The Austrian author Hermann Broch (1886-1951) is best known for his literary works. The discipline which, according to his own asseveration, represented both his first love, as well as the field in which his true talent lay, was, however, mathematics. This paper investigates the place, role and function of mathematics, particularly the Philosophy of Mathematics, within Broch’s broader epistemological thought before the background of the mathematical Grundlagenkrise “foundational crisis” of the early 20th Century. I suggest that Broch’s view of mathematics must be read within the context of his position between idealism and positivism, that his concept of mathematics made it an ideal tool for exploring the conditions and possibilities of human Erkenntnis “knowledge/cognition”, and that this was reflected within the creative process of his literary work.

Keywords: Hermann Broch, Philosophy of Mathematics, Erkenntnis, idealism, positivism, intuition, Logos, structural identity

1 Introduction

To many minds, literature and mathematics are most likely the ultimate antitheses. This is probably never more the case than when one considers the pair under such aspects as knowledge, truth and form. Mathematics is often seen as a source of indubitable fact, deduced through pure logic, whereas the poetic spirit has access to spheres of human experience inaccessible to analytic reasoning. Mathematics uses a relatively small set of symbols, while literature has the whole scope of language at its command. Yet it is precisely under the aspect of knowledge, truth and form that I am seeking an interface between the two disciplines by which to discuss the role of mathematics in literature in the twentieth century.

It is important to take a quick look at the historical background. Toward the end of the nineteenth century the triumph of the scientific worldview seemed all but complete. Newton’s laws of mechanics in particular appeared to describe the world we lived in with such precision and accuracy that it seemed only a matter of time until every aspect of the material world at least could be explained and, ultimately, controlled. Almost a hundred years earlier this mechanical, deterministic worldview had reached what can perhaps be called its pinnacle in the (in)famous ‘Demon’ of the French philosopher, physicist and mathematician Pierre Simon Marquis de Laplace. Laplace’s conviction was that, given sufficient data in regard to the position and impulse of all the molecules in
the universe, any and all future events could be predicted with unconditional exactitude. Thus, when the young Max Planck matriculated at the University of Munich in the year 1874, he was advised to study music instead of physics, as in the former new discoveries were still possible, whereas in physics there was nothing truly new to be discovered.

Planck, of course, did choose physics and went on to develop the quantum concept of light, something which was to be the beginning of a process which was to shake the notion of an immaculately determined world in its foundations, and change the scientific worldview forever. The work of men like Niels Bohr, Werner Heisenberg, Albert Einstein, to name but a few, while not negating Newton’s mechanics, made them, so to speak, a Grenzfall “an exceptional case” within the new theory (Heisenberg 119). The ways in which we conceive of such fundamental concepts as matter, space and time were to radically change. Equally, the question of what and how much we can know was raised anew and cast in new light. The breakdown of causality within the quantum mechanics, for instance, fundamentally challenged the concept of complete and absolute knowledge (Heisenberg 141-149).

This revolution in what seemed the most certain of sciences was paralleled by similar developments within the field of mathematics. At the end of the nineteenth century, the different disciplines within mathematics, which for most of its history had each been founded on independent axioms, had been unified by Cantor’s group theory, based in turn upon Frege’s predicate logic. The interface of science, mathematics and philosophy was dominated by the empiricists and logical positivists in the field of science, best represented perhaps by the Wiener Kreis “Vienna Circle”, to which belonged names like Moritz Schlick, Rudolf Carnap and, for a while, Ludwig Wittgenstein. One of the vital principles of their doctrine was the stipulation that everything was to be dismissed as meaningless which could not be formulated precisely and non-contradictorily. Mathematics, as the language of pure logic, was to be a vital tool to this end.

At the beginning of the twentieth century, however, the concept of the infallibility of mathematics was shaken in its foundations. Bertrand Russell’s famous discovery in 1901 of the principally unresolvable antimonies within group theory can be seen as the beginning of the so-called Grundlagenkrise “foundational crisis” of mathematics. As the author Robert Musil puts it: the mathematicians suddenly discovered that the whole construction was built on air (Musil 1006). This problem was exponentially compounded by the formulation of Ernst Gödel’s incompleteness theorems in 1930 which state (put simply) that no axiomatic system can be simultaneously complete

1 Unless otherwise indicated, all translations are by the author.
and non-contradictory. Suddenly, mathematics found itself in the position of having to justify its claim to truth.

A number of different schools of thought developed in the attempt to put mathematics back on a sure footing. Each was based on completely different views of the nature of mathematics, the ontic status of mathematical objects, and the basis on which a mathematical statement can be defined as ‘true’.

These can be divided into two main schools: Mathematical realism conceives of mathematics as a reflection of the empirical world. Mathematical statements are true because they reflect relationships which exist independently of the human mind. In other words, mathematics is ‘discovered’, not ‘invented’. Logicism equally views mathematical truths as a priori necessities, and this is so because they are expressions of necessary logical structures. The structures are, however, not located in the empirical world, but are reflections of the structures of human consciousness.

On the opposite side of the spectrum, formalism and intuitionism both reject the notion of any mathematical reality; both define mathematics as purely human constructions, but disagree on the conditions which a statement must meet to be defined as true.

These issues are in fact nothing new, but go back to the birth of European civilisation. For Plato, mathematical reasoning was insight into the absolutely necessary and unchangeable. Both arithmetic and geometrical objects were ideal Forms, existing independently of empirical manifestations. Mathematical truths were not contingent on human apprehension, let alone construction. Conversely, for Aristotle mathematical qualities were attributes, abstracted from the empirical objects. Both views are based, not only on different concepts of the nature of mathematics, but on completely conflicting views of the nature of the world and the nature of man’s cognition of it.

