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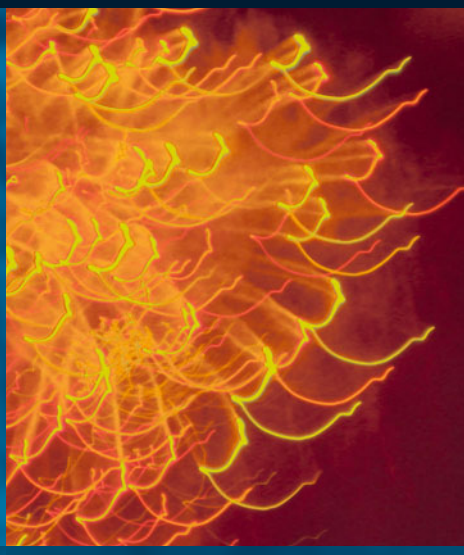

Bernd-Olaf Küppers

THE COMPUTABILITY OF THE WORLD

How Far Can Science Take Us?

Springer

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The Computability of the World

How Far Can Science Take Us?

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Preface

"If one tries to discover something new in science, one should avoid following well-worn paths. Along them there is nothing to be gained. Instead, one has to leave the road and to cross untrodden spaces".

This advice was given in the Age of Enlightenment by the German physicist Georg Christoph Lichtenberg. It contains a valuable nugget of truth about the nature of scientific progress. In fact, the ascendance of science in modern times has only been possible because science, again and again, has crossed borderlines to abandon its well-trodden paths.

Such border crossings are also the subject of this book. It asks the provocative question of the computability of the world. This is done by reference to the all-embracing phenomena that—in the traditional view—seem to lie beyond rigorous scientific computability: life, time and history. Behind this hides the deeper question of whether the complex phenomena of our world, which are often loaded with sense and meaning, can become the subject of an abstract science that is based on experiments and mathematics.

How far can the existence and the colourful variety of living beings, the unique character of information and language, the compelling beauty of Nature, the mysterious essence of temporality and the singular historicity of the world be explained and understood within the framework of the exact sciences—which by their very nature are designed to investigate comparatively simple phenomena of our world? It is obvious that the philosophical question of the possibilities and limits of human perception and knowledge will always resonate throughout this set of problems.

The chapters of this book are based upon lectures that I have given on various occasions for interdisciplinary audiences. Each chapter has been thoroughly revised and attuned to the others, with further material added, to make up (I hope) a unified whole. Nevertheless, one has to regard this book, to use another phrase of Lichtenberg, as an "experiment with ideas". As is characteristic of any true

experiment in science, the outcome will ultimately only teach us which of our ideas was wrong. This also must be seen as the consequence of an open-minded science, which is permanently changing and progressing.

Munich, Germany
January 2012

Bernd-Olaf Küppers

Note on the English Edition

The questions dealt with in this book were the subject of a series of lectures that I have given over the last 30 years, mainly in Germany. In order to make these lectures accessible to a wider audience, the publisher has encouraged me to prepare an English translation and to revise and to update them at the same time. Above all, I have felt the need to improve Chaps. 3 and 5, in which I have now included recent advances in the objectification and quantification of semantic information. The research in this particular field seems to me to be of general relevance: not only for the science of information itself, but also for the theoretical foundations of modern biology, which rests largely upon the concept of information.

As far as possible, the references have been rearranged to include only articles and books published in English. Foreign-language quotations are taken verbatim from English translations of the originals wherever an authorized translation is available. All other quotations, mostly from German philosophy and literature of the eighteenth and nineteenth century, have been translated directly from the original in close cooperation with the translator of this book, Paul Woolley, whom I wish to thank for his dedicated work.

Munich, Germany
July 2017

Bernd-Olaf Küppers

Contents

Chapter 1
Is Absolute Knowledge of the World Possible?

In his famous fresco "The School of Athens", Raphael showed the philosophers Plato and Aristotle engaged in disputation. Plato is pointing upwards to the superterrestrial world of ideas and Aristotle is pointing downwards to the manifest world of real objects—a scene symbolic of the towering question of philosophical reasoning: Is there an ideal world of absolute knowledge that is independent of any kind of experience, or is human knowledge always bound to the experience and critical analysis of the real world?

