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The Crisis of the Form. The Paradox of Modern Logic and its Meaning for Phenomenology

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Abstract
The goal of this paper is to provide an account of the role played by logic in the context of what Husserl names the "crisis of European sciences." Presupposing the analyses offered in the *Krisis*, I look at *Formale und Transzendentale Logik* to demonstrate that the crisis of logic stems from the deviation of its original meaning as a "theory of science" and from its restriction to a mere "theoretical technique." Through a comparison between Aristotelian syllogistic and modern logic, I show why the modern discovery of the purely formal dimension of knowledge which makes possible such a mathematical technization is a positive achievement that hinders at the same time the disclosure of the truly philosophical nature of logic. The correct appraisal of this ambiguous phenomenon will explain why the rise of modern logic represents a decisive challenge for the success of Husserl's late phenomenological project.

1 Introduction

Although Husserl's most complete and rhetorically effective characterization of the "*Krisis*" of the European sciences is to be found in his celebrated last, and unfinished, work, its original, possibly vaguer, conception stretches back to the beginnings of his philosophical research. To be sure, the whole question is shaped at this final stage in a new way, and the narrative is made very powerful because of the focus on one single science (physics) according to one operation of its theoretical development (the so-called "mathematization" of the natural world) through the lens of one key figure (Galileo). As decisive as this event may be for the constitution of "modern consciousness," Husserl stresses nonetheless that all the epistemological enigmas that are originated by it and that determine the current "critical" situation do not only

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concern physics, but every other positive science, and thus puts into question the possibility of a truly philosophical knowledge overall.

The goal of this paper is to assess the role of logic in the general framework of the crisis. The question is motivated, and its answer is guided, by two important assumptions.[1] The first, more theoretical assumption is related to Husserl's belief that modern physics is in crisis insofar as it has become a *mathematized* science, that is, a science that for the first time has successfully applied the exact method of modern mathematics to determine a relevant portion of natural phenomena.[2] Despite a few significant pages devoted to it in § 9f, however, Husserl mainly treats formal disciplines (namely, logic and pure mathematics) according to the methodical import that they provide for physics and geometry, but not as autonomous sciences. This might be surprising if we realize that the original step for the new kind of rationalism that determined Galilean physics was primarily driven by mathematics, and by "the immense change of meaning [*gewaltige Sinnwandlung*] whereby *universal* tasks were set […] – tasks of a style which was new in principle, unknown to the ancients" (Husserl, 1970, 21). Husserl mentions the beginnings of algebra, the mathematics of continua, and analytic geometry as major examples of the "actual discovery and actual conquest of the infinite mathematical horizons" (1970, 22). All these results are, in his eyes, collected in the authentic idea of formal logic that only takes shape with the tentative unfolding of a *mathesis universalis* during his time (1970. 45). Being the *telos* of the process of formalization itself that began with Vieta, the role of formal logic (in Husserl's wide sense which also includes formal mathematics) appears then to be decisive in relation to the epistemological enigmas that define for him modern thought.

The second, more historical assumption regards the *continuity* of Husserl's philosophy in relation to the diagnosis that he provides for the deficiencies of positive sciences.[3] Thus, despite the absence of a specific treatment of logic in the *Krisis*, it is legitimate to look at his previous texts explicitly devoted to the nature of formal sciences to find some clues. In particular, I shall show that even though the crisis-narrative was not emphasized, we find in *Formale und Transzendentale Logik* (henceforth: *FTL*) many ideas that will be presupposed or developed in the later text.[4]

[1] I won't discuss these assumptions in depth in this text for reasons of space. See on this point Baratelli (2022).

[2] As Burt Hopkins puts it, "the 'breakdown' of science and the consequent crisis situation of European humanity" is grounded in Husserl's "experience of the unintelligibility of the 'completely universal formalization' to which the instinctive and unreflective praxis of theorizing begun in Galileo's day leads" (2011, 86).

[3] As Emiliano Trizio argues, "neither Husserl's interest in the history of philosophy and science, nor his disaffection with the present state of Western culture are new. The expression 'crisis of the sciences' is, if anything, exploited by Husserl to highlight the connection between these two themes on the one hand, and Husserl's life-long struggle to characterize the insufficiency and incompleteness of positive sciences, on the other" (2016, 192).

[4] As Dieter Lohmar has suggested, *FTL* (especially its second part) may be read as a kind of general introduction to Husserl's subsequent works: "Sowohl die zu diesem Zeitpunkt fast fertig konzipierte deutsche Fassung der *Cartesianischen Meditationen* als auch die prinzipiellen Linien der *Krisis* werden neben den Grundgedanken von *Erfahrung und Urteil* entfaltet. Man könnte also ebenso behaupten, der

This analysis, I maintain, will show what is peculiar in the "crisis of logic," and why it is of special import for the realization of Husserl's late phenomenological project.

2 The Paradox of a Crisis of Logic

Let us focus first on the Introduction to *FTL*. If looked at retrospectively from the standpoint of the *Krisis*, this is a highly significant text for understanding the phenomenological method as well as the crisis itself. The interest lies in the fact that Husserl addresses the science of logic in a way that is in many respects reminiscent of the more detailed examination of mathematical physics in the *Krisis*. Even though the structure of the philosophical critique of logic, based on the dichotomy between logic as a theoretical technique and as *Wissenschaftslehre*, does not fit *pariter* the case of physics, three common features in the two discussions can be nonetheless singled out. In fact, Husserl higlights:

1) The reduction of logic to a theoretical technique. This entails the loss of its authentic epistemological task. Namely, "instead of keeping its eye unfalteringly on its historical vocation [*historischen Beruf*] and developing as the pure and universal theory of science [*Wissenschaftslehre*], logic itself became a special science [*Spezialwissenschaft*]" (1969, 4);[5]
2) the modern character of this technization, insofar as, despite the "*radical defect of historically existing logic*," this situation concerns "modern logic in particular" (1969, 14), which has witnessed "a remarkable reversal" of the "original relationship between logic and science" (1969, 2);[6]
3) the possibility to restore logic's "final sense [*Zwecksinn*]" via "radical considerations [*radikaler Erwägungen*]" (1969, 4). This is made possible by the "essentially identical core [*Kerngehalt*] of unrelinquishable content" (1969, 8) which determines the threatened continuity of its history.[7]

II. Abschnitt von *Formale und Transzendentale Logik* sei eine Einleitung in die drei letzten Hauptwerke Husserls" (2000, 10).