These issues have still today not been entirely resolved, despite the fact that mathematics is used daily to perform feats as complex as sending satellites out of our solar system, something which famously led Eugene Wigner to write of *The Unreasonable Effectiveness of Mathematics in the Natural Sciences* in 1960.

Thus my research is based on a certain number of ‘axioms’:

- There is no one single definition of mathematics, just as there is no one theory of mathematics or even one discipline of mathematics.
- The tendency in much of literary research to view the role of mathematics and mathematical concepts in literature simply as representatives of ‘pure logic’, ‘analytic reason’ or ‘the ability to make precise statements’ is, while not entirely untrue, (I do not mean to negate the significance of reason, logic or precision for mathematics) to a certain extent an over-simplification and a reduction.
- Mathematical ‘truths’ are not necessarily self-evident.
Questions of the foundations of mathematics (the Philosophy of Mathematics) are also questions about both the nature of the world and the means by which we recognise it. Both scientific and mathematic worldviews in the twentieth-century can to a certain extent be characterised by the loss of their claim to absolute certainty.

Within the same timeframe as these developments, twentieth-century novelists, poets and playwrights also questioned the fundamental nature of their art. New perspectives were developed on aesthetic theory, new means of poetic expression and new forms were sought. Questions of the purpose, consequence and vocation of art were raised anew. To a certain extent the issues of form and purpose went hand in hand. The question of how art is to represent reality, for instance, is contingent upon the question of whether it is (or should be) its calling to do so. Similarly, the question of form and purpose can also be formulated in terms of the question of to what extent art, and literature in particular, is capable of either presenting or representing knowledge or truth.

Of these writers, I am investigating three. These are Robert Musil (1880-1942), Hermann Broch (1886-1951) and Friedrich Dürrenmatt (1921-1990). These authors all share what I would think of as two distinguishing characteristics. The first is a fascination with, and at least a certain degree of proficiency in, mathematics. Both their literary and theoretical writings are permeated with allusions to mathematical concepts, mathematical analogies and even (at times extended) passages discussing mathematical issues, as well as the nature of mathematics itself. This has, of course, not remained unnoticed by research, but has not, I believe, been fully contextualised or interpreted. Research devoted specifically to mathematics in the works of these authors has tended to focus solely on analysing the mathematics themselves, or, at best, linking them with a single aspect of the corresponding author’s thought, whereas in the rest of research, the mathematical content is either completely ignored or largely interpreted in an oversimplified manner. This last tendency, I would argue, stems from the tendency mentioned above to reduce mathematics to being the representative solely of precise, analytic reasoning.

The second trait shared by these three writers is that each one in one way or another refers to literature (in particular their own) as the search for knowledge or truth. Correspondingly, one of the principal aspects of their reflections on aesthetics, poetics and literary theory is the question of the potential of art and literature to present, or more fundamentally, represent or be knowledge or truth.

In this paper I would like to present some of my findings to date in regard to Hermann Broch.

2 Hermann Broch

The Austrian novelist Hermann Broch (1886-1951) is best known for his literary works such as The Sleepwalkers and The Death of Vergil. Also very famous is Hannah Arendt’s epitaph of the Dichter
wider Willen “poet against his will”. Another expression one frequently encounters in research is that of the Poeta Doktus (Jens 209). For Paul Michael Lützeler, no other novelist of the 20th century was to such extent a theorist (10). His interests and abilities ranged from such heterogeneous fields as philosophy and politics, to economic theory and ethics. The discipline which, according to his own asseveration, represented both his first love, as well as the field in which his true talent lay, was mathematics. He calls himself “in principle a mathematician” (Broch GW10: 317). Broch studied philosophy, mathematics and physics at the University of Vienna in two separate stints (1904-1905 and 1925-1930). Among his teachers were such famous representatives of the so-called “Vienna Circle” as Moritz Schlick, Rudolf Carnap and Hans Hahn. Broch’s critical position toward the precepts of this school, as well as the effects of the Grundlagenkrise “foundational crisis” of mathematics, permeates a large part of his writings.

A substantial part of Broch’s work dealing directly with mathematics has been lost, confiscated and destroyed by the Nazis after his flight from Austria shortly before the beginning of the Second World War, work consisting of thousands of pages which he himself considered irreplaceable and hoped would constitute a major contribution to modern mathematics (Broch 1999: 95). Mathematical excurses are, however, distributed throughout his many essays, including those dealing with the nature of literature and art. I argue that the significance of these passages cannot be appreciated when they are viewed in isolation, since they play a pivotal role in the formation of his thought. As Broch puts it: To view mathematics as a lonely island of deduction within our Gesamtdenken “the whole of our thought” is nonsense (Broch GW7: 177). At the same time he calls the separation of science and arts the declaration of bankruptcy of modernity (35). For Broch, scientific and artistic Erkenntnis were branches of the same stem, that of Erkenntnis in general (88).

