Towards a Statique (Non-Quantitative) Rationnelle: Deriving the Complete Physics of Rational Human Intelligence from a Single Physical Principle, in the Footsteps of Lagrange’s Derivation of the Complete Physics of Mass and Motion or Mechanics from a Single Physical Principle in His Mécanique analytique

致力于一个“Statique (Non-Quantitative) Rationnelle”：基于唯一物理学原理推导出的完整的人类推理智能物理学，效法拉格朗日在《Mécanique analytique》一书中的做法（即基于唯一物理学原理推导出完整的关于质量和运动的物理学）
1. Statement of Purpose

The design of this Preface is to describe in outline

1) the single physical principle from which all rational human intelligence is derived and
2) the ways in which the principle is manifested in the five flavors of rational human intelligence.

1) is defined in sections 24 and 25 below after much introductory matter. 2) is described in sections 26, 27, 28, 29, and 30.

A much more detailed description of these two items, especially the second item, will appear later elsewhere. Producing the detailed description will be a little bit like building a cathedral. The entire blueprint exists. But the structure still needs to be erected stone by stone. And that may take a while.

Apparently, in the course of human evolution, the brain has exploited one single physical principle and maximized its use in all kinds of ways to produce the totality of rational human intelligence. It is a marvel to behold how the brain has developed all that it was in need of in order to be able to reason by itself and together with other brains by just exploiting one single principle, only one. It was able to exploit this single principle again and again in various ways to make reasonable speech possible.

This evolutionary development is a process of physics. Therefore, its description requires a theory of physics. And the language of physics is mathematics.

Why the term Statique (non-quantitative) rationnelle? What’s in a name? Mechanics, Mécanique, is all about matter—or mass—and motion. And motion involves speed. Speed changes in quantity. And so does mass. Clearly, there is no way in which everything in nature has the same mass and always moves at the same speed. Quantity is crucial to mass and motion all the time. But the physics of rational human intelligence involves neither motion nor quantity in the least. The absence of motion makes it static. Statics already has a meaning in the physics of matter and motion, which exhibits quantity. It pertains to forces that are at work when nothing moves, as in a painting hanging from a wall. There is no motion. But there is measurable quantity. The terms “statics” is used here for a theory of physics that also does not exhibit motion but in which quantity is absent.
2. Rational Human Intelligence: The Universally Shared Platform of Human Intelligence

The notion that all of rational human intelligence derives from a single principle, just one, may come as a surprise and even seem preposterous to some.

It would seem to contradict the great variety that exists in human intelligence in general. There are so many types of human intelligence. There is artistic intelligence, emotional intelligence, musical intelligence, political intelligence, sports intelligence, and so on. The list could be carried on at great length. However, all these types of intelligence differ from one human being to another. The structure of all these types of intelligence cannot therefore be mathematical because mathematics is universal. Derivation from a single physical principle does not apply to all these many types of intelligence.

By contrast, rational human intelligence is more or less the same in every reasonable human being. In fact, it is easy to sense that there is something that all of us as human beings share when it comes to intelligence. When we approach other people to communicate, we have a certain expectation of being understood if everyone agrees to be reasonable. Even though we realize that human intelligence differs greatly from one human being to another (not to speak of differences in temperament and in other traits of the human mental disposition), we all sense the presence of a certain core intelligence that we all share. Somewhere in all the seemingly endless variety of human intelligence, there is a kind of common platform and everyone senses its presence. That common platform is rational human intelligence.

It is possible at this time to describe all of rational human intelligence in its entirety. The same cannot be said about all other forms of human intelligence. That is because the other forms are not strictly mathematical.

3. Theories of Physics as Constructs or Properties of the Brain

Theories of physics are constructs of the thinking human brain. So are individual principles of physics. Therefore, if a theory of physics can be derived from one single principle, as is the case with J.-L. Lagrange’s *Mécanique analytique* and as—I firmly
believe—is the case with the theory of rational human intelligence, then this single principle too is a construct of the human brain. It is something that the brain has done or is doing. It is an activity of the brain.

The location of theories of physics, including all their principles, is the brain. It would seem as if theories of physics can also be found on the pages of books. But that impression is quite deceptive. These pages become alive as theories of physics only when they are engaged by a thinking brain.

This reminds one of the proverbial tree falling in the forest. In this regard, I deem it quite certain that a physics book does not contain physics if there is no one there to read it. A physics book sitting on the shelf of a library by itself is not physics. Physics requires the intervention of a human brain. At best, one might call the physics explained on the pages of a book dormant, until it is woken up when someone reads the book.

4. Physical Reality, That Is, Physical Bodies or Mass, as the Referent of the Theory of the Physics of Matter and Motion

Theories of physics are a product of the brain. Then again, the brain does not produce them out of nothing. The theories of physics that germinate inside the brain are the result of the brain engaging reality outside itself. In other words, theories of physics and all their principles relate to or refer to physical nature outside the brain, that is, to physical bodies or mass. In other words, physical reality is the referent of theories of physics.

One such theory is the physics of matter and motion, as J. C. Maxwell preferred to call it. It is also known as mechanics. It may also be called the physics of mass and motion because “mass” now seems more common as a designation than “matter.”

The theory has everything to do with physical bodies and all the effects that forces and displacements have on them. Many consider the history of this theory from G. Galileo to A. Einstein one of the most exciting developments of modern science, if not the most exciting one.

It has also served as a model for other theories. It does not quite serve as a model
for the theory of rational human intelligence but rather as an analogue. Something like the theory of rational human intelligence has already been done before? Why can it not be done again?

The theory of matter and motion is also heavily mathematical, a property that it shares with the proposed complete theory of rational human intelligence. In this regard too, the two are analogue.

To the extent that matter or mass is considered a quantity, in the sense that it can become bigger or become smaller, the most widely used unit of mass as a quantity is the kilo (k).

What is more, different theories of physics refer to different facets of physical nature. The question arises: How does the referent of the physics of matter and motion differ from the referent of the physics of rational human intelligence? Let us first turn to the physics of matter and motion. To which facet of physical reality does the physics of matter and motion refer.

5. (Quantities of) Mass Positioned in (Quantities of) Space and (Quantities of) Time as the Referent of the Physics of Matter and Motion

Let us consider a physical body or a mass, say, a car. A first observation is as follows. It is immediately apparent to the human brain that the car has a certain position in space. The brain has no difficulty in establishing that the car is, say, here and not over there.

There is otherwise something profoundly elusive about space. It may not even be possible for the brain to understand what space is. In fact, theoretical physicists do not really understand what space is in the end. But then, this seems in a way expected. There are things that the brain can do and there are things that the brain cannot do. There are absolute limits to the brain’s abilities. And the true nature of space is beyond those limits.

A second observation made by the brain is the contrast between where the car is and where it is not. It may already be anticipated at present that the corresponding
observation essential to the physics of rational human intelligence will be the contrast between what the car is and what it is not.

A third observation made by the brain concerns changes of the positions of masses in space. It seems evident that a physical body or mass can change its position from where it is to where it is not. That process is called motion.

Motion takes place simultaneously in the dimension of time and in the dimension of space. There is no denying that it takes a distance in space to make motion possible. What could be more obvious? And there is no denying that traversing that distance in space takes time. In other words, changes in time and place have to occur at the same time. They cannot be divorced from one another.

6. Excursus: Pre-Modern Notions of Mass Positioned in Space and Time as the Referent of the Physics of Matter and Motion

What follows in the present section is not necessary to follow the main line of argument and can, if so desired, be skipped.

The relation between space and time has not always been as obvious and as generally accepted as it is today. The Greek philosophers struggled mightily with contrasts such as the one between being something and not being something and the one between being something and becoming something, and so on. Their efforts were in the end far from successful. But there is no doubt that they were looking in the right direction. And, for this reason, Parmenides and Plato remain worth reading even if their writings may on occasion seem like gibberish. Plato’s dialogue Parmenides, by some regarded as the pinnacle of Greek philosophy, represents a culmination of sorts of the Greek efforts in question. To me, it serves as an excellent illustration of how the Greeks could not quite put their finger on what it was that they were looking for even if they were generally looking in the right direction. And they were the first in human history to do so to such a high degree. For that, they deserve every credit, even if they in the end did not achieve their aim.

Along these lines, the Eleatic philosopher Zeno (fifth century B.C.E.) and other Greek philosophers engage the relation between time and space and twist it into a
number of paradoxes. One such paradox involves someone running at the same speed towards a finish line in a stadium. Since the runner must first cover half the distance towards the finish line and then half of what remains and again half of what remains and so on in all perpetuity, he will never reach the finish line. I hope to deal with Zeno’s paradoxes in a definitive manner elsewhere.

Zeno does not indicate explicitly, as far as I know, at which speed the runner is running. But there is no reference of acceleration or deceleration (negative acceleration). It may therefore be assumed that the runner is in all probability running at an even speed.

Let the finish line be 128 meters away and let the runner run at two meters per second (7.2 kilometers per hour). According to the modern physics of matter and motion, the runner will reach the wall after 64 seconds, in about a minute.

Zeno states that the runner will never reach the finish line. How can this be? In fact, if the runner does exactly what Zeno says, he will never reach the finish line. If he covers first half of the distance, and then half of what remains, and then again half of what remains, it is certain that he will never get to the finish line. No doubt about it.

What Zeno does not tell us is that the runner cannot do this without slowing down to an ever more excruciatingly slow pace.

For let us assume that the runner does not slow down in the sense of covering less and less space in the same amount of time. He will complete the first 64 meters in 32 seconds, half of the rest or 32 meters in 16 seconds, half of the rest or 16 meters in 8 seconds, half of the rest or 8 meters in 4 seconds, half of the rest or 4 meters in 2 seconds, half of the rest or 2 meters in 1 second, half of the rest or 1 meter in half a second.

There can be no doubt that, if the runner proceeds in this fashion, he will not reach the finish line. But something else is certain as well: he will not live as long as 64 seconds. In other words, as he approaches the finish line, time itself would need to slow down to half of half of half of half, in conjunction with a concurrent diminution of space. This is clear from the scenario described above, according to which the runner always covers the same amount of space in the same amount of time.

Under the normal scenario, the long arm of a clock will tick for 64 seconds and at
the 64th tick the runner will arrive at the finish line. But if the runner must in all perpetuity always cover half of half of half, and so on, of the distance, then the arm will gradually slow down as it approaches 64 seconds. It will not quite get to the 64th tick, though it will presumably get there in the dimension of eternity.

By moving always half of what remains of a distance, the distance covered by the runner gradually becomes smaller. But since time is linked to space in that the same amount of time always passes for the same amount of space, time has to slow down as well and this is not possible.

The slowing of the clock is in contradiction with reality.

Is there a scenario in which the runner will never reach the finish line while the clock behaves as it normally does? There is, namely if the runner runs ever less space in the same amount of time. But that means that he is slowing down, eventually to an infinitely slow crawl. That way he will never reach the finish line. But that too is in contradiction with reality because he runs an equal amount of space in an equal amount of time.

In sum, Zeno’s paradox in its brevity fails to detail that it contradicts reality. But the fact is not immediately apparent because there are two possible ways in which reality can be contradicted. Some analysis is necessary to establish in exactly which ways the contradictions apply.

One can keep the link between space and time. In this case, time becomes smaller and smaller. In other words, time itself slows down and space, linked as it is to time, becomes smaller and smaller too. Or one can discard the link, and space becomes smaller and smaller in relation to time.

7. J.-L. Lagrange’s Derivation of the Theory of Physics of Matter and Motion or Mass and Motion or Mechanics from a Single Principle

As was noted above, theories of physics are properties of the brain. In his Mécanique analytique, J.-L. Lagrange demonstrates how all of the theory of dynamics and statics, the theory of the physics of matter and motion, can be derived in a purely mathematic-
cal way from one single principle, which he calls the “Principle of Virtual Velocities”. J.-L. Lagrange attributes the formulation of the principle to G. Galilei.

Like any theory of physics in general, the principle from which an entire theory of physics is derived is a product of the brain. It resides in the brain. What exactly its relation is to reality is not quite clear and may never be. The significance of the principle is measured by its effectiveness. The principle works and, as J.-L. Lagrange showed, all of the physics of matter and motion can be derived from it.

Along the same lines, much is made of calculus. In the physics of matter and motion, calculus is everything. It is clear that calculus is a product of the brain. It is tempting to think that calculus is embedded in nature. But calculus may be just one way of presenting motion and changes in motion by means of the human brain. Who knows what a brain of a different and alien constitution would have come up with? In other words, something like calculus is embedded in nature. The question as to whether calculus itself is embedded is another matter.

The details of the derivation do not matter to the present line of argument. J.-L. Lagrange’s theory is adduced here because it constitutes a perfect analogy to the proposed theory of rational human intelligence. The fact that one theory of physics has demonstrably been derived from a single principle makes it seem much less preposterous that another theory of physics might be too, as I am convinced that the theory of rational human intelligence can be. A precedent has been set, as it were.

But there is one prominent difference between motion and rational human intelligence. Theories of the physics of matter and motion are all about *quantity*. The three quantities of the physics of matter and motion are, 1), mass, 2), space, and 3), time. Mass, space, and time are all capable of increase or diminution. By contrast, in the physical and mathematical theory of rational human intelligence, quantity plays no role.

It will be described below how the theory of the physics of rational human intelligence, like the theory of the physics of matter and motion, can be derived from a single principle. It is truly remarkable that, in the course of human evolution, the human brain exploited just one sole principle to build and construct all of its rational intelligence, just one.
8. The Physics of Rational Human Intelligence as a Referent to Mass

The physics of matter and motion is all about where a physical body or mass is and where it is not. By contrast, the physics of rational human intelligence is all about what a physical body or mass is and what it is not.

It will be useful to recall, once again, that quantity plays no role in the physics of rational human intelligence. In the physics of matter and motion (which most everyone considers physics tout court), quantity is essential. Consider the example of the car. It matters greatly in physics how much a car weighs.

In the physics of rational human intelligence, all that matters is whether something is a car or not a car. A car is a car independently of how much it weighs or how fast it goes. Quantity plays no role.