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1.1 The Dream of Parmenides

It seems too good to be true: the idea of inalterable, timeless knowledge; a knowledge that does not depend upon changing observations and experiences, because it has its sole origin in the logic of rational thought; a knowledge that, nonetheless, allows all experience to be ordered within a grand, universal context; a knowledge that is given a priori and is conditioned by nothing but itself. In short: Knowledge that can claim for itself absolute certainty and validity.

Parmenides of Elea and the school of philosophers he founded were probably the first to entertain the vision, more than 2000 years ago, that it might be possible to attain an absolute knowledge of the world. With their effort to recognize the nature of "true being", they initiated an understanding of the world according to which the phenomenal reality is merely the deceptive illusiveness of a true and unchangeable world. This hidden world of true being, Parmenides believed, is only accessible by pure reasoning.

Thus, right at the outset of Western philosophy, the idea coagulated that true knowledge of the world could only be arrived at by following the path of rational thought, a path that is free of any sensual perception, any observation or experience. In this way Parmenides laid the foundations of a philosophy, called "metaphysics", which seeks to uncover the ultimate principles, causes and coherences of the world.

Parmenides claimed that the way towards the truth was revealed to him in a dream by the goddess Dike. This tale, however, served alone the purpose of justifying his assertion that metaphysical insights are superior to all forms of empirical knowledge. Only rational access to reality, Parmenides insisted, will lead to absolute truth, while empirical knowledge will always be deceptive and illusory.

Parmenides' understanding of true being implies that reality is ordered according to rational principles and that true knowledge of this reality culminates in the strict deduction of these principles. Moreover, according to this view, there must not only be an over-arching principle of reason that lies at the bottom of all knowledge, but this principle must also be absolutely certain. Only on this presupposition can any metaphysical knowledge lay claim to being true, once for all time.

Parmenides justified his metaphysics with a statement that is already true because of its linguistic construction: the tautological statement "being *is*". Proceeding from this statement, he developed his doctrine of true being in the form of a didactic poem.

The logic of his arguments can be rendered as following: The statement "being *is*" expresses a timeless truth, one that clearly does not admit variations in tense such as "being *has been*" or "being *will be*". It follows in turn that being will never be extinguished, nor can it originate; it is eternal and unchangeable. Every "movement"—that means in ancient philosophy: every spatial or qualitative change of things—must therefore be regarded as a deceptive image of an empirical world, an image that distorts our view of true and unchangeable being.

Furthermore, the statement "being *is*" also implies its linguistic converse: "non-being *is not*". From this statement Parmenides concluded that there is no

empty space. Therefore, being must be seen as a continuum, which has no inner or outer boundaries. This led Parmenides to his final conclusion, that true being is not only unchangeable, but that it has further attributes like that of uniqueness, unity, indivisibility and boundlessness.

In the Eleatic school of philosophy, it was above all the logician Zenon who, with the help of sophisticated paradoxes, sought to prove that the true being put forward by Parmenides really is unchangeable, and that every "movement" within reality which seems to refute this conclusion is merely a delusion of the world that we perceive. To demonstrate this, he skilfully used the idea of the infinite, to show that our impressions of movement, multiplicity, divisibility and the like are deceptions, since they lead to irresolvable logical contradictions.

The abstruse pictures of reality engendered by the doctrine of true being were ultimately based upon the fact that logical truths alone cannot lead to meaningful statements about our experienceable reality. Rather, logical truths apply for all conceivable worlds, so that a concrete reference to our real world has to be established in a further step. For Parmenides this was accomplished in the rider "non-being *is not*", from which he deduced that there is no empty space. However, this is only justified, if being is to be conceived of as something that is "material". Yet precisely this (tacit) assumption—that being can only take on material form—is among the arbitrary constructions that in the end lead to the inconsistencies of the Parmenidean world.

It is interesting to note that this weak point in the ontology of Parmenides was already pointed out by Aristotle, who critised Parmenides' simple linguistic usage of the word "being". Instead, Aristotle introduced a distinction between that which *is* ("actuality") and that which *might be* ("potentiality"). This he ultimately raised to a point of departure for his own metaphysics, in which he differs clearly from that of the Eleates.

1.2 In Search of the Archimedean Point of Knowledge

Despite the terminological difficulties with respect to the concept of "true being", which already became apparent in ancient philosophy, the vision that one can arrive at absolute knowledge has persisted right down to modern times. It was sustained, just as Parmenides intended it, by the conviction that such knowledge must be based solely upon rational thought, which is free from the deceptions practised on us by sensation and experience.

