and Hilbert to Husserl. The optimism in the later writings is not based on a mechanist conception of reason but rather on a conception of reason that allows for the possibility of finding systematic and finite but non-mechanical methods for the decision of mathematical questions on the basis of clarification of the intuition of the abstract meanings of the terms involved in the problems. The appeals here to the grasp or intuition of meaning, and to the fact that this meaning is 'abstract' (connecting meaning with a kind of platonism), are based on Gödel's view of the philosophical consequences of his incompleteness theorems, and they all mirror elements in Husserl's philosophy that were of interest to Gödel.

In addition to what was said about Kant above, I would also like to note here the following points concerning Kant. We know that Gödel was interested in aspects of Kant's transcendental idealism. Gödel connected his own idealistic views on time and relativity theory directly to Kant (Gödel 1949 and 1949a), and in his later unpublished 1961 paper on the foundations of mathematics (Gödel *1961/?, p. 387) he speaks about how we can come to a better understanding of some of Kant's important insights on the basis of Husserl's phenomenology. From 1954 to 1959 he corresponded with Gotthard Günther at some length about transcendental philosophy. In a letter written to Günther of 30 June 1954, Gödel says

> The reflection on the subject treated in idealistic philosophy ... the distinction of levels of reflection, etc., seem to me very interesting and important. I consider it entirely possible, that this is "the" way to the correct metaphysics. However, I cannot go along with the denial of the objective meaning of thought that is connected with it, [although] it is really entirely independent of it. I do not believe that any Kantian or positivistic argument or the antinomies of set theory or

> quantum mechanics has proved that the concept of objective being (no matter whether for things or abstract entities) is senseless or contradictory. When I say that one can (or should) develop a theory of classes as objectively existing entities, I do indeed mean by that existence in the sense of ontological metaphysics, by which, however, I do not want to say that abstract entities are present in nature. They seem rather to form a second plane of reality, which confronts us just as objectively and independently of our thinking as nature. (Gödel 1954-1959, pp. 502, 504).

The complaint about Kant in this passage, reflecting Gödel's platonism or objectivism about mathematics, is a recurring theme in Gödel's philosophical notes.

Consider what Kant says about platonism in the *Critique of Pure Reason*. Kant says (*CPR* A3/B7 - A6/B10) that once we are outside the circle of sense experience we can be sure of not being contradicted by sense experience. The charm of extending our knowledge is so great that that nothing short of encountering a direct contradiction can suffice to arrest us in our course. Contradiction can perhaps be avoided if we are careful with the fabrications that occur when we leave behind sense experience, although we are nonetheless still dealing with fabrications. Mathematics, Kant says, gives us a shining example of how far, independently of sense experience, we can progress in a priori knowledge. Misled by such a proof of the power of reason, however, the demand for the extension of knowledge recognizes no limits.

> The light dove, cleaving the air in her free flight, and feeling its resistance, might imagine that its flight would be easier still in empty space. It was thus that Plato left the world of the senses, as setting too narrow limits to the understanding, and ventured out beyond it on the wings of the ideas, in the empty space of the pure understanding.

Kant says that Plato did not observe that with all his efforts he made no advance. It is a common fate of human reason to complete its speculative structures as speedily as possible and only afterwards enquire whether the foundations are reliable. Platonic realism, in a word, is unfounded. It is just this kind of claim in Kant's philosophy that Gödel wants to overcome.

Now note, by way of contrast, what Gödel says about Husserl's transcendental idealism in a draft letter of 1972 to Gian-Carlo Rota (van Atten and Kennedy, p. 446):

> I believe that his [Husserl's] transcendental phenomenology, carried through, would be nothing less than Kant's critique of pure reason transformed into an exact science, except for the fact that [in footnote: Kant's subjectivism and nega-

. tivism for the most part would be eliminated] the result (of the 'critique') would be far more favorable for human reason.

The Kantian critique of reason was clearly too restrictive by Gödel's sights. Husserl agrees that it is too restrictive, as we will see below in a number of quotations in which Husserl portrays the phenomenological method as a way to develop and defend a new kind of rationalism that avoids the excesses of older forms of rationalism but also avoids any kind of mysticism.

Let us now turn to some of Gödel's comments about Husserl. Among Wang's own comments on his discussions with Gödel about Husserl are the following:

> For Gödel, the appeal of Husserlian phenomenology was, I think, that it developed the transcendental method in a way that accommodated his own beliefs in intellectual intuition and the reality of concepts. (Wang 1996, p. 165)
>
> In the 1960s he recommended to some logicians that they should study the sixth investigation in the *Logical Investigations* for its treatment of *categorial intuition*. In his discussions with me in the 1970s he repeatedly urged me to study Husserl's later work. (Wang 1996, p. 164)
>
> Gödel told me that the most important of Husserl's published works are *Ideas* and *Cartesian Meditations*: "The latter is closest to real phenomenology -- investigating how we arrive at the idea of the self". According to Gödel, Husserl just provides a program to be carried out; his *Logical Investigations* is a better example of the execution of this program than is his later work, but it has no correct technique because it still adopts the "natural" attitude". (Wang 1996, p. 164)
>
> I once asked Gödel about Husserl's *Formal and Transcendental Logic*, because I thought it might be more accessible to me than some of the other books. Gödel said that "it is only programmatic: it is suggested that formal logic is objective and transcendental logic is subjective, but the transcendental part -- which is meant to give justifications -- is rudimentary". (Wang 1996, p. 164).