The term Erkenntnis is probably the most important in all of Broch’s writings. In English this is translated alternatively as knowledge, perception, cognition, insight or recognition. The vital point in interpreting Broch is that for him the term means all of these at once. For this reason I will continue to use the German word throughout this paper. For Broch, Erkenntnis is the highest value and primary principle. It is also the ethical calling of art. Very rightly, Karl Menges recognises that for Broch literature in its essential function was never synonymous with merely subjective imagination (4). Repeatedly, Broch expresses his distaste for what he calls Geschichtel-Erzählen “telling ‘little stories’” (Broch GW8: 184). The notion of ‘l’art pour l’art’ was a hell into which art had strayed and from which it was to be rescued (Broch GW6: 208). His own concept of literature was one in which Kitsch does not represent the harmlessly trivial, but rather absolute evil.2 Above

2 In this paper I will use the word ‘literature’ for the German word Dichtung.
and beyond this, it was Broch’s conviction that it was literature’s vocation to be, rather than to present, *Erkenntnis*.

### 3 Broch and Mathematics in Research

Much of the research dealing with the significance of mathematics for Broch is dedicated chiefly to the somewhat controversial question of the actual quality of Broch’s self-attributed mathematical competence (of how good he really was). In this regard, completely contrary positions have been adopted. In the chapter of his book *Mathematische Spuren in der Literatur* dedicated to Hermann Broch, Knut Radbruch accredits the author with both comprehensive and specific mathematical knowledge. A number of examples from Broch’s theoretical work are provided, but Radbruch concentrates on the novel *Die Unbekannte Größe*. With reference to this work, he writes that a complete understanding of the text requires an intimate knowledge of a considerable number of terms, as well as insights which can only be acquired during the study of mathematics. Radbruch determines that detailed knowledge of both older works (such as Crelle’s *Journal für die reine und angewandte Mathematik* from the year 1826), as well as important aspects of the mathematical discourse of Broch’s own time (such as the works of Lorenz and Weyl, or the at times polemical debate on the status and significance of infinitely large and small numbers) are directly embedded into the novel (159).

In his doctoral thesis titled *Symbolism, Mathematics and Monism: Contextual Studies in Herman Broch*, submitted in the year 1979 at Yale University, Willy Riemer offers a contextual analysis of non-literary concepts in the writings of Broch. In chapter three of the dissertation, Riemer identifies mathematics as an area deserving particular attention, stating that “allusions in his essays and fictional work to mathematical concepts and issues” have traditionally “carried little weight in Broch research, except as literary oddities” (112). Although he admits that Broch’s unusual professional education makes it difficult to evaluate the author’s competence as a mathematician, it is precisely this task to which a large part of his investigations are dedicated. To this end he has painstakingly collected data drawn from the university curriculum of the courses Broch attended at university, as well as Broch’s own notebooks and lecture notes, most of which are archived at Yale University, in order to reconstruct his academic career. The sources he references include course lists from Broch’s longer stint at the University of Vienna (1925-1930), and Broch’s own records and notebooks from the time. His conclusion is that the courses Broch took were mostly introductory (e.g. differential and integral analysis), but that a few dealt with higher mathematics: “The notebooks for the courses by Carnap and Menger in particular indicate exposure to a very advanced treatment of mathematics” (127).
In regard to the mathematical content interspersed throughout Broch’s theoretical writings, he states that “mathematical concepts and arguments inform most of his essays, drafts and fragments”, but downplays their significance, as in his opinion they are merely used as analogies, and are furthermore mostly ill chosen, failing to clarify the concepts they refer to (127). His analysis of Broch’s inquiries into the philosophical and methodological foundations of mathematics comes to a similarly negative conclusion. Broch’s fascination with the subject, as well as the fact that he was at least well-read on the topic, are affirmed, but Riemer disallows:

At the same time it is clear that his investigation of the foundations of mathematics is little more than an historical summary of developments. Broch’s outline of developments in modern mathematics is competent and reveals an interest beyond the classroom requirement, but it adds nothing new. Lacking the technical skill to make a substantial contribution in any branch of mathematics, Broch resorts to generalisations.

(134)

In regard to Broch’s literary work, Riemer establishes that mathematics plays a role in regard to both content and structure (156). What the role of mathematics in terms of structure might be is, however, not further explicated. Riemer’s investigation of the mathematical content in Broch’s literary work is limited to an analysis of a number of passages dealing directly with mathematics in the novel Die Unbekannte Größe, showing that these are drawn from the mathematical discourse of the time by correlating them with specific theories which were under discussion at the time of the novel’s conception.

Riemer’s final conclusions are as follows:

The most remarkable feature of Broch’s life-long fascination with mathematics is its pervasiveness in his work. His early writings […], for example, already reveal a tendency to invoke mathematical concepts. Similarly, the essays and narratives of Broch’s mature years bear the imprint of his interest in mathematics. As I have shown, numerous manuscripts and fragments deal specifically with philosophical problems of mathematics and with mathematical considerations of disciplines such as aesthetics. In his imaginative works as well, mathematics informs both content and structure. […] I would suggest, however, that Broch’s affinity for mathematics was engendered by his propensity for abstraction and by his universalist ambitions. For a would-be philosopher, mathematics would provide a convenient vehicle for considering problems as diverse as aesthetics, cultural decline, and the theory of knowledge.

(167)

It is this last point which, perhaps somewhat surprisingly, Riemer’s investigations largely fail to explore. Most particularly, the work lacks detailed reflection upon Broch’s frequent insistence on the common epistemological roots of all human forms of cognition, or upon the fact that mathematics is repeatedly alluded to in this regard. This concept appears only once within the isolated statement that
“for Broch, mathematics has certain correspondences with the structure of consciousness” (153), without further discussion. As numerous statements by the author document the fact that he assigns the structure of human consciousness a constitutive role for the formation of Erkenntnis (be this of scientific or poetic character), it is somewhat surprising that the link between the two is not further analysed. Riemer arrives at a negative evaluation of the quality of Broch’s mathematical skills. This, it seems, is translated into a depreciation of the role mathematics play in his works.