The notion that there is a contrast between what something is and what it is not seems rather trivial. But the claim that this seemingly trivial contrast lies at the root of all of rational human intelligence in its entirety may raise eyebrows. How could such a single sole property of reality have generated inside the brain the totality of what makes us into rational human beings over the centuries? The design of the complete physical and mathematical theory of rational human intelligence is to show how it did.

9. The Specific Referent of the Physics of Rational Human Intelligence: The Form or Shape or Appearance of Physical Bodies or Mass

It was mentioned above that mass is the referent of both the physics of rational human intelligence and the physics of matter and motion. But whereas the specific referent of the physics of matter and motion is all about where a mass is and where it is not, the specific referent of the physics of rational human intelligence is all about what a mass is and what it is not.

Consider, for example, a tree. What does it mean to observe the contrast between what the tree is and what it is not?
First of all, the contrast has nothing to do with space. Space belongs to the domain of the physics of matter and motion. It is not a contrast between the tree and the space that it occupies, on the one hand, and the space outside the tree, on the other hand. The contrast in physical reality in which all of rational human intelligence is ultimately rooted pertains to certain features that the tree exhibits, its form or shape or appearance. The contrast is therefore between the physical bodies that exhibit the features of a tree and the physical bodies that do not.

There is no denying that mass exists in different forms or shapes or appearances or whatever one may call it. A tree does not look like a car. However, the difference between the form or shape of a tree and the form or shape of a car plays no role in the physics of matter and motion. A tree of 3000 kilogram and a car of 3000 kilogram behave exactly the same in relation to the laws of gravity. By contrast, the physics of rational human intelligence pertains to differences in form or shape or appearance such as that between the form or shape of a tree and the form or shape of a car.

10. The Fundamental Characteristic of Physical Reality Lying at the Origin of the Single Theoretical Principle from Which All of the Theory of Rational Human Intelligence Is Derived

It has been noted above that the physical theory of rational human intelligence inside the brain pertains to, or makes reference to, differences in appearance between physical bodies or mass outside the brain. Furthermore, it is proposed that this entire theory can be derived from a single principle, just one. It follows that this single principle must also pertain to differences in appearance between physical bodies because the entire theory of rational human intelligence pertains to such differences.

But to which specific facet of the differences in appearance of physical bodies or mass does the single theoretical principle from which all of rational human intelligence is derived pertain? Surely not to all of it. The facet in question concerns a fundamental characteristic of the differences in the appearance of physical bodies or mass.

The countless differences in appearance between physical bodies, such as the difference in appearance between a tree and a car, a tree and a house, a car and a house,
and so on, cannot be that fundamental characteristic. The differences are not only too specific to be part of a mathematical theory. They also all differ from one another. A mathematical theory requires a much more general principle that applies to all physical bodies or masses at the same time.

What all physical bodies of any kind have in common in terms of their form or shape or appearance is the following fundamental characteristic: they all contrast with, or are differentiated from, all the physical bodies or mass that do not exhibit their form or shape or appearance.

For example, the car is differentiated from all that does not look like a car, the tree is differentiated from all that does not look like a tree, and the house is differentiated from all that does not look like a house. This is the fundamental characteristic of reality in which the theoretical principle from which all rational human intelligence derives is rooted. Evidently, the fundamental characteristic manifests itself differently with different physical bodies. But it is in the end the single same fundamental characteristic.

How does the brain derive from this fundamental characteristic of physical reality the single principle yielding the entire theory of rational human intelligence? Before answering this question, a crucial observation is in order: There is no rational human intelligence outside language. Since the afore-mentioned principle is part of rational human intelligence, it must be embedded in language.

11. There Is No Rational Human Intelligence outside Language

The statement in the title of this section may not be self-evident at this time and even invoke skepticism. However, once rational human intelligence will have been described in its entirety, it will appear that there is indeed no rational human intelligence outside of language (though there is more to language than rational human intelligence). In other words, it is possible to account for all of rational human intelligence without ever leaving language. Conversely, a significant component of language serves to propagate rational human intelligence.

The task at hand is to define the single theoretical principle inside the brain from
which all of rational human intelligence is derived. This principle is itself a principle of rational human intelligence. And since there is no rational human intelligence outside language, the single principle in question must be part of language.

But before identifying and defining the principle, something needs to be said about how the brain assimilates physical reality that is outside itself. The tree, the car, and the house were mentioned above as examples of physical bodies or mass outside the brain. It is obvious that there are reflections or biochemical imprints of the three physical bodies inside the brain, presumably stored by clusters of neurons.

The brain can evidently conjure up the image of a tree, or of a car, or of a house. But so can a cat or a cow. How does a human brain conjure up these images specifically in terms of rational human intelligence and therefore also in terms of language because there is no rational human intelligence without language? The human brain is able to think rationally about trees, cars, and houses. How so? And which single principle underlies all rational thinking about trees, cars, and houses?

12. How Does the Brain Store Reflections of Physical Reality in Terms of Rational Human Intelligence and Therefore in Terms of Language? Three Basic Biochemical Imprints in the Brain: 1) Image, 2) Sound Pattern, and 3) the Link between the Two

The present concern is not solely with how a brain stores a visual image of anything that it sees. Any animal brain can do this. The present concern is as follows: How does the brain make this image part of language and hence of rational human intelligence? In other words, how are the words of language formed in the brain, words such as “tree”, “car”, and “house”? How does an image become part of a word and hence also of rational human intelligence? It is clear that pronouncing the words “tree”, “car”, and “house” invokes the images of a tree and a car and a house. But there is more to a word than just the image.

Incidentally, the brain treats non-physical notions such as “friendship” for all practical purposes as physical. Thus, one can “extend friendship” and one can speak of a “short friendship” or a “long friendship”.
In order to make the perception of a physical body outside itself—such as a tree—into language and therefore into the object of rational human intelligence, the brain needs to generate three basic biochemical imprints, presumably all three stored by means of clusters of neurons. The biochemistry of this process is at the present time totally unknown. The physical and mathematical theory of rational human intelligence is a black box theory. It needs to be reconstructed from the outside without looking inside the black box, that is, inside the brain. Then again, in spite of this, the mathematical structure of the process can be completely accounted for.

I have elsewhere described the process by which the brain makes its perception of physical objects into language and hence into rational human intelligence [1]. The description of this process owes most to F. de Saussure, the founder of modern linguistics.

The three crucial biochemical imprints may now be discussed in succession.

13. First Basic Biochemical Imprint Presumably Stored by a Cluster of Neurons: Image

It is evident that the brain is somehow able to store an image of the tree as a physical body.

Before describing how the brain makes the image of the tree part of language and therefore of rational human intelligence, the following question needs to be addressed: On the assumption that no two brains have exactly the same general image of the tree as a physical body or mass, how is communication about trees between two brains possible?

The answer is, as the linguist F. de Saussure first clearly articulated: “In language, there is only difference”.

In other words, however much the respective images that two brains have of the tree may differ from one another, these respective images are in both brains sufficiently different from any other images that the two brains have stored of any other physical bodies for the two brains to experience no difficulty whatsoever in communicating about trees. The two brains can be confident that they are communicating about the same physical body, even though they do not quite imagine the same thing.
when thinking about trees.


In order to make the image of the tree into language, the brain needs a second biochemical imprint. It is the biochemical imprint of a sound pattern that corresponds to the biochemical imprint of the image described above.

The sound pattern differs from language to language. In English, the sound pattern is *tree*. In French, the sound pattern is *arbre*. In German, it is *Baum*.

Clearly, the brains of English speakers know that the sounds *tree* correspond to the image of that physical object typically bearing leaves. The biochemical imprint of the sound pattern therefore presumably inhabits the brains of the speakers of English whether they pronounce it or not—even when they are asleep.

15. Biochemical Imprints Associated with the Basic Biochemical Imprint of the Sound Pattern

There is no reason why the biochemical imprint of the sound pattern, say *tree*, should be absent from English speakers when it is not activated.

Two ways in which the sound pattern is activated or spurred into action are as follows. Each way involves a biochemical imprint of its own.

The first way is when the ears hear the word “tree” spoken. A connection is made between the ear and the basic biochemical imprint of the sound pattern so that the brain can recognize the word for what it is. The conduit from the ear to the imprint of the sound pattern must be a biochemical imprint in its own right. It is at present entirely unknown what this presumed imprint looks like. But about its existence there can be little doubt.

The second way is when the brain activates the imprint of the sound pattern by making it trigger the speech organs (vocal chords, tongue, lips, and so on) to pronounce the word. The conduit from the imprint of the sound pattern to the speech or-
gans must be a biochemical imprint in its own right. It is at present entirely unknown what this presumed imprint looks like. But about its existence there can be little doubt.

But there is more. Written language has so far been disregarded. Yet it is evident that, if the eye of literate speakers of English sees the word “tree” on a page, they will be able to associate it with the sound pattern tree. This presupposes the existence of more than one biochemical imprint. One biochemical imprint stores the knowledge of being able to read the word “tree”. Another biochemical imprint connects the brain’s ability to recognize the written word “tree” with the basic biochemical imprint of the sound pattern tree. A third biochemical imprint runs from the eye to the area where the written word “tree” is recognized for what it is.

There are presumably more biochemical imprints. It will be useful to try to define them all as an aid in searching for them inside the brain. There is no doubt that this search will be of enormous complexity. But it will be good to know what to expect beforehand.


It is not sufficient for the brain to store an image of the tree in one cluster of neurons and the record of the sound pattern tree in another cluster of neurons. The two have to be somehow linked to one another inside the brain. That link needs to be an electrochemical imprint or conduit in its own right. How could it not be?

F. de Saussure calls the combination of the image and the sound pattern the “linguistic sign (signe linguistique in French)”. Words are linguistic signs. The singular “sign” might potentially confuse because it describes a word as a single thing. Seeing a word written on a page reinforces the false impression that a word is a single thing. The expression “a word” is itself singular. However, a word is really two things, in fact, three.

F. de Saussure does not sufficiently stress that the link between image and sound
pattern needs to lead an independent biochemical existence in its own right. He is aware of the three way distinction between 1) what has been called above the image, 2) what has been called above the sound pattern, and 3) what has been called above the link. But he has names for 1) the image, 2) the sound pattern, and the combination of the two, but not for the link itself.

He calls the image the “signified (signifié)”, the sound pattern the “signifier (signifiant)”, and their combination of the two the “linguistic sign (signe linguistique)”. The link is left without its own name. The danger is real that the independent existence of the link between the two is obscured by the lack of a name.

F. de Saussure is otherwise quite aware that language is fundamentally not a tape recording or words written on a page, in other words, something outside the brain. Language is in its essence not located outside the brain but inside the brain, and F. de Saussure is on record as having said so. What is outside the brain are only emanations or manifestations or reflections of language. The words printed in a book are not language until a brain reads them. Until a brain engages them, the words are only ink on a page. However, in F. de Saussure’s time, it was not all that common to speak about language as something materialistic and biochemical, like eating and walking. As the most sophisticated vehicle of human culture and civilization, language has resisted interpretations of itself as a physical thing.

17. The Combination of the Three Basic Biochemical Imprints, F. de Saussure’s “Sign”, or the Attribute, as the Fundamental Component of the Physics of Rational Human Intelligence

The three basic biochemical imprints described above are evidently inextricably connected to one another. Like the Trinity of Christian theology, they are three units from one perspective but one unit from another perspective. F. de Saussure calls the three imprints together as a single unit the “linguistic sign (signe linguistique)” or just the “sign”.

I have called the same elsewhere the “attribute” [1] and will do so here as well. That does not mean that other terms might not have been suitable as well. Also, I use the term attribute in two meanings. On the one hand, the attribute is a property of
physical reality. On the other hand, the attribute is a property of the rationally thinking brain. The two realities are quite distinct. Then again, they are deeply connected because one is the direct source of the other. Still, calling the same thing two things that are really not is not entirely efficient. Perhaps, a better solution will present itself at some point.

18. Attribute and Quantity in the Framework of Theories of Physics

18.1. Quantity

My choice of the term “attribute” was mainly inspired by the need for a counterpart of “quantity”. The theory of rational human intelligence is mathematical. But its mathematics is not the mathematics of quantity, which most everyone would consider to be mathematics tout court.

The mathematics of quantity is concerned with that which is capable of increase or diminution. When applied to the physics of matter and motion, the mathematics of quantity pertains to properties of mass that are capable of increase or diminution, more specifically 1) size and 2) speed. Masses are either bigger or smaller and they move either faster or more slowly.

The three dimensions of the physics of matter and motion are 1) mass (as measured, say, in \( k \)), 2) space (as measured, say, in \( m \)), and 3) time (as measured, say, in \( s \)).

The two elementary ways in which these three dimensions are capable of increase or diminution are 1) that the mass can be bigger or smaller (as measured in \( k \)) or 2) move faster or more slowly (as measured in \( k \) in \( m \) over \( s \), or \( k \times \frac{m}{s} \)). There is no velocity without mass, or no 2) without 1).

In the three compound ways in which the three dimensions are capable of increase or diminution, dimensions appear more than once. They are 1) Force (as measured in newtons), 2) Work (or Energy) (as measured in joules), and 3) Power (as measured in watts).

1) Acceleration is an increase of velocity over time (\( \frac{m}{s^2} \)). But there is really no ac-
celeration without a mass that accelerates. An acceleration of a mass is a Force 
\( k \times \frac{m}{s^2} \), or newtons).

2) An acceleration of a mass over a certain distance is Work (or Energy) 
\( k \times \frac{m}{s^2} \times m \), or \( k \times \frac{m^2}{s^2} \), or joules).

3) And an acceleration of a mass over a certain distance in a certain time is Power 
\( k \times \frac{m}{s^2} \times \frac{m}{s} \), or \( k \times \frac{m^2}{s^3} \), or watts). Some engines can accelerate a mass over a certain 
distance in a shorter time than other engines. In other words, the former engines have 
more Power.

Quantity is a property of physical reality. To what does it correspond inside the 
thinking brain? It corresponds to such concepts as unit and number, in short, the con-
cepts of quantitative mathematics.

18.2. Attribute

Like the physics of matter and motion, the physics of rational human intelligence 
pertains to mass. But it does not pertain to properties of mass that are capable of in-
crease or diminution, like 1) size or 2) speed. The properties to which it pertains are 
incapable of increase or diminution. Let us call them attributes of physical reality to 
distinguish them from quantity as a property of reality.