Wang also recorded in his notes certain direct comments of Gödel on Husserl. I reproduce a few of these here, in order to refer to them in the analysis that follows:

> Husserl's is a very important method as an entrance into philosophy, so as to finally arrive at some metaphysics. Transcendental phenomenology with *epoché* as its methodology is the investigation (without knowledge of scientific facts) of the cognitive process, so as to find out what really appears to be -- to find the objective concepts. (Wang 1996, p. 166)

> Husserl used Kant's terminology to reach, for now, the foundations and, afterwards, used Leibniz to get the world picture. Husserl reached the end, arrived at the science of metaphysics. [Wang notes that this last sentence is different from what Gödel said on other occasions.] (Wang 1996, p. 166)
>
> Some reductionism is right: reduce to concepts and truths, but not to sense perceptions. Really it should be the other way around: Platonic ideas [Wang includes: what Husserl calls "essences" and Gödel calls "concepts"] are what things are to be reduced to. Phenomenology makes them [the ideas] clear. (Wang 1996, p.167)
>
> Leibniz believed in the ideal of seeing the primitive concepts clearly and distinctly. When Husserl affirmed our ability to 'intuit essences' he had in mind something like what Leibniz believed. (Wang 1996, p. 168)

Among other things, these comments of Gödel and Wang indicate that it is Husserl's *transcendental* phenomenology, with its *epoché* (= phenomenological reduction), that is of most interest to Gödel. Gödel mentions the *epoché* explicitly in one of the comments cited above. Here is another comment that Gödel makes about the *epoché*:

> Introspection is an important component of thinking; today it has a bad reputation. Introspective psychology is completely overlooked today. *Epoché* concerns how introspection should be used, for example, to detach oneself from influences of external stimuli (such as fashions of the day). (Wang 1996, p. 169)

I asked Wang about Gödel's references to introspection, since there have been various objections to introspection as a source of knowledge. It is my impression that when Gödel spoke of introspection in connection with the *epoché* what he had in mind was just the kind of turning of regard that Husserl in various writings takes to be characteristic of transcendental, eidetic phenomenology. Without going into details about the *epoché* I will only note for now that with the *epoché* we are supposed to suspend or "bracket" the "natural attitude", that is, the ordinary assumption of the existence of the world around us (see, e.g., Husserl 1913, 1923-24). The suspension applies also to the sciences, including psychology, that assume the existence of the objects they study. The point of such a suspension is to shift attention away from the objects and facts in any domain to *consciousness* of the objects and facts. This shift from focusing on objects to the consciousness of objects seems, at least loosely, like introspection, but it is necessary to be very careful about this. It is important to distinguish what Husserl has in mind from empirical introspectionist psychology. There is a tradition of thinking of introspection as "inner sense", analogous in some ways to "outer sense". Outer sense, i.e., the deliverances of the five senses that put us in touch with

things external to us, gives us particulars. Similarly, inner sense is supposed to give us particulars about our own mental lives. It reports about private or subjective individual acts, act-contents, feelings, images, and so on. It yields the kind of information that allows us to distinguish one human subject from another. This is quite different from engaging in the *Wesensanalyse* of consciousness. Phenomenology, as an eidetic science, is supposed to be a priori in nature (see, e.g., Husserl 1908). It would issue in an a priori, material or regional ontology. It is supposed to be concerned with universal features of consciousness. These features should be deliverances of reason. This would all be quite distinct from introspection, at least on standard conceptions of introspection. Essence analysis is not about what is individual, private or subjective. It does not, by its own nature, seek what is particular, at what makes one human subject different from another. Essence analysis involves a kind of abstraction. The actual contents of particular beliefs, the feelings and images with which they are associated in different subjects, and so on -- all of that would be data for introspection, and introspection would presumably be corrigible, just as what is given in outer sense is corrigible.

In the *Logical Investigations* and other writings Husserl says that there will no doubt be difficulties in phenomenological analysis due to the seemingly unnatural direction of intuition and thought required by phenomenology (see the "Introduction" to the six Logical Investigations). Instead of becoming lost in the performance of acts built intrinsically on one another and instead of naively positing the existence of objects, we must practice phenomenological reflection. We must, that is, make these acts themselves and their meaning-content our objects. This is a direction of thought that runs counter to deeply ingrained habits, as Gödel notes in the next passage quoted below. Among other things, the *epoché* involves a shift to analysis of the *meanings* by virtue of which we are directed toward objects in the world. This is supposed to allow us to focus on our experience itself, on the constitution of the meaning of being, without the prejudices or presuppositions that may be built into the natural attitude or the existing sciences. As Gödel says, it should allow us to detach ourselves from external influences, including fashions of the day.

One of the central features of consciousness that we find after engaging the *epoché* is intentionality. Gödel refers to this in connection with psychology, perhaps because he is thinking of Husserl's introductions to transcendental phenomenology by way of phenomenological psychology, but the point remains the same in transcendental phenomenology:

> One fundamental discovery of introspection marks the true beginning of psychology. This discovery is that the basic form of consciousness distinguishes between an intentional object and our being pointed (directed) toward it in some way (willing, feeling, cognizing). There are various kinds of intentional object. There is nothing analogous in physics. This discovery marks the first division of phenomena between the psychological and the physical. Introspection calls for learning how to direct attention in an unnatural way. (Wang 1996, p. 169)

§ 2. Husserl on Plato, Leibniz, and Kant

It is very interesting to see how several themes concerning the work of Plato, Leibniz, and Kant mentioned above come together in Husserl's own writings, especially in works such as the "London Lectures" (Husserl 1922), *Erste Philosophie* (Husserl 1923-24), the drafts of the *Encyclopedia Britannica* article (Husserl 1927-28), *Cartesian Meditations* (Husserl 1931), and others.