The paradigm for the rational reconstruction of reality has been the so-called deductive method, which had been applied in a rigorous way by the mathematician Euclid for the axiomatic foundations of geometry. Ideally—this was the leading thought of modern rationalism—true knowledge of reality should, as in geometry, be deducible in its entirety from a highest, and in itself irrefutable, principle. This principle was assumed not only to be the ultimate reference point of all knowledge,

but also to be capable of providing a justification for the claim that the knowledge deduced from it is coherent and true.

The modern search for rational knowledge was mainly influenced by thinkers like Descartes, Spinoza and Leibniz. However, the rational systems which were developed in the 17th and 18th centuries revealed substantial differences regarding the question of how the form and the content of the highest principle of knowledge are to be conceived of.

In the school of German Idealism this question became a matter of violent controversy. Starting directly from Kant's investigation of the basic conditions of gaining knowledge, Fichte, Schelling and Hegel each claimed to possess the key to the perfection of the critical philosophy of Kant. Each was convinced that he had discovered the first principle of knowledge, which could claim absolute truth and which would allow it to place human knowledge on an ultimate foundation. But how were they able to make this remarkable claim? To answer this question we have to involve ourselves, at least a little, in a complex philosophical debate concerning the understanding of the so-called "absolute".

Kant is well known to have pushed his way forward to the foundations of knowledge in his epochal work "Critique of Pure Reason" of 1781. The analysis of the conditions under which knowledge becomes possible led him to the concept of the "transcendental subject" as the source of knowledge, prior to all experience. In his view, the subject's perception of the external world is affected by, as he called it, "things in themselves". Following Kant, "things in themselves" constitute reality intrinsically, that is, independently of how we may experience reality. They make up the cause of the phenomena and their determinedness, but they are themselves not recognizable.

Kant initially appears to have supported a realistic view of the "thing in itself". Later he moves towards an idealistic interpretation, according to which the "thing in itself" is merely a terminological construction, but which nevertheless is a logical necessity for the understanding of the source of human knowledge.

This conception was rejected first by Fichte, in 1794, in his "Doctrine of Science". He argued that the knowledge-engendering function of "things in themselves" leaves knowledge still dependent upon the external world, and that knowledge therefore lacks the property of being unconditional. However, in Fichte's view, unconditionality is an indispensable prerequisite if the knowledge acquired by the transcendental subject is to be absolute and no longer dependent upon changes in external experience.

Fichte therefore set out from the idea that the actions of the transcendental subject must be completely unconditional, that is, caused only by the subject itself. To develop from this idea the first principle of all knowledge, Fichte proceeded in an extremely formal manner. At the top of his system of knowledge he put the formal-logical identity "A = A". As a logical truth, the statement "A = A" cannot be doubted. It thus fulfils the fundamental philosophical condition that the highest principle of all knowledge of reality must be absolutely true. However, it immediately raises the question of how the abstract statement "A = A" can ever be related to the real world. Fichte purported to solve this problem by analysing the

meaning of the statement "A = A" under the premise that the highest principle must be unconditional without any restrictions.

To come to the nub of Fichte's considerations: statements are always statements by a subject. Therefore, the statement "A = A" presupposes a subject, the "pure Ego" or "I", that sets "A" in an identity relationship to itself. In this way, however, the formal-logical identity becomes conditional upon the "I", and is no longer unconditional, as is demanded by the highest principle of philosophy—with one exception: the only content of "A" that gives the formal-logical identity the character of the unconditional is the "I" itself. It is the statement of the self-authenticating "I", which poses itself: "I am I" or "I = I". Form and content of the highest philosophical principle are thus conditional upon each other and impart to the highest principle the property of complete unconditionality.

Fichte's further arguments along this line can be summarised as follows: As the "I" opposes a "non–I" to itself, it also posits its object of cognition. Moreover, the differentiated world of objects finally arises from the repeated self-limitation ("negations") of the "I" as the "I" again and again poses itself, within the divisible "I", a divisible "non–I". In this way an increasingly fine network of borderlines arises between the "I" and the "non–I" and of demarcation of the "non–I" by the "I". According to Fichte, the world of objects thus appears as a manifold of demarcations, which arise through the iterative self-demarcation of the autonomous "I".

