Mathesis Universalis and the Life-World: Finitude and Responsibility

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Abstract Scientific philosophy may be objectively or subjectively oriented for Husserl. As the former, it develops in a third-person perspective and employs deductive-explanatory methods. As the latter, and in a first-person perspective, it may become truly critical and radically foundational in character, its ultimate source of evidence being intuitive experiences belonging to self-responsible subjects. Formalism and the problems related to the *mathesis universalis* arise within the first sense of science, whereas transcendental phenomenology is, according to Husserl, scientific philosophy in the second sense. This paper seeks to show that since human experiences (which are ultimately founding) are essentially ongoing, finite and uncompletable, scientific philosophy in both its senses can only claim partial and relative truths and validities. Thus the radical scientific philosopher as a transcendental phenomenologist is called upon to lay bare the ultimate, *responsible* causes for the meaning and validity of being, and the 'ultimate foundations' of philosophy.

Keywords Transcendental phenomenology • Husserl • Formalism • Mathematics • Life-world • Radical foundations • Responsibility

The Twofold Sense of Scientific Philosophy

For Husserl, scientific philosophy ultimately has a twofold sense. On the one hand, it is developed within a 'subjective' or *first*-person perspective and is radical or 'critical' insofar as it attempts to disclose the philosophical origin of the positive sciences. Thus, it seeks to clarify both *how* their concepts, laws and theories, as well as their objects, can become manifest 'for us' if they are essentially 'in themselves'; and *how*, entering the flux of lived experience, they can be thought, expressed and applied to experience without thereby losing their objectivity and transcendent meaning. Regarding knowledge, then, the aim of scientific philosophy in this first

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sense is to "*understand* the *ideal meaning* of the *specific* connections in which the objectivity of knowledge may be documented" (Husserl 2001b: §7, 178 [127]).[1] Such scientific philosophy is conceived of as an open-ended, unified edifice on which successive generations perpetually and rigorously build, in a teleological process of infinite tasks, with the goal of resolving "all conceivable problems in philosophy". Phenomenologists, as scientific philosophers, accordingly "foreswear the ideal of a philosophical system" as humble members of a community living and working "for a *philosophia perennis*" (Husserl 1997: 179 [301]).[2]

On the other hand, the usual, *positive* sense of scientific philosophy developed within an 'objective' or *third*-person perspective arises and develops in the natural, 'dogmatic' attitude, employing concepts and laws or building systems and theories with theoretical-explanatory methods. Even scientists working in purely formal-deductive sciences presuppose knowledge as a *factual* occurrence in nature. Sciences oriented 'objectively' find their highest degree of rationalisation in conceptual and symbolic thought, and ultimately in the universal development of a *mathesis universalis*, which, as a powerful formal tool, promises to enable the overcoming of the finite capacities of human experience.

But, according to Husserl, this second sense can secure its radical foundation only if it is complemented by the first sense; such that the sciences' conceptual and symbolic structures are traced back to their respective meaning-constituting judging experiences, and these in turn to the ultimate source of their evidence in intuitive experiences, finite and limited in scope though they are. Husserl allots this foundational task to transcendental phenomenology as the idea of a scientific, rigorous, universal, self-founded and founding philosophy, which is characterised as a reflexive movement towards the experiencing subject and its ultimately intuitive, meaning-giving and validating experiences in the life-world. Transcendental phenomenology is thus imbued with an ethical-cognitive pathos of *self-responsibility*: it requires that the subject assume its *responsibility* for its theoretical and practical productions and endow them with meaning and validity, rather than justifying them by appealing, say, to a *deus ex machina*.

Since science, for Husserl, is ultimately founded on the radical open-endedness and finitude essential to human experience in the life-world, it is essentially ongoing and uncompletable in both its senses – subjective/critical and objective/dogmatic. For this reason, transcendental phenomenology itself can lay claim solely to truths and validities that are always only partial, relative and provisional achievements in an ongoing, teleological process of infinite tasks.

The problem of formalism and of *mathesis universalis*, which is the present study's chief concern, arises within the second sense of science. And this problem

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[1] German edition: Husserl 1984. Henceforth, cited with English and [German] page references, respectively. NB: translations cited in the course of this study have been modified (without notice) whenever it has been deemed necessary; all others stem from the author. NB in quotations throughout, emphasis is in original, unless otherwise stated.

[2] German edition: Husserl 1962. Henceforth, cited with English and [German] page references, respectively.

has two aspects: a conceptual, properly 'logical' – that is, philosophical – aspect and a technical aspect, which inheres in a technique or an *ars* of calculative operations. The development of a *mathesis universalis*, by means of a sophisticated formalisation of mathematics in an open-ended process, is carried out at the cost of an erosion of its meaning-foundation in the life-world.

The Phenomenological Critique of Formalism

Formalism cannot *per se* be criticised – even when it is equated with the purely technical dimension of signs, calculative operations and their 'game rules'. So when phenomenology undertakes a critique of formalism, it is in view of three ways in which formalism conceals and forgets its meaning-foundation: firstly, when, as an *ars*, it conceals its *conceptual* foundation (both inauthentic and authentic); secondly, when it replaces natural deductive procedures with formal calculative operations and rules, and then claims that the latter are a *logic* and not merely a *technique*; and, thirdly, when it employs an *ontological* interpretation of forms as constituting the 'being in itself' of the world, and does not simply interpret them as mere *methodological* yet powerful human tools to overcome the limitations of our intuitive capacities of representation.

Following Brentano, Husserl undertakes the first critique of formalism – that as an *ars* it conceals its conceptual foundation – in *Philosophy of Arithmetic*. There he rejects the purely analytical understanding of arithmetic, mathematics' founding science, found in Helmholtz's or Riemann's accounts of that discipline (Husserl 2003).[3] Husserl maintains this view in all essentials for the rest of his life. He complains that the development of mathematical operational techniques during the eighteenth and nineteenth centuries *has not brought with it* a corresponding development of the *philosophy of mathematics*, since those "portentous" techniques do not provide the means for acquiring the requisite *philosophical* understanding of the nature of mathematics (Husserl 1994c).[4] To gain such an understanding, he contends, logical investigations into the origin of symbolic (inauthentic) methods must follow psychological, intuitive investigations. And although in this first book he still conceives of intuition as empirical, his use of it there nevertheless anticipates traits of his future ideal concept of categorial intuition.