Husserl was beginning to connect his phenomenology with ideas in Leibniz's philosophy already around 1917, and this continued in his writings throughout the nineteen twenties and early thirties. In the *Cartesian Meditations*, for example, Husserl says that

> The [transcendental] ego, taken in full concreteness [vs. as mere identical pole, as substrate of habitualities], we propose to call by the Leibnizian name: monad. Since the monadically concrete ego includes also the whole of actual and potential conscious life, it is clear that the problem of *explicating this monadic ego phenomenologically* (the problem of his constitution for himself) must include *all constitutional problems without exception*. Consequently the phenomenology of *self-constitution* coincides with *phenomenology as a whole*. (Husserl 1931, p. 67)

The remark here about explicating the monadic ego phenomenologically should be compared with Gödel's remark to Günther, cited above, that the reflection on the subject treated in idealistic philosophy might be the way to the correct metaphysics, except that the denial of the objective meaning of thought connected with idealism must be resisted. It should also be noted that Husserl speaks only about the transcendental ego in its full concreteness as a monad. We know that Leibniz has a range of different kinds of monads but Husserl's focus is much narrower. It is on the kinds of 'monads' that we are.

Elsewhere in Husserl's *Cartesian Meditations* we find this:

> Phenomenological transcendental idealism has presented itself as a *monadology*, which, despite all our deliberate suggestions of Leibniz's metaphysics, draws its content purely from phenomenological explication of the transcendental experience laid open by transcendental reduction, accordingly from the most originary evidence, wherein all conceivable evidences must be grounded... Actually, there-

> fore, phenomenological explication is nothing like "metaphysical construction"... (Husserl 1931, p. 150)

In claiming in this passage that phenomenological explication is nothing like "metaphysical construction" Husserl is saying, among other things, that phenomenology is not engaged in the naive metaphysics of earlier philosophical projects. In language that Gödel uses in his 1961 text (Gödel *1961/?), phenomenology seeks to avoid "the death-defying leap into a new metaphysics" that would only amount to another dubious metaphysical scheme. We will see below how Husserl wishes to distinguish naive metaphysics from phenomenological ontology.

In a long interesting passage from a draft of the *Encyclopedia Britannica* entry that contains language quite similar to some of Gödel's remarks on Husserl we are told that

> Remarkable consequences arise when one weighs the significance of transcendental phenomenology. In its systematic development, it brings to realization the Leibnizian idea of a universal ontology as the systematic unity of all conceivable a priori sciences, but on a new foundation which overcomes "dogmatism" through the use of the transcendental phenomenological method. Phenomenology as the science of all conceivable transcendental phenomena and especially the synthetic total structures in which alone they are concretely possible -- those of the transcendental single subjects [monads] bound to communities of subjects [monads] is *eo ipso* the a priori science of all conceivable beings [*Seienden*]. But [it is the science], then, not merely of the totality of objectively existing beings taken in an attitude of natural positivity, but rather of the being as such in full concretion, which produces its sense of being and its validity through the correlative intentional constitution. It also deals with the being of transcendental subjectivity itself, whose nature is to be demonstrably constituted transcendentally in and for itself. Accordingly, a phenomenology properly carried through is the truly universal ontology, as over against the only illusorily all-embracing ontology in positivity -- and precisely for this reason it overcomes the dogmatic one-sidedness and hence the unintelligibility of the latter, while at the same time it comprises within itself the truly legitimate content [of an ontology of positivity] as grounded originally in intentional constitution. (Husserl 1928-28, p. 175)

From the notes for the "London Lectures" we have

> Transcendental phenomenological subjectivity or monadologism as [is a] necessary consequence of the transcendental phenomenological attitude. The knowledge that any objectivity is only what it is through intentional meaning or significance shows that there is only one possibility for an absolute and concrete being: the being of a concretely full transcendental subjectivity. *It* is the only genuine "Substance". The *ego* is what is it from its own fundamental meaning. The *ego* is in so far as it constitutes itself for itself as being. All other being is merely relative to the ego and is encompassed within the regulated intentionality of subjectivity. (Husserl 1922, p. 72)

Apart from the references to Leibniz, universal science (ontology), and transcendental phenomenological method in these passages, it is important to note the language about how the monad produces the meaning (sense) of being and of validity through "intentional constitution". The idea that monads constitute the meaning of being of the objects toward which they are (intentionally) directed by their mental acts plays a very important role in my view of how Gödel's ideas can be developed.