[5] Accordingly, Husserl will say in the *Krisis* that because sciences underwent to "the transformation of a formation of meaning which was originally vital [*Verwandlung ursprünglich ledendiger Sinnbildung*], or rather of the originally vital consciousness of the task which gives rise to the methods, each with its special sense," they got detached from the "*historical meaning of their primal establishment*": "this is precisely what has been lost through a science which is given as a tradition and which has become a τέχνη" (1970, 56–57).

[6] Compare this with the case of geometry in the *Krisis*: "ancient geometry was, in its way a τέχνη" (1970, 49). Yet, "without the actually developed capacity for reactivating the original activities contained within its fundamental concepts, i.e., without the 'what' and the 'how' of its prescientific materials, geometry would be a tradition empty of meaning […]. Unfortunately, however, this is our situation, and that of the whole modern age" (1970, 366).

[7] Similarly, in the *Krisis* Husserl remarks that "we understand [geometry's] persisting manner of being: it is not only a mobile forward process from one set of acquisitions to another but a continuous synthesis in which all acquisitions maintain their validity, all make up a totality such that, at every present stage, the total acquisition is, so to speak, the total premise for the acquisitions of the new level. […]. The same thing is true of every science" (1970, 355). Therefore, "a theoretical task and achievement like that of a natural science (or any science of the world) – […] – can only be and remain meaningful in a true and

Moreover, both in *FTL* and in the *Krisis* the critical appraisal of the contemporary condition of given sciences works as a premise to justify the *need* of the subsequent phenomenological investigation. Despite the strong similarity, though, the situation is not entirely the same. Not *every* consequence that can be drawn for the phenomenological inquiry from the case of physics corresponds to those drawn from logic. This is the case because of the *exceptional* role that logic plays, according to Husserl, in the overall architecture of scientific knowledge.

First, logic is essentially twofold. In this phase of Husserl's philosophy, the term "logic" can mean two very different, albeit related, things. It can either refer to the "theory of science" (*Wissenschaftslehre*) or to logic as a positive discipline. The former concept, inspired by Bolzano rather than by the idealistic tradition,[8] means to capture the theoretical task of "the clear theoretical explicating of the genuine sense of all science as such" (1969, 9). In other words, it is the inquiry concerning the conditions of possibility of science in general, that makes a science genuinely "scientific."[9] This is the broad and authentic sense of the term "logic" whose discovery Husserl ascribes to Plato and Aristotle. Its status is clearly meta-scientific. Consequently, logic should not be limited to the science of correct inferences. This latter goal strongly restricts logic's scope and tends to emphasize the calculatory-algorithmic character of the discipline, which runs the risk of being reduced to a theoretical technique. Even if this outcome is shared with all the other sciences, the case of logic is much more dangerous since it does not only indicate the lack of the epistemological grounding determining its authentic scientificity but also entails the *impossibility* of providing such grounding. Because logic as *Wissenschaftslehre* is, for Husserl, the only answer to overcome this incompleteness, *its crisis encapsulates the crisis of European sciences overall*.

Second, the crisis of logic is exceptional also because the role played by formalization in it is different under an important respect. In fact, contrary to material disciplines such as geometry, in which the algebraic treatment of idealities can be interpreted as threatening the integrity of their original meaning, the complete formalization of logic cannot.[10] This is the case because *logic is defined by its formality*. For formalization does not imply a dangerous application of extraneous methods to its subject, but rather it represents the disclosure of its inner nature. Logic does not lose but *realizes itself* in formalization. The fact that logic is in crisis *notwithstanding the absence of an original material phase* demonstrates that the problem with formalization should not be interpreted in terms of the original-derivative schema.

original sense *if* the scientist has developed in himself the ability to *inquire back* into the *original meaning* of all his meaning-structures and methods" (1970, 56).

[8] On the Bolzanian roots of this conception, see the first chapter in Bucci (2000).

[9] This definition can of course be meant in many ways. For a detailed reconstruction of its various strata in Husserl, see Cavallaro (2022).

[10] As Husserl writes in the *Krisis*: "The arithmetization of geometry leads almost automatically, in a certain way, to the emptying of its meaning. The actually spatiotemporal idealities, as they are presented firsthand [*originär*] in geometrical thinking under the common rubric of 'pure intuitions,' are transformed, so to speak, into pure numerical configurations, into algebraic structures. In algebraic calculation, one lets the geometric signification recede into the background as a matter of course, indeed drops it altogether; one calculates, remembering only at the end that the numbers signify magnitudes" (1970, 44).

The crisis does not lie in formalization as a possible distortive process of an original meaning whose truth can be only preserved in material, pre-formalized, knowledge. It is not, in other terms, a necessary evil that has to be forcibly accepted when it cannot be completely ostracized by scientific discourse. For Husserl, it reveals something essential. The crisis of modern (i.e., algebraic-formal) logic opens up the possibility of addressing the real issue at stake, which is the question of the *formal qua formal* – and not the formal as opposed to the (supposedly original) region of the material.

It is important to stress that these two aspects that make the position of logic exceptional within the general frame of the crisis of European sciences are not as disjointed as they appear to be. They are rather two sides of the same coin. The possibility of the institution of a *Wissenschaftslehre*, and thus the overcoming of the crisis, *requires* the understanding of the proper sense of the formal. As Husserl states in *FTL* (§ 80):

> The chief reason why logic is incapable of satisfying the idea of a genuine theory of science – that is: incapable of actually sufficing as a norm for all sciences – is that its formal universalities [*formalen Allgemeinheiten*] stand in need of the intentional criticism [*intentionale Kritik*] that prescribes the sense and limits of their fruitful application. (1969, 208)

Thus, the achievement of the formal universality of logic is a *necessary* (*but not sufficient*) *condition* for the establishment of an authentic theory of science. This is not something trivial, insofar as the fulfillment of this condition, as we shall see, is only attained through the *modern* formalization of logic.[11] The unfolding of the formal dimension is sufficient for the development of a successful positive science producing objective results, but it still demands a phenomenological investigation to complete and transform it into a true theory of science.[12]

If what I have said so far is correct, modern logic embodies a critical paradox representing a decisive challenge for phenomenology. On the one hand, modern formalization elicits a technization of the discipline which tends to conceal its original sense, that is, "the ideal of genuine science that was vitally operative in the sciences from the time of Plato" (1969, 3–4). On the other, it discloses that condition whose absence precluded Plato and Aristotle themselves from carrying out their projects. *The tragic situation of modern logic is that it has forgotten its sense as a theory of science while having finally reached the possibility of its authentic accomplishment*. The phenomenological task of pursuing a "radical sense-investigation [*radikale Besinnung*]" should be correctly located at this junction. It is understood as an

[11] This is why Aristotle's seminal try of the constitution of a pure syllogistic logic is necessarily partial: "Though the specific sense of its formalness may have remained undifferentiated [*mochte auch der spezifische Sinn des Formalen unabgehoben bleiben*], this formal logic was, according to its sense, the first historical attempt at a universal theory of science, a theory relating to the essential conditions for any possible science whatever" (1969, 8).

