On Reality and Science

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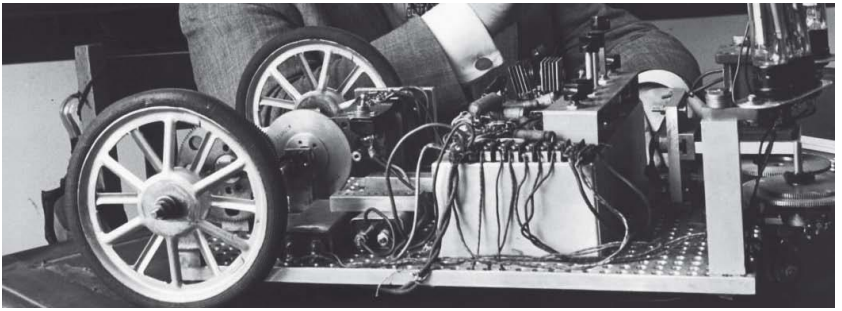
Translated from the Dutch by Maatkamp Publishing, Zelhem, Netherlands

This is an abridged version of the inaugural speech entitled *de tijd zal het leren* ('Time Will Tell', only available in Dutch), held by prof. Roos on December 10, 2003, at Delft Technical University upon his acceptance of the office of professor at the Faculty of Electrical Engineering, Computer Science and Mathematics. Roos accepted this position with the aim of working in the field of optimisation techniques.



Many people think the domain of science[1] covers all of reality, and that science is the only source of reliable knowledge. This means there can be no God, creation or re-creation. How can this reasoning be countered?

In this article, emeritus professor Kees Roos demonstrates that the domain of science is limited to only a part of reality. He does so on the basis of the work of two scientists: the most famous language philosopher of the 20th century, Ludwig Wittgenstein, and mathematician Kurt Gödel. The final word is given to the apostle John, whose visions shed much light on the subject.

The fact that the average scientist does not believe in miracles is no a recent development. As early as the 13th century, intellectuals were having heated debates on the subject. Under the influence of the Arab scholar Averroës, who based his work on Aristotle, the creation of the world and the immortality of the soul were called into question. In 1277, two hundred nineteen of Averroes' propositions were condemned by the bishop of Paris Tempier, who was responsible for education at the Parisian universities.

To give you an impression, let me cite several of the denounced propositions:

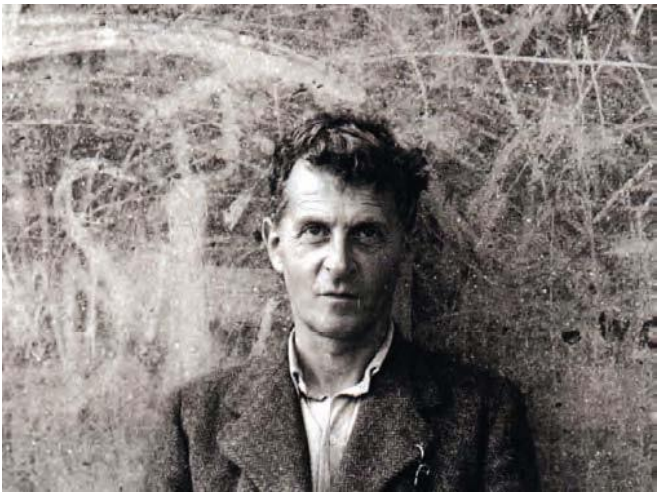
1. The natural scientist, who bases his ideas on natural causes and natural reasoning, cannot but deny the creation of the world.
2. The future resurrection from the dead cannot be endorsed by a scientist, because it is impossible to study the resurrection by means of the intellect.
3. Christian doctrine hinders science.
4. In everything, only that which is possible or impossible according to science is possible or impossible.
5. The impossible cannot be done by God or anyone else.

These notions continue to enjoy wide approval among scientists, as I experienced when I was part of the governing board of the Evangelical College (Dutch: 'Evangelische Hogeschool' or 'EH') in the Netherlands.