Hence Husserl seeks to secure the positive, natural *concept* of cardinal number as 'plurality' by tracing it back to the concrete, intuitive *phenomenon* of a totality or compound of whatever objects, devoid of qualities and reduced to mere unities or 'somethings'. This compound is also endowed with a specific sort of relation among

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[3] German edition: Husserl 1970a, b, c. German page reference, which is indicated in the text of the translation.

[4] German edition: Husserl 1979 [1891]a. Cited with German page reference, which is included in the margins of the translation.

or combination of its unities: a *collective combination* (Husserl 2003: 18–20, 79), a *sui generis* "psychical" combination that is not affected by any change within the units it combines; for the combination and the combined units are not on the same level. The *reflection* upon this collective combination guided by a unitary interest enables one to abstract from the phenomenon of totality the indeterminate concept of plurality, represented by '1 + 1 + 1', where '1' represents the unities and '+' represents the relation (Husserl 2003: 74). To reach the "general and abstract concept of number" – namely, the ideal intuitive (or authentic) concept of number – the concept of plurality must be determined "from below", based on this abstraction from a totality or compound of related unities.[5] Indeed, it is our contention that, even when Husserl expands his notion of intuition to include eidetic and categorial intuitions, this determination "from below" is still operative, since both types are conceived of as "founded acts". For even if the *eide* or forms prevail over their concrete or illustrative instantiations – and thus the eidetic and categorial intuitions prevail over sensible intuition (perception or imagination) – the latter is what enables the operation at different levels of idealising abstraction. We shall return to this matter in section "The Actualisation of the Ideal World" below.

Now it is true that in *Philosophy of Arithmetic* Husserl still maintains that a *symbolic* abstraction must replace authentic concepts with 'inauthentic' or empty ones, and a further replacement of these symbolic concepts with *physical* signs must ensue due to the essentially finite and limited scope of our intuitive capacities. Hence, although these psychological investigations do not suffice to offer a complete philosophical foundation to arithmetic and mathematics as a whole, they nevertheless reveal Husserl's epistemological commitment and enduring elements of his nascent phenomenology insofar as they demand that the evidence of formal thought be traced back to its intuitive source.

The second critique of the replacement of deductive operations by calculative techniques appears in Husserl's review of Ernst Schröder's *Vorlesungen über die Algebra der Logik (Exakte Logik)* (Husserl 1994c). There Husserl challenges the then-current attempt to substitute the limited domain of "pure logical deduction" – still operative in the old "intensional logic" or "logic of contents" (*Inhaltslogik*) – with inferential techniques of logical calculus that prevail in the new "extensional logic" (*Umfangslogik*); a contention that he develops elsewhere (Husserl 1994a, b).[6] Husserl refutes Schröder's contention that the study of extensional logic should be utterly independent "from all contents and content relationships whatsoever" (Husserl 1994c: 19). He maintains instead that "an extensional logic which is independent in *this* manner is impossible in principle" and that "so little is it true that the logic of extension is to be treated independently of the logic of intention…that when doing extensional logic we yet stand within intensional logic, or subordinate to it" (Husserl 1994c: 19–20). By the same token, the "algebra of logic", or "algebraic calculus", is merely a "dexterous technique", but is not

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[5] This is Burt Hopkins's argument (see Hopkins 2002: esp. 58–63).
[6] German editions: Husserl 1979 [1891]b, 1979 [1891]c.

equivalent to "deductive logic", which governs the domain of "pure deduction" (Husserl 1994c: 8). Thus, to calculate is not to deduce; indeed, calculus is not even logic but only a "technique to manipulate signs" (Husserl 1994c: 8). The lack of clarity on the part of logicians in this regard is similar and related to the lack of clarity on the part of mathematicians regarding arithmetic, "the most highly developed of calculative disciplines", which they have elaborated "far removed from a deeper grasp of its fundamental principles", with a "lack of clarity" "so far-reaching that there is not even minimal agreement upon the true conceptual foundations of this science" (Husserl 1994c: 22).

Thus, despite the fact that this symbolic substitution – not only of conceptual representations with 'signs' but also of the *psychic* and real *activities* with 'mathematical calculative operations' that have their own 'game rules' – gains in importance in Husserl's account of the foundation of mathematics (see section "Positive Appraisal: Formalism as the Highest Degree of Rationalisation" below), he will henceforth maintain his distinction between the tasks and qualifications assigned to the *philosophers* of logic and to logical *technicians*, respectively – where the latter are never qualified to undertake the tasks of the former (Husserl 1994c: 9). Philosophers motivated by epistemological concerns regarding the question of *evidence* will always be concerned with the founding character of authentic (*eigentlich*) or intuitive thought in relation to symbolic and inauthentic (*uneigentlich*) thought. This idea lies at the heart of Husserl's conviction that *Inhaltslogik* founds *Umfangslogik*. Nevertheless, in his 1891 review of Schröder's book he acknowledges that we can refer to the content of the ideal symbolic concepts of *Inhaltslogik* only in an "empty way" (Husserl 1994c: 17–20).[7] It is only after his inclusion of "categorial intuition" as the source of the evidence of categorial or syntactical forms in 1900–1901 that the distinction between 'logical technicians' and 'philosophers of logic' is strengthened. At the centre of this distinction is the complex Husserlian notion of 'eidetic intuition', which cannot simply be equated with Descartes's mathematical and dualistic conception of intuition.