These attributes make one mass or one physical body look different from another 
mass or another physical body, independently of size or speed. Two examples of 
attributes are being a tree and being green.

The brain observes physical reality through the senses, especially sight and hearing. 
It is presumably able to store a record of these observations by means of clusters of 
neurons. The attribute of physical reality has been transformed from something out-
side the brain to something inside the brain. But the record of an attribute by itself is 
not rational human intelligence. In order to make such a record into a building block 
of rational human intelligence, a sound pattern needs to be attached to it. Again, there 
is no rational human intelligence without language.
In the English language, the sound pattern attached to the biochemical record of a tree is *tree*. In French, it is *arbre*. In German, it is *Baum*.

By creating a sound pattern and linking the sound pattern to the biochemical record inside itself of an observed attribute of physical reality, the brain is transforming an attribute into a building block of rational human intelligence. Therefore, in order to function as a building block of rational human intelligence, the record of an attribute needs to be attached to a sound pattern. For the sake of brevity, I refer to the record of an attribute linked to a sound pattern inside the brain also as an attribute. Evidently, the attribute inside the brain is physically distinct from the attribute observed outside the brain.

19. The Attributes of Rational Human Intelligence: Inextricably Connected to Mass as Part of Their “Extensive” Interpretation

In rational human intelligence, attributes are always thought of as being associated with mass or physical bodies. After all, the theory of rational human intelligence is a theory of physics and theories of physics are concerned with mass. This is called the “extensive” interpretation of the attribute. Consider the attribute “red”. It is possible to think about what redness means independently from its association with any mass or physical body. This is the “intensive” interpretation of “red”. I have described the difference between the “extensive” interpretation and the “intensive” interpretation in more detail elsewhere [2]. In any event, the mind is not able to reason rationally about the attribute “red” without thinking about physical bodies that exhibit red as a property. Whatever else the brain knows about red is part of knowledge and not of reason.

20. Comparing Quantity to Attributes as Foci of Theories of Physics

20.1. In Terms of What Is outside the Brain and inside the Brain

Both quantity and attributes form the focus of different theories of physics. Additional
comparison between the two may shed more light on the latter.

A first comparison involves what is outside the brain and inside the brain. Both quantity and attributes are found outside the brain and inside the brain. Inside the brain, they are part of theories of physics. What inside the brain in terms of theory corresponds to the physical realities of quantity and attributes?

As regards quantity, there are concepts such as units of mass, space, and time, velocity, calculus, and so on. Are these concepts part of rational human intelligence? They are not. They are part of a certain type of knowledge. After all, it is not necessary to know calculus to be a rationally thinking human being.

As regards attributes, the crucial concept inside the brain is the link between a record of an attribute and a sound pattern. The two together, along with the link that binds them together, can also be called an attribute for brevity’s sake, as was suggested earlier.

### 20.2. A Dual Contrast

A second comparison of quantity and attributes as properties of physical bodies involves a remarkable dual contrast between the two. The brain exploits certain discrete properties of reality to make sense of the world outside itself.

If all properties were always the same in all physical bodies, no knowledge or intelligence would be possible on the part of the brain, it seems. Rather, the brain exploits differences with regard to properties. In this regard, quantity and attributes exhibit a remarkable relation of dual contrast. The dual contrast involves the following two interrelated facets:

1) All physical bodies exhibit the property of quantity. But not all physical bodies exhibit any given attribute, say “red”, as a property.

2) In regard to quantity, the difference between physical bodies is within the property itself because all physical bodies exhibit the property of quantity. “Within” applies in two ways in the physics of matter and motion or mass and motion.

With regard to mass, the difference applies within a single property from one physical body to another. In other words, as one moves from body to body, one stays
within the same property. For example, a bike is lighter than a car. As one differentiates a bike from a car in terms of mass, one moves from one physical body to another but stays within the same property. What changes is the quantity of the same property from physical body to physical body.

With regard to motion, the difference applies not only within a single property and from one physical body to another but also within a single physical body. A bike can go fast and it can go slow. In this case, the differentiation of the property of motion occurs within a single body. At the same time, the changing speed of the bike can be differentiated from the changing speed of the car. In this case, there is an added dimension to the differentiation. The differentiation applies from one physical body to another.

In regard to attributes, the difference between physical bodies is between properties because different physical bodies exhibit different properties.

21. Relation between the Physics of Matter and Motion and the Physics of Rational Human Intelligence

The physics of matter and motion presupposes the physics of rational human intelligence. Rational human intelligence is needed as a base platform for the brain to manipulate the theory of the physics of matter and motion. Rational human intelligence is the platform on which all kinds of knowledge are processed. Rational human intelligence is also the platform on which many other forms of intelligence are wholly or partly processed. Take, for example, emotional intelligence. It is possible to make a verbal emotional appeal to someone. The appeal requires the use of rational human intelligence. But there is more to the appeal than reason.

22. The Shared Interpretation of the Notation of the Theory of Rational Human Intelligence and the Theory of Matter and Motion as a Sure Indication of Their Common Status as Theories of Physics

Nothing lends more support to the notion that the theory of rational human intelli-
gence is a theory of physics—just like the theory of matter and motion—than the follow-
ing undeniable fact: its notation is to be interpreted in the same way as the not-a-
tion of the theory of matter and motion. This shared interpretation differs sharply
from the interpretation of the notation of (pure) mathematics.

It is important to note that the notation of pure mathematics may outwardly look
exactly like the notation of physics. But the interpretation differs radically. The stark
difference will be illustrated by means of examples below.

The notation of the physics of rational human intelligence is mainly due to G.
Boole. Yet, G. Boole himself defined what he was doing as a type of mathematics.
This is clear from the title of his most significant work: *An Investigation of the Laws
of Thought on Which Are Founded the Mathematical Theories of Logic and Probabil-
ities*. B. Russell even famously claimed that G. Boole was the inventor of pure ma-
thematics.

However, what G. Boole was doing was rather physics, even if he did not define it
as such. Then again, the type of physics that he was doing came with its own specific
mathematics and he defined most of that specific type of mathematics. In that sense,
his work on rational human intelligence was deeply mathematical.

Why physics and not mathematics? And why does G. Boole’s notation of the
theory of rational human intelligence reveal that it is a theory of physics and not of
mathematics?

Let us consider the following mathematical-algebraic Equation:

\[ x = yz. \]  \hspace{1cm} (2)

This formula is rather vague and its usefulness hence rather limited. Still, there are
solutions that are possible and solutions that are not possible. Solutions that are possi-
ble are as follows:

\[ x = 1; \quad y = 1; \quad z = 1; \]
\[ x = 2; \quad y = 1; \quad z = 2; \]
\[ x = 2; \quad y = 2; \quad z = 1; \]  \hspace{1cm} (3)

and so on.
A solution that is not possible is as follows:

\[ x = 1; \ y = 2; \ z = 2. \]

Now let us consider the following Equation from physics:

\[ s = vt. \] (4)

The mathematical Equation (4) has the same appearance as the physical Equation (2). But there is a fundamental difference, as will be clarified below.

In Equation (4), \( s \) stands for distance, \( v \) for speed, and \( t \) for time. I disregard the difference between speed (vectorless) and velocity (vectorial) and between distance (vectorless) and displacement (vectorial).

Let us assume that a car is traveling at a uniform 10 meter per second. How far will it have traveled after five seconds? The following simple calculation provides the answer:

\[ s = vt \]
\[ = 10 \text{ m/s} \times 5\text{s} \]
\[ = 50 \text{ m} \] (5)

Another Equation of the same outward appearance as (4) is I. Newton’s Second Law, according to which force equals mass multiplied by acceleration:

\[ F = ma. \] (6)

At the surface, the mathematical Equation (2) and the physical Equations (4) and (6) look alike. But they are fundamentally different. The difference reveals a fundamental distinction between mathematics and physics. How so?

A simple test reveals the difference. Let Equation (2), Equation (4), and Equation (6) be changed in the following identical manner, in that the second letter symbol is moved to the left side of the Equation sign:

\[ xy = z; \] (7)
\[ sv = t; \] (8)
It is clear that Equation (7) is still correct, though with different solutions, whereas Equations (8) and (9) are wrong.

The second Equation is wrong because distance multiplied by speed is obviously not time. Changing the numbers in (5) does not make it less wrong, as in:

\[ 5 \text{ m} \times 10 \text{ m/s} \neq 50 \text{ s}. \]

The solutions listed in (3) are not valid in Equation (7). That does not mean that Equation (7) is itself invalid. But it is just valid for different solutions. By contrast, Equations (8) and (9) are invalid under any circumstances.

Equation (7) is pure mathematics. After all, Equation (7) makes no direct reference to physical reality. There is no reference to any properties of physical bodies such as mass, position in space and time, or (electric) charge, and so on.

The properties of physical reality stand in certain specific fixed relations to one another. Reality is as it is (for reasons whose deeper origins are not known). It is therefore not possible to change Equations such as (4) and (6), as is done in Equations (8) and (9), without distorting those relations and presenting a false picture of reality.

By contrast, the relation denoted by Equation (2) does not refer to specific properties of physical bodies and the relations between these properties. Changing Equation (2) to Equation (7) therefore does not distort reality because \( x, y, \) and \( z \) do not refer to specific properties of physical bodies. The values of \( x, y, \) and \( z \) that are valid just change.

In the end, all mathematics is rooted in physical reality. But Equation (2) relates to physical reality in a very general way.

The connection with physical reality limits what one can do with an Equation like (2). Then again, the rules of algebra still apply. Thus, from Equation (2) it follows that

\[ v = \frac{s}{t}, \quad (10) \]
Defining the boundaries between pure mathematics and mathematical physics more precisely is beyond the scope of the present paper. May it suffice to note that the simple test presented above reveals a critical difference between the two.

What matters presently is whether the mathematics of the theory of rational human intelligence aligns itself with pure mathematics, as B. Russell and perhaps also G. Boole himself assumed, or with physics.

It will be useful to subject the mathematics of rational human intelligence to the same simple test as above. Let us consider a statement of rational human intelligence that exhibits the same anatomy as the Equations cited above, namely the following:

\[ f = db \]

(11)

The Flemish or the Flemings are (all of the) Dutch-speaking Belgians.

There are three official languages in Belgium: 1) Dutch; 2) French; and 3) German. The Dutch of Belgium is also called Flemish or South-Dutch, as contrasted with the North-Dutch of the Netherlands to the north of Belgium. In other words, Flemish is a kind of Dutch. The relation between Flemish and the Dutch spoken in the Netherlands is very similar to that between American English and British English.

Let the simple test proposed above now be applied to Equation (11). The focus is on the following change to Equation (11):

\[ fd = b. \]

(12)

If this Equation makes sense, then the mathematics of rational human intelligence would appear to be very much like pure mathematics. If the Equation does not make sense, then the mathematics of rational human intelligence would appear to be very much like the mathematics of physics.

Equation (12) can be put into words as follows:

“The Dutch-speaking Flemings are (the same as all) the Belgians”.

It is evident that this statement is a falsehood. There are Belgians that do not speak Dutch. Moreover, Flemings all speak the variety of Dutch called Flemish; the result is a bit of a tautology.
The inability to interpret Equation (12) strongly suggests, to say the least, that the theory of rational human intelligence is a theory of physics. It shares a striking characteristic with the theory of matter and motion.

In the theory of the physics of mass and motion, it is possible to derive Equations such as

$$ v = \frac{s}{t} $$

from

$$ s = vt \quad (4) $$

Is the same possible in the theory of rational human intelligence? It is. But the interpretation of the notation of division differs.

The focus is on Equations such as the following two, which are derived from Equation (11):

$$ \frac{f}{d} = b \quad (13) $$

$$ \frac{f}{b} = d \quad (14) $$

The two Equations tell us who the Belgians \((b)\) are and who the Dutch \((d)\) are on the basis of the information provided in Equation (12).

At first sight, it seems as if Equations (13) and (14) state that the Belgians are the Flemish divided by the Dutch; the Dutch, the Flemish divided by the Belgians. What does this mean? Clearly, this cannot be the division of quantity mathematics.

G. Boole’s use of the sign for division has drawn much criticism and has done much to undermine any chances of acceptance of his entire algebra. Yet, the concept behind “division” is fully valid. J. Venn was the first to clarify its real life meaning [3].

This is not the place to discuss the issue at length. A couple of observations will
need to suffice. It is clear that we cannot know from Equation (11) whether there are Belgians outside of the Flemish and, if so, who they are. Or whether there are Dutch speakers outside of the Flemish and who they are.

Equation (13) tells us that \( b \) is a class that yields \( f \) if only \( b \) that is also \( d \) is taken. And likewise for Equation (14).

But what kind of sets or classes of physical bodies are \( b \) and \( d \) according to Equations (13) and (14). Without entering into detail, the answers can be obtained by G. Boole’s formula of development, discussed in detail in the article cited in [1] and [2]. The answers are as follows:

\[
b = fd + \frac{0}{0} \overline{f} \overline{d}
\]

“The Belgians are all those that are Flemish and Dutch-speaking and none, some, or all (\(0\)) of those who are neither”;

(15)

\[
d = fb + \frac{0}{0} \overline{f} \overline{b}
\]

“The Dutch speakers are all those that are Flemish and Belgian and none, some, or all of those who are neither”.

(16)

According to Equation (11), the Flemish are part (or all) of the Dutch speakers; the non-Dutch speakers part (or all) of the non-Flemish, the Flemish part (or all) of the Belgians, and the non-Belgians part (or all) of the non-Flemish. A simple Venn diagram with Flemish at the intersection of two circles “Dutch” and “Belgian” makes the matter clear. “Or all” cannot be excluded on the basis of just Equation (11). The positive exclusion requires extraneous knowledge.

Accordingly, (15) and (16) can be simplified as follows:

\[
b = f + \frac{0}{0} \overline{d}
\]

“The Belgians are all the Flemish and none, some, or all (\(0\)) of the non-Dutch speakers”.

\[
d = f + \frac{0}{0} \overline{b}
\]

“The Dutch speakers are all those that are Flemish and none, some, or all of those who are not Belgians”.
23. The Link between Image and Sound Pattern: At Once Arbitrary and Mandatory

The way in which sounds refer to an image exhibits a delicate balance between an arbitrary side of the coin and a mandatory side of the coin. F. de Saussure was the first to describe this balance in detail as part of a comprehensive theory of how language functions. But G. Boole was also quite aware of the balance, as I have noted elsewhere. However, G. Boole is not mentioned anywhere in any histories of linguistics.