Probably the fullest recognition of Broch’s mathematical talents can be found in Carsten Könneker’s article Moderne Wissenschaft und moderne Dichtung. Hermann Brochs Beitrag zur Beilegung der ‚Grundlagenkrise’ in der Mathematik, published in 1999. Könneker accredits Broch with “a comprehensive and detailed knowledge of the developments in new, and at that time most recent, mathematics” (331). It was, according to Könneker, in particular the foundational crisis of mathematics which captured the writer’s fascination, motivating him to make a contribution to its remedy (325). In this context, two aspects of Broch’s relationship with mathematics are emphasised. The first is his ever increasing antagonism toward the precepts of positivism as he experienced them during his time at the University of Vienna. The second is the difficulties one experiences in trying to link him with just one of the different schools of Philosophy of Mathematics. In Könneker’s view, the originality of Broch’s thought lies in his refusal to dogmatically accept just one view of the foundations of mathematics. He was much rather striving for a synthesis of the three principal theories of his time (339).

At the other end of the spectrum, in Dagmar Barnouw’s commentary to the at the time newly published volumes Nr. 9/1 and 2 (Kritik and Theorie) of the Kommentierte Ausgabe of Broch’s complete works, published in the Neuer Rundschau, one finds a scathing dismissal, not only of Broch’s mathematical expertise, but of the entirety of his non-literary work. For Barnouw it is characterised by “little expertise”, “conspicuous self-gratification” and a “disregard for the intelligent, critical, spontaneous reader”, to name only a few of the at times polemical aspersions (336-37). Barnouw categorically opposes taking Broch seriously outside of his strictly poetic endeavours (326). Her condemnation of Broch’s theoretical writings, as well as his faculties as a critical thinker, extends to those who would use them to find fruitful approaches to his literary oeuvre. Theodore Ziolkowski’s investigations into the significance of the Theory of Relativity for Broch’s novels, for instance, are dismissed as the “strangest postulations” (332). This censure includes Broch’s mathematical abilities. These are peremptorily dismissed: “Independent mathematical works do not exist” (329). I would, however, suggest that Barnouw’s assessments must be read within the context of her own scientific-theoretical position. Broch’s treatment of mathematics is, for instance to be rejected on principle as he advocates a ‘platonic’, tautological
concept of mathematics which she declares obsolete (330). The principle bone of contention appears to be Broch’s critical stance on empirical positivism, as well as his insistence on the idealistic origins of all philosophy. Barnouw takes an explicit stand in favour of the neo-positivist school.

Whether Broch’s lost mathematical works truly had the quality he himself attributed to them is a question upon which we can ultimately only speculate. There is, however, some evidence that he was perhaps a little optimistic in the evaluation of his own mathematical talent. The fact that mathematics plays an important role in his thought can, however, scarcely be denied. It is not the goal of my research to establish Hermann Broch as an important mathematician, but rather to investigate the place, role and function of mathematics within his broader philosophy and epistemology, and relate this to his literary work.

4 Mathematics and Philosophy

Broch’s entire Geschichtsphilosophie “Philosophy of History” (perhaps most concisely presented in one of his best known essays Zerfall der Werte “disintegration of values”) pivots around the concept of a Schwund des Absoluten “loss of the absolute”. The second half of his autobiography, Autobiographie als Arbeitsprogramm “autobiography as a work-program”, he describes as the “story of a problem” – the problem, again, being the loss of the absolute, something, “the apocalyptical consequences” of which humankind is experiencing today (Broch 1999: 83). The preservation of the absolute is a concept which permeates the entirety of his thought, appearing under many headings and in the form of diverse terminology, be this ‘the Platonic idea’, ‘totality’ or the ‘the unity of Self’. Broch subjects all aspects of modernity to this loss of the absolute – a deficit which has resulted in every segment of modern society laying claim to its own individual ‘absoluteness’. In the Verselbstständigung “becoming autonomous” of fractional spheres of human experience (each with its own particular logic such as ‘business is business’ or ‘war is war’), Broch sees the true malaise of his century. The emancipation of individual streams of scientific disciplines, as well as the lack of communication between the same, is simultaneously a symptom and a catalyst of this development. The charge laid upon modern humanity, whether within the spheres of science or art, is the (re)construction of the absolute. As Karl Menges writes: “The program is clear, the stipulations categorical: the ‘truly philosophical’ Standpunkt ‘viewpoint’ for Broch is the idealistic one, and the undertaking in light of general Entzweiung ‘disseverance/ rupture’ is to found it anew” (15).

Numerous passages in Broch’s writings support this statement (e.g. Broch 1999: 88). Correspondingly, Broch’s criticism of the positivist position is similarly vocal. He even goes so far as to call positivism an integral part of a world which produced Hitler (Broch GW8: 237). On closer inspection, however, his position on positivism is slightly more ambiguous than such statements
would suggest. Roesler-Graichen demonstrates in detail how Broch founds large parts of his epistemology on terminology borrowed from Carnap’s *Der logische Aufbau der Welt*, (e.g. his *Elementarsituationen* and –vorgänge “elementary situations and processes”), while at the same time sparing no pains to distinguish his use of terminology such as ‘intuition’ and ‘experience’ from that of Moritz Schlick (62-68). Broch also explicitly dedicates himself to the “strictly critical methods” of positivism (Broch 1999: 88).

It is between these two poles – (critical) Idealism and (critical) Positivism – that the whole of Broch’s thought rotates. It can be contended that this is also the case for his position on the Philosophy of Mathematics.

