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Routledge
2020

Hartimo , M 2020 , Husserl on 'Besinnung' and formal ontology . in F Kjosavik & C Serck-Hanssen (eds) , Metametaphysics and the Sciences : Historical and Philosophical Perspectives . Routledge .

http://hdl.handle.net/10138/356686

Husserl on 'Besinnung' and Formal Ontology[1]

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1. Introduction

In his *Logical Investigations* (1900-1901) and *Ideas I* (§10) Husserl conceived mathematics as the source of formal ontology (for a standard view of Husserl's formal ontology, see Smith 1989). In his *Formal and Transcendental Logic* (1929, Hua XVII, henceforth FTL),[2] Husserl however found the structuralism of mathematical theories insufficient to serve as the ontology for the real world and developed a new conception of formal ontology based on the ontological commitments of logic as opposed to those of mathematics. Crucial to Husserl's development is his usage of the method *Besinnung* as Husserl explains in the introduction to FTL: Husserl first states that the purpose of the essay is to provide "*an intentional explication of the proper sense of formal logic*" (Hua XVII, 14/10). 'Intentional explication' refers to the philosopher's task of clarifying and renewing the "final sense" of logic towards which the scientists have always been aiming. It thus assumes that the scientists—*exact* scientists, for Husserl—have been striving for certain goals for centuries. In FTL, Husserl seeks to make these goals explicit, examine them, and possibly revise them. Furthermore, according to Husserl, this aim should be pursued by means of *Besinnung*. Using radical *Besinnung* as his method, Husserl claims, he arrived at the contents of FTL (Hua XVII, 14/10). He points out also that his views have importantly changed in comparison to the *Logical Investigations* (1900-1901). The novelties of FTL are 1) the three-fold stratification of logic that he claims was not yet completely clear in *Logical Investigations*; 2) the radical clarification of the relationship between formal logic and formal mathematics; 3) the definitive clarification of the sense of pure formal mathematics; and, connected to this, 4) the genuine sense of *formal ontology* (Hua XVII, 15/11).

In what follows my aim is to examine the last novelty, that is, Husserl's new notion of formal ontology. Explaining this, however, requires some understanding of the other novelties as well. I will start by explaining Husserl's method of radical *Besinnung* and its relationship to Husserl's view of the "intentional history" of logic and mathematics. Thanks to his reliance upon *Besinnung*, Husserl's approach is informed by the practices of formal sciences and the goals of the logicians (in his terms, by the "living intentions of logicians" (Hua XVII, 14/10)). This is important, because in FTL it leads Husserl to distinguish between mathematics and logic and thus to isolate the proper sense of formal mathematics from logic as a *theory of science* , i.e., as a theory of the conditions of any scientific theory should seek to fulfill to count as a science (for more detail, see Smith 1989, 29-31). Formal mathematics is a universal and a priori discipline, and, hence, a *potential* candidate for offering a formal ontology. However, in FTL Husserl argues that since formal mathematics has nothing to do with questions of actual existence and truth, the genuine sense of formal ontology is subservient to the interests of logicians rather than to those of mathematicians. Thus Husserl's method of *Besinnung* makes his view of formal ontology sensitive towards the development of modern mathematics into an independent discipline. In FTL Husserl realizes that modern mathematics as a structuralist enterprise offers too little to serve as the source of ontology. Ontology, in the proper sense of the term, should be related to intuitable objectivities—to something that actually might exist. According to the final sense of logic, Husserl formulates a judgment theory through which ontology is related to the actual world so as to make up a universal but "wordly" ontology.

2. *Besinnung* as a method

As already briefly indicated above, the aim of FTL is what Husserl calls intentional explication of the proper sense of formal logic (Hua XVII, 14/10). Logic in turn is understood to be a theory of science (Hua XVII, 13/9), in particular, it is a study of pure essential *norms* of science (Hua XVII, 7/3). In other words, logic is about what (formal) sciences *ought to be*. Husserl believes that the scientists' understanding of what sciences ought to be like has been guiding scientists for centuries. For Husserl this normative ideal is an "intentive sense" of the scientific research.