Whence arbitrary and whence mandatory?

As regards arbitrary, it does not really matter what sounds that one uses to refer to a certain physical body. Any and all sounds are suitable. The best evidence for this observation is that all the languages of the world use different sounds to refer to the image of a tree. How could it possibly matter which sounds are used? The choice is completely arbitrary in this regard.

So who first chose the sounds to denote the tree in a specific language? These choices were made in prehistoric times, before the time of writing. There is no evidence about language before the time of writing. The precise circumstances in which certain sounds were selected, presumably unconsciously, for certain images are therefore lost forever to empirical observation. Obviously, the original sounds have changed over time.

So what about mandatory? It seems more than obvious that, once certain sounds have been selected to refer to a certain image in a completely arbitrary way, two speakers of the same language are bound to use these sounds as a necessary precondition for mutual comprehensibility.

For example, persons born into an English-speaking community are compelled to use the sounds tree to refer to the image of the tree if they wish to be understood by other speakers of English.

Speakers do not experience the need to refer to the image of the tree by means of the sounds tree as mandatory. And yet, while growing up they are unconsciously buying into a social contract that requires them to use those precise sounds to refer to that precise image. They accept this social contract without hardly being aware that
they did.

In sum, the mandatory facet has everything to do with the fundamentally social nature of language. Language is a tool of communication between people. If speakers of the same language wish to be understood, they need to refer to the same image by means of the same sounds. It would be difficult for a group of speakers of English to call a cow a horse and a horse a cow. But if they somehow could, they would still functionally communicate about cows and horses.

24. The Fundamental Principle inside the Brain from Which the Entire Theory of Rational Human Intelligence Is Derived

Formulation of the fundamental principle located in the brain:
Each attribute inside the brain contrasts with, or is differentiated from, that which it is not, more specifically all the other attributes.

The fundamental contrast involved is the following:
Between what something is and what it is not.

We finally arrive at what is anticipated in the title of this Preface: the definition of the single physical, theoretical, fundamental principle from which all of rational human intelligence is derived.

It was noted above that this theoretical principle, located inside the brain, is rooted in a fundamental characteristic of physical reality outside the brain. This fundamental characteristic, which all physical bodies of any kind have in common in terms of their form or shape or appearance, is the following:

Root of the fundamental principle in a fundamental characteristic of physical reality:
All physical bodies exhibiting a certain property or attribute in terms of form or shape or appearance contrast with, or are differentiated from, all the physical bodies that do not exhibit that property.

This fundamental characteristic involves a contrast. How is this fundamental cha-
racteristic transformed into a physical, theoretical principle inside the brain? When
the brain perceives anything outside itself, it forms an image of that perception, pre-
sumably stored by means of a cluster of neurons. Someday, it will be possible to de-
fine the constitution of this cluster of neurons.

There is no reason not to assume that the form or shape or appearance of this image
inside the brain contrasts with, or is differentiated from, all the other images inside
the brain of physical bodies that do not exhibit their form or shape or appearance.
This too is a contrast. And the contrast is very much physical. But now, it is no longer
a property of reality outside the brain. It has become a property or reality inside the
brain.

Is this contrast the single principle from which all of rational human intelligence is
derived? It is not. The reason is that rational human intelligence does not exist outside
of language. The form or shape or appearance of the afore-mentioned image needs to
be linked to a sound pattern. I have called 1) the image, 2) the sound pattern, and 3)
the link between 1) and 2) together, as a single unit, the attribute. F. de Saussure calls
it the linguistic sign.

Accordingly, the single theoretical principle from which all of rational human in-
telligence is derived can be formulated as follows.

Each attribute inside the brain contrasts with, or is differentiated from, all the oth-
er attributes.

This principle is very much physical and material. Each attribute is presumably lo-
cated in its own space in the brain. And each space is evidently here and not over
there.

25. An Observation on Said Fundamental Principle
 and the Evolution of Mankind and of Human
 Intelligence

The short and terse formulation of the fundamental principle from which all of ration-
al human intelligence is derived revolves entirely around the following concept:

The contrast between what something is and what it is not.
The principle is here called digital, using a metaphor from computer science. The term is slightly anachronistic. But “digital” has now become quite common as a term referring to two state contrasts.

Outside the brain, the contrast is that between physical bodies exhibiting a certainty property and any other physical bodies not exhibiting that property. Inside the brain, this means the contrast between an “attribute” (see above) or “sign” (F. de Saussure) corresponding to that property and any other attributes.

It is proposed that, over the course of many centuries—yes, millennia—the human race exploited this principle in all kinds of ways to obtain for itself the totality of its rational human intelligence as it is today. To this day, rational human intelligence serves as the common, unchangeable, fixed platform of countless verbal exchanges between members of the human race. It is a platform that human beings expect to find very much present whenever meeting something new and engaging in communication. Human beings are well aware that there are countless other forms of intelligence according to which everyone differs from everyone else: artistic, emotional, musical, physical, rhetorical, and so on, and so on. Yet, they are fully confident that they can go up to other persons and talk to them and make sense. This can go from just asking for directions in traffic to engaging in sophisticated discussions about philosophy. And this common platform has been developed from one single principle over the millennia. People assume the presence of rational human intelligence without giving it much thought.

It is also clear that the human race did not develop rational human intelligence according to a carefully considered plan. How could it be? People did not sit around a table like a committee of philosophers to decide how intelligence would develop in their brains. Rather, rational human intelligence developed in the brains of many, many generations of human beings over a very long time rather unawares or unconsciously.

Even a Neanderthaler must have noticed that there is a contrast between what a tree is and what it is not. Clearly, a tree is not a rock or a river. However, it may not readily be apparent to the student of the evolution of mankind that this simple awareness ultimately over tens of thousands of years led the human brain to develop all of its rational human awareness. All of it. Without exception. As for Neanderthalers themselves, they could not do much more than grunt, one assumes.
History is by definition the period from which we have written sources. What becomes before is prehistory. In that sense, history begins about 5000 years ago, around 3000 BC. It seems obvious that there was language many thousands of years before the earliest attested writings. Nothing is known empirically about the origin of language or about the many thousands of years that it existed while only being spoken and not written. No evidence survives from those years. Linguists have otherwise drawn certain conclusions about what language was like in those earlier years by extrapolating from language as it is attested in writing in later times.

26. Contrast Digitality (ConDi)

26.1. Definition

One of the first digitalities, if not the first, that the brain produced as it constructed rational human intelligence is what I propose to call contrast digitality. I am sure that other names would have been suitable as well. What is contrast digitality and how does it derive from the fundamental principle described above?

A brief definition first. Elaboration follows below.

As attributes or “signs” physically emerged inside the brain, the fundamental principle described above at some point triggered a need in the brain to refer positively to what each of those attributes is not. The physical phenomenon of contrast digitality made this possible. The principle itself is about the contrast between what something is and what it is not. The attributes denote what something is. Contrast digitality is all about denoting what an attribute is not.

Importantly, the negation of an attribute is itself an attribute. It allows the brain to make reference to a well-defined group or class or set of physical bodies outside itself.

26.2. The Relation between the Fundamental Principle from Which All Rational Human Intelligence Is Derived and Contrast Digitality

Are the fundamental principle and contrast digitality the same? They are not. But they
are intimately related. The fundamental principle is about the contrast between what something is and what it is not. Contrast digitality is about denoting what it is not, that is, making reference to all the physical bodies that do not exhibit a certain attribute. Contrast digitality is a way in which the brain has acquired the ability to refer to what an attribute contrasts with according to the afore-mentioned fundamental principle.

26.3. Analysis

It may be assumed that some human brain somewhere for the first time linked the image that it had of a tree with a certain sound pattern, everything presumably stored by clusters of neurons. In modern English, the sounds ended up being tree. Once in the possession of this image linked to a sound pattern, the brain must soon have been able to do a number of things, including instructing the vocal organs to produce the actual audible sounds connected in some way to the sound pattern inside the brain. Evidently, the sound pattern is stored in the brain at all times, even when it is not pronounced, even when one is asleep. With the ears, the brain could also hear the sound pattern whenever it pronounced the sounds itself or when other brains triggered pronunciations. The brain was therefore able to match the auditory perceptions of the ear with the muscle and breath movements of the vocal organs. How this sophisticated mechanism operates inside the brain will need to be determined by many anticipated exciting discoveries in biochemistry and neurology. But there is no doubt that there is such a mechanism. How many decades will it take to establish its exact physical constitution?

Newborns would evidently pick up from their mothers whatever the latter were able to do in terms of language and rational human intelligence. There was no need for babies to find it all out by themselves from scratch.

That much for calling a tree a tree. But where does contrast digitality come in?

The accomplishment of contrast digitality may well have stood at the beginning of all efforts of brains to engage reality to meet on a common platform. Once it was possible to call a tree a tree, the stage was set for the emergence of digitality in the human brain. At some point, the fundamental principle described in the previous section began manifesting itself. Again, the principle involves the contrast between a tree and what is not a tree. The brain confronted this contrast, first outside itself in what it
perceived in physical reality and then inside itself when it created an attribute or “sign” consisting of an image and a sound pattern and the link between the two.

Quite simply, the brain found itself in an urgent need, as it were, to unambiguously make reference to all that is not a tree. Because there sure is such a thing. But it originally lacked the notation. How to refer directly to all physical bodies that are not trees? This is when negation was born. How exactly this happened will never be known. But there is no doubt from what we know about language that it did.

There are as many definitions of negation as there are students of the phenomenon. These definitions can acquire extremely high levels of sophistication. Yet, it is proposed here that negation requires a strictly physical and mathematical interpretation, nothing more, nothing less. It may take some convincing that negation is all about mathematics supporting a theory of physics.

Negation manifests itself in different ways in the brain in different languages, including in the brains of English speakers in the words “no”, “not”, “not”, “nobody”, “none”, “nowhere”, “asymmetric”, “nonstarter”, and so on. These are all different manifestations of the same unchanging concept.

26.4. Negation as an Operator and Not an Attribute

In the physics and mathematics of rational human intelligence, negation is an operation and “not” is an operator—just as addition is an operation and “+” is an operator in quantitative mathematics.

Accordingly, a word like “not” functions on an entirely different level than most other words in language. Dictionary definitions do not reflect this view. Yet, the view in question involves the coherence and simplicity that one has every right to expect from mathematical definitions.

One indication that negation is better regarded as an operator and not as an attribute is that it cannot really exist or function by itself. Thus, it does not even in “No.” as an answer to the question “Did you go?” “No.” is elliptical. “I did not go” or the like has been omitted or not repeated. “None” is an abbreviation of “no one”, in which “no” accompanies “one”.
Also, negation can accompany all attributes. It is therefore rather something that is done to attributes than being an attribute itself.

26.5. Negation as the Mother of All Meanings

It is true that not everything is in actuality negated in spoken or written language. But it could be. The potential is always there. And there are no exceptions. Everything can possibly be negated. There is nothing that cannot be negated, from individual words to phrases to sentences, as in “not from non-individual non-words nor to non-phrases nor to non-sentences”.

Importantly, negated attributes are just as much attributes as non-negated attributes. They refer to a class or set of physical bodies just as much as an attribute.

Languages consist of many words and all words have meaning. But negations are special as words conveying meaning. Their status is unique. Negation is in a sense the mother of all meanings of language.

The following metaphor may be useful. Rational human intelligence as expressed by human language consists, after a manner of speaking, of two parallel universes. One is the affirmative universe and the other is the negated universe. The two universes are parallel to one another in that every component of the affirmative universe has a counterpart in the negated universe. There is perfect correlation between the two. One is like the mirror image of the other.

26.6. The Boolean Operator NOT as the Equivalent of Negation in Computer Science

The equivalent of linguistic negation in computer science is the so-called Boolean operator NOT. This does not mean that the Boolean operator NOT functions in exactly the same way in computer science as it does in rational human intelligence. It does not—even if there are many similarities. I would hope to elaborate on the similarities and differences between the two elsewhere. What matters presently is that NOT is as all-pervasive of computer architecture as the fundamental principle of rational human intelligence is all-pervasive of rational human intelligence.
27. Selection Digitality (SelDi)

27.1. Selection of an Image outside Rational Human Intelligence

It is an undeniable fact that the brain is able to call to mind the appearance or image or concept of a physical body at the exclusion of all other images, for example, the image of a tree. Abstract concepts such as wisdom and friendship are for all practical purposes treated as physical bodies by the brain. They can be great or long, one can give them and receive them, and so on, just like physical bodies.

How the brain focuses on an image biochemically is at this time unknown. I propose to call this biochemical process selection. But other terms are presumably suitable, such as focus or conception.

Selection of an image is not rational human intelligence. An animal is presumably capable of it. If selection of an image is not rational human intelligence, then what is? Selection of an attribute is. No rational human intelligence without attributes.

27.2. Selection of an Attribute as Part of Rational Human Intelligence

Selection cannot be part of rational human intelligence as long as an image—say, an image of a tree, or also an image of abstract notions such as friendship or wisdom—is not linked to a sound pattern inside the brain. The result is what I call an attribute and what F. de Saussure calls a “sign”. The biochemical image of an image, say of a tree, is linked biochemically to the biochemical record of a sound pattern, in English to the sound pattern tree. How the brain accomplishes this is at this time also unknown. I call the image and the sound pattern along with the link as a third component together an attribute. Each attribute has three parts: 1) an image of some kind; 2) a sound pattern; 3) the link between the two.

Importantly, attributes reside in the brain even when the brain is not doing anything with them, as when it is asleep.

Because of the biochemical link that exists between the image and the sound pat-
tern, the brain will easily be induced to call forth the sound pattern—even if just internally (that is, without instructing the speech organs to produce the sounds in question)—whenever the eyes see, outside the brain, the image that corresponds to the image inside the brain, whether in physical reality or in a picture in a book. In other words, the brain is induced to select the attribute.