The third critique, in which an ontological interpretation of forms replaces their merely methodological meaning, appears in Husserl's *Crisis of European Sciences and Transcendental Phenomenology*, from 1936, in the context of his claim that modern physicalistic rationalism has forgotten its meaning-foundation in the life-world (Husserl 1970b: 65 [66]).[8] This is due, he says, to the fact that a new ideal mathematical infinity and a new *formalised* mathematics – originating from a new formalising abstraction that occurs with the arithmetisation and later algebraisation of geometry – gives rise to analytic geometry and continuum mathematics as the basis of a new natural science. Thus, modern physicalistic rationalists come up with the idea of an "omniscience", "thought of as ideally complete", since they believe

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[7] See also: Husserl 1979 [1891]b, 1979 [1891]c.

[8] German edition: Husserl 1954b. Henceforth, cited with English and [German] page references, respectively.

themselves to be "in the happy certainty" of possessing "an infallible method of broadening knowledge, through which truly all of the totality of what is will be known as it is 'in-itself' – in an infinite progression" (Husserl 1970b: 65 [67]). The result of this process is a nascent philosophical 'naturalism', which views the entire universe as physical nature or its analogon. Thus, Galileo introduces the idea that the "book of the universe" is written *sub specie aeternitatis* in a mathematical language.[9] This idea is later retrieved by Johann Carl Friedrich Gauss (1777–1855) with his dictum *ὁ θεὸς ἀριθμητίζει*, an expression that Husserl criticises and replaces in his *Philosophy of Arithmetic* with his *ὁ ἄνθρωπος ἀριθμητίζει* (Husserl 2003: 192). He reiterates this same criticism in 1936, when he states that the prototype   of   geometry   and   physics   is   *arithmetic*,[10]   such   that "physics. . .hypothetically presupposes an analogon of the closed infinity of the number series" (Husserl 1992: 205–205). Gauss's view, which is influenced by modern physicalistic rationalism, is wrong according to Husserl: the universe can never have a logically determinable (*logifizierbaren*) horizon "in a logic that is logistic", where each may *idealiter* extend the evidence of his own experience of the universe *ad infinitum* (Husserl 1992: 205–206). Nevertheless, this view has prevailed in the Western world for 300 years, despite the fact that it cannot explain *how* it is theoretically *construable* in a human (transcendental) experience.

Hence, since modern times, arithmetic has been a calculative technique (Husserl 1970b: 46 [46]), which entails a 'mechanisation' of all domains of mathematics and natural science and an emptying of their meaning. As a result:

> It is through the garb of ideas that we take for *true being* what is actually a *method* – a method which is designed for the purpose of progressively improving, *ad infinitum,* through scientific predictions, those rough predictions. . .within the sphere of what is actually. . .experienceable in the life-world. It is because of the disguise of ideas that the true meaning of the method, the formulae, the 'theories', remained unintelligible and. . .was *never* understood. (Husserl 1970b: 52 [52])

Husserl's aim in the *Crisis* – much as in *Philosophy of Arithmetic* – is to understand (and thus 'recover') the forgotten meaning-foundation of this mathematised natural science (Husserl 1970b: 49 [49]). In this connection, Galileo is regarded as a "discovering and concealing genius" (Husserl 1970b: 52 [52–53]) who discloses the world in the light of "true exact lawfulness" (idealised and mathematised) while at the same time concealing the meaning of mathematisation itself. Here Husserl demands that we:

> inquir[e] *back* into the *original meaning* of all his [the scientist's] meaning-structures and methods, i.e., into the *historical meaning of their primal establishment*, and especially into the meaning of all the *inherited meanings* taken over unnoticed in this primal establishment, as well as those taken over later on. (Husserl 1970b: 56 [57])

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[9] See §6 of Galilei 1960. Italian edition: Galilei 1968 [1623].

[10] See Husserl 1992: 205 – "The *mos geometricus* is. . .in fact *mos arithmeticus*."

Positive Appraisal: Formalism as the Highest Degree of Rationalisation

At the same time, however, formalism does have positive aspects within objectively oriented philosophical research. In *Ideas* I Husserl notes that physics has been "rationalized" since the beginning of modern times with the application of Euclidian geometry, and the interpretation of the material thing's essence as *res extensa* from Descartes onwards (Husserl 1983).[11] The flourishing of formal mathematics since the dawn of modernity has continued this "*same function of rationalizing the empirical*" (Husserl 1983: 20). Formal ontology, beyond the material ontologies of physical nature, deals with mere *essence-forms*, each of which is "indeed an essence but completely '*empty*,'. . .that, *in the manner pertaining to an empty form*, *fits all possible essences*", prescribing formal laws and a common formal structure to all "material" universalities and their ontologies (Husserl 1983: 21). Thus, it deals not with a region but with "*the empty form of any region whatever*", subsuming "*under it – though only formally*. . .all the regions, with all their materially filled eidetic particularizations" (Husserl 1983: 22). As a consequence, "*formal ontology contains the forms of all possible* [material] *ontologies*" and coincides with the *mathesis universalis* (which "includes nothing but empty forms") (Husserl 1983: 27) or "pure logic in its full extent", an "eidetic science of any object whatever", whereby its "'fundamental' truths. . .function as '*axioms*' in the disciplines of pure logic" and "express the unconditionally necessary and constitutive determinations of an object as such, of any thing whatever" (Husserl 1983: 22).