In the eighties, we tried to set up a faculty of cultural philosophy at the EH. Legally this required approval from the Minister of Education and Sciences, who had to consult related faculties for recommendations. Speaking on behalf of all Dutch universities, the Erasmus University gave a negative recommendation. The main argument was that it is impossible to conduct science on the basis of the EH's fundamental principles.

It is obvious that the propositions I listed above, as well as the attitude expressed in the Erasmus University response, are based on the notion that the domain of science includes all of reality, and that science is the only source of reliable knowledge. How can we

counter this? The work of two of the last century's great souls, Wittgenstein and Gödel, may help us.



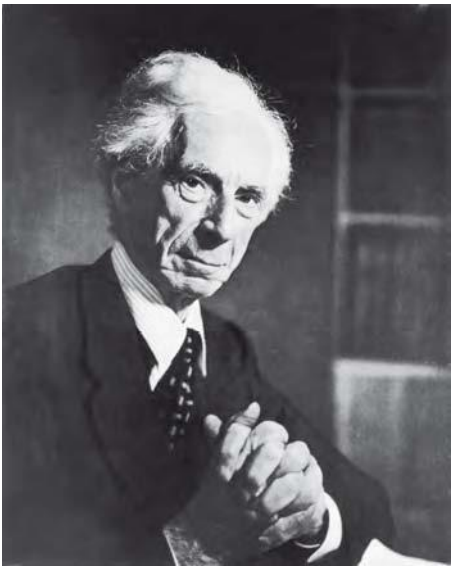
Ludwig Wittgenstein (1889-1951)

Wittgenstein is generally considered to be the greatest language philosopher of the last century. His reputation is largely due to the booklet Tractatus Logico Philosophicus, abbreviated to *Tractatus*[2], the only work of Wittgenstein's that was published while he was alive. His work is a convincing attempt to show that the domain of science limits itself to only part of reality, and, as he wrote somewhere, to 'the least important part' at that. In order to explain this, we must inevitably discuss the eventful life of this exceptionally captivating man, and his position in the scientific world[3].

The domain of science covers only one part of reality, and the least important part, at that

Wittgenstein was the youngest of eight children belonging to the very rich Viennese Jewish-Protestant family of steel magnate Karl Wittgenstein. After obtaining a degree in technical sciences in

Berlin and one in airplane engineering in Manchester, he became interested in the philosophy of mathematics. He went to Cambridge, where he attended lectures by Bertrand Russell (1872-1970) and George Edward Moore (1873-1958), world-famous professors of philosophy. After only one term, Russell was already convinced of Wittgenstein's genius: 'He has more passion for philosophy than I have; his avalanches make mine seem mere snowballs.'[4]



Bertrand Russell

When the First World War broke out, Wittgenstein volunteered for service in the Austro-Hungarian army. He fought on several fronts and was repeatedly distinguished for bravery. During that time he visited a bookshop in which he found only one book that interested him: *A Short Exposition of the Gospel*, by Leo Tolstoy. He fell under the spell of the book and always carried it with him. Among his comrades he became known as the 'the man with the Gospel'[5]. Others write that this book kept him alive in the difficult circumstances of war: 'If you are not acquainted with it, then you cannot imagine what an effect it can have upon a person.'[6]

Christianity, to Wittgenstein, was 'the only sure way to happiness' (in this period)[7].

Tractatus: the problem of philosophy

During this time he also completed a book he had started writing in Cambridge: the *Tractatus*. While a prisoner of war, he wrote to Russell, saying: 'I have written a book that will be published as soon as I get home (…) I believe I've finally solved all our problems. This may sound arrogant, but I can't help believe it.' Wittgenstein was referring to the philosophical problems surrounding the evaluation of scientific statements. According to him, philosophical problems are illusions that disappear like snow before the sun when it becomes clear that language has been used incorrectly to comment on reality (more on this will later). Through the intermediation of Russell, the *Tractatus* was published in 1922.