[12] Husserl stresses again this point in the Introduction to *FTL*: "An *independently developed logic* of ideal signification-formations [*idealen Bedeutungsgebilde*] is just as unphilosophic as any other positive science; it lacks in itself that originary genuineness [*Ursprungsechtheit*] by virtue of which it might achieve ultimate self-understanding and self-justification" (1969, 13).

"*original sense-explication* [*ursprüngliche Sinnesauslegung*], which converts (…) the sense in the mode of an unclear meaning into the sense in the mode of full clarity or essential possibility" (1969, 9). Specifically, it has to be interpreted as the conversion of the formal from its restricted, technical, and symbolical meaning (useful to empower calculating methods and to produce positive results) to its proper sense at the core of the theory of science, as it was conceived before its modern abdication. This is not an anti-modern, reactionary move, but rather an attempt to consciously bring modern science to its ultimate stage. The starting point is in fact formal logic as it has been transmitted up to now. This spiritual product is *inquired back* and not passively accepted. Since we had so far only theoretical techniques, the proper sense of logic and of the other sciences is not already there, somewhat implicit, but it must be "created" from, not superimposed to, the actual practices and operations of scientists: "So far as positive sciences already exist as historical facts, they are projects, claims [*Entwürfe*, *Ansprüche*]; as such they are *clues* [*Leitfäden*] to guide transcendental researches, the aim of which is to create [*schaffen*] sciences for the very first time as genuine" (1969, 14). This "new beginning" coincides nevertheless with the restoration of the continuity of meaning of the entire scientific tradition, finally liberated from the obscurities derived from its passive sedimentation.

3 Modern Logic Between Philosophy and Mathematics

It is useful now to focus more closely on Husserl's relationship with "modern logic." Despite the great interest that he devoted to the topic in many university courses before and after 1900, his views have always been to a certain extent foreign to the mainstream discussions flourishing in that period around the so-called *Grundlagenkrise* of mathematics. Arguably, this is partially due to the missed acknowledgment of the philosophical relevance of some of the great technical contributions of the time,[13] and to his intellectual debt towards authors whose work had marginal, if any, influence on the constitution of this science in the 20th century – notably, Franz Brentano.[14]

There are, however, also substantial reasons that justify his outsider position. Already in the *Prolegomena* Husserl theorized a fundamental "division of labor" between mathematicians and philosophers. According to this viewpoint, "the mathematician is not really the pure theoretician, but only the ingenious technician, the constructor, as it were, who, looking merely to formal interconnections, builds up his

[13] Commenting Husserl's 1902/03 lectures on logic, Mark Van Atten has remarked that "while Husserl, unlike most of his contemporaries, gave ample and serious attention to Frege's foundations of arithmetic, he virtually ignored Frege's theory of judgment" (2005, 146).

[14] Although Brentano shared with Frege a critical attitude towards the traditional Aristotelian theory of predication, he nevertheless did not base his argument on the alleged logical virtues of a symbolic language. Brentano is instead a great critique of the algebraization of logic: "la dénonciation d'un manque de fondement théorique de certains développements formels retenus pour leur seules vertus algorithmiques (…) traduit en fait, dans le chef de Brentano, une prise de position nette quant à la secondarité de l'expression linguistique par rapport aux actes de représentation, de jugement et d'inférence qui constituent, selon lui, l'essentiel de la logique" (Leclercq, 2017, 576). As we shall see, Husserl (who attended Brentano's 1884-85 lectures on logic in Vienna) will retain some aspects of this attitude.

theory like a technical work of art" (2000, 159). The philosopher instead "does not seek to meddle in the work of the specialist but to achieve insight in regard to the sense and essence of his achievements as regards method and manner" (2000, 159). The two tasks are clearly complementary but, to a notable extent, independent of one another. The mathematician can manage to produce and technically master theories without a clear insight into the essence of theoretical objects and methods. The philosopher, in turn, has to start with a reflection on the doctrines of their time but does not need to take them as a *Faktum*, since the aim is a presuppositionless reflection concerning the principles that make science in general possible – and not simply of the theories accepted in a given time.

Now, since the entire development of modern logic is seen by Husserl as the progressive implementation and refinement of algebraic methods beyond the domain of "quantity," he deems the technical achievements so produced external to the proper philosophical analysis. Husserl's general critique addressed to the great figures engaged in this project (from Boole to Frege) is always the same: they are great mathematicians, but bad philosophers.[15] One might say: they are engineers of logical thinking whose lack of philosophical awareness does not hinder the efficient discovery of new algorithmic methods to deal with concepts and propositions. This effort is of course praiseworthy, inasmuch as philosophical reflection is not expunged, and the meaning of logic is not exchanged for its computational power. But this is, as we know, Husserl's worry. Therefore, the rich philosophical-mathematical debate to which he was contemporary, so dependent upon the interpretation of the impressive technical results of "logistics," together with the emergence of the antinomies of set theory and related disciplines, might have been easily judged as not sufficiently radical to give an appropriate response to the real issue. The sense of the *Krisis* hinted at by Husserl, I might sum up, is much deeper than that implicit in the debates over the *Krise* of mathematics.[16] Accordingly, the impasse encountered by the exact sciences cannot be solved technically, through some kind of ingenious method that practically excludes paradoxes understood as mere obstacles to the capacities of calculation. For Husserl, the solution requires something more: *in primis*, the adequate understanding of the actual *philosophical* question behind them; *in secundis*, an authentically new philosophical logic leading to a *Wissenschaftslehre*.