As noted above, in 1890 the 'logical foundation' of arithmetic that Husserl deemed necessary involved a "formalizing abstraction" that consists in a *sui generis* "substitution" of its intuitive point of departure, which is acknowledged to be essentially finite and limited. For:

> If we had authentic representations [*Vorstellungen*] of all numbers, as we have of those at the beginning of the number series, then no arithmetic would exist, since it would be completely superfluous. The most complex relations among numbers, which we now discover with difficulty by means of longwinded reckoning, would be simultaneously intuited with evidence just as propositions of the sort $2 + 3 = 5$. . . .In fact, however, we are limited in our representation capabilities. The fact that we find here some kind of limit within ourselves resides in the finitude of human nature. We can only expect authentic representations of *all* numbers from an infinite understanding; . . .Thus the entire arithmetic, as we will see, is none other than a sum of technical means to overcome the essential limitations [*Unvollkommenheiten*] of our intellect here mentioned. (Husserl 2003: 191–192)

Indeed, the arithmetical domain includes negative, rational, irrational and imaginary numbers. The introduction of the irrational numbers poses the greatest

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[11] German edition: Husserl 1976. Henceforth referred to as *Ideas* I with reference to the pagination of the original German edition, which is included in the margins of both Husserliana edition and the translation.

difficulties, since it implies the inclusion of infinite operations and sets, as well as the 'actual' or 'mathematical' infinite (see Strohmeyer 1983: xvii).

So when Husserl acknowledges in *Philosophy of Arithmetic* that when he refers to "infinite groups" or "multitudes" (as the points of a line, or the limits of a continuum) and what we *de facto* are able to represent ("a determinate unlimited process", or "what is *included* in its conceptual unity"), he is employing an "essentially distinct" concept, "as it were, imaginary", "which is no longer a concept of a 'group' in the true sense of the word" (Husserl 2003: 221). Furthermore, symbolisation itself and the formation of conceptual numeric series do not take place uniquely on the basis of purely symbolic, inauthentic or 'empty' *concepts*. They must somehow be 'fixed' in a 'sensible' manner, which puts us again in contact with some sort of *sui generis* intuitability that allows us, however strangely, to overcome the intuitive limitations of our representations. As a consequence, *physical signs* finally come to be substituted for the inauthentic *symbolic concepts* by which they are determined and denoted.

But if this is the case, if the arithmetician moves within the operative terrain of a 'technique', the question arises as to how formal calculative processes with signs are validated or legitimated. There must be a parallelism of some kind between 'symbolic concepts' and signs, such that arithmetic may validate *the extension of the numeric domain*. But already, in a manuscript from 1890 in which Husserl discusses different extension theories (*Erweiterungstheorien*), he presents his own theory according to which such extension concerns not the *conceptual* foundation of arithmetic but only the *rules* of *signs* and the calculative *technique* (Strohmeyer 1983: xxxii–xxxvi).[12] Hence, he considers extension to be the result of "pure formalism" insofar as it is totally *free* and *independent* of its conceptual basis. Furthermore, this formal domain need not be founded on *axioms*. Only later in Göttingen, under Hilbert's influence, does Husserl reinterpret his *arithmetica universalis* with reference to axioms. In any case, his initial conception was not subject to Kurt Gödel's later critique of axiomatic systems (see Gödel 1967).[13] But our concern here is that arithmetic, for Husserl, henceforth has a purely *formal* character.

Formalism serves, then, to *compensate* for the *finitude* of our constitution of infinite manifolds, such as mathematical series, and our capacity to represent them authentically on the basis of units (Husserl 2003: 219). For more than any other science, says Husserl, arithmetic manifests the finite and imperfect constitution of human cognition. It is in this connection that he introduces his expression ὁ ἄνθρωπος ἀριθμητίζει.

Formalism therefore plays a crucial role. The finite, temporal character of human cognition is compensated for by the "portentous" possibilities that the formalisation of arithmetical thought entails:

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[12] See also Husserl 1886–1901: 28–44.

[13] German edition: Gödel 1931.

> A symbolic extension of the substantially finite construction of groups is necessary, according to Husserl, since we are *finite* and *temporal* beings. An eternal and infinite being does not calculate. The *infinitude of mathematics* would thus be conceived of as a peculiar form of finitude. An *actual* infinitude would be from the outset absurd. (Eley 1970: xiii–xiv)

Husserl maintains this view *mutatis mutandis* until the end of his life. Hence we read in the *Crisis*: "Here we must take into account the enormous effect – in some respects a blessing, in others portentous – of the algebraic terms and ways of thinking that have been widespread in the modern period since Vieta (thus since even before Galileo's time)" (Husserl 1970b: 44 [43–44]).

Research for the second volume of his *Philosophy of Arithmetic* led Husserl to develop a philosophy of calculus that, on the unitary basis of the *formal* character of arithmetic, aims: firstly, to develop the *logical foundation* of general arithmetic as a science of *calculus*; secondly, to solve the problem of the *extension* of the numeric domain as an algorithmic extension of the same (formally understood); and thirdly, to analyse the possibility of applying arithmetic to different conceptual domains with identical algorithms (see Strohmeyer 1983: xxxviii). Thereafter, Husserl regards not the concept of natural number but rather the set or group and the manifold as the most general and founding concepts of the arithmetisable domain (Strohmeyer 1983: xxxviii),[14] even though he never abandons his initial conception of arithmetic as a "general theory of operations" or a "science of calculus" (Strohmeyer 1983: xiv). Thus Husserl says in 1900 in the foreword to his *Logical Investigations*:

> There were evidently possibilities of generalizing (transforming) formal arithmetic, so that, without essential alteration of its theoretical character and methods of calculation, it could be taken beyond the field of quantity, and this made me see that quantity did not at all belong to the most universal essence of the mathematical or the 'formal,' or to the method of calculation which has its roots in this essence. I then came to see in 'mathematicizing logic' a mathematics which was indeed free from quantity, while remaining none the less an indefeasible discipline having mathematical form and method, …important problems then loomed before me regarding the universal essence of the mathematical as such, …and especially, e.g., regarding arithmetical and logical formality. (Husserl 2001a: 1–2.[15]

The Idea of a Pure Formal Logic

Finally, in his *Prolegomena to Pure Logic*, in view of the aforementioned formalism and technical advances in mathematics during the nineteenth century and while attempting to clarify the essence of pure logic as an *a priori* (universal, necessary) science in the sense of a 'theory of theories', Husserl proposes the idea of a "*theory form*" which can govern any nomological sphere of cognition "*having such a form*",

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[14] See also Husserl 2003: 493.