In August of 1919 Wittgenstein was released. In the honest conviction that he had solved the problem his book dealt with, he wanted to dedicate his life to 'more useful' matters. For seven years, he worked as a teacher at various elementary village schools in Austria. During that time he also renounced the right to his family fortune. A lecture by Dutch mathematician L. E. J. Brouwer (1881-1966) in March 1928 motivated Wittgenstein to take up philosophy again. In January 1929 he returned to Cambridge, where the *Tractatus* had become the focus of much philosophical discussion and, in fact, had come to be considered a philosophy classic.

It didn't take long for him to receive his PhD (18 June 1929). The *Tractatus* was his 'thesis'. The examination started with a chat between friends who had known each other for a long time. This was followed by a short discussion. Russell tried to show Wittgenstein that his statements were inconsistent, but he did not succeed in persuading him. Wittgenstein ended the conversation by giving the examiners (Russell and Moore) a pat on the back while making the conciliatory comment: 'Don't worry, it doesn't matter, I know you will never understand.' In his report on

the examination, Moore wrote: 'It is my personal conviction that this dissertation is a work of genius; but even if I am mistaken on that point, it certainly meets the standard required for the degree of Doctor of Philosophy.'[8]

Don't worry, it doesn't matter,

I know you will never understand

Putting mathematical truths into perspective

In the autumn of 1930 Wittgenstein was appointed as fellow of Trinity College. In the following years he occupied himself primarily with the philosophy of mathematics. An intense battle concerning the foundations of the philosophy of mathematics had been raging since the beginning of the 20th century. It involved logicians (led by Frege and Russell), formalists (led by Hilbert) and intuitionists (led by Brouwer and Weyl). Wittgenstein contributed to this debate by attempting to undermine its foundations.[9] According to him, the whole idea that mathematics should be concerned with the discovery of truths was a misunderstanding. 'If we looked on mathematics as a series of techniques (for calculating, measuring etc.), then the question of what it was about would simply not arise.'[10] In saying this, he turned against those who presupposed the immutable and unconditional validity of mathematical truth.

For Wittgenstein, philosophy, like mathematics, was a series of techniques. After the annexation of Austria by Germany in 1938, Wittgenstein narrowly escaped serving in the German army by obtaining a British passport in June, 1939 thanks to his appointment as professor (and successor to Moore, who had retired). His lectures on mathematics are part of Wittgenstein's general attack on the idolatry of science: 'What a curious attitude scientists have - 'We do not yet know that; but it is knowable and it is only a matter of time before we will get to know it!' As if that can be taken for granted!'[11] At another time, he warned against a form of idolatry in which science and scientists were the idols.[12]

Danger of idolatry

When the Second World War broke out in 1939, Wittgenstein faced a dilemma: it seemed impossible to him to be teaching philosophy while there was a war going on. Once again, he wanted to do something 'useful', preferably at the front lines. But his German name and Austrian background made this difficult in the United Kingdom. A friend introduced him to a doctor at Guy's Hospital in London who arranged a small job for him: on behalf of the hospital pharmacy he delivered medicine to patients who had been wounded during the heavy bombings of London.

Darwin must have been wrong:

his theory 'lacks the necessary versatility'

In October 1944 he returned to Cambridge. There he met both Russell and Moore again. Wittgenstein still admired Russell's sharp intellect, but scorned much of his popular work on ethics and politics. Neither did he have anything good to say about Russell's liberal lifestyle. For instance, once he said: 'Russell's books should be bound in two colours: those dealing with mathematical logic in red - and all students of philosophy should read them; those dealing with ethics and politics in blue - and no one should be allowed to read them.'[13]

In the summer of 1947, Wittgenstein began to hatch a plan aimed at giving up his chair at the university and finding a quiet spot in order to finish a book on 'the philosophy of psychology'. By the end of that year, he was dismissed at his request and moved to Ireland. In Dublin he stayed in a hotel situated within walking distance from the Royal Zoological Gardens. He received many former colleagues and students there and enjoyed walking with them in this park. One of them wrote this about his experiences with Wittgenstein: 'He stressed life's irreducible variety.' During the walks in the Zoological Gardens, he expressed his admiration for the huge diversity in flowers, shrubs and trees and the many different kinds of birds, reptiles and mammals. Not surprisingly,

Wittgenstein believed any theory seeking to impose a single system onto this diversity must be fundamentally wrong. Darwin must have been wrong: his theory 'lacks the required versatility'[14]. In 1951, Wittgenstein developed intestinal complaints. As it turned out, he had cancer. He died, surrounded by friends, on April 29, 1951, at the age of 62.