The radicality of Husserl's project is revealed by the fact that he puts into question the *modern process of mathematization itself* which is presupposed by all the attempts to deal algorithmically with any type of object. At this level, philosophical reflection has been in his view lagging behind. After Leibniz's initial stage, in which mathematics and philosophy cooperated to produce the revolutionary idea of a *mathesis universalis*, the successive tradition has lost this unity and instead privileged the endless improvement of mathematical method over a serious philosophical reflection on the essence of the fundamental concepts involved. With respect to mathematical

[15] For example, Husserl said that "Boole himself did not have an entirely clear conception of the reasons for the validity of his method. In his case we are dealing with a brilliant intuition rather than with a conceptual insight. The logical principles of the calculatorial method remained completely precluded to him as well as to later researchers" (2001, 322–323).

[16] This is not to say of course that Husserl ignored such a debate and that he did not engage himself in more technical issues, see Hill and Da Silva (2013), Leclercq (2015), and Fraisopi (2018).

logic, Husserl believes that philosophers have generally renounced giving an account of the *possibility* of a successful mathematization of logic and have preferred to simply refuse in principle the legitimacy of the project. Despite a few exceptions (such as Bolzano and Lotze), this attitude has often resulted in the attempt to defend the Aristotelian temple of syllogistic against the profane mathematical, and thus supposedly anti-philosophical attack. But this tendency misses the real point. As we shall see in the next section, it is meaningless for Husserl to deny the applicability of any calculatory method to logic since it is a simple *fact* that we do calculate with concepts and propositions just like we do with numbers and magnitudes. Rejecting the mathematical treatment of logic would be as absurd as rejecting the calculus with ciphers by invoking the betrayal of the inner nature of numbers perpetrated by the decimal system. Unfortunately for those philosophers, this alleged nature allows numbers and logical entities to be symbolically governed by a calculus – and it is at this point that a philosophical interrogation has to be placed. Fortunately, though, mathematicians have pursued their duty without caring about the illusionary Pillars of Hercules set by philosophers. As Husserl concludes: "The genius of mathematics was right, as always, about the matters at issue, even though its logical self-understanding was faulty" (1969, 94).

4 The Concept of the Formal and the Critique of Extensionalism

What does the genius of mathematics teach us in modernity? The fact that there is an *essential unity* that binds syllogistic (apophantic logic) and formal mathematics together. This unity is *de facto* attested by the possibility of the employment of the same algorithmic methods in the two disciplines:

> The methodically perfect development of this [Aristotelian] analysis […] necessarily leads to a formal apophantic 'mathematics': once anyone has become acquainted with deductive technique, as practiced in modern mathematics and mathematical analysis generally, he must see forthwith (as Leibniz was the first to see) that proposition-forms [*Satzformen*] can be treated in the very same manner and that one can 'calculate' [*rechnen*] with them, just as one can with numbers, quantities, and the like – nay more, that this is the one manner in which a universal theory of propositions (as essentially a deductive theory) can be built. (1969, 76)

In this respect, Husserl's understanding is very close to Frege's and to the other mathematical logicians. This does not amount to saying that his view can be identified with "logicism," and thus with the project of a "reduction" of mathematical truths to logical principles. Although the attempt is in itself legitimate, it might be misleading if it exchanges the *technical* elaboration that it requires with a *philosophical* clarification of formal mathematics.[17] Moreover, it is imprecise to equate the thesis of the

[17] As Mirja Hartimo clarifies: "Frege's logical construction uses a formal method, which Husserl believes is not the proper method with which to evaluate the essence of mathematics. At best, it is able to produce

unity of logic and mathematics to the quite different statement that mathematics is *reducible to* logic, as it is in the Fregean tradition, or vice versa, that logic is reducible to mathematics. In Husserl's view, it is not a question of the priority of one discipline over the other. Apophantic logic and mathematics are rather united in virtue of *the common process of algebraization* to which both were subjected in modernity and which leads to the disclosure of their authentic, *properly formal*, dimension. It is then this "formal" character that must be elucidated by a radical philosophy, and not simply presupposed by a naïve theorization.

The goal assigned to philosophy is very challenging because the *modern* notion of "form" is for Husserl a *concept of a new genre*. By combining his previous philosophical conclusions with a historical frame mainly inspired by Oskar Becker's *Mathematische Existenz*,[18] he highlights the exceptional traits of this concept by stressing its difference with respect to ancient conceptions. As Becker suggests (1973, 263), while the Platonic εἶδος and the Peripatetic μορφή are still dependent on a kind of mathematics that never exceeds the geometrical boundaries rooted in the intuitions of sensuously idealized figures, the modern concept of the formal reaches a further "abstract" dimension that makes it both *uneidetic* and *amorphic*.[19] But then, what kind of "concept" is it?

Husserl finds in the radical break with ancient metaphysics the reason for the evasiveness of the formal to any consistent clarification. Instead of considering it on a new basis, the concept has been read through the familiar lens of tradition as the "genus" of the highest kind. A typical example of this misunderstanding is offered by modern logicians' extensionalistic self-interpretation of their own practice – a theory against which Husserl devoted an important part of his early research in the philosophy of mathematics, and that it is succinctly recalled in § 23b of *FTL*. In the 1891 review of Schröder's book on the algebra of logic, Husserl already criticized the understanding of the discipline as a "calculus of classes," in which the variables of the calculus were interpreted as signs denoting the "extension" (*Umfang*) of concepts. On this view, logic and mathematics end up being embraced by a single concept, that of "class," as it encompasses both extensions of concepts and "collectivities" which make up numbers.[20] This is deceptive, Husserl argues, because an *Umfangslogik* is only *one* possible interpretation (and even a derivative one)[21] among the infinite many admitted by the same deductive calculus. As he points out, "the best confutation of Schröder's argument is provided by the following fact: exactly in the same sense in which so-called extensional logic is a valid theory, also a 'logic of

ingenious formal translations, but it would not yield the kind of insight that philosophy is after. […]. Using the mathematical method to give foundations for mathematics is circular" (2021, 52–53).

[18] See Gérard (2008).

[19] As Becker claims: "dieser Begriff der Form ist der Antike ganz fremd. Er steht in geradem Gegensatz zur anschaulichen Gestalt, worauf die Worte εἶδος und μορφή gehen" (1973, 259).

[20] As Husserl remarks, "classes themselves are nothing other than collectivities, and only insofar as they are collectivities does the calculus consider them. Indeed, this is so far true that the calculus in its *general* conception is to be designed as a general calculus of collectivities, from which the class calculus proceeds only by means of the special interpretation of the collectivities as extensions of concepts" (1994, 63).