Conversely, because of the same link, the brain will easily be induced to call forth the image in question whenever the ears hear the associated sound pattern or whenever the eyes see the word that is the written expression of the sound pattern on a page. In this case too, the brain is induced to select the attribute.

27.3. Attributes inside the Brain and outside the Brain

In regard to rational human intelligence, attributes manifest themselves in two ways, outside the brain and inside the brain. Outside the brain, attributes are properties of physical bodies. Rational human intelligence is a phenomenon of physics. Inside the brain, an image of these properties is linked to a sound pattern. Inside the brain, the attribute consists of three connected biochemical imprints.

By adding negation as an operator to an attribute, the brain obtains a negated attribute. This operation has been called Contrast Digitality. Outside the brain, a negated attribute corresponds to all the physical bodies that do not exhibit a certain attribute. Contrast Digitality is all about the ability to make reference to all the physical bodies that do not exhibit a certain attribute in addition to making reference to the attribute itself. It corresponds more or less to the operator NOT of computer science.

Contrast Digitality is not quite about selection but about the tool that is needed to make a certain type of selection, namely a selection of negated attributes.

27.4. Relation between Attributes outside the Brain as Properties and Attributes inside the Brain: A Theory of Physics on Two Levels

Rational human intelligence is a physical phenomenon. This physical phenomenon exists inside the human brain. In that regard, the theory of rational human intelligence is a theory of physics, though with its own mathematics. But the theory of rational
human intelligence is a theory of physics on another level as well. The physical phenomenon inside the brain relates to certain properties of physical bodies outside the brain. Theories of physics pertain to the mathematical laws that govern properties of mass or physical bodies. And so does the theory of rational human intelligence. Therefore, the theory of rational human intelligence is a theory of physics in that sense as well. In sum, the theory of rational human intelligence describes not only a certain facet of physical reality but also what the brain does physically when it engages this facet of physical reality. The result is a description of the common platform on which all rationally thinking human beings can expect to meet.

In sum, when the brain selects attributes inside itself, it also conceives that as selecting the physical bodies exhibiting these attributes.

### 27.5. Attributes as Properties of Physical Bodies

As part of rational human intelligence, the brain needs to think of attributes as properties of physical bodies. It may be possible for the brain to think about what it means to be green independently of any physical body that is green. But for the attribute “green” to be used as part of rational human intelligence, it must be interpreted as an attribute of physical bodies.

### 27.6. Selection Digitality: Selection by Means of One Attribute

As a consequence of the fundamental principle from which all rational human intelligence is derived, each attribute involves two selections:

1) the selection of the attribute itself and
2) the selection of that which is not the attribute.

For example, the attribute “French” involves two selections:

1) “French” and
2) “not French” or “non-French”.

The selection of the attribute evidently produces, inside the brain, the attribute itself.
The selection of that which is not the attribute also produces the attribute, but accompanied by negation as the manifestation of Contrast Digitality. Accordingly, Contrast Digitality plays a crucial role inside selection as a component of rational human intelligence. It is the tool that makes the selection of a certain type of attribute possible, namely a negated attribute.

Again, it is crucial not to lose sight of the fact that the selection of attributes is also the selection of physical bodies that exhibit the attributes. In how many ways do physical bodies exhibit the attribute “French”. It seems obvious that the answer is: two ways. Physical bodies can either be French or they cannot be French.

In terms of selection digitality, the brain’s attribute “French” selects the physical bodies that are French. The attribute “French” augmented by the negation as an operator selects the physical bodies that are not French.

By being combined with negation as an operator, an attribute does not lose its status as an attribute. A negated attribute is still an attribute. It makes reference to physical bodies in reality just as much as affirmative attributes do. “Tree” refers to a certain class of physical bodies and so does “what is not a tree”.

One of the most important characteristics of all the possible ways of selection is that they encompass all that is possibly thinkable. For example, all that is a tree and all that is not a tree add up to all that is thinkable. Accordingly, the universality that is a necessary condition for a mathematical description is guaranteed.

27.7. The Impossibility of Selecting Physical Bodies by Means of Two or More Attributes Alone by Themselves

As regards two or more attributes, let us consider the simple case of just two attributes. It will be easy to see that it is representative of cases in which there are more than two attributes. In other words, one can extrapolate from the simple case of two attributes to all cases involving more than two attributes.

Take, for example, the two attributes “French” and “doctor”. According to section 27.6, each attribute viewed by itself allows two selections of physical bodies: 1) the
attribute in the brain can be used all by itself to select physical bodies that exhibit the corresponding attribute in physical reality as a property. The attribute augmented in the brain by negation can be used to select physical bodies that do not exhibit the attribute as a property.

But what about selection by means of the two attributes together?

Take, for example, the two attributes “French” and “doctor”, both without negations. How can the brain use these attributes to select physical bodies exhibiting the attributes as properties in the way that the attribute “French” and the attribute “doctor” each can select physical bodies by itself? It cannot.

The brain cannot use two or more attributes by themselves alone to select physical bodies in the way that single attributes can. What does it need? It needs two operators, AND and OR, nothing more, nothing less.

27.8. The Need for AND and OR to Select Physical Bodies by Means of Two or More Attributes

At stake is a theory of physics with its own mathematics. All possible cases always need to be strictly accounted for when it comes to mathematics. It is not possible to select for two or more attributes inside the brain without two operators.

The two operators correspond more or less to the AND and OR gates of computer architecture. There are no other gates besides these two in addition to NOT gates. Any other gates, XOR gates, NOR gates, and so on, are all constructed from these three alone.

I will refer to the two operators of the selection digitality of rational human intelligence as AND and OR, for brevity’s sake, borrowing terms from computer science. The borrowing is slightly inappropriate. While AND and OR function more or less the same in computer science and in rational human intelligence, there are differences. These differences will need to be examined elsewhere.

It is necessary to propose a definition of AND and OR that is both 1) physical and 2) mathematical. In terms of being physical, AND and OR ought to reflect something fundamental about physical reality as perceived by the brain. In terms of being ma-
27.9. The Physics and Mathematics of AND and OR in the Brain: An Observation about Physical Reality

AND and OR are an excellent confirmation of what I believe to be the fact that the theory of rational human intelligence is a theory of physics with its own mathematics. Theories of physics begin with the observation of the properties of physical bodies.

Let us consider physical bodies, then, in their relation to the two attributes “French” and “doctor”. The attributes “French” and “doctor” that are part of the (English-speaking) brain reflect attributes as properties of physical bodies. All begins, as in any theory of physics, with a clear and stark look at physical reality. If being French and being a doctor are properties of reality, then how do these properties manifest themselves in physical bodies?

Physical bodies are either French or not French and either a doctor or not a doctor. For the selection of those physical bodies that are not French and are not a doctor, the brain needs the operator NOT.

But what does one know about physical bodies when two attributes are involved, both 1) being French and 2) being a doctor.

Well-known elementary notions pertaining to permutations and combinations that lie at the origin of the theory of probabilities provide the answer.

If a coin is tossed twice, then there are four possibilities: 1) tossing first heads and second heads; 2) first heads and second tails; 3) first tails and second heads; and 4) first tails and second tails.

Likewise, there are four possibilities according to which a physical body can exhibit a first attribute such as being French and a second attribute such as being a doctor: 1) being French and being a doctor; 2) being French and not being a doctor; 3) not being French and being a doctor; and 4) not being French and not being a doctor. The four possibilities may be presented in the following list:
Two attributes yield four, or \(2^2\), combinations of two attributes, affirmative or negated. Three attributes—say, “French” \(f\), “doctor” \(d\), and “male” \(m\)—yield eight, or \(2^3\), combinations of three attributes, affirmative or negated. In general, \(n\) attributes yield \(2^n\) combinations of \(n\) attributes, affirmative or negated. The fundamental principle is reflected in the base 2. And in a sense, one attribute yields two, or \(2^1\), combinations of one attribute, that is, the affirmative attribute and the negated attribute.

The progression \(2^1\), \(2^2\), and \(2^3\), and beyond, can be clarified by presenting the three attributes as follows, with \(\overline{f}\) representing non-\(f\), and so on:

\[
\begin{array}{ccc}
  f & d & m \\
  \overline{f} & \overline{d} & \overline{m}
\end{array}
\]

Either of the two members of the first column can be combined with either of the two members of the second column. The result is \(2 \times 2\) or four combinations. Each of these four combinations can be combined with the two members of the third column. The result is \(2 \times 2 \times 2\) or eight combinations. And so on.

The following is a list of all the possible ways in which physical bodies can present themselves in relation to just two attributes:

1) French doctor
2) French non-doctor
3) non-French doctor
4) non-French non-doctor

This much about physical bodies and physical reality, the basis of any theory of physics. Now on to rational human intelligence.

27.10. The Physics and Mathematics of AND and OR inside the Brain

The physical world looks as follows according to 27.9. Four classes or sets make up
everything thinkable:

1) all who or all that are or is French and a doctor;
2) all who or all that are or is French and not a doctor;
3) all who or all that are or is not French but a doctor;
4) all who or all that are or is neither French nor a doctor.

This much for physical reality.

But what about the brain? The brain aims to select certain physical bodies by means of attributes that it stores. These attributes correspond outside the brain to attributes as properties.

The four relevant attributes inside the brain are as follows:

1) French
2) non-French
3) doctor
4) non-doctor

Each of these four attributes can be used individually to select a certain class or set of physical bodies. But as was said, two attributes together cannot. Why not?

Take for example, the two attributes 1) French and 3) doctor. Let the brain call to mind these two attributes that are stored inside itself in order to select specific sets or classes of physical bodies. It appears that a fundamental problem arises, the following.

Where in physical reality does one find the attributes as properties of physical bodies that correspond to the two attributes “French” and “doctor” inside the brain? It appears that the corresponding attributes as properties are found in three of the four classes or sets listed above:

1) all who or that are or is French and a doctor;
2) all who or that are or is French and not a doctor; and
3) all who or that are or is not French but a doctor.

It is at this point that the brain encounters a dichotomous quandary, as it were. The key question that lies at the origin of the operators AND and OR as physical and ma-
thematical phenomena is as follows: To which of the three classes or sets 1), 2), and 3) listed above do the two attributes inside the brain “French” and “doctor” make reference?

There is no clear answer to the question. What is otherwise clear is that there are really only two possible answers to the question. What are they and what is the difference between the two?

Physics is about physical bodies. The attributes of rational human intelligence inside the brain make reference to attributes as properties of physical bodies outside the brain. There are two ways in which attributes inside the brain such as “French” and “doctors” can make reference to attributes as properties of physical bodies.

Either the two attributes are always exhibited by the same bodies. In other words, there is only reference to physical bodies that exhibit both properties. Only class 1) listed above is referred to in this case. This is one way in which the brain could very well have the sense that it is referring to all instances of both attributes. The desire is for referring to both attributes together. Finding them together in a single physical body is definitely a striking mode of togetherness. The togetherness of both attributes in a single physical body prevails.

Or the two attributes can be distributed across physical bodies, whereby they may or may not co-occur in a single body. Classes 1), 2) and 3) listed above are referred to in this case. This is a second way in which the brain could very well have the sense that it is referring to all instances or presences of both attributes. The desire is for referring to both attributes. In this case, the brain makes reference to all instances of the two attributes wherever they can be found. Nothing is left out. The all-encompassing reach of both attributes together prevails in this case.

It is tempting to assume that the counterpart of the first way, making reference to just class 1), is making reference to just classes 2) and 3). The latter seems complementary to the former. But there is a problem. How could the brain call forth the two attributes “French” and “doctor” and somehow exclude—by the mere evocation of these two both attributes, without the support of any other signals—any reference to physical bodies in which both co-occur?

The first way is about the junction of attributes into single bodies. The second way is about distribution of attributes across bodies. In the course of the history of human-
kind, the brain was confronted with the problem that two or more attributes can refer to both ways. In response, the brain produced the operators AND and OR, expressed in English by “and” and “or”. “Or” derives from “other”, that is, “other” physical bodies and not the same. “And” may derive from the same word as “in”, that is, one attribute “in(side)” the other attribute.

In sum, the operators AND and OR came about naturally in a strictly physical and mathematical way in response to a physical and mathematical necessity.

I hope to treat Selection Digitality in detail elsewhere.

“French OR doctors” is understood as including those that are both if the brain does not give all that much thought to the matter. Still, the desirability arises to explicitly signal that such inclusion is not the case. Toward that purpose, the brain derived the compound operator EITHER OR from the simple operator OR. The relation between EITHER OR and OR clearly reflects the fact that EITHER OR marks a special case of OR. Something special requires an additional mark. EITHER is the additional mark.

This matter too, I hope to treat at greater length elsewhere.

27.11. AND and OR in the Extension of the Mathematics of Rational Human Intelligence

The physics of rational human intelligence operates by its own specific mathematics. The mathematics in question may be called digital. Digital types of mathematics exist outside rational human intelligence. One such type is the mathematics that steers computer architecture, often called Boolean algebra. There is much similarity between the mathematics of computer science and the mathematics of rational human intelligence. But there are also differences. I hope to discuss the matter elsewhere.

The present concern is with the mathematics of rational human intelligence. In general, mathematics can be extended on and on in its own characteristic deductive way. The mathematics of rational human intelligence is no exception. It too can be extended into greater completion. The result is mathematical inferences that, while being of the exact same kind as the mathematics of rational human intelligence, are not really for the most part explicitly used by the brain for the purpose of rational
human intelligence.

Still, if mathematics is expanded independently and correctly by itself, it stays in tune with physical reality as perceived by the brain. The mathematics of rational human intelligence is no exception. In this regard at least, it retains close ties with rational human intelligence. Indeed, on closer inspection, the brain can recognize itself in any extensions of its own mathematics.

In his *Laws of Thought*, G. Boole does not really make a difference between the mathematics used by rational human intelligence and its extension. Nor does J. Venn.

A good example of an extension is G. Boole’s generalization of the syllogism to any number of terms and premises, which I have described at length in the article cited in [1] and [2]. It is not necessary to know anything about syllogisms to be endowed with rational human intelligence. Still, syllogisms follow the exact same digital mathematics as the mathematics of rational human intelligence.