Finally, in a formulation that brings together ideas in Leibniz, Plato, and transcendental philosophy, Husserl says

> Thus, as Phenomenology is developed, the Leibnizian foreshadowing of a Universal Ontology, the unification of all conceivable a priori sciences, is improved, and realized upon the new and non-dogmatic basis of phenomenological method. For Phenomenology as the science of all concrete Phenomena proper to Subjectivity and Intersubjectivity, is *eo ipso* an a priori science of all possible existence and existences. Phenomenology is universal in its scope, because there is no a priori which does not depend upon its intentional constitution, and derive from this its power of engendering habits in the consciousness that knows it, so that the establishment of any a priori must reveal the subjective process by which it is established.
>
> ... Once the a priori disciplines, such as the mathematical sciences, are incorporated within Phenomenology, they cannot thereafter be beset by "paradoxes" or disputes concerning principles: and those sciences which have become a priori independently of Phenomenology, can only hope to set their methods and premises beyond criticism by founding themselves upon it. For their very claim to be positive, dogmatic sciences, bears witness to their dependency, as branches merely, of that universal, eidetic ontology which is Phenomenology.
>
> ... The endless task, this exposition of the *Universum* of the a priori, by referring all objectives to their transcendental "origin", may be considered as one function in the construction of a universal science of Fact, where every department, including the positive, will be settled on its a priori.
>
> ... Thus the antique conception of Philosophy as the Universal Science, Philosophy in the Platonic, Philosophy in the Cartesian, sense, that shall embrace all knowledge, is once more justly restored. (Husserl 1927-28, pp. 191-194)

Hence,

> The ideal of the future is essentially that of phenomenologically based ("philosophical") sciences, in unitary relation to an absolute theory of monads.

After these comments on Plato, Leibniz and phenomenology I would also like to take note of some of Husserl's critical comments about Kant that would have resonated with Gödel. We saw above that Gödel recommended the Sixth Investigation of Husserl's *Logical Investigations* to some logicians in the seventies. Let us consider some of Husserl's remarks about Kant in this Investigation. We should note, first of all, that the idea that human consciousness exhibits intentionality is, at best, only implicit in Kant's philosophy, while it is front and center in Husserl's work. This means that the ideas about intentionality, meaning and constitution that are so central to Husserl's philosophy are not present in Kant's thinking at all. Husserl does, however, argue for a general Kantian kind of distinction between thinking and intuiting, or signification and intuition. Departing substantially from Kant again, he argues that if we take the intentionality of human consciousness seriously then we must recognize both sensory and categorial intuition. There can be mere thinking or signification concerning sensory objects and there can also be intuition of sensory objects. Analogously, there can be mere thinking or signification concerning categorial objects and there can also be intuition of categorial objects. Viewed in terms of genetic epistemological analysis, the thinking and intuition in the case of categorial objects, which are objects such as natural numbers, sets, propositions, and the like, is not the most basic kind of *founding* thinking or intuition but is a *founded* kind of thinking and intuition. It is a thinking about and, where possible, an intuiting of ideal objects. Husserl sometimes calls the intuition of ideal objects, especially in connection with intuition of essences, 'ideation'. In the *Logical Investigations* he distinguishes 'real' from 'ideal' objects. 'Real' objects are objects that are either temporal in nature (such as 'inner' mental processes), or temporal and spatial (such as 'outer' physical objects), while ideal objects such as numbers, sets, and propositions are neither temporal nor spatial. Regarding intuition, Husserl holds that there can be adequate and inadequate intuitions and, in fact, that there are degrees of (in)adequacy. We also need to recognize a difference between individual and universal intuition. Husserl says that individual intuition is usually conceived in a narrow way that is baseless, as sensory intuition exclusively. On his alternative view the distinction between individual and universal intuition also has an application with respect to ideal objects.

Husserl says that Kant fails to draw any of these distinctions clearly in his theory of knowledge.

> In Kant's thought categorial (logical) functions play a great role, but he fails to achieve our fundamental extension of the concepts of perception and intuition over the categorial realm, and this because he fails to appreciate the deep difference between intuition and signification, their possible separation, and their commixture. And so he does not complete his analysis of the difference between the inadequate and the adequate adaptation of meaning to intuition. He therefore also fails to distinguish between concepts, as the universal meanings of words, and concepts as species of *authentic* universal presentation, and between both, and concepts as universal objects, as the intentional correlates of universal presentations. Kant drops from the outset into the channel of a metaphysical epistemology in that he attempts a critical 'saving' of mathematics, natural science and metaphysics, before he has subjected knowledge as such, the whole sphere of acts in which pre-logical objectivation and logical thought are performed, to a clarifying critique and analysis of essence, and before he has traced back the primitive logical concepts and laws to their phenomenological sources. It was ominous that Kant (to whom we nonetheless feel ourselves quite close) should have thought he had done justice to the domain of pure logic in the narrowest sense, by saying that it fell under the principle of contradiction. Not only did he never see how little the laws of logic are all analytic propositions in the sense laid down by his own definition, but he failed to see how little his dragging in of an evident principle for analytic propositions really helped to clear up the achievements of analytic thinking.
>
> All of the main obscurities of the Kantian critique of reason depend ultimately on the fact that Kant never made clear to himself the peculiar character of pure Ideation, the adequate survey of conceptual essences, and the laws of universal validity rooted in those essences. He accordingly lacked the phenomenologically correct concept of the a priori. For this reason he could never rise to adopting the only possible aim of a strictly scientific critique of reason: the investigation of the pure, essential laws which govern acts as *intentional* experiences, in all their modes of sense-giving objectivation, and their fulfilling constitution of 'true being'. (Husserl 1900-01, pp. 833 - 834)

Husserl elaborates on his critique of Kant's view of logic in § 100 of *Formal and Transcendental Logic*. Here he points out how Kant failed to ask transcendental questions about logic itself. Cognition is of course involved in logic, just as it is involved in natural science and in our everyday involvement with the world, and yet Kant does not ask about the conditions for the possibility of this kind of cognition. Husserl thinks that pure logic is concerned with ideal objects and states of affairs. As he says in § 100,

> Pure logic has as its thematic sphere ideal formations. But they would have had to be clearly seen, and definitely apprehended, as such ideal objectivities, before

transcendental questions about them and about pure logic could have been asked. The eighteenth century and the age that followed were so strongly actuated by empiricism (or better, by anti-platonism) that nothing was remoter from them than recognition of ideal formations as being objectivities -- in the manner of the good and never-relinquishable sense whose legitimacy we have established in detail.