[21] In fact, "an *Umfangslogik* cannot be erected without considering the corresponding relations between concept-contents, while the opposite is well possible" (Centrone & Minari, 2017, 141).

ideal contents' can be erected, by means of a technique, which is identical with that of the former" (1994, 66). That amounts to saying that the "validity" (*Gültigkeit*) of the calculus should not be grounded in one allegedly fundamental domain defined by a single concept—in Schröder's case that of "class." This leads to hiding the "equivocal" and purely relational nature of the formal by reconducting it to a determinate "genus." But it is precisely this "equivocity" that should be accounted for.

Husserl observes that "when one asks for the all-embracing concept [*Universalbegriff*] that should delimit the unitary province of these disciplines [i.e., logic and mathematics], one is perplexed" (1969, 77). The lesson that he got from his failed project of the *Philosophie der Arithmetik* is that there is none.[22] Apophantic logic and mathematics are not sciences that study a specific object belonging to the same genus. Rather, they are united because they are *formal* "in the sense of having as fundamental concepts certain *derivative formations of anything-whatever* [*Ableitungsgestalten des Etwas-überhaupt*]" (1969, 77). Their common "domain" is *not* determined by a genus but is the "empty universe" [*Leeruniversum*] in which anything in general has to be judged "with a formal universality that, on principle, leaves out of consideration every material determination of objects" (1969, 77).[23]

Having this in mind, I now turn to Husserl's idea of modern logic by comparing it to the ancient Greek, pre-algebraic, understanding.[24]

5 The Incompleteness Of Ancient Science

Let's start by enumerating the reasons why the Greeks did not reach the formal unity of logic and mathematics. Husserl gives three historical explanations to account for this defect.

[22] As Claudio Majolino puts it, after the *Philosophie der Arithmetik*, for Husserl "il est inutile de chercher dans les numérations les concepts 'propres' sur lesquels bâtir l'ensemble de l'arithmétique générale. Car *l'arithmétique est une science foncièrement équivoque*. Son unité n'est pas à chercher dans le rapport à l'unité d'un *concept*, elle se fonde uniquement sur l'unité d'un algorithme : à savoir sur une unité de *structure*" (2006, 104).

[23] It would be interesting at this point to consider other conceptions of formal logic besides the algebraic extensionalistic one, for example those expressed in Frege's, Peirce's, and Hilbert's works, and see how each position should be interpreted in light of Husserl's general understanding. Besides some occasional remarks, Husserl does not engage himself in such a detailed investigation, and it seems that in the later phase of his life, he is not even interested in it. There are arguably accidental reasons for that, but I assume that it ultimately depends on the cardinal distinction between technique and philosophical clarification: no matter how mathematically sophisticated a certain logic is, it will remain essentially defective. In this respect, I agree with what Leclercq (2019) has claimed about mathematics: Husserl's ultimate goal is not to propose a technical reform of formal sciences assuring the *certainty* of their results, but rather to *elucidate* the origin of their basic concepts and the inner meaning of their operations.

[24] My emphasis on the "unity" of logic and mathematics does not imply that they are "identical." In fact, they are directed towards, respectively, the apophantic sphere (forms of judgments) and the ontological sphere (forms of objects). Husserl speaks of "bilaterality" (*Doppelseitigkeit*) to characterize their essential connection and spends a lot of effort in *FTL* trying to show it as an *a priori* correlation. I will not pursue a discussion of what distinguishes the two here, as I insist on their formal unity.

1. The "lack of the concept of pure empty form [*Leerform*]" (1969, 80), which means that the Greeks could not distinguish between a material and a purely formal science. Thus, in the case of arithmetic, not even the concept of cardinal number (ἀριθμός) was "emptied of all non-formal material; in the units thought of as counted, it is not yet related to the of the empty anything-whatever [*Etwas-überhaupt*]" (1969, 80). In other words, units of calculation were still taken as *determinate items*, either sensible things or ideal monads, and as such were representable through images (e.g., as groups of points) analogously to geometrical shapes. It is only in modernity that the notion of number is finally formalized, so that the "units" are no more considered as "objects," but rather as *forms of objects*, mere *Etwas* having no content whatsoever. This "emptiness" would explain both the *irrepresentability* of numbers, and so their purely categorial nature, and the *universal applicability* of the act of counting. That is to say, the possibility to count *everything* (see Da Silva, 1999). The same line of thought might be applied *mutatis mutandis* to Greek logic, although this will raise further problems, as we shall see below.
2. The tendency to *objectify* arithmetical-geometrical formations and to *psychologize* logical ones. Thus, while the formers were distinguished from the act of counting and tracing lines, the latter never gained such independent status. This implies that logic could never become a *theoretical* science with its own objective field of idealities, as it was reduced to an ὄργᾰνον or, in modern times, to a deductive technique. This led to the confusion of logical formations (i.e., judgment-contents as ideal meanings) with the subjective act that produces them (i.e., the psychological act of *judging*). The origin of this confusion is traceable, for Husserl, to the peculiar way of givenness of formal objects. Contrary to sensuous objects, they are not given in the "outside world," and *then* subjectively experienced. They "are given *exclusively from inside*, exclusively from spontaneous activities [*spontanen Tätigkeiten*] and *in* them" (1969, 81). Furthermore, contrary to ideal *but material* objectualities, such as geometrical shapes, logical formations lack "the continual support of the sensuous configurations, spatial and temporal, which furnished examples and drew attention to the objective side from the start" (1969, 82). That is, while the geometer can linger on the written signs which make the ideality sensuously imaginable, the logician cannot since formal objectualities are not prone to any imaginative representation.[25] One cannot fix their own thought on external support and one is therefore tempted to take the objective result of this theoretical work as merely subjective formations.
3. The lack of a "serious philosophical exploration of the origin of the concepts fundamental to formal mathematics, precisely as concepts of subjectively constituted formations" (1969, 83). This would have been shown that "judging and counting are closely kindred active spontaneities [*aktive Spontaneitäten*], which constitute their respective ideal correlates, judgments and numbers, in similar

[25] This is a remarkable point since it hints at a fundamental semiotic difference. In fact, formal truths *can* be represented through an algebraic language. But Husserl is saying that algebraic symbols do not "represent" in the same way as lines, points, even words etc. I consider this crucial point in the conclusion.

manners" (1969, 83). Once again, the recognition of this similarity would have led to the understanding of their essential commonality.