Husserl further explains that sciences should be approached by means of *Besinnung*, which he defines as follows:

> *Besinnung* signifies nothing but the attempt actually to produce the sense 'itself', …, it is the attempt to convert the 'intentive sense' … the sense 'vaguely floating before us' in our unclear aiming, into the fulfilled, the clear, sense, and thus to procure for it the evidence of its clear possibility (Hua XVII, 13/9).

By means of *Besinnung*, the normative ideals of the sciences are made explicit. Furthermore, Husserl holds that it requires standing in, or entering, "a community of empathy with the scientists" [*Mit den Wissenschaftlern in Einfühlungsgemeinschaft stehend oder tretend*, …] (Hua XVII, 13/9). The "intentive sense" of the scientific research is thus drawn from scientists' activities, not from a priori sources. This feature makes Husserl's view context-dependent and "mathematics-first"—indeed, reliant on a kind of naturalism about mathematics.[3] Mathematics-first view is a conception in which mathematics is approached as an autonomous discipline, "on its own", as opposed to the philosophy-first views, in which the practice of mathematics is found subservient to different kinds of philosophical demands. In accordance to such mathematics-first view, in FTL, Husserl begins by discussing the aims of the scientists, especially those of the formal scientists —aims which are typically implicit. Thus he does not start with a theory of evidence and claim that the mathematicians should hold on to it, but the other way around, he seeks to clarify the evidences that are already used in mathematicians' practices

Husserl also holds that *Besinnung* should be radical. To be radical in Husserl's phenomenology is to attempt to expose the tacit presuppositions held in the practices, whether theoretical or not. In FTL, this brings Husserl to ask transcendental questions about logic, that is, to engage in what he calls 'transcendental logic.' Through transcendental logic, formal logic and mathematics are seen to aim for certain kinds of evidence. Husserl also identifies several presuppositions that are made in the exact sciences.[4] Such transcendental questioning distinguishes his approach from any mathematical naturalism akin to the one that can be found in Maddy: While Husserl evaluates the practices in terms of their goals, as Maddy does, too, he also aims at revealing how these goals are constituted, and, thus, their conditions of possibility. This adds a further revisionary element to Husserl's approach: By means of a transcendental examination, Husserl hopes to revise confused senses and concepts, so as to make the practices *genuine* [echt] (Hua XVII, 14/10).

Assuming that Husserl indeed used this method, as he claimed he did, to obtain the results published in FTL, one is led to examine his "fellow mathematicians." The books in his private library, and especially his notes in them, suggest that in the early 1920s the fellow mathematicians were primarily David Hilbert, Hermann Weyl, and Oskar Becker. Husserl had markings in Hilbert (1922) as well as in Weyl (1925; 1926) (see further Hartimo 2018b). Of the people around Husserl in the 1920s, Oskar Becker was the most knowledgeable one in mathematics and physics.[5] Becker worked as Husserl's assistant from 1923 and stayed in Freiburg until 1931 (Mancosu 2010, 281). During that time, Becker wrote *Mathematische Existenz*, published in Husserl's *Jahrbuch* in 1927. Husserl had read at least the beginning of it.[6]

Based on his methodological considerations, Husserl's FTL should thus be read as an evaluation and renewal of the aims of mathematics discussed primarily by Hilbert, Weyl, and Becker in the 1920s.[7] These aims concerned the axiomatic approach to mathematics and different ways of providing it with intuitionistic, predicative, or proof-theoretical foundations—motivated by the discovery of the set-theoretical paradoxes. As we will soon see, Husserl accordingly isolates the pure sense of mathematics as axiomatics, and then, in his logical considerations, explores the ways in which the formal sciences relate to intuition and to the world. Husserl's method involves examination of what the fellow scientists, especially mathematicians, are seeking, seeing that as part of historical developments towards certain goals—their "final senses," and evaluating these goals critically. Consequently FTL should be read as a clarification of the potentially overlapping and unclear goals of the approaches discussed by Hilbert, Weyl, and Becker.