The radical subjectivism that we encounter here was already in Fichte's time a target of criticism. For example Schelling, initially a loyal follower of Fichte, remarked—not without a certain element of mockery—that the divine works of Plato, Sophocles and other great minds were actually his own, as they—if one construes the subjective idealism consistently—are engendered by him through productive intuition [14, p. 639]. Schelling did indeed recognise Fichte's achievements in restoring the subject-object identity to a central position in philosophical debate, but at the same time he criticised Fichte for relegating identity to the position of a particular feature of subjective consciousness. As a consequence of this, he argued, the identity principle itself would remain "after extraction of all substance from the speculation" as no more than "empty chaff" [12, p. 396].

Fichte's philosophical approach, promoting the perceiving subject to the sole and unconditioned source of knowledge, led inevitably to a contradiction with empirical reality. In respect of its understanding of reality, the subjective idealism of Fichte clearly reveals the same weaknesses, the same loss of reality as did Parmenides' doctrine of true being.

In his "Ideas for a Philosophy of Nature", published in 1797, Schelling attempted to correct this deficiency by first objectifying the subject-object identity and not, as Fichte had done, regarding it as an identity proceeding exclusively from the subject. Moreover, according to Schelling the subject-object identity must be considered as absolute. This means that subject and object are not two separate entities that stand in an identity relationship one to another, but rather that the entire Subjective *is* at the same time the entire Objective, and the entire Objective *is* at the same time the entire Subjective. Only when Subject and Object unambiguously and

reciprocally depict one another, one to one, is there—as Schelling believed—no inconsistency between the inner and the outer world.

Unlike Fichte, Schelling regarded the real world as more than just an epiphenomenon of the ideal world. Rather, he saw conceptual and material appearances as two manifestations of one and the same entity, and understood this as an absolute subject–object identity. At the same time he realised that he had to pass beyond the concept of Fichte's "Doctrine of Science" and to regard the "I" as an all-embracing world concept, one that encompassed both the entire Subjective and the entire Objective. Schelling admittedly retained Fichte's idea that the absolute "I" engenders its world of perceptions in an act of free will ("freie Tathandlung"); however, at the same time he interpreted the absolute I as being the highest level of existence of a self-creating Nature, which in the human mind becomes conscious of itself.

Fichte's statement "I = I" thus becomes a self-statement of self-creating Nature: "I = Nature". Consequently, the acts of free will on the part of the absolute "I" are interpreted by Schelling as objective acts of creation of an all-encompassing, autonomous and unconditional activity of Nature, which are raised into the realm of human consciousness. Schelling [12, p. 380] summarises: "Nature is the visible mind, the mind is invisible Nature". This is to be taken as meaning that the perceiving subject can regard itself in Nature as in a mirror. Nature is the visible mind. Conversely, mind is invisible Nature, insofar as mind mirrors Nature at the highest level of its being. Thus, mind in Nature and Nature in mind can contemplate one another.

1.3 Utopian Fallacies

Schelling's philosophy of Nature rests upon the identity of rational and natural principles, which is assumed to be absolute. The aim of his philosophy is to reach knowledge of Nature a priori, which is—, according to the identity relation—, constituted from the principles of rational thought. By definition, this knowledge does not depend upon changeable experience. Consequently it cannot be refuted through experience. At the same time, knowledge a priori is the highest authority to decide over the question of how experience is to be ordered and interpreted. In comparison with this kind of knowledge, the discoveries of empirical research into Nature are only of marginal significance; these only become "knowledge" when their necessity, i.e. predetermined place in the theoretical system of natural philosophy, is recognised. In this sense, Schelling's natural philosophy claims to be a "higher knowledge of Nature", a "new organ for regarding and understanding Nature" [12, p. 394].

In Schelling's system, the task of empirical science is—at best—to verify the principles dictated to it by natural philosophy. On no account could they be disproved: the refutation of these principles would immediately have refuted the principles of reason and, thus, pursued the possibilities of cognition *ad absurdum*.

In fact, the principles of natural philosophy were seen as unchallengeably certain. If empirical results did not accord with them, then the principles remained unchallenged, whereas the empirical observations were taken to be obviously at fault, or incomplete, or deceptive.

Schelling did at least admit that empiricism might occasionally have a heuristic function in the discovery of hitherto unknown phenomena of Nature. However, the constructive rôle thus assigned to empiricism clearly marks it out as a foreign body in the stringent system of a priori epistemology.