[15] German edition: Husserl 1975: A vi. Henceforth, cited with English and [German] page references, respectively.

a sphere that in mathematics is termed 'multiplicity'. In other words, multiplicities are subordinated to certain possible combinations of their objects, and to *certain* principles of a *determinate form*, namely, to certain "theory forms". The contents of those multiplicities have been dispensed with, and what is defined is simply their *theory form*. Husserl contends that all individual theories concerning diverse multiplicities "are specializations or singularizations of corresponding theory forms" (Husserl 2001a: §70). Pure logic is therefore held to constitute this "formal theory of science" as a "*theory of possible forms of theories* or (correlatively) the *theory of multiplicities*" (Husserl 2001a: §69). Later, in *Formal and Transcendental Logic*, Husserl conceives of this *broadened analytics* in the sense of the Leibnizian ideal of *mathesis universalis* as the highest level of formalisation – as a "theory of deductive systems" and correlatively a "theory of multiplicities" built on a formal apophantics and, correlatively, a formal ontology. Indeed, Husserl indicates that this formalising abstraction or "reduction", which leads to the theory of multiplicities, is possible only on the basis of "nomological" or exact sciences, such as Euclidian geometry (Husserl 1969: §§29–30).[16] Accordingly, the ideal of this science has already been partially accomplished by Riemann and others; namely, through their development of the "multiplicity theory of modern mathematics" as a science of possible deductive systems. Instead of the 'Euclidian space' we would thus obtain the "categorial *form* 'space'" (Husserl 1969: 82).

What is novel in this formulation in *Formal and Transcendental Logic*, from 1929, relative to how he expressed the idea in 1900, has to do, of course, with Hilbert's influence and his idea of a "complete system of axioms" or his "axiom of completeness" (Husserl 1969: 84). It gives rise in turn to the idea of a "*definite multiplicity*" (Husserl 1969: 83), which is "the pregnant concept of multiplicity" as a "'deductive', 'nomological' system" (Husserl 1969: 82). At issue here is a purely formal axiomatic system, which is to say, a deductive system whereby a multiplicity in the sense of an "*infinite sphere of objects*" has the "*unity of a theoretical explanation*" (Husserl 1969: 83–84). This means, above and beyond the formalisation of the Euclidean axiomatic system, that *any* "*nomological science*" and its correlative *infinite sphere* (or "multiplicity") "is defined, *not by just any formal axiomatic system*, but by a '*complete*' one" (Husserl 1969: 84). So, for Husserl, a science is a multiplicity when it has a "*unity-form that can be constructed a priori*…on the basis of a finite number of pure axiomatic forms, by *means of logical categorial concepts*", from which is deduced "the infinite multiplicity of propositions making up a science" (Husserl 1969: 90). There is thus a *finite*, *complete* number of *axioms* that function as premises, and an *infinite* number of possible propositions that can be inferred as conclusions. As a result: "*Mathesis universalis* (which henceforth is equivalent to logical analytics) is, *for a priori reasons*, *a realm of universal construction*" (Husserl 1969: 90–91).

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[16] German edition: Husserl 1974: §§29–30. Henceforth cited with page references to the original German edition, which are included in the margins of both the Husserliana edition and the translation.

The Actualisation of the Ideal World

As a 'critical', radical science, philosophy cannot rest satisfied with this 'objective' orientation, even if it achieves the 'highest levels' of rationalisation, as in pure logic in the sense of a *mathesis universalis*, for this orientation remains in the 'natural attitude'. Instead, *critical* philosophy must attempt to clarify the question of the essential origin of every positive science, including formal logic. Thus, it has an epistemological motivation: to discover how logical and mathematical entities in general (and the 'deductive forms of connection') can have empirical application, even though their evidence does not derive from sensuous experience. Or even how it is that what 'is in-itself' and its 'rational evidence' can be articulated by empirical, cognitive consciousness and its 'psychological evidence'. These issues led Husserl in 1898 to the "universal apriori of correlation" (Husserl 1970b: §46), and thus to the version of *intentionality* he developed in his transcendental phenomenology.

Indeed, whereas the *natural* surrounding world is the correlate of our perception and of most of our actual and possible *experiences* as "*immediately* present" (Husserl 1983: 50), "pure numbers and their laws" (Husserl 1983: 51) are not present for us unless we adopt the *arithmetical attitude* by focusing our cognitive regard on the arithmetical realm. For one to perceive the natural, real world, one need only open one's eyes and be awake. Matters are different in the case of "surrounding ideal worlds", such as the arithmetical world. Indeed, the "contact" between these two worlds arises from a *spontaneous act of our subjective consciousness*, and its activities or experiences. Accordingly, Husserl asserts: "The two, simultaneously present worlds are *not connected* except in their relation through the ego by virtue of which I can freely direct my regard and my acts into the one or the other."

Since this ideal, formal world is the result of the spontaneity of our consciousness, this cognitive activity must be distinguished from any arbitrary product of our likewise spontaneous imagination, and specified in relation with the otherwise *passive* character of sensory perception.