Nothing else hindered a clear insight into the sense, into the proper questions and methods of genuine transcendental philosophy so much as did this anti-platonism, which was so influential that it actuated all parties, and even the thinking of a Kant, struggling to free himself from empiricism.

For the succeeding age this meant, however, that those investigations in the psychology of cognition, or rather those transcendental phenomenological investigations, that are the thing actually needed for a full and, therefore, two-sided logic were never seriously undertaken. But that was because no one ventured, or had the courage to venture, to take the ideality of the formations with which logic is concerned as the characteristic of a separate, self-contained, "world" of ideal Objects and, in so doing, to come face to face with the painful question of how subjectivity can in itself bring forth, purely from sources appertaining to its own spontaneity, formations that can be rightly accounted as ideal Objects in an ideal "world".

> For only then was one faced with the unintelligibility of *how ideal objectivities* that originate purely in our own subjectivities of judgment and cognition, that are there originaliter in our field of consciousness purely as formations produced by our own spontaneity, *acquire the being-sense of "Objects"*, existing in themselves over against the adventitiousness of the acts and the subjects. How does this sense "come about", how does it originate in us ourselves? And where else could we get it, if not from our own sense-constituting performance?

Note the formulation of the problem of the relation of the subjectivity of consciousness to the objectivity and ideality of logic in these last two quotations. Husserl asks how human subjectivity can bring forth formations from sources of its own spontaneity that can be considered as ideal objects in an ideal world. He asks how the objects of cognition in logic can acquire their sense or meaning as ideal and existing in themselves, over against the subjective acts in which they are known. How does this sense or meaning *originate* in us? There is a substantial amount of work on this question in Husserl's writings.

Husserl thus says that

> Accordingly the *transcendental problem* that *Objective logic* ... must raise concerning its field of ideal objectivities takes a position *parallel to the transcendental problems of the sciences of realities*, the problems that must be raised concerning the regions of realities to which those sciences pertain, and, in particular, the transcendental problems concerning Nature, which were treated by Hume and Kant. It seems then, that the immediate consequence of bringing out the world of ideas and, in particular (thanks to the effectuation of impulses received from Leibniz, Bolzano, and Lotze), the world of ideas with which pure logic is concerned, should have been an *immediate extension* of transcendental problems to this sphere. (Husserl 1929, § 100)

§ 3. A New Combination of Philosophical Views

With the material described above in mind, the general picture of Gödel's turn to Husserl's transcendental phenomenology that we obtain is roughly as follows:

The transcendental ego in its full concreteness is a "monad" ("substance"). It constitutes the meaning of being of the world through its intentionality. In the case of mathematics, logic, and the other a priori sciences, including phenomenology itself, it constitutes the meaning of the being of its objects (essences, categorial objects) in a rationally motivated way as ideal or abstract and non-mental. Evidence in these domains is acquired on the basis of categorial or eidetic intuition. This suggests a kind of platonism with its emphasis on non-mental and mind-independent ideal objects (in the sense of "mind-independence$_2$" discussed in Tieszen, forthcoming), with its rationalism, and its robust sense of objectivity. I call this kind of platonism *constituted platonism*. Constituted platonism is unlike traditional mathematical platonism since traditional platonists have not been transcendental (phenomenological) idealists. Plato certainly did not speak of the constitution of the meaning of being by "monads", and he is engaged, by Husserl's sights, in naive metaphysics. This is also true of other traditional mathematical platonists. As we saw above, Husserl says that through transcendental phenomenology "... the antique conception of Philosophy as the Universal Science, Philosophy in the Platonic sense, that shall embrace all knowledge, is once more justly restored". In his "London Lectures" (Husserl 1922, p. 73) he says that

> Phenomenology realizes (thought of as developed) the original and genuine idea of logic. For originally (in the Platonic dialectic) logic was to be the science of rendering clear the significance, result and legitimacy of possible knowledge and was thereby to make possible genuine wisdom and a universal philosophy.

Leibniz is not a platonist about mathematical objects or facts but he is a rationalist who is interested in philosophy as a rational (not empirical) universal science. He is interested in deciding mathematical and other problems by human

reason, through the analysis of concepts, although in his writings on logic he tends to think of decidability in a mechanical way. For Leibniz, as for other classical rationalists, concepts of reason, including those of logic and mathematics, are exact and our grasp of such concepts either is or can be made clear and distinct, whereas empirical knowledge lacks, in various degrees, just these features. Leibniz holds that the science of possibilities and necessities precedes sciences of actualities. Leibniz is a monadologist but his monadology is not brought into line with the methods of transcendental phenomenology and in this respect it remains, by Husserl's sights, naive. In the quotation from the *Encyclopedia Britannica* draft above, however, Husserl says that the systematic development of transcendental phenomenology brings to realization the Leibnizian idea of a universal ontology as the systematic unity of all conceivable a priori science on a foundation that overcomes dogmatism and one-sidedness through the use of the transcendental method. Phenomenology is the science of all conceivable beings, taken not in the attitude of naive positivity but rather as understood though correlative intentional constitution.