These three historical arguments are not only closely connected to each other but also hierarchically organized. They are not equally relevant criteria for the determination of the difference separating ancient and modern logic. In fact, both (2) and (3) are clearly as much ascribable to ancient as to modern science. As far as logical psychologism is concerned, Husserl has devoted plenty of pages to its refutation in each of his published books. In this dispute, the emphasis has been mainly put on the modern (empiricist but even Kantian) versions of the doctrine. He maintains that only Bolzano's theory of the *Sätze an sich* gives us the chance to eliminate this centuries-old mistake from philosophy.

Likewise, the complaint about the overlooking of the role played by subjectivity in the constitution of the objective logical sphere is not only addressed to ancient philosophy but equally, if not with more emphasis, to the objectivistic attitude of modern science and to the entire philosophical tradition (from Descartes to Kant) that was not capable to overcome it on new scientific (albeit not objectivistic) bases. A decisive breakthrough in this direction is made by Brentano's descriptive psychology and thus by the scientific exploration of the intentional nature of the acts of consciousness.

The critical remark raised by (1) can instead be *exclusively* imputed to ancient science. Husserl's assessment of the crisis of modern logic does *not* consist in saying that it *still lacks* the pure concept of the empty form, and that it has thus inherited the same flaws of ancient science, as he does in the other cases. Rather, he tries to show that, although this concept has been implicitly, i.e., *only technically*, developed and exploited for calculation, it has not so far reached a *philosophical* clarification—a circumstance that by the way gives rise to paradoxes even within the mathematical practice.[26] *This* is the decisive transformation that constitutes the modern difference and, at once, its crisis. A further sign that makes it the determinant factor is derived from the fact that Husserl attributes to himself the first conceptualization of the idea of a "formal ontology" in the *Prolegomena* (even though he did not refer to it with that name at the time), and therefore the achievement of a first philosophical elucidation of the formal (1969, 86). Bolzano's farsightedness is not decisive in this respect. Although he defined mathematics as "a science that treats of the universal laws (forms) with which things must accord in their existence" (1969, 85), he never distinguished between material and empty-formal ontology, and in this sense, he never got rid of the Greek ontological chains. Hence, according to Husserl, "Bolzano did not attain the proper concept of the formal, the concept that defines formal ontology, though in a certain manner he touched upon it" (1969, 85).[27]

[26] Husserl remarks that the "sciences that have paradoxes, that operate with fundamental concepts not produced by the work of originary clarification and criticism, are not sciences at all but, with all their ingenious performances, mere theoretical techniques" (1969, 181).

[27] The evaluation of this thesis in historical terms has been given by Benoist (2000).

6 Ancient and Modern Forms

Having assessed the significance of the new concept of "form" in the characterization of modern logic, it is still unclear what this "form" really is. The general negative metaphor of the "emptiness" of the content of logical formations is a good clue to spell it out, but it is certainly not enough to univocally grasp its full meaning, especially once it is compared to the ancient manifestations of the discipline. In fact, Husserl's historical-intentional reconstruction seems to meet a destructive counterexample in Aristotle's logic, which is usually considered as the first successful attempt to establish a *formal* theory of argumentative reasoning. The use of "schematic letters" instead of proper names in the formulation and classification of argumentative patterns in logical and ethical treatises is certainly the most apparent sign that might elicit this conclusion. Husserl himself in the § 12 of *FTL*, tellingly entitled "The discovery of the idea of the pure judgment-form [*Urteilsform*]," credits "Aristotelian analytics" as the "first commencement [*erster Anhieb*] of a logic of theoretical formations" (1969, 48). Still, his characterization is extremely ambiguous. Although he concedes that it was "a *'formal' logic in a particular sense* [*in einem besonderen Sinn*]," he is forced to say, according to (1) of the previous section, that "it did not attain the full purity and breadth [*Reinheit und Weite*] prescribed by its essence" (1969, 48). What does it mean? How can a formal logic be less "formal" than another one?

Aristotle is indeed a pivotal figure, and although I think that the ambiguity within Husserl's conceptualization cannot be dissolved, Husserl's understanding of Aristotle's achievements and, above all, shortcomings is key to getting an insight into the novelty characteristic of logic in modernity. My conjecture is precisely that the latter can be only made clear *by contrast*, that is, through a zigzag movement from ancient to modern times inspired by the methodical indications sketched in the famous § 9l of the *Krisis*. In this "circle," the clarification of the present condition of logic is reflected back to the beginnings of this tradition: the enigma of the formal goes hand in hand with the disentanglement of *Husserl's* Aristotle. For this purpose, I suggest taking two closely related passages belonging to the same § 12 as footholds for the inquiry.[28]

First passage:

> Aristotle was the first, we may say, to execute in the *apophantic* sphere – the sphere of assertive statements ("judgments" in the sense expressed by the word in traditional logic) – that "formalization" or algebraization which makes its appearance in modern algebra with Vieta and distinguishes subsequent formal 'analysis' from all material mathematical disciplines (geometry, mechanics, and the rest). (1969, 48)

[28] What follows is not meant to be a contribution in the history of logic. It is rather an attempt to form a coherent set of hypotheses out of Husserl's own, apparently inconsistent, elaboration to single out the *theoretical* problem of the formal dimension of knowledge. I leave to historians the task of judging whether this account has some historical interest or not.

Second passage:

> To be sure, in Aristotle the variability of the terms is not completely free, and consequently the idea of form is not quite pure: since, as a matter of course, Aristotle relates his analytics to the real world [*auf die reale Welt bezieht*] and, in so doing, has not yet excluded from his analytics the categories of reality. For modern thinkers it was the emergence of algebra [*der Durchbruch der Algebra*] that made possible for the first time the advance to a purely formal logic. (1969, 49)

6.1 Aristotle's Alleged "Algebraization"

Despite the relative simplicity, the first text already borders on contradiction. Husserl claims, on the one hand, that Aristotle was the first to "formalize" or "algebraize" judgments, and, on the other, that this very operation was first possible only in modernity (Vieta being a mathematician who wrote at the end of the 16th century). Should we interpret this in the sense that Aristotle somehow foreruns algebraic thinking? Husserl goes on to say that Aristotle "substituted algebraic letters [*algebraische Buchstaben*] for the words (terms) indicating the material" in determinate statements taken as examples. This is not, to be sure, a mere syntactic operation, since "as concerning the sense, this implied that he substituted the moment 'anything whatever' [*beliebiges Etwas*] for each materially filled 'core' [*Kern*] in the judgments, while the remaining judgment-moments were held fast as moments of form" (1969, 48–49).