To do so it is first necessary to discard all *nominalist* prejudices regarding essences, ideal forms, and their correlative essential intuitions. These forms are not merely "grammatical hypostases", or abstractions stemming from "psychic processes". Consequently, the logical element (e.g. in 'π is a transcendent number') must be clearly distinguished from the individual cognitive act or lived experience (judgment) whereby we posit it. Husserl does not assume here the existence of a τόπος οὐράνιος where these logical entities (both linguistic meanings and ideal objectivities) would reside, since this "metaphysical hypostasis" is also absurd (Husserl 2001a: 230 [105–106]). Rather, besides *reality* proper, constituted by *factual*, *actual*, *existing*, *individual* entities, he contends that there is a realm of *essential*, *possible*, *ideal*, *universal objectivities* that, though they do not "exist", nevertheless have a right "to be". Thus, he says:

we know with *full insight* that propositions. . .such as 'a + 1 = 1 + a', 'a judgment cannot be colored', 'of any two qualitatively different tones, one is lower and the other higher', 'a perception is, *in itself*, a perception of something', . . .give explicative expression to data of eidetic intuition. (Husserl 1983: 38–39)

By contrast, *real objects* or entities – whether physical or psychical – are *experienced* in *empirical intuitions*; the most basic being the *perception* of physical things and *reflection* upon psychical states, the ego, or consciousness. All sciences of sensory experience are "*factual* sciences" that deal with *individual and existing beings*, the essences of which are *contingent*. The "laws of nature" concern these factual or morphological essences (essential types or *eide*), and are obtained by *inductive generalisations* based on *empirical intuitions* of the "essential properties" shared by a set of individual facts. These "essential predicates" of empirical facts, which express "essential universality and necessity" of the laws of nature, are correlates of eidetic intuitions. Laws of nature, then, are judgments or propositions that *essentially* predicate properties of *existent beings*, and their correlates are *facts of nature*. But the essential predicates of factual data or *eide*, and the corresponding laws of nature, *are not exact*, but merely *morphological* or "descriptive". Thus, concepts such as "'serrated', 'notched', 'lens-shaped', 'umbellated', and the like – all. . .are *essentially, rather than accidentally, inexact* and *therefore* also non-mathematical" (Husserl 1983: 138). Yet, there are judgments or propositions that predicate *essentially* about exact entities that do not exist, such as geometrical figures. Indeed, geometers draw their particular figures on the basis of 'sensuous intuitions' that are merely exemplary illustrations of the ideal, general attributes and properties expressed in their theorems. Consequently, the "essential universality" of geometry is *unconditioned*, thereby differing from the "inductive generality" of the laws of nature. For eidetic intuition to occur in such cases, an additional step must be taken beyond the "inductive generalizations" by means of which the morphological *eide* are accessed. Another sort of "idealizing abstraction" is necessary in order to grasp entities whose "mode of being" is *entirely ideal and exact*. The objects of "purely mathematical disciplines, the material disciplines such as geometry and phoronomy, the formal (purely logical) disciplines such as arithmetic, analysis, etc." (Husserl 1983: 44) – disciplines with the highest degree of rationality – are *purely exact essences*, "ideal possibilities", among which axiomatic relations are established by means of purely deductive inferences" (Husserl 1983: 136–137). Such concepts are, for Husserl, "'*ideas*' *in the Kantian sense*", namely, "*ideal 'limits*'", which in principle cannot be "seen", since they have no corresponding sensuous intuition or perception, and towards "which morphological essences 'approach' more or less closely without ever reaching them" (Husserl 1983: 138).

Here it is necessary to clarify Husserl's position, since it is widely believed that the "laws of nature" are exact formulations of how nature really works. As noted above in section "The Phenomenological Critique of Formalism" regarding Husserl's third critique of formalism, since the dawn of modernity and the 'mathematisation' of nature, the consequence of the *application* of both Euclidian and analytic geometry in physics has been the *ontological* interpretation of this

"portentous" mathematical instrument as depicting nature "in itself", which has given rise in turn to the popular view that the laws of nature are exact. Yet for Husserl this view entails an error and a *μετάβασις εἰς ἄλλο γένος*; indeed, he contends that Newton was wrong when he said "*hypotheses non fingo*" (Husserl 1970b: 42 [41]). The laws of nature *themselves* are not exact; what are exact are the mathematical *eide* or forms, and their respective laws. But these have only a *methodological* and *hypothetical* – not an *ontological* – significance regarding nature.

In *Ideas* I, Husserl also contrasts two sorts of exact "ideal" concepts or entities: "material" and "formal" (Husserl 1983: 26–27) – the heirs of the former distinction between "authentic" and "inauthentic" concepts – to which correspond two distinct cognitive processes. Thus, the *eide* of Euclidian geometry are distinct from those of the "*formal-ontological* disciplines, which, besides formal logic in the narrower sense, embrace the other disciplines of the *mathesis universalis* (including arithmetic, pure analysis, the theory of multiplicities)" (Husserl 1983: 18). As noted, formal entities are "devoid of content", whereas *material eidetic disciplines* such as Euclidean geometry are regional ontologies of physical nature, upon which are founded the physical sciences themselves: "*Every factual science* (experiential science) *has essential theoretical foundations in eidetic ontologies*" (Husserl 1983: 19). So the following strata of objectivities are distinct, yet connected: *real* or individual entities, "material" *eide*, and finally "formal" entities.

The cognitive intuitive process that leads from *individuals* to *species*, namely, to the material and synthetic region (e.g. from the 'drawn' triangle to the 'essence triangle' and to the 'spatial figure'), is *generalisation*; whereas the inverse process leading from the ideal to the real sphere is called *specialisation* (Husserl 1983: 26). The symbolic process leading from synthetic *eide* to "formal, analytic, universalities" and consisting in an "emptying of content" is called *formalisation*, whereas the inverse process of "filling out" the empty *formal categories* with content is termed *materialisation* (Husserl 1983: 22, 26–27). Formalisation, as noted, can occur not on the basis of morphological *eide*, which belong to descriptive sciences, such as phenomenology itself (Husserl 1983: 141), but only on the basis of *exact eide*, such as those of Euclidean geometry or other nomological sciences, whence emerges the *form of multiplicity in a pregnant sense*.