Kant is not a monadologist, although his idea of the transcendental unity of apperception foreshadows Husserl's transcendental ego. Husserl, as we saw, refers to the transcendental ego in its full concreteness as a monad. Kant, like Leibniz and Plato, does not put the intentionality of human consciousness at the center of his philosophy. Kant is also not a platonist about mathematical objects or facts, and he mounts a critique of classical rationalism (including Leibniz). For Kant, knowledge is restricted to sensory intuition and the two forms of sensory intuition, space and time. Kant, unlike Husserl, distinguishes phenomena from noumena (which is what Wang call Kant's dualism in the first passage quoted above) and is able to develop the transcendental method far enough to show how *empirical realism* is compatible with transcendental idealism, but in his work there is no question of showing how a kind of platonism or mathematical objectivism is compatible with transcendental idealism.

Thus, in transcendental phenomenology the transcendental ego in its full concreteness as a monad can now be combined with a kind of (constituted) platonism about logic and mathematics (unlike in Leibniz and Kant), and with the idea of universal science (as in Leibniz and Plato) in a way that keeps Kantian transcendental method or idealism in broad outlines but extends it to mathematics, logic, and philosophy itself, avoiding Kant's dualism, his restrictions on intuition, his critique of rationalism and his skepticism about ideal or abstract objects (concepts). Elements in the work of Plato, Leibniz, Kant, and Husserl come together in one picture in which the monad (as a concrete transcendental ego), in a

community of monads, constitutes the meaning of being of its objects in mathematics and logic as ideal or abstract and non-mental and acquires evidence in these domains on the basis of categorial intuition or *Wesensanalyse*.

One can in principle substitute for "monad" in the singular in this picture the plural "monads", or transcendental egos. The constitution of the meaning of being of one objective world, Husserl says, requires the community of monads, a single universe of compossible monads. Intersubjectivity and the constitution of the meaning of the objective world is held to require a universe of compossible ("harmonious") monads. Each monad (transcendental ego), to extend the analogy, would presumably be 'windowless' but would mirror all of the others, if there is to be constitution of one objective world. Of course the issues of intersubjectivity and of the layers of constitution involved in the meaning of being of the objective world have been analyzed in great detail by Husserl and others in the phenomenological movement.

One caveat that should be entered, as indicated above, is that it is not clear how much of Leibniz's original monadology, with all of its attendant ideas, either Husserl or Gödel wanted to preserve. We can see that certain elements of Leibniz's monadology are at least loosely echoed in Husserl's thinking. Recall also that Gödel says that he wants something like Leibniz's monadology transformed into an exact theory with the help of phenomenology.

§ 4. Gödel's Philosophical Applications of the Incompleteness Theorems

Many of Gödel's own technical results in logic and mathematics are related to the themes we have discussed. In this section I provide a brief overview of some of the relationships between the ideas discussed above and Gödel's *philosophical* thinking about the incompleteness theorems in particular. In his philosophical writing Gödel brings his incompleteness theorems to bear in three main areas: Hilbert's program, the issue whether human minds are machines, and Carnap's early view of mathematics as syntax of language. I discuss each of these in turn.

On Hilbert: The second incompleteness theorem shows that no formal system T capable proving elementary arithmetical statements contains the resources required to prove the sentence asserting the consistency of T if T is consistent. Suppose T is finitist mathematics, F. F might be, for example, primitive recursive arithmetic PRA. This is the mathematics of the mechanical manipulation of concrete, 'real', finite sign configurations given in sensory intuition (experience), on the basis finite sets of rules, where we do not need to know the meanings (content) of the signs. On the basis of the second incompleteness theorem we know that a mathematical proof of Con(F) will require objects or concepts that are not

finitary, not concrete, not given in sensory intuition (see, e.g., the opening sections of Gödel *193? and Gödel 1972, pp. 271-272). It will instead require infinitary, ideal or abstract objects or concepts. If intuition and not mere conception is required for knowledge then the consistency proof will require "categorial" intuition, where we evidently *do* need to know the meaning (content) of the signs. We in fact have consistency proofs for systems such as F. These results can be seen as supporting and being supported by Husserl's ideas about the capacity of 'monads' for meaningful thinking about and categorial intuition of ideal objects/concepts. In the 1961 text (Gödel *1961/?) Gödel argues, on the basis of his incompleteness theorems, that we cannot retain Hilbert's rationalistic optimism about solving clearly formulated mathematical problems if we insist on a Hilbertian finitist foundation of mathematics, but that such rationalistic optimism is still a possibility if we turn to Husserl's ideas.