In his essay from 1928 *Die sogenannten philosophischen Grundfragen einer empirischen Wissenschaft* “the so-called philosophical fundamental questions of an empirical science”, Broch deals, as the title states, with *Die Stellung der Mathematik zu ihren Grundlagen* “mathematics’ position on its own foundations”. The essay lays no claim to comprehensiveness; the goal is rather, in Broch’s own words, to gain an overview of the relevant problems (Broch KW10/1: 144). Here one finds a summary of the most important developments in the field of mathematics from the mid-nineteenth century onwards, one which Carsten Könneker calls *souverän und trotz ihrer Bündigkeit in der Sache genau* “sovereign and, despite its brevity, precise in content” (331). Among the topics and issues portrayed are the different schools of mathematical thought as represented by David Hilbert’s formalism on the one hand and mathematical logistics on the other, Cantor’s group theory and its antimonies, and the *Stufenlehre* “ramified theory of types” of Bertrand Russell and Hermann Weyl.

Broch’s representation of the different stations mathematics passed through in the seventy odd years preceding the essay is indeed impressive, and his commentary displays insight. As Könneker points out, he refuses to wholly endorse one single school of mathematical thought – it is instead his goal to strive for a synthesis of the three:

> He combined the belief of formalism in a mathematics which can be deductively constructed independent of the empirical world with the intuitionistic concept of the continuum of numbers as well as certain reflections of the logicists on the relationship of logic and mathematics to form his ‘own’ theory.

(339)

The perhaps key word in this respect is that Broch *strove* to create a synthesis of all three. Whether Könneker’s assertion that Broch had managed to develop his own approach to the resolution of the foundational crisis of mathematics is tenable, is a controversial question which cannot be satisfactorily discussed here.
Broch’s original point of departure in this essay is, however, the so-called *irreduziblen Reste* “irreducible rests” which can be identified in every science, but cannot be resolved by means of the science’s particular methods. These appear in two forms: as *sachhaltige* and as *methodologische ‘Reste’* “content-based and methodological ‘rests’” (Broch KV10/1: 131). Science does not generally deal with these ‘rest elements’ itself, but rather delegates them to philosophy. Such elements always possesses *Aprioritätscharakter* “the character of apriority”, something one is accustomed to allocate (if not always rightly) within the sphere of philosophy (132). Thus every particular scientific discipline develops its own specific philosophy (e.g. the Philosophy of History or the Philosophy of Mathematics).

Mathematics is the perfect example of this phenomenon. Mathematics is forced by both its nature and its methods to remain in contact with its foundations and ever reflect upon them anew. Its irreducible rests are not open questions which can be left aside, but a dynamic *Agens* in the ceaseless evolution of its system (ibid). Three examples Broch offers of such irreducible rests are:

1) *metaphysische Fragen der mathematischen Wirklichkeitsgeltung* “metaphysical questions of mathematical ontic status”
2) *methodologische Fragen der Axiomsanalyse* “methodological questions of axiom analysis”
3) *logische Fragen der Infinitesimalprobleme* “logical questions of infinitesimal problems” (132).

Cases in point for the first two questions would be the development of non-Euclidean geometry as a consequence of the verification of the parallel axiom, and the axiomization of probability theory (133). Where Broch moves beyond a mere vademecum of the historical developments in the Philosophy of Mathematics, however, furnishing them with commentary and interpretation, it is chiefly to illustrate his conviction as to how large a degree the progress of the Philosophy of Mathematics has been fueled by its reflection on its own ‘irreducible rests’ (134). Of particular interest in reconstructing Broch’s own personal position within the debate of the first half of the twentieth century is his insistence on both the ‘real’ (ontic) nature of Cantor’s group theory, as well as the “subjective moments” of its “free constructive principles” (138).

For the question of what goals Broch is ultimately pursuing in this essay, it is, however, impossible to ignore its second half: *Die Stellung der Philosophie zu den Grundlagen der Mathematik* “philosophy’s position on the foundations of mathematics”. Here Broch’s ‘initial axiom’ is that both poles of epistemology, positivism and idealism, ultimately share both the same goal and the same *Erkenntnisobjekt* “here: object of perception”. That is to say, both schools of philosophy converge in the fact that both seek to establish an ametaphysical, hypothesis-free theory of epistemology, one in which both reality and perception of reality can only exist on the basis of empirical science (139). Where the two fundamentally diverge is, however, in the determination of
the Erkenntnissubjekt “here: subject of perception/ perceiving subject”. Whereas the Erkenntnissubjekt of idealism is the Self, the positivist, his eyes fixed solely on the world of facts, can acknowledge only one legitimate Erkenntnissubjekt, namely the empirical human being, someone who for idealism can at best act as the subject of psychology (ibid).

Thus the core questions of both schools differ fundamentally. Whereas idealism asks: “In which form is science possible?”, the question for positivism is: “Which knowledge is true to reality?” (ibid). As mentioned above, it is between the antitheses of these two positions that Broch’s own philosophy is located. For positivism it is the Gegenüberstellung von Denken und Wirklichkeit “confrontation of thought and reality”, which has led to a Zwiespalt zwischen Mensch und Welt “schism between humankind and the world”, with which it must continually contend (142). At the same time, Broch refuses to completely adhere to the opposite position – one which recognizes no reality outside of its perception by the human mind.