3. Intentional history of logic, intentional history of mathematics

Husserl's examination of the intentional history of the formal sciences takes place in two distinguishable progresses: On the one hand, there is the development of the theory of judgments and, on the other, there is the development of formal mathematics. Common to these two fields is that they are both "interested specifically in certain derivative formations of anything-whatever" (Hua XVII, §24), i.e., they are both formal. However, they differ in being guided by different ideals, i.e., intentive senses. The sense guiding formal mathematics is the Euclidean ideal, concretely captured by the notion of "definite manifold" (Hua XVII, §31). The definite manifold is a structure derived from the Euclidean axiom system by means of "formalization." With it a theory-form is obtained from Euclidean geometry understood as the theory of intuited world-space, so that "all the materially determinate What-contents of the concepts - in the case of geometry, all the specifically spatial contents – are converted into indeterminates, modes of the empty 'anything-whatever.'" (FTL, §29). It is complete in the sense that it captures its domain exhaustively ("there is no truth about such a province that is not deductively included in the 'fundamental laws' of the corresponding nomological science"). According to Husserl, the Euclidean captures Hilbert's intentions that led Hilbert to add the 'axiom of completeness' to his axiomatizations of geometry and arithmetic around the turn of the century. He also views his own formulations of the notion of definite manifold as attempts to give a concrete articulation n to the Euclidean ideal (Hua XVII, §31). I have argued elsewhere that Husserl's view of completeness embraces both categoricity and syntactic completeness (Hartimo 2018a). Husserl's notion of formalization thus refers to an abstraction from a domain of an individual theory (system) to the domain of a categorical theory (structure). According to Husserl, the great advance of pure mathematics, particularly thanks to Riemann, does not stop at characterization of such pure structures, but taking such structures as mathematical objects themselves (FTL, §30). This suggests that in Husserl's view the guiding goal of the mathematicians is increasing abstraction, and, hence, what captures the sense of pure modern mathematics in Husserl's view.

The guiding concept of logic (i.e., theory of judgment) is that of truth. A closer inspection shows that truth presupposes non-contradiction and grammaticality. Thus, logic can be divided into three goals and accordingly into three 'layers': grammar, logic of non-contradiction, and logic of truth. These are linked to three different kinds of evidences: the most general evidence, distinctness, and clarity, respectively. Husserl discusses first the development of "apophantic analytics," which is purely formal and consists only of grammar and logic of non-contradiction. To it belong, quoting Husserl, "not only the whole of syllogistics, so far as its essential content is concerned, but also (as we shall show) many other disciplines, namely those of formal-mathematical 'analysis'" (Hua XVII, §14). Apophantic analytics operates with what he calls 'apophantic senses' and relates, besides the most general evidence, to the evidence of distinctness. In Husserl's view this apophantic analytics and formal mathematics are equivalent disciplines. Formal logic (i.e., theory of judgment), adds to them an interest in truth. In fact, formal logic and formal mathematics are in the end distinguished only by their final senses or goals that are revealed by *Besinnung* of the scientists' goals. Logic and mathematics are practices carried out with different kinds of *intentions.* In addition to the most general evidence related to grammaticality and the distinctness related to non-contradictoriness, logicians aim at truth and its evidence of clarity. Hence, Husserl writes:

> a *formal mathematics, reduced to the above described purity, has its own legitimacy* and that, for mathematics, there is in any case no necessity to go beyond that purity. At the same time, however, a great advance is made philosophically by the insight that such a restrictive reduction of *logical* mathesis (formal logic, when it has attained the completeness befitting its essence)—namely its reduction to a *pure analytics of non-contradiction*—is essentially its reduction to a science that has to do with nothing but apophantic senses, in respect of their own essential Apriori, and that in this manner the *proper sense of 'formal mathematics'*, the mathematics to which every properly logical intention (that is: every intention belonging to a theory of science) remains alien—the mathematics of mathematicians—at last becomes *fundamentally clarified*. Here lies the *sole legitimate distinction between formal logic and mere formal mathematics* (Hua XVII, §52, 146/140-141).

In other words, there is (necessarily) no difference between formal logic and formal mathematics when their theories are considered purely formally. But when one pays attention to the mathematicians' and logicians' intentive senses, one notices that the logicians' interest in giving a true description of the actual world grammatical evidence, distinctness, as well clear [*klar*] evidence, analogous to the one had when perceiving middle-sized physical objects, whereas the mathematicians do not need to worry about the evidence of clarity.