There are two possible reasons why Schelling allotted a certain place to empiricism. On the one hand, he was hardly in a position to ignore the enormous and dynamic progress that empirical science had made, and was making, in his time. On the other, Schelling's natural philosophy never really progressed beyond the stage of being a mere epistemological programme, with the result that, to make even moderately concrete statements about the world, he was forced to resort to observation. This, too, shows that pure thought, free from any relation to experience, is unable to attain any recognition of experienceable realities.

Whatever Schelling's motives may have been in raising the status of empiricism, there is little doubt of their incompatibility with his philosophical programme of Nature. Even if Schelling occasionally re-interpreted experience as a priori knowledge that only appears to be a knowledge a posteriori as long as its transcendental-logical roots remain unrecognised, he kept a firm grip on the dogmatic epistemological claim of natural philosophy that its conclusions, as long as they were correctly inferred, cannot be falsified by experience but only verified. For him, the function of empiricism was at most to guide discovery, never to provide it. On the contrary: real discovery could only be made by natural philosophy.

A further aspect of Schelling's epistemology should be emphasized. In accordance with the identity principle, the ideal and the real together make up a whole that cannot be transcended. The whole is at the same time an allegory for the absolute, which however only reveals itself in the dichotomous form—that is, in ideal and real essence—to the subject. However, the absolute, when it "expands" into the ideal and the real, must not lead out of the absolute. As the absolute, it must always remain identical with itself in its entire absoluteness.

From this there inevitably emerges a picture of the holographic character of the world, which is the same as saying that "every piece of matter must in itself bear the imprint of the entire Universe" [13, p. 413]. According to Schelling, this is not least applicable to the relationship between Nature and organism—with the consequence that Nature is to be regarded as a universal organism, which is arranged according to the same principles as an individual organism and vice versa. Admittedly, organic matter, as an expression of the absolute, is not a static structure but, as Schelling emphasised again and again, a process. Only in this way was Schelling able to arrive at a self-consistent picture of Nature as pure natural activity that, in "infinite productivity", engenders all natural objects out of itself.

Natural philosophy and empirical research into Nature are thus concerned with two fundamentally different objects of knowledge. One is concerned with "Nature as a subject" and the other with "Nature as an object". "Nature as a subject" is a

metaphor for the infinite productivity of Nature ("natura naturans"). It is downright natural dynamics. Its driving forces are the creatively acting natural principles, the discovery of which is the task of natural philosophy. "Nature as an object", in contrast, is the productivity of Nature as made manifest in her products ("natura naturata"). These products are in themselves finite and appear as a terminated network of actions, the elucidation of which is the task of empirical research into Nature. However, to avoid the conceptional separation of Nature into two forms, Schelling employed an artifice. According to this, the productivity of Nature is not really extinguished in its products; rather, it still remains active with a force of production that, however, is infinitely delayed. As already encountered in the philosophy of the Eleates, the concept of the infinite again must be invoked in order to save the consistency of the epistemological model.

The organismic conception of Nature, as developed in detail by Schelling in his book "On the World Soul" entails an important consequence for the method of gaining knowledge. As the parts can be explained on the basis of the whole, Schelling argued, the whole—that is, the organismic character of Nature—is the basis for explanation of all natural phenomena from the highest levels of complexity of matter down to its simplest parts. In this way, the direction of explanation encountered in modern sciences, which leads from the simple to the complex, was turned upside-down. According to Schelling the organism is not to be explained on the basis of its material building blocks, but rather these building blocks must be explained on the basis of the overall picture of the organism. The organismic conception of Nature was thus given precedence over the mechanistic one.

In summary, we can say that Schelling's philosophy of Nature ran counter to today's scientific method in two important respects: (a) Theory occupies a more important place than empiricism. Claims to truth need not stand the test of experience; they are exclusively derived from logical reasoning. In short: Knowledge a priori is given precedence over knowledge a posteriori. (b) The research strategy propagated by Descartes, Newton and others, according to which one should proceed from the simple to the complex, from the part to the whole, from the cause to the effect, is turned by Schelling into its opposite. The analytical method, based upon dismantling, abstraction and simplification, is discarded—or at least diminished in importance—in favour of a holistic method (for a detailed criticism of this kind of philosophy see [5]).