For Broch most of the (to his time) current theories of mathematics had to be ascribed to the positivist stream, one dedicated to the study of the object, to which the human being (the subject) can at best be appended as a psychological or teleological factor. Thus, at their foundation, one reencounters the problem named above: die Frage nach der Übereinstimmung von Denken und Wirklichkeit “the question of the correspondence/reconciliation of thought and reality” (143).

5 Mathematics and Erkenntnis

Mathematics plays an important role in a wide range of further essays by Hermann Broch, most of which are dedicated to what at first glance may perhaps seem entirely incommensurable topics. This can consist of the scattered use of mathematical terminology or individual mathematical examples, but can also extend to the excurses on mathematics constituting a substantial part, or even the bulk, of the essay. As Hermann Krapoth writes: Broch’s style of both language and thought displays a strong influence of mathematical Denkformen “forms of thought” (2). On the other hand, Karl Menges criticizes his eigentümliche Hochschätzung der Tautologie “peculiar approbation of the tautology” (45), something Broch explicitly defends on mathematical grounds (Broch GW7: 158). Three of the most notable instances of the writings in which mathematics play a pivotal role are Das System als Weltbewältigung “The system as a means of ‘coping with the world’”, Über Syntaktische und Kognitive Einheiten “On syntactic and cognitive units”, and Notizen zu einer Systematischen Ästhetik “Notes on a systematic aesthetic”. Mathematics is vital to understanding his thoughts on music, architecture, language and syntax. These passages do not exhaust themselves in analogies and examples, but rather play an integral part in Broch’s argumentation. It is my contention that Broch’s fascination with mathematics derived to no small part from the fact that his concept of the
possibilities, scope and very nature of the discipline made it an ideal tool to investigate the conditions, limitations and the very nature of human *Erkenntnis*.

As mentioned above, Broch’s investigations into the Philosophy of Mathematics were chiefly dedicated to creating a synthesis of the predominant schools of the time. These occupied a range of positions between the two converse concepts of mathematics which have existed since Greek antiquity: those of mathematics as an ‘invention’ – a purely human construction - and of mathematics as a ‘discovery’ - an empirical reality. It can be argued that it is these two antithetical positions that Broch is trying to reconcile, and that this occurred within the larger framework of the question of the *Übereinstimmung von Denken und Wirklichkeit*.

From the aforementioned essays it is possible to reconstruct the fundamentals of Broch’s Philosophy of Mathematics. Distilled as far as possible it comes to this: mathematics is a mirror of the logical structures of the human mind. Projected by human beings into empirical reality, it there finds its confirmation. Thus in mathematics one finds the unity of perception, the unity of subject and object – ever the goal of idealistic philosophy.

Some of the most important aspects of this are the role of intuition, structural identity, the *Logos*, and unity.

### 5.1 The role of Intuition

‘Intuition’ has been a fundamental principle of Philosophy of Mathematics since the early 20th century. It is also a central concept of Broch’s entire epistemology. A not insignificant portion of the criticism levelled at Broch in regard to his writings on mathematics charges him with using the term wrongly. Broch, however, explicitly distinguishes his concept of intuition from that of the mathematical school of Intuitionism (as it was developed by Weyl and Brouwer). It is of a very different type or, more correctly, of a very different purpose from that with which Intuitionism operates: it is not a constructive element within the system of rational science. Once having been recognized as an essential pre-condition, it does not appear again within a science. It is not an affair of science, but rather one of the scientist; it may be a personal deficiency of the scientist, but disappears along with his person once the work is complete (Broch KW10/1: 143).

Specifically mathematical intuition is for Broch, as Könneker puts it: a mechanism immanent to the human faculty of perception, by means of which a human being can automatically access mathematical forms and relationships, which themselves possess an ideal being (332-33). For Broch there is no progress toward any form of *Erkenntnis* without a form of *Vorwissen* “pre-knowledge” of the unknown, and mathematics is no exception. In this case it is the *Vorwissen um das Unendliche und das Kontinuum, von dem sie [die Mathematik] zum zunehmend komplexer werdenden Aufbau der*
infinit-dimensionalen Vielfalt im Eigenschaftslosen getrieben wird “It is the pre-knowledge of infinity and the continuum which drives the ever increasingly complex development of the infinite-dimensional multifold of ‘that without qualities’” (Broch GW7: 165-66).

In this regard another interesting aspect of Broch’s concept of mathematics which cannot be fully investigated here is the link between mathematics and mysticism. Mysticism in the works of Hermann Broch is a subject to which much research has been devoted, probably never more comprehensively than in Grabowsky-Hotamanidis’ Zur Bedeutung mystischer Denktraditionen im Werk von Hermann Broch. It is common practice to loosely link mathematics and mysticism in respect to Broch (see e.g. “Mathematik des Traums” in Jens, and Weiss). A number of statements by Broch give rise to this. To give but two examples: Broch writes to Stefan Zweig of the beauty of irrationalism and mysticism in mathematics (Broch KW13/1: 391), and in a letter to Ludwig von Ficker one reads that mathematical truth cannot be solely errechnet “calculated/deduced”, but must first be felt (Broch GW10: 252). Much speaks for the hypothesis that, in regard to mathematics at least, mysticism and intuition (das Vorwissen um ein Unbekanntes) can be equated. This would question the concept one often encounters in research that, for Broch, rationality and mysticism are komplementäre Erkenntnisvorgänge “complementary processes of perception”. They would rather be two stages of the same Erkenntnisvorgang. Mysticism would then represent an Erkenntnisansatz “the preliminary stage of perception”.