G. Boole seemingly treats syllogisms as part of rational human intelligence. I would view them as an extension and completion to all possible cases of the exact same type of mathematics as the one used in rational human intelligence. Then again, if mathematics is done right, it stays in tune with rational human intelligence. In that regard, there is a deep and organic connection between G. Boole’s generalized syllogism and rational human intelligence.

Other extensions are possible. Consider the following inference, cited in the article cited in [1] and [2], at pp. 532-534, where the mathematical details may be found:

*All 10,000 meter runners and none, some, or all of the 3000 meter steeple chase runners are the same as all the 5000 meter runners and none, some, or all of the marathon runners.*

What can be inferred from this statement in a purely mathematical way about 5000 meter runners?

It can be inferred from this statement that the 5000 meter runners consist of 1) *all* the 10,000 meter runners who run the 3000 meter but not the marathon or neither, 2) *none, some, or all* of the 3000 meter runners who run both the 10,000 and the marathon or either, and 3) *none, some or all* of those who do not run the 3000 meter but
rather both the 10,000 and the marathon.

These inferences are fully in accord with physical reality. The mathematics of rational human intelligence alone would not be able to produce them. But a deductive extension of this mathematics can.

Another example of an extension of the mathematics of rational human intelligence is as follows. Equation (11) is part of rational human intelligence, as follows:

\[ f = db \]

“The Flemish or the Flemings are (all of the) Dutch-speaking Belgians”. \( (11) \)

This Equation is part of rational human intelligence.

G. Boole derives Equation (15) from Equation (11), as follows:

\[ b = fd + \frac{0}{0} f'd \]

“The Belgians are all those that are Flemish and Dutch-speaking and none, some, or all \( \frac{0}{0} \) of those who are neither”. \( (15) \)

Equation (15) may not belong to rational human intelligence, at least not at this time in human history. But it makes the mathematics of rational human intelligence complete and therefore explains fundamental properties of that kind of mathematics. What is more, the extension brings out the deeply digital nature of rational human intelligence.

Again, G. Boole did not classify Equation (11) and Equation (15) separately. His point of view was much more strictly mathematical. It can otherwise not be denied that Equation (15) constitutes an extension of the very same mathematics also found in Equation (11). And it was G. Boole’s great merit to have described that type of mathematics more or less completely.

How does the extended mathematics of rational human intelligence apply to AND and OR?

In considering the possible selections of the two attributes “French” and “doctor”, the following four alone were considered:
1) doctor French
2) non-doctor French
3) doctor non-French
4) non-doctor non-French

They are the only four that belong to rational human intelligence. But there are six more if one extends the mathematics of rational of human intelligence, as follows:

5) French non-French
6) doctor non-doctor
7) French French
8) non-French non-French
9) doctor doctor
10) non-doctor non-doctor

It is true that the 12 additional options in question are not part of rational human intelligence. They are an extension of the very mathematics found in rational human intelligence. But it is possible to evaluate them in relation to AND and OR. The result is 12 expressions that need to be evaluated:

5) French AND non-French
6) doctor AND non-doctor
7) French AND French
8) non-French AND non-French
9) doctor AND doctor
10) non-doctor AND non-doctor

5) French OR non-French
6) doctor OR non-doctor
7) French OR French
8) non-French OR non-French
9) doctor OR doctor
10) non-doctor OR non-doctor

G. Boole did not accept the four options 7) to 10) with OR, owing to the fact that he interprets OR as always standing for EITHER OR. This interpretation was not accepted by J. Venn or anyone else and I concur with J. Venn’s assessment and have made statements regarding the matter in the article cited in [1] and [2].
The evaluations of the twelve options provide the following generally accepted results:

<table>
<thead>
<tr>
<th>Option</th>
<th>AND/</th>
<th>non-AND/</th>
<th>RESULT</th>
</tr>
</thead>
<tbody>
<tr>
<td>5) French</td>
<td>AND</td>
<td>non-French</td>
<td>. does not exist (G. Boole: = 0)</td>
</tr>
<tr>
<td>6) doctor</td>
<td>AND</td>
<td>non-doctor</td>
<td>does not exist</td>
</tr>
<tr>
<td>7) French</td>
<td>AND</td>
<td>French</td>
<td>French</td>
</tr>
<tr>
<td>8) non-French</td>
<td>AND</td>
<td>non-French</td>
<td>non-French</td>
</tr>
<tr>
<td>9) doctor</td>
<td>AND</td>
<td>doctor</td>
<td>doctor</td>
</tr>
<tr>
<td>10) non-doctor</td>
<td>AND</td>
<td>non-doctor</td>
<td>non-doctor</td>
</tr>
<tr>
<td>5) French</td>
<td>OR</td>
<td>non-French</td>
<td>everything thinkable (G. Boole: = 1)</td>
</tr>
<tr>
<td>6) doctor</td>
<td>OR</td>
<td>non-doctor</td>
<td>everything thinkable</td>
</tr>
<tr>
<td>7) French</td>
<td>OR</td>
<td>French</td>
<td>French</td>
</tr>
<tr>
<td>8) non-French</td>
<td>OR</td>
<td>non-French</td>
<td>non-French</td>
</tr>
<tr>
<td>9) doctor</td>
<td>OR</td>
<td>doctor</td>
<td>doctor</td>
</tr>
<tr>
<td>10) non-doctor</td>
<td>OR</td>
<td>non-doctor</td>
<td>non-doctor</td>
</tr>
</tbody>
</table>

The most interesting options are definitely 5) and 6). All these purely deductive mathematical inferences stay in tune with physical reality, as one expects from purely mathematical inferences. For example, it seems obvious that, if one selects “the French AND the French” or “the French OR the French”, one still only obtains the French. Any search on an Internet search engine using the operators AND or OR will confirm this.

A detailed discussion of all these options will need to be postponed to an in-depth treatment of Selection Digitality, to be presented elsewhere.

For the sake of absolute completeness, one should also consider the inversions

<table>
<thead>
<tr>
<th>Option</th>
<th>AND/</th>
<th>non-AND/</th>
<th>RESULT</th>
</tr>
</thead>
<tbody>
<tr>
<td>5) non-French</td>
<td>AND</td>
<td>French</td>
<td></td>
</tr>
<tr>
<td>6) non-doctor</td>
<td>AND</td>
<td>doctor</td>
<td></td>
</tr>
</tbody>
</table>

and so on

But as G. Boole, and even those before him, already made very clear, digital mathematics is as commutative as quantitative mathematics. For example, in quantitative mathematics.

\[3 \times 5 = 5 \times 3.\]
28. Nexus Digitality

28.1. The Nexus (IS or =)

The brain is somehow able to associate two attributes with one another, as in “Aristotle is a philosopher”.

This kind of association has typically been called the nexus.

Most every sentence is a nexus. Another example is “Caesar conquered Gaul”. As G. Boole already observed, this sentence is the same in purport as “Caesar is (the) one who conquered Gaul” as far as rational human intelligence is concerned.

Only a few observations about nexus digitality will be possible here. A complete account of the physics and mathematics of rational human intelligence will take many pages. It also needs to be established more precisely how rational human intelligence is expressed in language.

28.2. The Duality of the Nexus

All nexuses are dual, pertaining to an association of two attributes. That is how the brain operates. There are no nexuses of three attributes, as in “Aristotle is a philosopher is Greek”. Perhaps, if rational human intelligence had evolved differently in the brain over thousands of years, a nexus between three attributes would have been possible.

Linking two attributes together establishes some kind of biochemical link between the loci of the two attributes in the brain. The physical constitution of this link is at present unknown.

28.3. The Nexus (IS) and AND

As a physical event with its own mathematics, the nexus is more like AND—as in “the Greek philosopher Aristotle”—than like OR. With AND as with IS, attributes are united in the same physical body or bodies and not distributed across physical bodies. Then what is the difference between AND and IS?
In the case of AND, two or more attributes are in a state of union exhibited by a single physical body. In the case of IS, a second attribute is brought into a state of union. In the expression “the philosopher Aristotle”, the focus is on a single physical body exhibiting two attributes. In the expression “Aristotle is a philosopher”, the focus is on a single body exhibiting the single attribute “Aristotle” and the additional attribution of a second attribute to this same physical body by means of a nexus.

Presumably, each attribution of an attribute is a separate action of the brain. Is this why, biochemically speaking, a nexus is always between two attributes in the sense that each attribution of an attribute to a physical body requires its own biochemical act and in the sense that it is not possible to do two of these acts at the same time.

28.4. The Nexus and Digitality

Digitality involves the fundamental principle of the contrast between what something is and what it is not. Where does this fundamental principle manifest itself with regard to the nexus?

A full account is not possible here. It is not obvious from a statement such as “Aristotle is a philosopher” that the nexus is riddled with digitality.

Still, it seems obvious that there are exactly three ways in which this statement can be negated, as follows:

1) “Aristotle is not a philosopher”;
2) “Those that are not Aristotle are philosophers”;
3) “Those that are not Aristotle are not philosophers”.

This is all about digitality. Two ways in which the digitality manifests itself are as follows.

A first way is that it makes determining all the possible types of nexus possible. The theory of rational human intelligence is a theory of physics with its own mathematics. In mathematics, it matters greatly always to consider all possible cases. This first way is described in section 28.5.

A second way is that the contrast between what something is and what it is not shows up everywhere in the extended mathematics of nexus digitality. This second
way is illustrated by means of examples in section 28.6.

28.5. The Types of Nexus

I have elsewhere listed all the mathematically possible types of nexus [4]. There are seven types. J. Venn counted five. But I believe that he overlooked two. The types can be presented by Venn diagrams consisting of two overlapping circles and therefore two compartments. Either one or two of the compartments are empty. In that regard, there are two main types. The first main type consists of the four subtypes with one empty compartment. The second main type consists of two empty compartments. G. Boole counted three main types. But I believe that his third one is something different altogether.

The seven types can be presented as follows:

1. \[ X \quad \text{EMPTY} \quad Y \quad \text{EMPTY} \]
2. \[ X \quad \text{EMPTY} \quad Y \quad \text{EMPTY} \]
3. \[ X \quad \text{EMPTY} \quad Y \quad \text{EMPTY} \]
4. \[ X \quad \text{EMPTY} \quad Y \quad \text{EMPTY} \]
5. \[ X \quad \text{EMPTY} \quad Y \quad \text{EMPTY} \]
6. \[ X \quad \text{EMPTY} \quad Y \quad \text{EMPTY} \]
7. \[ X \quad \text{EMPTY} \quad Y \quad \text{EMPTY} \]
The contrast between what something is and what it is not dominates in this classification. It is reflected in the contrast between a compartment being full and being empty.

Listing the algebraic equivalents of all seven nexuses in Boolean algebra would take up too much space here. I hope to have the opportunity to do this elsewhere.

As regards linguistic realizations, I personally count exactly 24, no more, no less. A full account of all the modes will also need to be reserved for another occasion. The 24 realizations are as follows.

**Digital Nexus (1)**
1. The $X$s are the $Y$s.
2. The $Y$s are the $X$s.
3. The non-$X$s are the non-$Y$s.
4. The non-$Y$s are the non-$X$s.

**Digital Nexus (2)**
5. $X$s are $Y$s.
6. Non-$Y$s are not $X$s.
7. The non-$Y$s are not the $X$s.

**Digital Nexus (3)**
8. Non-$X$s are not $Y$s.
9. The non-$Y$s are not the $X$s.
10. $Y$s are $X$s.
14. Some non-$X$s are not $Y$s.

**Digital Nexus (4)**
11. Some $X$s are $Y$s.
12. Some non-$X$s are $Y$s.
13. Some $X$s are not $Y$s.

**Digital Nexus (5)**
15. $X$s are not $Y$s.
16. The $X$s are not the $Y$s.
17. $Y$s are not $X$s.
18. The $Y$s are not the $X$s.

**Digital Nexus (6)**
19. The non-$X$s are the $Y$s.
20. The $Y$s are the non-$X$s.
21. The non-$Y$s are the $X$s.
22. The $X$s are the non-$Y$s.

**Digital Nexus (7)**
23. Non-$X$s are $Y$s.
24. Non-$Y$s are $X$s.

Again, the contrast between what something is and what it is not is everywhere. On this, much more elsewhere.
28.6. Nexus Digitality in the Extended Mathematics of Rational Human Intelligence

Again, G. Boole does not make the distinction between the mathematics of rational human intelligence and extension of this very same mathematics to mathematical completeness.

I return to the two examples cited above in 27.11.

In the first example, the following is posited:

All 10,000 meter runners \((t)\) and none, some, or all of the 3000 meter steeple chase runners \((s)\) are the same as all the 5000 meter runners \((f)\) and none, some, or all of the marathon runners \((m)\).

G. Boole would represent this as follows:

\[
t + \overline{s} = f + \overline{m}.
\]

G. Boole established that the following can be inferred about \(f\):

\[
f = ts\overline{m} + t\overline{s} \overline{m} + \overline{t}sm + \overline{t}sm + \overline{t}sm + \overline{t}sm.
\]

One way of putting this Equation into words is as follows: 5000 meter runners consist of 1) all the 10,000 meter runners who run the 3000 meter but not the marathon or neither, 2) none, some, or all of the 3000 meter runners who run both the 10,000 and the marathon or either, and 3) none, some or all of those who do not run the 3000 meter but rather both the 10,000 and the marathon.

The contrast between what something is and what it is not, say between those who run the 10,000 meters \((t)\) and those who do not \((\overline{t})\), dominates. The brain cannot make this derivation without aids. But the derivation involves the same type of mathematics as rational human intelligence.

29. Beyond G. Boole: Certification Digitality

Certification digitality is not represented at all in G. Boole’s algebra. I believe it to be essential to rational human intelligence. I believe it to be quintessential to how the
mind draws inferences that allow it to act. It is a cornerstone of rational human intelligence and of how human reasoning proceeds. I have written about the matter in detail elsewhere [5].

G. Boole’s algebra does contain all the elements needed for an expansion into certification digitality. Then why did G. Boole not implement the expansion himself?

It would appear that certain key empirical observations about how rationally endowed people behave escaped G. Boole’s, and J. Venn’s, attention. These empirical observations are what first brought my attention to G. Boole’s work. The observations pertain to what comes out of the mouths of people.