On Minds and Machines: Some of Gödel's basic claims about minds and machines can be found in the 1964 Postscriptum of Gödel 1934, Gödel *1951, and 1972a. In his later thinking the view would evidently be that the human mind ('monad') cannot be replaced by any Turing Machine (TM), whereas such a view would be more plausible if the incompleteness theorems and related undecidability results had not been proved. Consider the following assertion: The mind is a finite combinatorial mechanism and there are for it no absolutely undecidable number-theoretic questions. The incompleteness theorems refute this assertion if we take "finite combinatorial mechanism" to mean TM. Restating the negation of the assertion as a disjunction we obtain: "Either there exist infinitely many number-theoretic questions which the human mind is unable to answer or the human mind contains an element totally different from a finite combinatorial mechanism". A disjunction such as this is stated in various places in Gödel's writing (see especially Gödel *1951). In a note in the *Nachlass* (cited in van Atten 2006, p. 257) Gödel says "I conjecture that the second alternative is true and perhaps can be verified by a phenomenological investigation of the processes of reasoning". The idea is that the human mind ('monad') must use systematic and finite but non-mechanical methods for the decision of open problems in number theory, based on a grasp of the abstract meanings of the terms involved.

Gödel wants to use phenomenological considerations to investigate the decidability of (mathematical) problems posed by human reason. Human reason, on this view, is not to be understood in a completely mechanical manner, as Leibniz and others might have it. Indeed, if human minds, as finite 'monads', can know about mind-independent ideal concepts or objects on the grounds of categorial intuition or *Wesensanschauung* then human minds are not (Turing) machines, even though they might use such forms of intuition systematically.

On Carnap: Against Carnap's early view of the foundations of mathematics, Gödel argues that mathematics cannot be syntax of language (Gödel *1953/59). The nominalism and conventionalism of Carnap's program is refutable. Carnap recognizes two kinds of statements: analytic (tautologies and logical falsehoods) and synthetic (empirical). Statements of mathematics and logic are supposed to be true on the basis of linguistic or syntactical conventions (rules) alone. They are without content or object. All other statements are about the world and are to be considered meaningful or not and accepted or rejected on the grounds of their empirical verifiability. Metaphysical statements are, famously, rejected on these grounds.

In order for the syntactical view of mathematics and logic to be correct it is required that there be consistency proofs for the sets of syntactical conventions (rules), for if the rules are inconsistent then all statements will follow from them, including all empirical statements. The consistency proof, by Carnap's own sights, would have to be either mathematical or empirical in nature. If a consistency proof for the syntactical rules is mathematical then by the second incompleteness theorem it will require resources going beyond the concrete, finitary, and sensory objects needed for the nominalism and conventionalism of the syntactical program. Hence, we would again be faced with content, meaning, the ideal or abstract, the infinitary, and categorial intuition. And, again, we *do* have such consistency proofs.

On the other hand, suppose the consistency 'proof' is empirical in nature. In this case the claim to consistency is based on the fact that the syntactical conventions have thus far (in our use of them) not been found to lead to inconsistency. The evidence for consistency is based on past experience, i.e., it's inductive evidence. This reliance on empirical evidence or empirical facts to maintain syntactical conventionalism about mathematical truths again violates the claim that the latter truths should be based solely on syntactical (linguistic) conventions, come what may in the empirical world. Furthermore, the empirical assertions used to support the consistency claim in this case would have content, so that content will again be required, albeit empirical (as opposed to mathematical) content. Under this alternative mathematical statements completely lose their a priori character, their character as linguistic conventions, and their alleged lack of content. Thus, we can again not hold to strict linguistic conventionalism about mathematics.

In sum, it is not possible without a consistency proof to be a conventionalist/nominalist about mathematics in the manner of Carnap's early logical positivism, but what is needed for the consistency proof, whether it is mathematical or empirical in nature, undermines the conventionalism and nominalism of the logical positivists. For Gödel, the alternative to Hilbert and Carnap is the kind of transcendental phenomenological view we described in the earlier sections of this paper.

In light of the philosophical uses to which Gödel puts the incompleteness theorems, we might view the incompleteness theorems themselves as examples of philosophy become rigorous science.

San José State University

References

Feferman, S. *et al.* (eds.), 1986. *Kurt Gödel: Collected Works*, Vol. I. Oxford: Oxford University Press.

_____, 1990. *Kurt Gödel: Collected Works*, Vol. II. Oxford: Oxford University Press.

_____, 1995. *Kurt Gödel: Collected Works*, Vol. III. Oxford: Oxford University Press.

_____, 2003. *Kurt Gödel: Collected Works*, Vol. IV. Oxford: Oxford University Press.

_____, 2003. *Kurt Gödel: Collected Works*, Vol. V. Oxford: Oxford University Press.

Gödel, K., 1934. "On Undecidable Propositions of Formal Mathematical Systems" in Feferman, *et al.* (eds.), 1986, 346-371.

_____, *193?. "Undecidable Diophantine Propositions", in Feferman, *et al.* (eds.), 1995, 164-175.

_____, 1944. "Russell's Mathematical Logic", in Feferman, *et al.* (eds.), 1990, 119-143.

_____, 1949. "An Example of a New Type of Cosmological Solutions of Einstein's Field Equations of Gravitation", in S. Feferman, *et al.* (eds.), 1990, 190-198.

_____,1949a. "A Remark about the Relationship between Relativity Theory and Idealistic Philosophy", in S. Feferman, *et al.* (eds.), 1990, 202-207.

_____, *1951. "Some Basic Theorems on the Foundations of Mathematics and Their Implications", in Feferman, *et al.* (eds.), 1995, 304-323.