Given this definition, Husserl seems to identify *prima facie* the Aristotelian "formalization" of judgments with that of arithmetical sentences which gave rise to equations. That is, he interprets the denotative role of letters in a typical judgment-form of the *Prior Analytics* such as "All M are A" as equivalent to those that make up a symbolic expression in modern algebra such as "a+b=b=a", where "a" and "b" are not even constrained in the domain of numbers but vary in the empty domain of the something-in-general.

Now, this view is not only historically dubitable – in substance, but also terminologically, "algebra" being an Arabic word referring to quite different practices – but even inconsistent with Husserl's own account of the difference between ancient and modern exact science. The problem is that, despite the assumption of such a historical distinction, Aristotle's schematic letters are difficult to be grasped outside an "algebraic," and thus modern, conceptualization. We encounter here the well-known tendency to project into the past the categories and beliefs of the present in order to make it understandable and, in a way, similar to us. This tendency, let's call it "anachronism," is widespread but, I believe, is especially strong in the domain of exact sciences, where the "ideality" of their formations is often matched with the concept of "atemporality." It follows from this unwarranted conceptual alliance the idea that, after their original establishment, those sciences cannot but evolve through

a linear progression, simply accumulating new results that, so to speak, lie on the same immutable layer.[29]

6.2 From Syllogistic to Modern Logic and Back

Thanks to his interest in the question of time and historicity starting from the early 1920s and to the influence of the well-trained historian of mathematics Oskar Becker, Husserl avoided a one-sided reading of ancient theories. As we saw, instead of focusing exclusively on the similarities with traditional syllogistic, he looked for the *difference* that made modern logic what it is now. If we look carefully, both passages that I quoted point to a difference of this kind. In the first one, the nuanced critique of Aristotelian logic seems to depend on its incompleteness, that is, on the fact that Aristotle limited himself to the elaboration of a formal theory of judgments (apophantic) without reaching the concept of a formal ontology. It would miss here the grip on reality. In the second, Husserl blames instead the unnecessary *Weltbezogenheit* of logic as the source of its failure to achieve the authentic concept of the formal. In this case, the culprit would be an excessive commitment to external ontological constraints.

This seeming contradiction is solved by disambiguating the notion of "ontology." A *formal* ontology is not a theory of the existing world, but rather of the *formal conditions* that every possible world must satisfy in order to be "actual." It is a general theory of world-forms, and it is thus in principle indifferent to the specific features of the existing one. A *metaphysical* ontology is, on the contrary, a material theory which discloses the fundamental properties and internal relations that constitute the material conditions of our world. Thus, Aristotle's ontology is "metaphysical" (and not formal) because "if the first principles of being as such are nothing but the first principles of being in the sense of reality, then Aristotle's categories […] are nothing but the most general concepts by means of which reality qua reality is structured, experienced, and cognized" (Majolino, 2022, 498). It deals with the "essential categories of reality (thing, property, real relation, real whole, real part, cause and effect, real genus and species, etc.)" which are "a foundation and prerequisite for any further knowledge of reality" (Husserl, 2008, 108). Matter, in the second case, is not yet excluded from consideration and it is in turn dependent upon the more fundamental *formal a priori*.[30] Once this distinction is made, it is no more inconsistent to say that, to get to a genuine *formal* ontology, logic has to be independent of the "real world," and thus immune to any influence of a material ontology. In this light, I propose to unpack Husserl's dense line of thought in the second text as follows:

- Aristotle's logic is related to the real world,
- Therefore, it has not yet excluded the categories of reality,

[29] This anachronistic attitude is exemplified by Jan Lukasiewicz in his classic *Aristotle's Syllogistic from the Standpoint of Modern Formal Logic* (1951) in which Aristotle's schematic letters and the variables of modern logic are identified without a second thought.

[30] In the 1906/07 lectures on logic and theory of knowledge, Husserl summarized the difference as follows: "By formal logic, we could understand the science that is related to categories of form, and, on the other hand, by real logic, the science that is related to categories of matter determined by form, to the specifically metaphysical categories" (2008, 108).

- Therefore, the variability of the terms is not completely free,
- Therefore, the idea of form is not quite pure.

To understand the "impurity" of the Aristotelian form the argument can be reversed. Given what I have argued above, the notion of "variability" cannot be understood as if Aristotle already had the concept of formal ontology at his disposal, and for some odd prejudices, he chose to limit the range of his variables over a determinate set of it, namely that made up by existing entities. This implies that modern logicians would have simply extended the domains over which the very same *x* can vary up to the "universal domain" including anything whatsoever. This story cannot be true because Husserl's point is precisely that Aristotle *lacked* this concept. For modern logicians accomplished something *authentically new*, even though they did not recognize it.

The limitation of variability must therefore be understood otherwise. Now, assuming with Husserl that it becomes fully free only with algebraic thinking, we must look at the moment of its origin to perceive the novelty. As he claims, "the genuine discovery of the formal was first made, at the beginning of the modern age, by way of Vieta's establishment of algebra – that is to say, by way of the reduction of the theory of numbers and quantities to a deductive technique [*deduktive Technisierung*]" (1969, 80). The innovation consists in encompassing *two heterogeneous* domains of objects through the same "deductive technique" (i.e., using the same valid algorithms for both). The variability is then *free from the respective fundamental concepts* – in this case, "cardinal number" and "magnitude" – that define arithmetic and geometry. The "objects" are thus considered independently of any essential property, as "objects in general" (*Denkobjekten*) exclusively defined by their axiomatic relations and prone to calculatory techniques. A *new* formal "domain" emerges – which is rather the common *form* of the arithmetical and geometrical domains – and is then studied according to its formal dimension. That is to say, disregarding the *categories of reality* under which the objects originally fall. [31]

This result shows that the absolute "freedom" of the variability of the *x* is obtained through the liberation from the "categories of reality" which have traditionally determined the definition of entities. This is how the formal domain is "extracted" from the material and becomes an *autonomous* field of study. We can finally see why the "limitation" in the variability of terms that hindered Aristotle's logic is not merely "external," as if it involves the *number* of domains subjected to variation. It is instead "internal," in the sense that its "objects" are still materially determined. For example, in the proto-symbolic expression "All M are A," "M" and "A" always indicate a *determinate* universal, say, "man" and "animal." They are not *empty variables* referring to an autonomous formal-ontological sphere – variables that are possibly filled by an argument – but rather *abbreviations of words* whose meaning is provisionally