4. Formal ontology

These two historical developments, one within mathematics, the other within logic, can both be considered as pertaining to formal ontology insofar as they are about something that is universal and a priori. Husserl first maintains that since formal mathematics is about formal objects, "it is natural to view this whole mathematics as an *ontology* (an a priori theory of objects), though a *formal* one, relating to the pure modes of anything-whatever" (Hua XVII, §24). Such objects are completely indeterminate, "objects of thinking", that are determined

> exclusively by the form of the connexions ascribed to them. These connexions themselves are accordingly as little determined in respect of content as the Objects connected; only their form is

> determined, namely by the form of the elementary laws assumed to hold good for them… (Hua XVII, §28, cited from *Prolegomena to the Logical Investigations,* §70).

In other words, these objects are "pure positions" of structuralist ontology, determined only by the place they have in a structure. Indeed, Charles Parsons has pointed out that the most developed statement of structuralism before World War II is due to Husserl (Parsons 2008, 41).

Since the questions of truth and what actually might exist are excluded from formal mathematics, Husserl finds this structuralist view of formal ontology insufficient. The mathematical objects as conceived in structuralism are too abstract to have anything to do with truth and the substrates 'themselves.' Accordingly, Husserl thinks that proper formal ontology has to be carried out with the "logical interest."[8] Husserl writes that

> [l]ike the sciences themselves, *analytics as formal theory of science is directed to what exists* [*ontisch gerichtet*]; moreover, by virtue of its apriori universality, it is ontological. It is *formal ontology*. Its apriori truths state what holds good for *any objects whatever*, any object-provinces whatever, with formal universality, *in whatever forms they exist* or merely *can exist* – as objects of judgments [*urteilsmässig*], naturally: since, without exception, objects 'exist' only as objects of judgments and, for that very reason, exist only in categorial forms (Hua XVII, 126/120).

According to Husserl, objects have being for us only as making their appearance in judgments (Hua XVII, §25). Furthermore, logically considered, the arithmetic of cardinal numbers and the arithmetic of ordinal numbers and so forth have existence on their own (Hua XVII, §33) even though they are instantiations of the same structure. The structuralist ontology suggested by formal mathematics in its detachment from the questions of truth and existence thus is not formal ontology in the proper sense of the term. Formal ontology should relate to what is judged in formal apophantics to be possibly true. Thus, Husserl concludes that

> *The aforesaid pure mathematics of non-contradiction*, in its detachment from logic as theory of science, *does not deserve to be called a formal ontology*. It is an ontology of pure judgments *as senses* and, more particularly, an ontology of the *forms* belonging to non-contradictory – and, in that sense, possible – senses: possible in distinct evidence (Hua XVII, 150/144).

Structuralist ontology operates with *distinct* evidence that is the kind of evidence intended in the logic of non-contradiction, i.e., in formal mathematics. The proper formal ontology should relate to possible objects and theories given in addition in *clear* evidence obtained in an encounter with the world:

> *[F]or a …. 'pure' formal mathematics, there can be no cognitional considerations other than those of 'non-contradiction'*, of immediate or mediate *analytic consequence or inconsistency*, which manifestly include all questions of *mathematical 'existence'*. It is otherwise, to be sure, for the *logician*: Being interested in a theory of science even when consistently broadening the traditional confines, he presses onward to *mathesis universalis* (as I myself did in the *Logische Untersuchungen*), he will not easily come upon the thought of making this reduction to an analytics of pure senses; and therefore he will acquire mathematics as only an *amplified logic*,

> which, as a logic, relates essentially to *possible* object-provinces and theories (Hua XVII, 145-146/140).

Husserl thus distinguishes between mathematical, structural existence characterized by "non-contradiction" and connected to it distinct evidence, and "possible actuality" or "the possible true being." For him the objects of formal mathematics, or mere positions in structures, as structuralism will have it, are too abstract to account for what is meant in judgments about objects. The objects of formal ontology should have a relationship to judgments about individuals and hence to what is given in intuition, in evidence of clarity. Accordingly, Husserl explains in the introduction to FTL that

> though it seemed obvious that a science relating with this universality to anything and everything – to everything possible, everything imaginable – deserves to be called a formal *ontology*, still, if it is to be one actually, then the *possibility* of objectivities belonging in its sphere must be established by intuition (Hua XVII, 16/12).

Whereas formal mathematics offers us a merely possible formal ontology, an actual formal ontology has to establish the possibility of the objects by relating them to experiences in which objects themselves are given in clear evidence like when perceiving them.