Certification Digitality revolves in part around the contrast between condition and premise. It is a fact that “if” is typically defined as a marker of conditions in dictionaries and grammars of English. But it is typically a marker of a premise, something assumed to be true. An unambiguous marker of conditions is “whenever”. Another is “when” when it is not followed by the past tense. An unambiguous marker of premises is “if it is the case that”. Very often, “if” can simply be interpreted as an abbreviation of “if it is the case that”.

The difference between a condition and a premise can be illustrated by one simple example of each, as follows.

Condition “When(ever) the sun shines, the earth is warmed”.

Premise “If (it is the case that) the sun is shining, then the earth is being warmed”.

G. Boole and J. Venn deal at some length with what they consider to be conditional clauses introduced. But some of their examples are conditions and others are premises. The result is much confusion.

I have elsewhere established the precise physical mathematical connection between the condition and the premise, and how one can be converted into the other and back. A simple example will need to suffice. More details are found elsewhere [5]. The intention is to devote a separate essay to Certification Digitality at some point.

G. Boole would represent “Whenever the sun shines (S), the earth is warmed (W)” as follows:

\[ s = vw, \]
in which \( v \) stands for the indefinite class. I prefer another notation that has been proposed, the following:

\[
S = SW .
\]  

(17)

I also use capital letters for events as opposed to things. Equation (17) states that the instances of \( S \) are the same as those in which \( S \) and \( W \) occur together. That means that the former are part of the latter.

How is “If the sun is shining, the earth is being warmed” derived from “Whenever the sun shines, the earth is being warmed”? How does the premise “if the sun is shining” differ from the condition “whenever the sun shines”? In the premise, it is assumed that it is actually the case that the sun is shining”. In G. Boole’s algebra, “it is actually the case that the sun is shining” may be presented as follows:

\[
S = 1 .
\]  

(18)

Does the premise “If it is the case that the sun is shining” signify that the sun is indeed shining? No, it does not. It is assumed for the sake of the argument that the statement is true. It may in fact turn that the sun is not shining. By contrast, a clause like “since the sun is shining” signifies that the sun is indeed actually shining.

“1” is the symbol for all that one can possibly think about in G. Boole’s algebra. Therefore, \( S = 1 \) means that, whatever else may be the case, \( S \) is also the case. But what follows from this premise? It becomes clear what follows if one applies (18) to (17). If \( S \) is replaced by 1 in (17), the result is

\[
W = 1 .
\]

In other words, if it is the case that the sun is shining, then it also the case that the earth is warming.

One of the great assets of G. Boole’s algebra is the mathematical account of the relation between primary propositions and secondary propositions. It is an account that has been adopted by hardly anyone after G. Boole.

Primary propositions are about relations between things, as in “The sun shines” and “The earth is warmed”. Secondary propositions are about relations between primary propositions, as in “When the sun shines, the earth is warmed”.

G. Boole showed that the mathematics of both types of propositions is exactly the
same. In other words, “The sun” relates exactly in the same way to “shines” in “The sun shines” as “When the sun shines” does to “the earth is warmed” in “When the sun shines, the earth is warmed”.

Just as “When the sun shines, the earth is warmed” can be written algebraically as

\[ S = SW , \]

“the earth \((e)\) is warmed \((w)\)” can be written as

\[ e = ew . \]

Likewise, “The French \((f)\) are Europeans \((e)\)” can be written as

\[ f = fe . \] (18)

Substitution by 1, as in the derivation of premises from conditions, also applies on the level of the primary propositions. What does

\[ 1f = 0 \] (19)

mean? It means that, as far as what the discourse is about is concerned, everyone or everything is French. By substituting (19) into (18), one obtains

\[ e = 1 . \]

Indeed, if everyone in a certain situation is French, then everyone in that same situation will also be European.

The same derivations apply as much to secondary propositions as they do to primary propositions.

On the level of primary propositions, one can derive from

\[ f = fe \quad “The French are Europeans”. \]

that

\[ e = f + \frac{0}{f} \quad “The Europeans are all the French and none, some, or all \((\frac{0}{0})\) of those who are not”. \]
Likewise, from

\[ S = SW \]  “When the sun shines, the earth is warmed”,

one can derive

\[ W = S + \frac{0}{0} \]  “The occasions when the earth is warmed are all

the occasions when the sun shines and none, some, or all \( \frac{0}{0} \)

of the occasions when it does not”.

This much for Certification Digitality. A full account will need to follow elsewhere.

30. Beyond G. Boole: Supplement Digitality or Digitality to the Surface

Nothing has done more to convince me that all of rational human intelligence is entirely digital and can be derived from a single principle than that which I would call Supplement Digitality. There is not a single mention of anything like Supplement Digitality in G. Boole or in J. Venn or anywhere else. I have discussed Supplement Digitality already at length in some of the publications listed in Section 2. All the publications in question are followed by the term “Supplement Digitality” placed between square brackets. I single out item 9) for special attention.

Supplement Digitality occupies a rather vast space in the realm of rational human intelligence and unites a number of well-known and extremely common features of language that are classified widely apart from one another in grammars.

There is no mention of Supplement Digitality in G. Boole or J. Venn. Supplement Digitality does not strictly pertain to reasoning in the narrow sense.

What is “supplement” in Supplement Digitality? It is just a term used here to denote that which an attribute is not. For example, the supplement of “cat” is “non-cat”.

The most striking difference between Supplement Digitality and Selection, Nexus, and Certification Digitality is that the supplement is implicitly invoked in Supplement
Digitality whereas it is more part of the mathematical background matrix in Selection, Nexus, and Certification Digitality.

Supplement Digitality does much to cement the notion that the fundamental parameter of rational human intelligence is the contrast between what something is and what it is not.

A simple example. Consider the ubiquitous words “also”, “too”, and “well”. They invoke the supplement and therefore the fundamental principle permeating all of rational human intelligence, namely the contrast between what something is and what it is not. What does an expression such as “Jane too” mean. It clearly means: Jane in addition to someone or something that is not Jane. The brain is able to invoke the supplement.

Another simple example. What do the more or less synonymous expressions “It is Jane who did it” and “Jane did it” mean? They clearly mean: Jane and not someone else, or not-Jane, did it.

I refrain from entering into more detail. This introduction has already grown beyond proportions. In any event, Supplement Digitality requires a longer treatise in its own right.

31. The Earliest Significant Scientific Awareness of the Single Principle from Which All of Rational Human Intelligence Is Derived: Presocratic Greek Philosophy, with Special Focus on Anaximander of Milete and Heraclitus of Ephesus and a Closer Look at Parmenides of Elea

31.1. The Birth of Western Philosophy: The Presocratic Philosophers of the Sixth Century B.C.E. and the Early Fifth Century B.C.E.

In what precedes, it is proposed that all of the physics of rational human intelligence
is derived from a single principle, that is, the contrast between what something is and what it is not—altogether in the footsteps of J.-L. Lagrange, who derived all of the physics of mass and motion from a single principle. The ubiquity of negation in language—negation meaning that everything can be negated without exception—is an unmistakable symptom of the omnipresence of the principle in question.

When in the history of humankind did any conscious awareness that this contrast might be fundamental to a proper understanding of rational human intelligence first come into being? No doubt, ever since full-fledge languages came into existence, human beings must have been aware that “warm” and “cold” (or “not warm”) belong together, as do “light” and “dark” (or “not light”), and so on. But systematic attention to, and analysis of, such contrasts arrives with western philosophy, that is, with the Greek so-called pre-Socratic philosophers. There are otherwise also Buddhist religious texts that make much of binary contrasts. But I have not examined the matter in detail.

The contrast between what something is and what it is not evidently takes place in two directions. On the one hand, what something contrasts with what it is not. On the other hand, what something is not contrasts with what it is. In the contrast between “dry” and “not dry”, only one direction of the contrast is made explicit. The other direction is implied. There is a lack of balance. Balance is achieved linguistically by a special word denoting what is not dry, namely “moist”, and vice versa. Both directions are equally conveyed. What is dry is not moist and what is moist is not dry.

Greek philosophy begins in earnest in the sixth century B.C.E. Until the arrival of Socrates, who was born in 470/469 B.C.E., most of it took place outside of what is now the modern country of Greece, namely in areas where Greek was spoken at the time, especially in what is now southern Italy and westernmost Turkey. Because the teachings of Socrates—as transmitted by Plato—constitute an entirely new beginning and a shift to a higher gear, it is customary to group the philosophers who were active in the first century and a half or so before Socrates together under the name of Presocratics.

In the first edition of his justly celebrated text and translation edition of the Presocratics, the eminent Berlin classicist H. Diels speaks of “the incomprehensibly swift unfolding of philosophy in the sixth and especially the fifth century [B.C.E.] (die unbegreiflich rasche Entfaltung der Philosophie im sechsten und vor allem im fünften
Owing to constraints of time, it has not been possible to descend as deeply as may be desirable into Greek philosophy. Still, I believe that a partial rewriting of the history of Greek philosophy might be desirable. The time seems right to appreciate the history and development of the rational human intellect in its true dimension, that is, in terms of the complete and final physical and mathematical theory of rational human intelligence.

31.2. The First (Presocratic) Philosopher: Thales of Milete

It is generally accepted that philosophy in the modern sense was born in western Turkey on the Mediterranean coast, and more precisely in the ancient city of Milete. Thales of Milete is generally regarded, as he was already in antiquity, as the first philosopher and therefore also as the first Presocratic philosopher. At least, no records survive of any philosopher—philosopher in the modern sense—preceeding him. There are reports that Thales was influenced by Egyptian learning. There are also reports that he was of Semitic extraction. In any event, since 664 B.C.E., a dynasty ruled in Egypt, called the Saite dynasty or Dynasty 26, that engaged in close contacts with the Greek world, in sharp contrast with the isolation of earlier Egyptian history. The transmission of Egyptian learning to the Greek world must have become much easier from that time onward.

Thales was revered in ancient tradition. But he may well have written nothing. His belief that water is the primeval substance from which all reality has sprung forth, as it is in Egyptian religion, is well-known.

31.3. The Contrast between What Something Is and What It Is Not, the Seminal Principle of Rational Human Intelligence, as Found in the Presocratic Philosophers: Anaximander and Heraclitus

31.3.1. The Seminal Principle in Anaximander of Milete

I cannot readily discern traces of the fundamental principle of rational human intelli-
gence—that is, the contrast between what something is and what it is not—in the beliefs of Thales as transmitted by others writing about him.

The matter differs for Anaximander of Milete, who may have been Thales’s student. One citation is all that is assumed to have survived of his work, thus H. Diels. But there is general agreement in the later tradition that he dealt much with what is called in Greek

\[ \tau \alpha \ \varepsilon \nu\alpha\eta\nu\tau\alpha \]

ta enantia “the opposites”; I am relying on the unusually handy, succinct, and extremely informed, history of ancient philosophy by the Jesuit E. De Strycker, probably little used nowadays as it is written in Dutch [7]. Also, according to Aristotle, Anaximander stated that

\[ \varepsilon \kappa \ \tau\omicron \ \eta\nu\omicron\varsigma \ \varepsilon\nu\omicron\upsilon\omicron\sigma\varsigma \ \tau\alpha\varsigma \ \varepsilon\nu\alpha\nu\tau\iota\omicron\omicron\varsigma \ \varepsilon\kappa\kappa\rho\omicron\iota\nu\omicron\sigma\theta\varepsilon\varsigma\iota \]

“opposites are separated as they come into being out of the One” [8].

G. Boole also associated the earliest explicit interest in digital thinking with the Presocratics, relying mainly on Aristotle as his source [9]. G. Boole read Aristotle in the original Greek—an illustration, it seems to me, of what Roger Bacon, “the Admirable Doctor”, already stated some 800 years ago: the conquest of learning passes through the knowledge of languages.

G. Boole does not mention Anaximander, apparently because of what is said or not said about the philosopher in the sources available to him. I have not investigated the matter in detail.

Anaximander of the sixth century B.C.E. is mentioned here because he seems to be the earliest in whose writings contemplation of the fundamental principle of rational human intelligence is documented. But what about the later philosophers dating to before Socrates? The attention turns inevitably to Heraclitus. Why?

31.3.2. The Seminal Principle in Heraclitus of Ephesus

No one among the Greek philosophers has anywhere nearly as much promoted the contrast between what something is and what it is not as something that is fundamental
to understanding reality as Heraclitus of Ephesus once did. “Following Anaximander he conceived the universe as a ceaseless conflict of opposites regulated by an unchanging law” [10].

Heraclitus wrote a book in prose of which about 125 fragments have been preserved. The book does not consist of a systematic exposé but rather of aphorisms that often sound like riddles. The whole thing is a little confused. This particular circumstance did not do much to promote his ability to inspire later philosophers. He also seems to have been a somewhat arrogant character who felt far superior to what he perceived as the lesser intelligence of his fellow human beings. Still, I believe that an effort should be made to assess his place in the history of philosophy and of thinking of rational human intelligence. I believe his place to have been a rather unique one.

As regards the contrast between what something is and what it is not, there is his famous statement

Πόλεμος πάντων πατήρ...έστι

“War is the father of everything” [11]. By

πόλεμος

polemos “war”, Heraclitus means the contrast or conflict between opposites.

I also single out the following citation [12]:

tῶν ἐναντίων ἡ φύσις γλίστεται
καὶ ἐκ τούτων ἀποτελεῖ τὸ σύμφωνον
οὐκ ἐκ τῶν ὁμοίων

“Nature strives after opposites. It is from these that it achieves harmony, and not from what is the same”.

Heraclitus was “an uncommonly original thinker (een ongemeen oorspronkelijk denker)” [13]. He stood apart from almost all great Greek philosophers in not always trying to search for the unity or unifying principles of the universe while eliminating diversity. More on this below. Other philosophers were also aware of the presence of opposites in the universe. But they typically tried to transcend them, whereas Heraclitus was more inclined to stop right at them as fundamental characteristics of the universe.
More is said about this topic below.