The significance of Wittgenstein's work

What is the significance of Wittgenstein? The *Tractatus* is generally considered to be one of the most remarkable publications of the 20th century. Not because it is an easily accessible booklet, on the contrary. The organisation of the work into (very many) short propositions is unusual, and many of these propositions are difficult to understand. Its interpretation continues to occupy many minds. Someone once wrote that Wittgenstein wasn't a scholar in the ordinary sense of the word. He was more of a seer, a prophet, who was in continuous conflict with his professional colleagues.[15] This courageous man, who clung to the Gospel in many difficult and depressing moments, was definitely not much less than a seer, a prophet, delivering his message that the domain of science is limited to only a part of reality, and its least important part at that, in the very den of the lion. In a letter to Von Ficker, the editor of the literary periodical Der Brenner, he described his work as follows: 'You won't get much out of reading the book. Because you won't understand it; the content will be strange to you. In reality, it isn't strange to you, for the point of the book is ethical. My work consists of two parts: the one presented here plus all that I have not written. And it is precisely this second part that is the important part.

'Wovon man nicht sprechen kann,

darüber muss man schweigen'

My book draws limits to the sphere of the ethical from the inside out, as it were, and I am convinced that, strictly speaking, this is

the only way one can draw such limits. In short, I believe 'that where many others today are just gassing, I have managed in my book to put everything firmly into place by being silent about it. And for that reason, unless I am very much mistaken, the book will say a great deal that you yourself want to say. Only perhaps you won't see that it is said in the book.'[16] His clearest statement of all is perhaps this one: 'Wovon man nicht sprechen kann, darüber muss man schweigen' (One must be silent about that concerning which one cannot speak), the famous seventh proposition in the *Tractatus*. Many scientists had (and still have) a lot of difficulty with this statement. To them, the beauty and power of science, especially mathematics, lies precisely in its assumed ability to provide immutable truths in an otherwise uncertain world. Wittgenstein made it clear that this ability of science only covers a part of reality at most. Another great scholar, Kurt Gödel, added to this by showing that even our knowledge about that small part of reality is limited. In doing so, Gödel surprised many mathematicians who thought mathematics could be based on a set of universally acceptable axioms (foundational principles). We will look at this in the next paragraph.

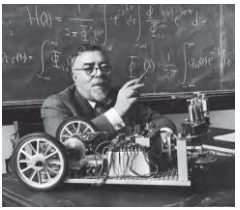
The Hilbert programme

Both the symbolism used by mathematicians and the strict rules of logic have given mathematics an aura of certainty and reliability among outsiders (and not just among them). The notion that complex physical phenomena can be described using simple mathematical relations is surprising and inspires awe. Around 1900, many mathematicians and physicists (and others) expected that before long a formula would be found that would describe all physical phenomena.