5. Transitional link

The logical interest in truth requires givenness of the meant objectivities themselves, and hence clear evidence that has its source in the world, outside the non-contradictory formal theory:

> Here a truth signifies *a correct critically verified judgment* – verified by means of an adequation to the corresponding categorial objectivities 'themselves', as given in the evidential having of them themselves: given originaliter, that is, in the generating activity exercised on the basis of the experienced substrates 'themselves' (Hua XVII, §46, 132/127).

It seems that the "generating activity on the basis of the experienced substrates" can be understood in two ways: either it refers to material applications of the formal theories (e.g., geometry, mechanics) or else it refers to a judgment theory as "a transitional link" [*Übergangsglied*] between logic of non-contradiction (formal mathematics) and logic of truth. Husserl explains the former route in more detail in *Ideas I*. The material realizations of the formal theories form material ontologies (Hua III/1, §10). The basic concepts of these disciplines are concepts of exact material essences that can be derived from the theory but can also be obtained from intuition through the method of eidetic seeing, which Husserl later develops into the method of eidetic variation (Hua III/1, §§4, 66, 72; EU, §87a, 410–411/340). Highest universalities delimit regions of objects (e.g. the region consisting of material things, the region of animate organisms, and the psyche). In these regions they form hierarchies, ranging from the most general (e.g. any physical thing whatever, any sensory quality, any spatial shape, any mental process) to the most specific, from the highest genus to the infimae species, the eidetic singularities (Ideas I, §12, 31/25).

However, these material ontologies are regional and, hence, not universal, as Husserl thinks formal ontology ought to be. This suggests that Husserl needs another way to connect the logic of non-contradiction to the world. This is provided by the "transitional link":

> In the first place, we require here an important supplementation of the pure logic of non-contradiction, a supplementation that, to be sure, goes beyond formal mathematics proper, but still does not belong to truth-logic. It is a matter, so to speak, of *a transitional link* between them (Hua XVII, 209-210/202).

The transitional link is a judgment-theory [*Urteilstheorie*], which is more explicit than the apophantic analytics, discussed in the beginning of FTL (esp. §13). Crucially, it carries in it the information about the grammatical cores of the judgments, which seems to be the source for its normalizability. Within pure apophantic logic one can construct complex judgments out of simple forms of judgment. Husserl explains that, for example, from the judgment 'S is p' one can construct the form 'Sp is q' and then '(Sp)q is r'. These judgments can be 'modified' so that they can occur as component parts in, e.g., a conjunction or a hypothetical form of judgments. Such construction is law-governed and reiterative. In addition to this, the judgment theory that provides the transitional link "normalizes" (not the term Husserl uses) so that "any actual or possible judgment leads back to ultimate cores when we follow up its syntaxes" (Hua XVII, §82, 210/202-203). Or, as Husserl also characterizes it:

> the reduction signifies that, *purely by following up the meanings*, we reach ultimate something-meanings; first of all, then, as regards the meant or supposed judgment-objects, supposed absolute objects-about-which (Hua XVII, 211/203).

Husserl's brief description of the reduction thus suggests that it is mechanical or computable.

The judgment theory envisioned by Husserl thus appears to have enough "computable" content in its forms of judgment to enable what one might call "strong normalization," that is, every judgment is mechanically reducible to elementary judgments. [9] The complex judgments of the theory can thereby be mechanically reduced into ultimate subjects, predicates, universalities and relations:

> it can be seen a priori that any actual or possible judgment leads back to ultimate cores when we follow up its syntaxes; accordingly that it is a syntactical structure built ultimately, though perhaps far from immediately, out *of elementary cores, which no longer contain any syntaxes*… And always it is clear that, by reduction, we reach a corresponding *ultimate*, that is: *ultimate*

> *substrates* – from the standpoint of formal logic, *absolute subjects* (subjects that are not nominalized predicates, relations, or the like), *ultimate predicates* (predicates that are not predicates of predicates, or the like), *ultimate universalities*, *ultimate relations* (Hua XVII, 210-211/202-203).

Thus the transitional link thus leads back to what Husserl calls *ultimate cores*, but what could also be called *canonical forms of expressions*.