What would have happened if it had somehow been possible to combine Heraclitus’s ideas on the contrast between what something is and what it is not with Aristotle’s syllogisms? Aristotle’s system of syllogisms is not wrong. It is just very incomplete and definitely not mathematically universal. As regards the contrast between what something is and what it is not, the syllogisms deal fairly well with what something is. But the system cannot quite handle what something is not. The syllogisms were avidly studied for more than 2000 years after Aristotle. They stood at the center of what is called logic, a term apparently first used in the meaning that it still has today by Cicero. But not much progress was made until the time of A. de Morgan and especially G. Boole, when what something is not was finally fully incorporated into an expansion of the system of syllogisms.

One should not overestimate the systematic nature of Heraclitus’s thinking. It is for a reason that he was known as

ο σκοτεινός

“the obscure one”. Still, his thinking about the universe is fully in harmony with what is proposed here regarding the nature of rational human intelligence. The universe, or what is truly knowable about it, is after all only what the brain perceives it to be. According to what is proposed here, the opposites observed in the universe lie at the root of the single principle from which the brain derived all of rational human intelligence, the contrast between what something is and what it is not.

31.3.3. The Lure of Unity at the Expense of Contrast

There is something seductive about the notion of unity. There is a perceived perfection about it. Why believe in two gods if one can believe in just one? G. Boole is now associated with all that is digital, with the contrasts between On and Off and between 1 and 0. Yet, he too could not resist the temptation of speculating about what might transcend such contrasts in the final pages of his Laws of Thought [14]. I am still not sure, and also slightly uncomfortable, about what God is doing in those final pages of G. Boole’s book. It almost reminds me of what the great Laplace famously replied to Napoleon when the latter asked where God was to be found in Laplace’s monumental Mécanique céleste: “But Sire, I had no need for this hypothesis! (Mais Sire, je n’avais
31.3.4. Traces of the Seminal Principle in Other Presocratic Philosophers

Anaximander and Heraclitus stand out in terms of the importance that they attach to the contrast between what something is and what it is not. What about the contrast between what something is and what it is not in other Presocratic philosophers?

Pythagoras may well be the best known such philosopher. But he probably did not write anything and the teachings attributed to him often veer from the philosophical into the religious. Pythagoras seems to have been in many ways more like a guru than a philosopher. Accordingly, he is known to have created a school. Or was it a sect? His pronouncements are said to have been accepted by his followers without questioning, and they were qualified as

\[ \alpha\upsilon\tau\omicron\omicron\zeta\ \epsilon\phi\alpha \]

*ille dixit* “He said it”. Certain mathematical results are attributed to him. But they too fall outside the scope of philosophy and the realm of rational human intelligence. In terms of the contrast between what something is and what it is not, Aristotle in his *Metaphysics* transmits a table of ten contrasts attributed to the followers of Pythagoras: even and uneven, right and left, male and female, and so on [15].

Other reflections about the contrast between what something is and what it is not can be found in Anaxagoras, Empedocles, Protagoras, Xenophanes, and others, but in no way to the same degree as in Heraclitus. I therefore retain as the most prominent propagators of the principle, Anaximander as the first and Heraclitus as the most explicit. In surveying the Greek philosophers in question, the afore-mentioned handbook by E. De Strycker has been very useful.

Like Socrates, Plato, and Aristotle after them, the Presocratic philosophers struggled mightily with being and not being, being and becoming, being the same and being different (that is, not being the same), and the like. These are topics that are close to the principle from which all rational human intelligence is derived. Greek philosophers were looking in the right direction. But they never quite found what they were looking for. They sensed that the contrast between what something is and what it is
not is somehow fundamental to an understanding of reality and they return to it con-
stantly. But they were not able to assign to that contrast its proper place in the totality
of human intelligence.

It would be easy to dismiss the results of the Greek philosophers as a record of
failure. They contradict one another so often. Surely, they cannot all be right at the
same time. Then, in such circumstances, how to decide who is right and who is
wrong?

In the end, the preferred approach is—so it appears to me—to validate their results
as a giant step in the right direction. The Greek philosophers were the first to ask so
many, many of the right questions. But as they were unable to find the exact right
answers, their answers were bound to differ and therefore to contradict one another.

A proper understanding of the place of negation in rational human intelligence
came with G. Boole. In that regard, A. de Morgan, G. Boole’s contemporary, was an
important precursor when it comes to the proper comprehension of negated classes,
classes of things that all share the absence of something.

Greek philosophers, and so many after them, were also optimistic regarding the
possibility of knowing what transcends rational human intelligence. However, only
speculation is possible beyond that limit. Not everyone will find it easy to accept that
the human brain is just a materialistic tool.

31.3.5. The Seminal Principle from Socrates Onward

I refrain from trying to document references to the contrast between what something
is and what it is not in philosophers from Socrates onwards. There is so much to be
found. I just single out the following re-classification by Aristotle of the four basic
elements, pointed out by E. De Strycker [16], for its remarkable digital quality. The
classification is as follows:

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Fire</td>
<td>warm</td>
<td>dry</td>
</tr>
<tr>
<td>Air</td>
<td>warm</td>
<td>moist</td>
</tr>
<tr>
<td>Water</td>
<td>cold</td>
<td>moist</td>
</tr>
<tr>
<td>Earth</td>
<td>cold</td>
<td>dry</td>
</tr>
</tbody>
</table>
A more digitally inspired expression of the same would be as follows:

<table>
<thead>
<tr>
<th></th>
<th>warm</th>
<th>moist</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fire</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Air</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Water</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Earth</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

31.4. The Contrast between Being and Not Being in the Presocratic Philosopher Parmenides

Parmenides probably lived from about 515 B.C.E. to at least about 450 B.C.E. He has always been held in such high esteem—all the way from antiquity down to modern times—that one is not a little curious to find out what he, of all philosophers, has to say, if anything, about the contrast between what something is and what it is not. Ancient and modern testimonials regarding his reputation are provided below. In some ways, Parmenides’s reputation at times seems to rise above those of Socrates, Plato, and Aristotle.

For the sake of clarity, the main conclusion of the present brief inquiry may be formulated as follows. In what is preserved of his work, Parmenides focuses entirely on being and not being and on the importance of studying the former and not the latter.

In modern interpretations, this contrast between being and not being has on occasion been associated with the contrast between what something is and what it is not. But I believe that the two contrasts are not the same, other than both involving negation.

A principal difference is as follows. As it is understood here, the contrast between what something is and what it is not, the seminal principle from which all rational human intelligence is derived, is part of physics. It is empirical and material. Even Parmenides could not deny that some things are warm and some things are not warm, that is, cold.

By contrast, Parmenides’s contrast between being and not being is part of metaphysics, as far as I can see. Parmenides wonders what it means to be and what in con-
The answers that Parmenides provides are obviously speculative. Metaphysics is part of philosophy. There are no final absolute answers to questions in philosophy. It has been said that the aim of philosophy is rather to formulate the questions better. Philosophizing about being and not being culminated in M. Heidegger’s existential question: “Why on earth is there something and not rather nothing?” Those who dislike speculation will presumably not be very sympathetic to what Parmenides writes.

Presumably, the contrast between what something is and what it is not has also been treated in part philosophically by Anaximander and Heraclitus. In the present book, the interpretation of the contrast is strictly physical and mathematical.

All that survives of Parmenides’s work is about 150 verses of a didactic poem entitled “On Nature”. There is a very poetic opening of 33 verses describing the author’s phantasmagoric chariot voyage through the gate that leads from night to daylight to meet a goddess who will tell them all that he needs to know. This opening has done much to cement Parmenides’s reputation in Western civilization as a restless and passionate seeker of truth. No one in the history of human civilization had ever written quite in this way and so enthusiastically about the quest for truth. The rest of the poem is the address by the goddess. What does she say?

It becomes readily apparent that the entire poem revolves around the contrast between being and not being. There are many references to this contrast. There has been a tendency in interpreting Parmenides to associate this contrast between being and not being with the contrasts expressed by τὰ ἐναντία “the opposites”, such as the contrast between “warm” and “cold” (or “not warm”) and the contrast between “dark” and “light” (or “not dark”).

It seems clear, however, that Parmenides’s contrast between being and not being differs from the contrast between what something is and what it is not, the seminal principle from which all rational human intelligence derives.

For starters, the two types of contrasts simply belong to two different realms of human thought. The contrast between what something is and what it is not is a principle of physics. Surely, there is no way in which Parmenides would have denied that certain things are patently warm and others are patently cold. It has been suggested that Parmenides tried to eliminate the relevance of the senses. I find this difficult to believe. Rather, Parmenides is engaging in what is now called metaphysics. In phys-
ics, the answers to questions are empirical and material. In metaphysics, they are not. What Parmenides is writing is philosophy, not physics. There are no firm and final answers in philosophy.

Consider the following fundamental statement by the goddess in line 16 of fragment 8:

\[ \text{\textit{\textit{\varepsilon\sigma\tau\iota\nu \eta\omicron\upsilon\kappa\varepsilon\sigma\tau\iota\nu}} } \]

Some translate this as a declarative statement: “It is or it is not”. Others translate it as a question: “Is it or is it not?” It is not even certain that either of these translations reflect what Parmenides meant. It cannot be excluded that “it” functions somewhat in the way that it does in “It rains” or “It snows”. “It rains” is more or less equivalent to “There is rain” or “Rain is happening”. If “it” has the same meaning in “It exists”, then the statement by Parmenides might perhaps something like “Is being happening or is there no being happening?”

I cannot claim to fully understand what Parmenides is trying to say. And I doubt that anyone else ever has. There are so many contradictions in the interpretations of poem. In fact, it may well be that Parmenides did not fully understand himself what he was looking for. How so? It may provisionally be suggested that his views were in large part a reaction against an approach that he deemed unacceptable. What unacceptable approach?

There is so much that ends or dies or vanishes in human existence. In fact, everything does, movies, football games, and human life itself. The introduction to Parmenides’s didactic poem shows that he aspired to something eternal, stable, unchanging, in short, something that \textit{is} without ever \textit{not} being. He badly wanted that to which he aspired to \textit{be} without being diminished by any modality of \textit{not} being.

It has also been assumed that Parmenides was the first to formulate the fundamental axiom of thought. Aristotle was the first to clearly define it in the form of the so-called Principle of Non-contradiction. According to this principle, “Something cannot be both a cow and not a cow”. Two related principles of medieval philosophy are the Principle of Identity, as in “A cow is a cow”, and the Principle of the Excluded Middle, as in “Something is either a cow or not a cow”. I intend to treat these three principles mathematically elsewhere. Since Parmenides does not formulate the fundamental axiom explicitly, it is not clear to me to which extent he assigned it inde-
I concluded with some testimonials about Parmenides. Plato admired him and called him “the great Parmenides”. One of Plato’s dialogues is entitled *Parmenides*. In it, Parmenides and Zeno are on a visit to Athens and converse with a young Socrates around 450 B.C.E. about such subjects as the one and the many, a meeting of minds indeed. There are those that have deemed the dialogue spurious. And it is not entirely clear to what extent the views attributed to Parmenides are his.

D. Gallop writes the following about Parmenides [17].

*The development of western philosophy was once said by A. N. Whitehead to have consisted in a series of footnotes to Plato. In a similar vein, and with hardly more exaggeration, Plato’s own writings might be said to have consisted in footnotes to Parmenides of Elea.*

And also the following.

*He should be viewed not only as “the most original and important philosopher before Socrates” but as the first extant author deserving to be called a philosopher in a present-day sense of the word.*

K. R. Popper writes as follows about Parmenides’s theory [18].

*It was, for all I know, the first deductive theory of the world, the first deductive cosmology: One further step led to theoretical physics, and to atomic theory.*

An unusually strong condemnation of Parmenides, and also of Zeno of Elea and Socrates, comes from M. O’Sullivan [19].

*As Parmenides categorically threw out all observation with the senses, so this student of philosophy is inclined to throw out Parmenides as a complete waste of time! His static theories denying motion and change were in direct antithesis to the Kinetic metaphysics of Heracleitus, and his depressing monism was later refuted by the atomists…*

*Zeno however impressed his dialectical ability on Socrates…*

*I only think that it is a pity that when they asked Socrates to drink the hemlock in*
399 B.C., they didn’t include Zeno and Parmenides in the invitation.

I am not sure that wishing anyone dead is a desirable approach. What is more, philosophy is not an exact science. It is not empirical in the way that a science is. It is true that philosophical thought is not everyone’s cup of tea. But one should not judge it by a standard by which it does not measure itself.

There is absolutely nothing empirical about the afore-mentioned question by M. Heidegger, “Why on earth is there something and not rather nothing?” Related questions are: “Why do we exist and not rather not exist?” “Why do we exist in the way that we do and not in some other way?”

It is true that there does not exist at this time, or ever will, any way of knowing the answers to these questions. Still, one would like to think that there ought to be room in the humanities to identify the questions and systematically think about them. Does M. O’Sullivan want to deprive us all of the right to wonder about these questions and reflect on them because the endeavor is, as she seems to think, stupid? It is in fact possible to reintroduce the empiricism that she so desires back into the picture. It is empirically undeniable that human beings are likely to wonder about such questions. Surely, this reality must mean something. One cannot dictate human beings to block out that about which they are naturally inclined to think. Or can one?

In the end, philosophy is closer to music than it is to biology. It seems to be a fact that metaphysicists after Parmenides recognize themselves so well in him and feel that he was the first to think in a way that metaphysicists still do today and therefore consider him the Father of what is now called fundamental philosophy or metaphysics, as opposed to ethical philosophy, political philosophy, and so on. Perhaps, some may be inclined to write off Parmenides’s reasoning and the lines of argument found in Plato’s dialogue “Parmenides” as plain nonsense. Then again, was the intent of Parmenides, Zeno, Socrates, and Plato to fool us all with some kind of twisted, deceptive use of the Greek language? It seems rather as if they were looking for something. They may not have found it. And perhaps, it cannot be found. But the deep common desire to keep searching is empirically undeniable.

What matters the most, as regards Parmenides, to the line of argument presented in this book is that he is not really interested in the nature of rational human intelligence, that is, the way in which we think rationally, but rather in the nature of human existence. He liked to believe that, considering all the change and instability of human
existence, there are somewhere out there certain truths that are eternal and never change. He identified them as Being, as opposed to Not Being.

32. References


[9] G. Boole, “An Investigation of the Laws of Thought, on Which Are Founded the Mathematical Theories of Logic and Probabilities,” Walton and Maberly,