A paradox blows down the whole building of mathematics

It suggests the end of all science

The aforementioned debate concerning the foundational principles of mathematics was raging at the same time, with scholars divided into several factions. Paradoxes played an important role in this debate. A frequently quoted paradox in this respect is found in Titus 1:12: 'One of Crete's own prophets has said: 'Cretans are always liars.' Is the Cretan prophet lying or not? Yes, he must be, as he himself is a Cretan and all Cretans always lie. But if he himself is lying, it is not true that all Cretans always lie. So perhaps he isn't lying. The Cretan prophet's statement thus leaves us perplexed. In of his lectures Wittgenstein, made fun of all the consternation such contradictions caused.[17] 'It is most strange, really, that this should have puzzled anyone - much stranger than one might think: that anyone would make a fuss over this. Because the thing works like this: if a man says 'I am lying', we say that it follows that he is not lying, from which it follows that he is lying, and so on. Well, so what? You can go on like that until you are blue in the face. Why not? It doesn't matter.' This response touched a sore spot for many famous mathematicians. It was true that to mathematicians, paradoxes[18] are impermissible. A paradox, eventually, may lead to the conclusion that 1 equals 2 and that would undermine everything. This is why scientists have put so much effort into finding simple foundational principles (axioms) for mathematics that ensure that no one will ever prove that 1 = 2 (in other words, into developing a paradox-free mathematical system). A paradox knocks down the whole building of mathematics. It suggests the end of all science (in the conventional understanding of the word). During the 19th century, mathematics developed towards an ever increasing level of abstraction, culminating in Georg Cantor's (1845-1918) set theory.



Mathematician Hilbert

In set theory, problems occurred that were very similar to the Cretan paradox mentioned earlier. The problem arises when one considers the set of all sets which do not contain themselves as an element (see Russell's quote further down). Set theory allows for the proving of statements whose opposite can also be proven. At the beginning of the last century, German mathematician Hilbert (1862-1943) therefore invited mathematicians to base all mathematics on a system of axioms acceptable. This system could be used to ground all known mathematical results - by applying the conventional rules of logic - as well as to answer unsolved questions (this effort became known as Hilbert's Programme). The main requirements for such a system of axioms were consistency and completeness. A 'complete' system would be one from which all true claims could be derived, while a 'consistent' system would only true claims to be derived from it. In other words: if a claim is true it must be possible to derive it from the axioms - otherwise it is false. Earlier on, in 1903, Russell had published a book called *The Principles of Mathematics*. When this work was almost completed, Russell discovered a paradox he couldn't solve. It is interesting to read what he writes about it himself and to compare this with the Wittgenstein quote we looked at earlier:

'I thought the work was nearly finished, but in the month of May I had an intellectual set-back (…) Cantor had proof that there is no greatest number, and it seemed to me that the number of all the things in the world ought to be the greatest possible. Accordingly, I examined his proof with some minuteness, and endeavoured to apply it to the class of all the things there are. This led me to consider those classes which are not members of themselves, and to ask whether the class of such classes is or is not a member of itself. I found that either answer [to this question, Kees Roos] implies its contrary. At first, I thought I would be able to overcome the contradiction quite easily and that probably there was some trivial error in my reasoning, but (...) as it turned out, there was some similarity between my problem and the ancient Greek contradiction about Epimenides the Cretan. It seemed unworthy for a grown man to spend his time on such trivialities, but what was I to do? (…) in the end I had to conclude it was too

big of a job. I therefore decided to finish the book, leaving the solution in abeyance.' In the *Principia Mathematica*, Russell thought he had found the solution by introducing an additional axiom. Prominent scholars such as Brouwer and Wittgenstein, however, insisted that the Hilbert Programme was doomed to fail.

Paradoxes within mathematics: Kurt Gödel (1906 - 1978)

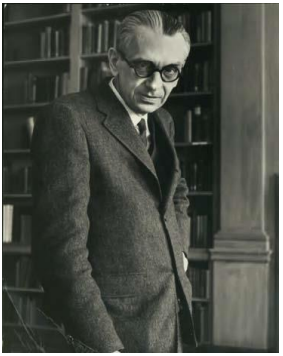
This is where Kurt Gödel comes in. In 1931, he published an article in which he brilliantly proved the unfeasibility of the Hilbert Programme.[19] The article came as a complete surprise to everyone.

It was like a time-bomb under the Hilbert Programme. Gödel proved the so-called incompleteness theorem: if you have a sufficiently strong axiomatic system that is consistent, it is incomplete. So there will always be claims that are true (in the sense that they don't contradict the chosen axioms), but cannot be derived from the axioms using the rules of logic! One would think that adding axioms would solve this dilemma, but it doesn't. The incompleteness theorem applies to every axiomatic system, it turns out. An immediate consequence is that any (sufficiently strong) axiomatic system that is complete, cannot be consistent and therefore can lead to contradictions.