Broch’s concept of intuition can be further distinguished from that of mathematical Intuitionism by means of the criterion of time. Intuitionism chooses the iterative act of counting as its fundamental starting point. This is, however, inextricably linked with the human experience of time. One of the founders of Intuitionism, L.E.J Brouwer, writes:

First act of intuitionism: Completely separating mathematics from mathematical language and hence from the phenomenon of language described by theoretical logic, recognizing that intuitionist mathematics is an essentially languageless activity of the mind having its origin in the perception of a move of time. This perception of a move of time may be described as the falling apart of a life moment into two distinct things, one of which gives way to the other, but is retained by memory. If the twoity thus born is divested of all quality, it passes into the empty form of the common substratum of all twoities. And it is this common substratum, this empty form, which is the basic intuition of mathematics.

Broch, too, accords the system of natural numbers a prominent role in the construction of mathematics, but for him intuition is a phenomenon inextricably linked to the “miracle of consciousness”, the last and most unconditional fact of thought (Broch KW10/1: 143). The knowledge of the “pure logos” (in an idealistic sense) is only made possible by an act of ur-intuition
of the human consciousness (ibid). Intuition is access to the erkenntnistheoretischer Bereich “epistemological sphere”, the domain of the intelligible or erkenntnistheoretische Ich “the intelligible or epistemological Self”. Time is, however, according to Broch, always something completely foreign to the epistemological Self.

It is above all the prominent role Broch affords his concept of intuition in his view of the nature of mathematics which links him most firmly with a idealistic (Platonic) view of the discipline. (On positivism’s categorical rejection of any notion of intuition see Hahn et al: 136).

5.2 Structural Identity

In Broch’s essay Geist und Zeitgeist, we read:

For mathematics within its tautologically constructed, colossal structure of symmetry contains – since it is constructed on the strength of logic – every conceivable logical structure which can occur between objects – or, put more correctly – with every new expansion of its construction (with every mathematical discovery) it establishes a new possible logical structure in the world. Thus mathematics contains on the one hand an ever finer, more complicated and ever widening representation of all logical structures of the world (and is from the very beginning the language in which these express themselves). On the other hand, it extends far beyond this representational function and – itself part of the world – becomes (in Kantian terms, in metaphysical terms) the condition of possible experience of the world.

(Broch 10: 292)

For Broch, mathematics contains (in principle) every possible relational constellation and projects (represents) these progressively within the never ending construction/development of its system. It is simultaneously structurally identical with every conceivable relationship (within the human mind), as well as all those which actually occur in the outside world. Both can, as Broch says, (in principle) be mapped onto mathematics. He goes as far as to call every empirical relationship, as well as those only imagined, a subset of mathematics. In this sense mathematics is also structurally identical with the aforementioned erkenntnistheoretischer Bereich (Broch GW 7: 166).

5.3 The Logos

In Broch’s work the term Logos is both ubiquitous and somewhat difficult to nail down. It is perhaps best described as the a priori structure of all human Erkenntnis, thus representing the precondition of the same. ‘Logic’ is not to be directly equated with the Logos, but neither can the two be separated. It is, for instance, the Gebundenheit “bond” between logic and the Logos which enables the otherwise “inexplicable fact of communication between human beings” (Broch GW 7: 39). It is Broch’s (perhaps somewhat radical hypothesis) that it is this which guarantees both the ‘translatability’ of all
languages, as well as the “unity of the human being and his humanity” (ibid). A similar relationship exists between logic and mathematics. Mathematical operations are identifiable as the operations of logic. As the “second form of logic”, mathematics is the visible mirror image of the same. At the same time, mathematical progress is made through the solving of ‘problems’ or ‘examples’ – problems which must be presented from outside of its autonomous sphere. The source of these can, according to Broch, only be logic. Thus logic builds both the inside and outside of mathematics (Broch GW 7: 182). As mathematics, the perfect system of relationships, is furthermore free of all content, logic can freely develop within it (ibid). This means, too, that here the operations of the Logos are most immediately observable.

5.4 Unity

For Broch it is only in the ‘unity of thought and being’ that the ‘absolute of the logos’ can become manifest. To the extent that mathematics is empirically confirmed in the outer world, mathematics is in the unique position to act as a ‘mediator’ between the logical structures of the outer world (which it can express/communicate) and the logical structures of the human mind (of which it is itself an expression). Broch’s concept of ‘the number’ is an illustration of two forms of unity. For Broch, formal mathematical symbols are characterized by “complete reversibility” (Broch GW 7: 162). In other words, they represent the perfect identity of thought and expression. On the one hand they are logische Gedankendinge “logical objects of thought” par excellence. On the other hand, in the form of “actually created numbers” (the natural numbers), they possess for Broch real-empirical existence. (196)

These aspects only gain their true significance in their interdependence, their collective conditionality. It is, for example, logic, as it forms both the ‘inside’ and ‘outside’ of mathematics, thus mediating between thought and being, that contributes to the concept of the unity of Geist “mind” and Welt “world”. If one aspect were to bear particular significance, however, for questions of Broch’s general philosophy, one extending beyond the field of mathematics, it could only be that of structural identity. Numerous passages indicate that, for Broch, the fundamental structures of every form of Erkenntnis are the same (e.g. Broch 1999: 89). These are the structures of the human mind, the human consciousness (and for Broch ‘logic’ is nothing more or less than the mirror image of these). In a letter to Hans Sahl he writes that every statement about das Wahre an sich “ultimate truth” is a statement about the structure of consciousness and that, if one is to arrive at true statements about the world, one first must perform the necessary erkenntniskritische Arbeit “epistemological-critical investigations” of these structures (Broch GW 8: 206). Every truth is revealed in its logical structure (Broch 1999: 93). I suggest that, for Broch, mathematics was a particularly favourable
object of analysis in that, within mathematics, these structures appear in their purest form. Such investigations need not, however, necessarily be an end unto themselves. Insight into the structures of mathematics would allow insight into the structures of every form of Erkenntnis. It is the structural identity of the mathematical system with other Erkenntnissysteme “here: systems of knowledge” which allow such transference.