Schelling's philosophy of Nature was not the only attempt made in the 19th century to dictate to empirical research which way it had to go. Hegel, Eschenmayer, Steffens and others likewise developed their own ideas of natural philosophy. However, none of these had anything like the effect that was attained by Schelling's approach. Schelling, with his metaphysical, speculative understanding of Nature, was the only philosopher to succeed in initiating a counter-movement to the mechanistic sciences and to found the so-called "romantic" philosophy of Nature, a world-view that even today finds numerous adherents.

Schelling's philosophy emerged from the sober logic of the rationalistic perception of reality. One may therefore ask how this philosophy ever acquired the

attribute “romantic”. To answer this is no easy matter, as—to start with—the term “romantic” does not have a clear meaning. It is one of those elastic words whose meaning is only clear within the particular context in which it is used.

In the present case, this context is as follows: At the beginning of the 19th century, Schelling’s philosophy offered an alternative to the then predominant mechanistic view of Nature. It presented the mechanistic view of reality as a constricted perspective of a world which in actual fact is a complex whole. Moreover, Schelling’s conception of Nature as an all-embracing organism appeared to correspond perfectly to the romantic ideal of an organic, indivisible unity of Man and Nature. In this way his philosophy took on a constitutive rôle for the romantic understanding of the world. Nevertheless, the organismic conception of Nature propagated by Schelling led directly into the fog of a romantic transfiguration of Nature, in which, even today, adherents of a romantic understanding of Nature appear to be straying about.

The vagueness of this view of Nature can easily be illustrated by examination of its concept of the whole. According to the organismic view, the phenomena of Nature inherently make up a unified whole and must be recognised from the perspective of this unity. For this, even in our times, again and again the idea of a holistic method for the understanding of the organism is propagated—a method believed to be in contrast to causal-analytical thinking. However, the idea of an irreducible whole is anything but transparent. It cannot even be explicated meaningfully, let alone be determined by analytical thought. In the end, all that remains is the tautological conception of “the whole” as some kind of “whole”.

This problem refers back to the problem of the absolute. In fact, the concept of the whole was introduced by Schelling precisely for the purpose of giving appropriate expression to the absolute. The absolute appears, however, persistently to resist analysis, because it—being unconditional – completely eludes any relationship of conditionedness, not least that of reflection. The unconditional, as a synonym for the absolute, cannot be subjected to the conditions of consideration. There is no Archimedean point outside the absolute, one from which the absolute might be determined. The absolute as such is indeterminate. For exactly this reason, one encounters repeatedly in Schelling’s philosophy empty formulas according to which we are invited to think of the absolute first and foremost as “sheer absoluteness”. And in the passages where Schelling finally does undertake the endeavour to encircle the absolute conceptually, his thought dissolves into poetry.

The addendum to the Introduction of Schelling’s “Ideas of a Philosophy of Nature”, in which he repeatedly attempts to express the inexpressible, is rich in morsels of poetic word-creation and pictorial comparison that exhaust themselves in nebulous abstraction. We read, for example, that the absolute is “enclosed and wrapped up into itself”, or that the absolute “is born out of the night of its being into the day”. There Schelling speaks of the “æther of absolute ideality” and the “mystery of Nature” [12, p. 387 ff.].

The poetic language that Schelling makes extensive use of is clearly the inevitable accompaniment of a philosophy in which human thinking perpetually seeks to transcend itself. Only thinking about the absolute can be reflected in it, but not the

absolute itself. Consequently there arises an unsolvable intellectual problem, an *aporia*, regarding the absolute, which Schelling tried to circumvent by introducing the concept of intellectual intuition ("intellektuale Anschauung"). This means the contemplative act of self-ascertainment of the absolute by the introspective self-consideration of the absolute. Thus, intellectual intuition appears like an inwardly inverted Archimedean point, from out of which the absolute was supposed to be made comprehensible.

Schelling generalised the concept of intellectual intuition (which had already been used by Fichte) and abstracted it from the beholder and thus, as he put it, only considers the purely objective part of this act. Nevertheless, in this way a quasi-meditative, almost occult element crept into his natural philosophy, and remained permanently stuck to it like an annoying vermicular appendage.