[31] This leads, through the formal consideration of "multiplicities" of objects as such, to the fundamental notion of "definite multiplicity" (*definite Mannigfaltigkeit*), which represents the final stage of this development. As Lohmar explains, "Husserl versteht die Eigenschaft der Definitheit eines Axiomsensystems bzw. einer Mannigfaltigkeit als ein verborgenes Ideal der Axiomatisierung. Sie zeichnet für Husserl den prägnanten Begriff einer Mannigfaltigkeit aus. Eine definite Mannigfaltigkeit ist ein Gebiet, für das es die Einheit einer theoretischen Erklärung gibt, d.h., jede in diesem Gebiet gültige Wahrheit ist eine Folge der Axiome" (2000, 80).

covered but explicatable at any moment. To be as clear as possible, in pre-algebraic logic, there is always a definite answer to the question "what is 'M'?". In modern logic, instead, to "what is *x*?" we can say nothing but "*Etwas-überhaupt.*" In this sense, there are no *Denkobjekten* in Aristotle's ontology, general objects devoid of any properties, but only individuals ("primary substances") and universals ("secondary substances") that are essentially characterized. This is dictated by Aristotle's own metaphysics and theory of knowledge, according to which to "know" means to *define* entities within the genus-species hierarchy. Hence, despite the first establishment of a theory of syllogisms to categorize general patterns of arguments, he remained bound to the metaphysics of genus and species, and he did not fully separate the formal and its new kind of generality from it. As Jacob Klein has argued (1968), there is no contradiction in this: the generality of the *procedure* that is necessary for the demonstration of a geometrical theorem in Greek mathematics does not entail the generality of the *object* (which is in fact always a determinate figure, an imperfect image of the ideal object).[32] The same goes *mutatis mutandis* for logic: the generality of the syllogistic figures does not correspond, as we have seen, to the formal generality of the objects. It is only modern logic that completes and transforms Aristotle's logic through the removal of his metaphysical commitments and the development of a formal ontology becomes possible.

7 Conclusion

What is special about modern logic is that it has achieved that *symbolic separation* which is both a blessing and a challenge for a "theory of science." It involves, on the one hand, the separation of the formal (apophantic and ontological) domain from any material connotation traditionally set by the genus-species dichotomy. On the other hand, it indicates the separation of symbols from "language." Namely, algebraic signs lose their original meaning (e.g., as number-signs) to acquire a "formal" meaning. For example, the sign "+" in the discipline of highest logical generality, the *Mannigfaltigkeitslehre*, "is not the sign of numerical addition but the sign of any connection whatever for which laws of the form 'a+b=b+a', and so forth, hold good" (1969, 91). This allows a "free creation" of forms of deductive systems and multiplicities, under the satisfaction of the logical norms (especially, the principle of non-contradiction), and correspondingly a multiplication of valid calculi.

The paradox embodied by modern logic is that this separation has been *technically* achieved, but not understood. Thus, for instance, Bernhard Riemann is considered to have paved the way to the *Mannigfaltigkeitslehre* because of the treatment of "*system-forms themselves as mathematical objects*" (1969, 93). His success is due to the fact that in this way it did *not* obey "the rules for differentiating the species of a genus [*nach Gattung und Art*] according to the Aristotelian tradition (such a differentiat-

[32] According to Klein, "ancient mathematics is characterized precisely by a tension between method and object. The objects in question (geometric figures and curves, their relations, proportions of commensurable and incommensurable geometric magnitudes, numbers, ratios) give the inquiry its direction, for they are both its point of departure and its end" (1968, 122).

ing being meaningless here), but rather in conformity with the formal-mathematical superordinations and subordinations [*Über- und Unterordnungen*] that present themselves in the province of the formal" (1969, 93).

This liberation of the chains of metaphysics through technization vanishes once philosophical thinking is demanded to conceptualize the inner sense of it. There is here the tendency of assimilating the formal, which is a concept of a new genre, to the traditional genus-species coordinates set by the Platonic-Aristotelian conceptuality. This is not only the effect of a comprehensible human inadequacy in adapting categories in a completely new epistemic horizon. This is instead implicit in the movement of algebraization, especially in the *symbolic separation* that it provokes. Husserl underlines in particular the "danger of becoming lost in an excessive symbolism [*in einem übersteigernden Symbolismus*]" which "has greatly hindered uncovering the properly logical sense of the new formal mathematics" (1969, 98).

Here is where I think the emphasis should be put. *Symbols are taken as something they are not, as they hide or misrepresent the categorial difference between matter and form*. Because formal objectualities, which are in principle irrepresentable, are somehow embodied in an exact symbolism and thus become the objects of a deductive method, they run the risk to succumb to this technization. That is, the fascination with symbols and the possibility of using them without an inner understanding of their sense prompts one to rest at this symbolic level without further inquiry into the pre-symbolic roots of such knowledge. A purely mathematical logic can be content with this. A philosophical logic demands instead to go beyond the symbolic stratum which governs the logic of non-contradiction to implement a "logic of truth" which takes into account the *material* origin of logical meanings. This original sphere of truth reminding of the primary experience is easily overlooked by the formal logician because the success and precision of his practice precisely depend on the more or less successful *removal* of any material elements that threaten the purity of the logical principles. His interest is in fact "directed one-sidedly to the syntactical" and to the "algebraizing of the cores as theoretical irrelevancies, as empty somethings that need only be kept identical" (1969, 218).

The philosopher acknowledges this danger and deactivates the seduction of symbols and formalization by focusing on what the mathematician avoids and tends to see as a pre-logical, and therefore merely subjective, dimension, which would damage the purity of his theorizing. The open world *prior to* any formalization is the source of any further knowledge, so that any higher scientific theory cannot be but traced back to it. In this field, it is *essential* to what is then made *indifferent* by the operation of algebraization. Here everything has to do with anything else according to a kind of normativity that refers to the structure of experience without being alien to logic. The logic of truth starts where mathematical logic ends:

formal-logical considerations and theory, with their focusing on what is Objective [*objektiven Einstellung*], have nothing to say about that; but every one of their logical forms, with their *S*'s and *p*'s, with all the literal symbols [*Buchstabensymbolen*] occurring in the unity of a formal nexus [*formalen Zusammenhanges*], *tacitly presuppose* that, in this nexus, *S, p*, and so forth, *have "something to do with each other" materially*. (1969, 219)

This dimension is disclosed only when the "logic of truth" goes *beyond* symbols and neutralizes the deceptive consequences of the symbolic separation. This step is the required link that completes formal logic and restores its meaning in the direction of a *Wissenschaftslehre*.

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