The reduction takes place first on the level of senses, and then analogously on the level of truth:

> To the reduction of judgments to ultimate judgments with an ultimate sense, there corresponds a *reduction of truths*: of the truths belonging to a higher level to those belonging on the *lowest level*, that is: to truths that relate directly to their matters and material spheres, or (because the substrates play the leading role here) that relate directly *to individual objects* in their object spheres – individual objects, objects that therefore contain within themselves no judgment-syntaxes and that, in their experienceable factual being, are *prior to all judging*. That judgments (not judgment-senses) relate to objects signifies that, in the judgment itself, these objects are meant as substrates, as the objects about which something is stated; and reductive deliberation teaches, as an *Apriori*, that *every conceivable judgment ultimately* (and either definitely or indefinitely) *has relation to individual objects* (in an extremely broad sense, real objects), and therefore has *relation to a real universe*, a 'world' or a *world-province*, 'for which it holds good' (Hua XVII, 212/204).

The judgment-theory ultimately establishes that the complex judgments can be reduced to judgments about individuals in the world.

> Furthermore there is the set of problems offered by th*e relation of predicational truth to objects-about-which* and, finally, to 'ultimate substrates', objects of possible 'experience'. These objects, the material [*das Sachliche*] in the ultimate sense, are in the opinion of traditional logic, something '*Objective'*: Experience as such is *Objective experience*; truth as such is *Objective truth*. Truth is truth in itself concerning "Objects" – belonging to an *Objective world.* (Hua XVII, 208/201)

The judgment-theory aims to provide the connection between the abstract structuralist formal mathematics, or what Husserl also calls logic of non-contradiction, and the objects that possibly actually exist. Husserl points out that this is not something mathematicians need to care about, but it is something we need to do if we are interested in truth, and hence in formal ontology:

> For *mathesis universalis*, as formal mathematics, these ultimates have no particular interest. Quite the contrary for *truth-logic*: because ultimate substrate-objects are *individuals*, about which very much can be said in formal truth, and *back to which all truth ultimately relates*. If one keeps to the formal of pure analytics, if the evidence – the evidence serving this discipline – accordingly relates only to pure judgment-senses as distinct, one cannot establish this last proposition. To have insight into it, one must *make ultimate cores intuited*, one must draw fullness of adequation, not from evidence of the judgment-senses, but instead from evidence of the 'matters' or 'affairs' corresponding to them. (Hua XVII, 211/203)

The role of judgment theory is thus not to prove a certain part of mathematics consistent or otherwise to justify a body of mathematics. Rather, its role is to transfer intuition of objects to more complex formations and, presumably, ultimately to (at least part of) formal mathematics. Judgment theory preserves evidence, whether distinct or clear. The body of mathematics that can be normalized into basic forms of judgments about actually existing objects can thus be known with clarity.

Husserl’s notion of evidence is thus more general than, for example, Charles Parsons’s broadly Kantian view of intuition. For Parsons, mathematical intuition is one which gives objects that instantiate concepts that have a sharp and precise character (2008, 165). His paradigm example for mathematical intuition is intuition of strikes, or strings of strikes, that are “quasi-concrete,” so that by way of perceiving a token of a type, the type is intuited (ibid., 160). In contrast, in his discussion of the evidence of ideal objects Husserl merely claims that it is analogous to the evidence of ordinary perception. He writes that in it

> [t]he identity and, therefore, the objectivity of something ideal can be directly ‘seen’ … with the same originality as the identity of an object of experience in the usual sense – for example: an experienced object belonging to Nature or an experienced immanent object (any psychic Datun). (FTL, §58)

Decisive for it is that the evidently given object has an identity and that it is given in itself, as if “in person.” For Husserl the basic mode of such evident givenness is perception, but he considers also more complicated modes, such as recollection (FTL §§58-59). Whereas Parsons is worried about the vagueness of our spatial perception, Husserl takes it as a fact that we are able to individuate objects. Whereas Parsons, like Hilbert, searches for certainty in intuition, Husserl readily acknowledges that “[t]he *possibility of deception* is inherent in the evidence of experience and does not annul either its fundamental character or its effect” (FTL, §58).