_____, *1953/9, III and V. "Is Mathematics Syntax of Language?, in Feferman, *et al.* (eds.), 1995, 334-363.

_____, 1954-1959, "Correspondence with Gotthard Günther" in Feferman, *et al.* (eds.), Vol. IV, 2003, 476 - 535.

_____, *1961/?. "The Modern Development of the Foundations of Mathematics in the Light of Philosophy", in Feferman, *et al.* (eds.), 1995, 374-387.

_____, 1964. "What is Cantor's Continuum Problem?", in Feferman, *et al.* (eds.), 1990, 254-270. Revised version of Gödel 1947.

_____, 1972. "On an Extension of Finitary Mathematics Which Has Not Yet Been Used", in Feferman, *et al.* (eds.), 1990, 271-280. Revised version of Gödel 1958.

_____, 1972a. "Some Remarks on the Undecidability Results", in Feferman, *et al.* (eds.), 1990, 305-306.

Husserl, E., 1900-01. *Logical Investigations*, Vols. I, II. Translation of the 2nd edition by J.N. Findlay. London: Routledge and Kegan Paul, 1973.

_____, 1908. "Philosophy as Rigorous Science", translated by Q. Lauer in *Phenomenology and the Crisis of Philosophy*, New York: Harper, 1965, 71-147.

_____, 1913. *Ideas Pertaining to a Pure Phenomenology and to a Phenomenological Philosophy. First Book.* Translated by F. Kersten. Dordrecht: Kluwer, 1982.

_____, 1922, "The London Lectures (Syllabus of a Course of Four Lectures)", in *Husserl: Shorter Works*, P. McCormick and F. Elliston (eds.), University of Notre Dame Press, 1981, pp. 68 - 74.

_____, 1923-24. *Erste Philosophie. Erster Teil: Kritische Ideengeschicte.Husserliana* Vol.7. The Hague: Nijhoff, 1956.

_____, *1923-24. Erste Philosophie. Zweiter Teil: Theorie der phänomenologischen Reduction. Husserliana*, Vol. 8. The Hague: Nijhoff, 1959.

_____, 1927-28, "Phenomenology" (drafts of the *Encyclopedia Britannica* Article), in *Psychological and Transcendental Phenomenology and the Confrontation with Heidegger (1927 - 1931)*, Dordrecht: Kluwer, 1997, pp. 83 -194.

_____, 1929. *Formal and Transcendental Logic.* Translated by D. Cairns. The Hague: Nijhoff, 1969.

_____, 1931. *Cartesian Meditations. An Introduction to Phenomenology.* English translation by D. Cairns. The Hague: Martinus Nijhoff, 1960.

Kac, M., Rota, G., and Schartz, J. T., 1986. *Discrete Thoughts: Essays on Mathematics, Science and Philosophy.* Boston: Birkhaüser.

Kant, I., 1973. *Critique of Pure Reason.* Translated by N.K. Smith. London: Macmillan. First edition originally published in 1781; second edition originally published in 1787.

Kreisel, G., 1980. "Kurt Gödel, 28 April 1906-14 January 1978", Biographical Memoirs of Fellows of the Royal Society 26, 148-224.

Mahnke, D., 1917. *Eine neue Monadologie.* Kantstudien Ergänzungsheft 39. Berlin: Reuther and Reichard.

_____, 1925. "Leibnizens Synthese von Universalmathematik und Individualmetaphysik. Erster Teil", *Jahrbuch für Philosophie und phänomenologische Forschung*, Vol. VII, 304 - 611.

Pagels, H., 1988. *The Dreams of Reason: The Computer and the Rise of the Sciences of Complexity.* New York: Simon & Schuster.

Parsons, C., 1983. *Mathematics in Philosophy: Selected Essays.* Ithaca, New York: Cornell University Press.

Sieg, W., 2006. "Gödel on Computability", *Philosophia Mathematica* 14, 2, 189 - 207.

Tieszen, R., 1992. "Kurt Gödel and Phenomenology", *Philosophy of Science* 59, 2 176-194. Reprinted in Tieszen 2005.

_____, 1998. "Gödel's Path from the Incompleteness Theorems (1931) to Phenomenology (1961)", *Bulletin of Symbolic Logic* 4, 2, 181-203. Reprinted in Tieszen 2005.

_____, 2002. "Gödel and the Intuition of Concepts", *Synthese* 133, 3, 363-391. Reprinted in Tieszen 2005.

_____, 2005. *Phenomenology, Logic, and the Philosophy of Mathematics,* Cambridge University Press.

_____, 2006. "After Gödel: Mechanism, Reason and Realism in the Philosophy of Mathematics", *Philosophia Mathematica* 14, 2, 229-254.

_____, forthcoming. "Mathematical Realism and Transcendental Phenomenological Idealism", in L. Haaparanta and M. Hartimo (eds.), *Phenomenology and Mathematics.*

Van Atten, M., 2006. "Two Draft Letters from Gödel on Self-Knowledge of Reason", *Philosophia Mathematica* 14, 2, 255 - 261.

Van Atten, M., and Kennedy, J., 2003. "On the Philosophical Development of Kurt Gödel", *The Bulletin of Symbolic Logic* 9, 425-476.

Wang, H., 1974. *From Mathematics to Philosophy.* New York: Humanities Press.

_____, 1987. *Reflections on Kurt Gödel.* Cambridge, Mass.: MIT Press.

_____, 1996. *A Logical Journey: From Gödel to Philosophy.* Cambridge, Mass.: MIT Press.