In his 1936 text on 'The Origin of Geometry',[17] Husserl describes these complex processes as occurring historically, generatively and intersubjectively in the life-world, from the time of the first geometers in Ancient Greece down to the modern mathematisation of nature with Galileo (Husserl 1970a). According to Husserl, geometric "ideal objectivities" are "discovered" by geometers, who *interpret* them, thereby "constituting" their "meanings" and fixing them in linguistic predications, which in turn gives rise to geometric *science*. In other words, it is by means of "linguistic expressions", by geometrical propositions constituted throughout history, especially by written language (ideal *meanings* and their sensible *bodies*), that

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[17] German edition: Husserl 1954a.

geometry's *objective* truths become manifest. Indeed, only by means of semiotic, sensuous elements do ideal meanings become *fixed* and *sedimented*, thereby acquiring their objective *stability*, which allows their reactivation in new, spontaneous, cognitive acts, as well as their iteration and intersubjective transmission throughout the generations (Husserl 1970a: 358 [369]). Every cultural production is marked by a similar *historicity*, from its "original constitution of meaning" on (Husserl 1970a: 371 [380]). Geometry's "history of meaning" started with "idealizing abstractions" that were based on observed *reality*. The first geometers initially faced perceptual and empirical forms and magnitudes in the surrounding natural world, besides such "secondary" qualities as colour, temperature, weight, hardness and impenetrability (Husserl 1970a: 376 [384]). Based on those measurable, more or less perfect forms, contours, and surfaces, inductive generalisations or vague abstractions were carried out, which led to the imperfect circular figure (or morphological *eidos*). Thus, in Ancient Greece, the new "theoretical attitude" introduced a new type of *subjective-cognitive theoretical activity*: "a spiritual idealizing activity...that...creates 'ideal objectivities'", such as the absolutely perfect, spherical, "limit-ideal" figure of 360 ° (or exact *eidos*) (Husserl 1970a: 377 [384–385]). Such ideal objectivity was transmitted and reproduced with unconditioned universality throughout history down to Galileo as a "cultural acquisition" by means of written language. When reactivated in the Renaissance, it underwent a "transformation": the introduction of algebra enabled the formalisation of Euclidean geometry, which yielded analytic geometry.

So on Husserl's view, the "crisis of European sciences and humanity" is due not to the "application" of analytic geometry to the physical world but to the "shift in meaning" whereby it is *concealed* and *forgotten* that mathematical disciplines are only powerful "methods" and ingenious "hypotheses" *constructed by finite human beings*, not *ontological* descriptions regarding a supposed reality "such as God sees it in itself". It is forgotten that the "ultimate source of meaning" of such a hypothetical method is the fruit of an idealising abstraction – a *subjective activity* whereby its origin is found in pre-predicative experiences occurring in the "life-world" that initially are entirely *passive* (Husserl 1970b: 48–53 [48–54]). To this initial contingency is added the vicissitude of a "secondary passivity", which stems from the historical sedimentation of original evidences as they are generatively transmitted throughout history, and which brings about the aforementioned crisis of European sciences and humanity.

The Genealogy of Logic

The essential *limit* of the right and legitimacy of logical principles is none other than the limit of experience. The acknowledgment of that limit is none other than the "realization of its *critique*" (Husserl 1969: §§73–80, emphasis added).

As noted above, from 1890 to the end of his life, Husserl maintained that mathematical concepts and their analytic predications were to be traced back to

pre-predicative experiences, through a series of interpretative acts of "inductive generalization", "idealizing abstraction" and finally "formalization".

In accord with these early notions, his posthumous work, *Experience and Judgment*, also indicates that "every predicative evidence must be ultimately founded on the evidence of experience", so that "the task of elucidating" the "origin of predicative judgment" in "pre-predicative evidence", as well as that of clarifying the latter's origin "in experience", is "the task of the *retrogression to the world* as the universal ground of all particular experiences, . . .immediately pre-given and prior to all logical functions". This task, the "genealogy of logic", is carried out by means of a "*retrogression to the 'life-world'*" (Husserl 1973: 41, emphasis added).[18]

Experience, in its widest and primary sense, is thus the evident experience of individual objects. Our first judgments or predications, *sensu stricto* "experiential judgments", deal with individuals. But every *judgment* or predication is preceded by the "evident givenness" or *experience* of those same individuals.[19] This pre-predicative experience is the point of departure of every judicative, predicative or linguistic inquiry. Objects are always pre-given to us with certainty before we ever act cognitively on them. "Passive pre-givenness" prior to every apprehension is pure "affection", which is never an isolated act of an isolated object, but rather is given within a surrounding context or horizon. This passive, pre-given horizon is the "*world* [that] always precedes cognitive activity as its universal ground, and this means first of all a ground of universal passive belief in being which is presupposed by every particular cognitive operation" (Husserl 1973: 30 [24]). Husserl had previously named this "passive belief" the "general thesis of the natural attitude" (Husserl 1983: §30). So the "belief in the certainty" that the world as a whole "is there" precedes not only every judicative activity but also every lived *praxis* (Husserl 1973: 30 [25]).

Furthermore, regarding every object, "*every experience has its own horizon*", namely, its core of immediate effective determinations, and its possible and potential background of new experiences and determinations that are pre-figured in its actual core. Thus, all of the experiences dealing with "the same" correlate are synthetically and open-endedly related. These horizons may be "internal" (referred to the essential properties of the respective types of things and their possible variations (Husserl 1973: 31–32 [27–28]) or "external" (referred to "co-given objects" in the experience of every particular thing). This is "immediately true for the world of simple, sensuous experience, for pure nature", but it also holds "for human and animal subjects, . . .for products of culture, useful things, works of art, and the like" (Husserl 1973: 33–34 [29]). "Everything mundane participates in

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[18] German edition: Husserl 1985 [1938]: 38. Henceforth cited with English and [German] page references, respectively.

[19] See the title of §6: 'Experience as Self-evidence of Individual Objects. Theory of Pre-predicative Experience as the First Part of the Genetic Theory of Judgment' (Husserl 1973: 27 [21]).

nature" (Husserl 1973: 34 [29]), asserts Husserl, though this may be misconstrued in a positivistic way. Hence, the *world* is the spatio-temporal, universal and open horizon that encompasses every conceivable reality – the actually known, as well as the unknown though potentially known. It is a horizon of known ("filled") and unknown ("empty") – or still "undetermined" – determinations that the course of experience may eventually fill out. Thus, every particular experience contains a "*transcendence of meaning*" whereby it "is relative to the continuously anticipated potentiality of possible new individual realities" (Husserl 1973: 34 [30]). And on this basis Husserl says that "*the structure of the known and the unknown* is a *fundamental structure of world-consciousness*" (Husserl 1973: 37 [33]).