For Parsons intuitive knowledge can be preserved by certain logical inferences, e.g., simple tautologies, addition and multiplication, but to him reiteration is not always able to preserve intuitive knowledge (2008, §29). One may raise a question about how exactly Husserl’s judgment theory preserves evidence, and hence intuitiveness of knowledge. One answer could be, indeed, in its use of reiteration, which in a “Brouwerian” manner could be thought of as the fundamental intuition of mathematics (as Mark van Atten has argued against Parsons, whose concept of intuition runs out at this point), and, hence, as what enables passing on intuitive knowledge (cf. Parsons 2008, 175, 235-262). Taking into account also Husserl’s earlier approaches to the problem, I am inclined to claim that for Husserl the criteria for whether inferences preserve intuitive knowledge lie in strong normalization, that is, in mechanical reducibility of the judgment to elementary judgments suggested in his discussion of the transitional link.

Around the turn of the century, Husserl advocated a similar approach that took place by means of equational reductions (for the detailed argument, see Hartimo & Okada 2016). In FTL, mechanical reducibility is based on the structure of the judgments that includes information about their original "cores." These cores thus provide the "computational" content to enable normalization.

Husserl explains that the "*reductive deliberations* [*reductive Überlegungen*]," as here explained, uncover "*hidden intentional implications* included in judging and in the judgment itself as the product of judging. *Judgments as senses accordingly have a sense-genesis* [*Sinnesgenesis*]" (Hua XVII, 215/207). Husserl's "transitional link" is what reveals the sense-genesis of the judgments. Curiously, Husserl thereby arrives at a rather systematic judgment-*theory* [*Urteilstheorie*] in his transcendental questioning concerning the constitution of the judgment senses (Hua XVII, §86).[10] Husserl's judgement-theory, and "true" mathematics formulable by means of it (to be sure, Husserl does not explicitly articulate such "true" mathematics, but it seems to be implied in what he does in FTL), resembles Hilbert's formulation of real mathematics that has an intuitive basis in intuition of strokes and primitive recursive operations. Both, Husserl and Hilbert, thus seek to investigate the extent of intuitive knowledge in mathematics (for the way in which Hilbert does it see Parsons 2008, §28). Husserl thinks that instead of Hilbertian strings of strokes the paradigm case of evidence is perception of external, concrete objects. Furthermore, he distinguishes the evidence of clarity from the evidence of distinctness, and hence the search for non-contradiction from the search for truth. Furthermore, Husserl thinks that consistency can be established model-theoretically, whereas Hilbert created his proof-theory for this purpose. Husserl thinks that mathematicians do not need to seek for any intuitive basis as long as their theories are consistent. Regarded from Husserl's perspective, Hilbert simply confuses distinctness and clarity. Thus, it seems that regarding this particular issue, Husserl's radical *Besinnung* is an evaluation of especially Hilbert's attempt at providing mathematics with intuitive foundations. Husserl does not, however, approach Hilbert's view "philosophy-first", but engages in *Besinnung* of the various normative goals of mathematicians. Only after having examined the sense of mathematics as opposed to the sense of logic, is he in the position, not only to reformulate his view of formal ontology, but also to suggest revisions to Hilbert's project.[11]

6. Conclusion

Husserl arrived at formal ontology with a method he termed *Besinnung*. By means of *Besinnung*, he engaged in gleaning the intentive senses of his fellow mathematicians, especially those in Hilbert. By its means, Husserl formulates the proper sense of formal mathematics in contradistinction to that of formal logic. As Husserl sees it, different aspects of formal ontology have been sought in different ways in mathematics and in logic. Whereas in mathematics one has aimed for Euclidean manifolds and has thereby reached the notion of "any objectivity whatever," logic as a theory of science is concerned with truth and intuitability of objects. Husserl's initial formulation of formal ontology suggests that it consists of objects as conceived of in purely structural terms. This is too abstract to properly capture the objects as they exist and relate to truth. Hence, in his ultimate conception of formal ontology, Husserl substantiates his otherwise structuralist ontology with a constructive-intuitive judgment theory.