6 Mathematics and Literature

The goal of this paper has been to present some of my findings to date in regard to the place, function and role of mathematics within Hermann Broch’s broader thought and philosophy. The aim of my research as a whole, however, is to relate this to the author’s literary work. In conclusion, therefore, I would like to sketch some of the possible applications.

For Roesler-Graichen, Broch’s fascination with mathematics can also be seen as an “Ausdruck seines Interesses […] zu neuen Ausdrucksformen der Dichtung vorzudringen” ‘an expression of his interest in advancing to new forms of literary [poetic] expression’ (9). On the same page he writes:

The example of modern mathematics (since the end of the 19th century) teaches Broch that, within the scientific-logical sphere, an expansion of the previous possibilities of expression exists. For the largest part of mathematical terminology no gegenständliche “concrete” or anschauliche “representational” correspondence in outer reality exists. In part they can be derived (traced back) to simple operations, but represent no Vorstellungsgehalt “content of imagination/image”. Here Broch sees the analogy to literature: our complex reality, which can no longer be adequately represented, can only correspond to sprachliche Symbolqualitäten “verbal/stylistic symbolic qualities” which can intimate complex entities which vastly surpass the human faculty of imagination.

One example of this is how Broch uses the comparison of the aesthetic symbol with the mathematical formal symbol to establish the Symbol an sich “the symbol in itself” as being simultaneously an aesthetic and a cognitive unit.

It can, however, be argued that the link between mathematics and literature exists for Broch also on a more fundamental level. At the beginning of the essay Über Syntaktische und Kognitive Einheiten one reads that the true work of art is not an artificial, but rather a natural product (Broch GW7: 151). The work of art is a part of nature and its laws have the same logical status as laws of nature. This is not a naturalistic concept of art, but is rather a reference to the premise of the Erkenntnisstruktur which both share – one which is the precondition of man’s recognition of any form of law. A law of nature, although not dictated to nature and only derivable from nature, is a product of the human mind, the stamp it presses upon nature (ibid). At the same time, it is only the
recognition of the relationship of one’s Innenwelt “inner world” with the Außenwelt “outer world” which allows one to draw conclusions regarding the structure of one’s own mind through observation of the surrounding objects, in order to better ‘understand’ such structures through Rückprojizierung “projecting back” into the sphere of objects. Both art and nature are silent. Only on the level of higher logical categories is it possible to deduce ‘necessities’ or laws – elements with the character of universal apriority. Such a priori elements are fundamentally independent of any particular means of expression, but become ever less distinct the further one moves from the spheres of purely formal expression. (Broch calls this Aprioritätsverdunkelung “the darkening of apriority”.) In their most lucent form they appear within mathematics and music.

In the introduction to this paper it was mentioned that, for Broch, the calling of literature is to be rather than to present Erkenntnis. One of the principle hypotheses of my research is that, in order to achieve this goal, Broch continually strives to combine aesthetic concepts with epistemological principles (or better: to found aesthetic concepts in epistemological principles), and that (among other things) mathematics is used as a tool to this end. It is by no means my intention to equate mathematics and literature, but rather to investigate the extent to which Broch’s fascination with mathematics is reflected, not so much in the content, but in the creative process of his literary work. Two of his statements are of particular interest in this regard. The first is that during the course of his life he came evermore to the conviction that engagement with mathematics and mathematical logic is the foundation of any fruitful thought, yes even of literature (Broch GW8: 200). Broch also calls upon Novalis as one who knew of the pythagoräische Verwandtschaft der Dichtungs-Logik mit dem mathematischen Denken “the Pythagorean relationship between poetic-logic and mathematical thought” (Broch GW 6: 145).

Broch also repeatedly states that the truth-value or the veracity of knowledge (or Erkenntnis) is far more a question of form than of content. Correspondingly, he states that literature means the gaining of knowledge through form - not content (Broch GW8: 78). On the basis of this I argue that, for Broch, the form a work of literature takes is not a question merely of artistic technique, but rather a question of to what extent a work of art is capable of being Erkenntnis.

Two examples of this are Broch’s repeated insistence on the fundamental significance of the ‘architecture of the novel’, as well as his so-called Satz des Gleichgewichts. “Axiom of Balance”.

7 Conclusion

It can be argued that, in many of the essays containing mathematical content, Broch is seeking perceptions which (by means of transference) can provide insight into other forms of human Erkenntnis. As he himself puts it: the human faculty of deduction is not partiell “partial/fragmented”,
and it would be absurd to limit it to the field of mathematics (Broch GW7: 164). This extends to the relationship between mathematics and literature. To directly equate the two would be extravagant and false – Broch makes this exceedingly clear. Both are separate means of human expression, and are correlated to separate spheres of human experience. At the same time, however, every form of human Erkenntnis is made possible only on the basis of the same fundamental structures. Thus I suggest that, for Broch, mathematics is to a significant extent not necessarily an end in itself, but rather a tool to an end. It is a means of exploring the possibilities, conditions and limits of Erkenntnis – insights which could subsequently be fruitful for the conception of his creative literature.

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