Despite its romantic exaggeration by the organismic view of Nature, Schelling's philosophy is nonetheless, deep down, even more mechanistic than the mechanistic sciences that he criticised so violently. It is true that he attempted to replace the causal-analytical view, according to which the world can be described as linear chains of cause and effect, by an organismic approach with cyclic cause-and-effect relationships. At the same time, however, everything was subjected to the highly mechanistic logic of deductive philosophy. That in this way the experience and the consideration of Nature ultimately came under the wheels, was an objection that even Goethe raised against the proponents of romantic philosophy of Nature.

Goethe was initially sympathetic to the aims of these philosophers and gave them active encouragement by supporting, for example, Schelling's appointment to Jena University; later, however, he turned away, "shaking his head", from their "dark", "ambiguous" and "hollow" talk, which he felt was "in the manner of prophets" [3, p. 483 f.]. He went so far as to see in their speculative philosophy an "ugly mask", a thing "highly fantastical and at once dangerous", because here "the formulae of mathematics pure and applied, of astronomy, of cosmology, of geology, of physics, of chemistry, of natural history, of morals, religion and mysticism […] were all kneaded together into a mass of metaphysical speech", with the consequence "that they substitute the symbol which suggests an approximation, for the real matter; that they create an implied external relationship to an internal one. Thus, instead of exposing the matter they lose themselves in metaphoric speech" [3, p. 484].

More so: even the closest comrades-in-arms of the Jena Romantics' Circle, such as Friedrich Schlegel and Johann Wilhelm Ritter, criticised the notion that pure speculation, unaided by any experience, could provide the basis for a any profound knowledge about the world. "Schelling's philosophy of Nature", concluded Schlegel, "will inevitably invoke strong contradiction from the crass empiricism that it had hoped to destroy" [15, p. 50]. And Ritter insisted that "pure experience […is…] the only legitimate device to allow the attainment of pure theory" [11, p. 122]. We shall, according to Ritter, "approach imperceptibly the true theory, without searching for it—we shall find it by observing what really happens, for what more do we desire of the a theory than that it tells us what is really happening?" [11, p. 121].

Ritter rejected the claim of Schelling's philosophy to deliver a theoretical foundation a priori of all natural phenomena. But at the same time he moved towards this philosophy because he made its speculative theses into guidelines of his experimental studies. Other scientists, such as Hans Christian Ørsted, Lorenz Oken and Carl Gustav Carus, moved in a similar direction. From this trend there finally emerged an approach to research, which its proponents regarded as "romantic study of Nature" (see above). Not least, they were engaged in finding an experimental demonstration of the mysterious force that, as was assumed at the time, permeates and connects all organic and inorganic matter.

Toward the end of the 18th century, the field of choice for experiments in romantic research into Nature was above all the phenomena of electrochemistry. At the centre of Ritter's studies, for example, were the observations made by Luigi Galvani that a suitably prepared frog's leg could be set in motion by electric currents. Everything seemed to point to galvanic electricity as the key to understanding living matter. Moreover, this fitted in with the—at the time—highly popular conception of polarity and of enhancement (another idea popularised by Goethe) as the "two great driving wheels of all Nature" [2, p. 48].

In his writing "On the World-Soul" Schelling believed not only that he could provide a rigorous philosophical foundation for this conception, but also that his ideas had found impressive confirmation in Galvani's observations. For the experimenter Ritter, the phenomena of polarity and enhancement became the central guiding principle of his research. His urge to discover rose to the degree of an obsession, as he began to conduct electrochemical experiments on his own body. The fact that Ritter's self-experimentation ultimately brought about his death can be regarded as a macabre climax of this period of dogmatic understanding of Nature, in which the borders between self-knowledge and knowledge of Nature, between the human body and the corpus of Nature, were blindly negated (see [1]).

1.4 From the Absolute to the Relative

For Schelling, knowledge of Nature consisted in reconstruction of the self-construction of Nature. The concepts of natural philosophy were thus regarded as necessarily true, and considered to be immune from refutation by experience. In this they differed fundamentally from the theories of empirical research into Nature; these have only a relative validity and are always subject to critical examination by experience.

In the claim of natural philosophy to represent a "higher" knowledge of Nature, we recognise once more an idea of ancient metaphysics that originated with Parmenides: the idea that phenomenological reality, upon which empiricism is founded, is only the surface of a deeper-lying, true reality. In accordance with this, Schelling conceived of Nature in a double sense: "Nature as object" and "Nature as subject".