Structuralism has been criticized in the literature because of the *incompleteness* of its objects. Probably the best-known instance of this criticism is due to Paul Benacerraf (Benacerraf 1964, 291). The incompleteness objection runs as follows. It must be possible to individuate the abstract objects of mathematics independently of the role they play in a structure. Objects, as conceived of in structuralism, are "incomplete," because they can only be ascribed properties defined by a structure. Their existence is not independent enough. This indeterminateness poses problems, e.g., for the applications of mathematics (Parsons 2008, 106; 151). Husserl appears to share these concerns in his claim that formal ontology acquired from formal mathematics does not deserve to be called 'ontology.' But Husserl's approach is "mathematics-first": he thinks that mathematicians should not worry about such philosophical concerns. These concerns are of interest only to those who share the logical interest in truth. Husserl then formulates a judgment theory, putatively with a strong normalization property. By its means, Husserl examines and describes the way in which evidence can be mediated from a direct confrontation with the concrete, actual world to the higher flights of abstraction. The judgment theory then helps to single out one universal but mundane ontology that is shared by all material ontologies. I conclude with a quote from Husserl's own conclusion on this:

> this mundane ontology explicates the all embracing Apriori of any purely possible world whatever [*das universal Apriori einer in reinem Sinne möglichen Welt überhaupt*], the Apriori of the eidos *world* —an eidos that must arise concretely by virtue of the method of eidetic variation, which starts with the world that is given us in fact and takes it as the directive 'example'. This thought is the basis from which arise, at successive *levels, the great problems* pertaining to a *world-logic* [*Welt-Logik*] that is to be grounded radically, a genuine mundane ontology — some parts of which have already been indicated (Hua XVII, 296/291).

Husserl's reference to the apriori of the eidos world anticipates his later analyses of the life-world and its apriori structures. However, that lies beyond the scope of the present chapter and will be left for another occasion (I discuss it in Hartimo 2018d).

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[1] I greatly acknowledge the support from the Centre for Advanced Study in Oslo, Norway, which hosted our research project "Disclosing the Fabric of Reality - The Possibility of Metaphysics in the Age of Science," during the academic year 2015/16. The present article was conceived as part of the project.

[2] In this article, I will refer to the text by means of paragraph numbers and thereby simultaneously to all editions and translations of the same work. When references are to pages in the Introduction and Conclusion that do not have numbered paragraphs, I will first give the page number in the German version and then that of the English translation. The same convention is used in citations. The italics are from the originals unless otherwise indicated.

[3] In particular, as I have argued elsewhere, on this point Husserl's view is remarkably similar to that formulated by Penelope Maddy (1997, 2007, 2011). It is important to note that this kind of naturalism does not entail reductionist scientific naturalism, but when generalized to all disciplines a kind of liberal naturalism.

[4] I explain all this in detail in Hartimo (2018c).

[5] Becker had a background in mathematics, but he wrote his *Habilitationsschrift* entitled "Beiträge zur phänomenologischen Begründung der Geometrie und ihre physikalischen Anwendungen" (1922) with Husserl. Husserl praised the work, writing to Weyl that: "It is nothing less than a synthesis of Einstein's and your discoveries with my phenomenological investigations on nature… " (Letter to Weyl, dated April 9, 1922, cited from Mancosu 2010, 282).

[6] Husserl-Chronik reports that on March 1937,"H. *hat* gröβere Abschnitte gelesen (insbesondere zum ersten Mal auch [?] die zweite Hälfte) *von* Oskar Becker, Mathematische Existenz, 1927." (Schuhmann 1977, 484).

[7] Zermelo was at the time in Freiburg as well. His role for Husserl's views is unknown.

[8] Parsons, too, notes that for Husserl structuralism does not give a complete account of mathematical objects (Parsons 2008, 41).

[9] For these reasons, Husserl's judgment theory appears to intend something like intuitionistic type theory, in which so-called 'type checking' makes the strong normalization possible (Dybjer & Palmgren 2016). Crosilla (forthcoming) explains this to be the import of the Curry-Howard isomorphism, which makes set theory and logic "entangled" in Martin-Löf's type theory.

[10] What is curious about this is that Husserl's transcendental phenomenology is *defined* as a study in which the usage of scientific theories, logic, and mathematics is put in brackets so that they cannot be used in transcendental constitutional analyses (obviously scientific theories, mathematics, and logic can themselves be transcendentally analyzed). But here, the judgment-theory serves as an aid for the properly transcendental analyses. This shows how the analyses carried out in natural and transcendental attitudes can be interrelated in Husserl's phenomenology.

[11] For the relationship between Hilbert and Husserl, see Hartimo (2017).