This is how pre-predicative experience is acquired. The fields of perception that always pertain to conscious life and are apprehended as "unities of a 'possible experience'" are "*possible substrates of cognitive activities*" but are themselves given against a pre-given background that affects us *passively* (Husserl 1973: 37 [34]). To talk about an "object in general" always *presupposes* the *familiarity* with "something in particular". However, meaning-constituting activities do not begin with judgments.

Indeed, pre-predicative *perceptual experiences* are *active* apprehensions of things 'as such and such'. They presuppose, as noted above, the *passive* background of an affective pre-givenness of the world, a *passive* genesis, whence emerge the first associative articulations that passively pre-constitute meaning. However, judgment rests on active pre-predicative experiences, and not directly on passive experiences: "The object of judgment is bound by the fact that it is a something in general, i.e., something identical in the unity of our experience, and hence such that it must be accessible to objective self-evidence within the unity of experience" (Husserl 1973: 39 [36]). The life-world, as horizon, is thus the experiential background of traditional logic, which is also remotely related to modern logics (Husserl 1973: 40 [37]).[20]

The Transcendental Relativity of Evidence to the Life-World and Ultimate Self-Responsibility

Husserl's concepts of *meaning-constitution* and *evidence* are intimately related. Evidence is the constitution of *validated* or *legitimated* meanings, namely, those found in knowledge in a pregnant sense: "Every rightness comes from evidence, therefore from our transcendental subjectivity itself; every imaginable adequation originates as our verification, is our synthesis, has in us its ultimate transcendental basis" (Husserl 1960: 60).[21] Evidence is founded on intuition, which is never an isolated, immediate, or instantaneous experience.

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[20] See also: Husserl 1969: §92a, 102.

[21] German edition: Husserl 1950: 95. Henceforth cited with German page reference, which is included in the margins of the translation.

The 'syntheses' to which Husserl refers in this context are twofold: a "synthesis of coincidence" from the noetic viewpoint, and a "synthesis of identification" from the noematic one. These are syntheses that develop within the all-embracing or "universal synthesis of transcendental time", thus in a process of increasing fulfillment (Husserl 1960: §18). Different types of lived experience, whether positional or *quasi*-positional, such as acts of imagining, have different modalities of *making evident*. Furthermore, evidence also embraces position-takings pertaining to practical and evaluative reason, which are also *expressed* or *known* in doxical acts (see Bostar 1987: 159). And, as we have seen, predicative evidence and propositional truths are themselves built on pre-predicative experience, intertwining the different levels and dimensions of intentional life (Husserl 1969: 217).

How is the phenomenological concept of *evidence* related to 'truths in themselves'? Evidence is *essentially related* to the *subject's experiences in the lifeworld*. Husserl explains that since experience is a *process*, the *continuum* of identifying syntheses that refer to one and the same thing enables us to acquire the idea of a *permanent* being (Husserl 1960: 96). So *transcendence* is the ideal, infinite *correlate of all our* actual and potential *lived experiences*; and *objective being* is the ideal, infinite, actual and potential *correlate* of *every experience belonging to all subjects in general*.

Husserl's concept of evidence therefore contains a deep *relativity*, though that concept is not marked by skepticism, since it does not exclude the idea of 'truth-in-itself'. Accordingly, he asks:

> But what if truth is an *idea*, lying at infinity? ...What if each and *every* truth about reality [*reale Wahrheit*], whether it be the everyday truth of practical life or the truth of even the most highly developed sciences conceivable, remains involved in *relativities* by virtue of its essence, and normatively relatable to "*regulative ideas*"? ...What if the relativity of truth and its evidence, and the infinitely distant, ideal, absolute truth, which is beyond all relativity, each has its legitimacy and each demands the other? (Husserl 1969: 245)

In fact, the notions of 'truth in itself' criticised by skeptical relativists and naturalistic psychologists, on the one side, as well as thematised by logical absolutists, on the other, prove to be two sides of the same coin: "mutual bugbears that knock each other down and come to life again like the figures in a Punch and Judy show" (Husserl 1969: 246).

Husserl's concept of evidence implies, then, a 'teleological truth in itself' correlative to a 'transcendental relativism' that necessarily relates it to human *self-responsibility*. The correlates of truth-in-itself and being in-itself are thus teleological, open-ended *syntheses* of experience, of *actual* and *potential* experiences of the same objects along with pre- and co-intentions. The *horizonal* character of evidence points to the *perspectivism* involved in our world experience. The world *transcends* consciousness, of course, though it is itself "*an infinite idea, related to infinities of harmoniously combinable experiences – an idea that is the correlate of the idea of a perfect experiential evidence,* a complete synthesis of possible experiences" (Husserl 1960: 97). Hence, the "idea of truth-in-itself" is "not a dispensable invention", but rather reveals "in an ultimately responsible manner" the *historicity* involved in this "new sort of scientific thinking"; namely, how the

"in-itself" of the "objective world" is given to "the subject and the communities of subjects...as the subjectively relative valid world with particular experiential content and as a world which...takes on ever new transformations of meaning" (Husserl 1970b: 337 [270–271]), in indefinite, open-ended and ever-renewed asymptotic approaches.

This finally leads us to the self-responsibility of the radical scientific philosopher bent on the resolution of "all conceivable problems in philosophy", in an ongoing teleological process of infinite tasks. Indeed, by questioning back "into the ultimately conceivable presuppositions of knowledge", which are the fertile profundities of experience, the radical scientific philosopher lays bare the ultimate, *responsible* causes for the meaning and validity of being, and the "ultimate foundations" of philosophy.

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