Neither mathematics nor logic (let alone the other sciences) are able to offer us a solid foundation for understanding the reality in which we live

The question of whether mathematics and/or logic could offer an Archimedean point in our thinking, had thus been answered. The answer is no. Neither the language of mathematics nor any other formal language can be guaranteed to be free of contradictions. Neither mathematics nor logic (let alone any of the other sciences) is able to offer us a solid foundation for understanding the reality in which we live. Reality (both physically and spiritually) is much too complicated for that. Science offers us

no more than (minor) techniques based on partial understanding. To our *frequent surprise*, these can at times be used astonishingly well. Even if mankind's faculty for logical thought had not been damaged by the Fall (as proposed by C. Steenblok, a.o., in a proposition accompanying his Ph.D. thesis)[20], it wouldn't help us design a paradox-free thought system. Such a thought system simply does not exist.



Kurt Gödel

C. J. B. Jongeneel has rightly defended[21] Gödel's proposition as a special case of proposition 6.52 from the *Tractatus*: 'There are, indeed, things that cannot be put into words. They make themselves manifest. They are what is mystical.' Scientific knowledge is 'partial knowledge' and it falls short of what matters most (Wittgenstein). The nature of this knowledge, based on logic, is unreliable and leads to confusion (Gödel). Science and logic are no more than supports to help us survive the imperfections of this dispensation. When the perfection of God's Kingdom comes, they will be 'annulled' (see 1 Corinthians 13:9-12 and Calvin's commentary on it).

Wittgenstein probably meant to express this in the penultimate proposition (proposition 6.54) of the *Tractatus:* 'My propositions are elucidatory in this way: he who understands me finally recognizes them as senseless, when he has climbed out through them, on them, over them. (He must so to speak throw away the ladder, after he has climbed up on it.) He must surmount these

propositions; then he sees the world rightly.' Perhaps the source of the prevalent idea as to the basis from which science derives its authority - namely that science offers us a paradox-free thought system and protects our thinking from confusion - is the river in Revelation 12 (there are of course other interpretations of this river, ***E. Maatkamp***). I would like to comment on this in the following, closing paragraph.

Revelation 12: new knowledge

In relatively few words, Revelation 12 gives us a glimpse behind the stage of world history. A dragon is mentioned that seeks to prevent a cosmically described woman from giving birth to a child. When the moment arrives, the child is pulled away from the dragon by God. The dragon then directs its wrath at the woman. She escapes to the desert, where God has prepared a place for her. The dragon pursues her and makes war with 'the remnant of her seed'. This, in short, is the image portrayed. The dragon also turns out to be the 'old snake' (i.e. the devil, 'who leads the whole world astray') and the child is the Lamb, Jesus Christ.

After the Lamb is taken up into heaven, the woman stays in the wilderness for 1,260 days, or 42 months, or 'two times, a time and half a time' (in this context that is 3.5 years). According to Hendriksen[22], this time span - which occurs in the book of Revelation several times - is the period between the Ascension and the Second Coming of Christ. The weapons the woman is given to escape the dragon (the two wings of a great eagle) are faith and prayer.

The dragon's weapon is a river, with which he tries to carry the woman away (from the desert). His anger focuses on those who 'keep the commandments of God' (the Jews?) and on those who 'have the testimony of Jesus Christ' (Christians?); thus, in the vision, they are represented by the woman (***E. Maatkamp:*** there are other interpretations than Hendriksen's of the woman and the child that I prefer, but they are not important in this context).

Scientific knowledge is partial knowledge based on a darkened reasoning that will be annulled when God's Kingdom comes

This impressive vision clearly shows Satan's objective. First, he tries to prevent the birth of Jesus. Consider for instance, the pharaoh who wanted to kill all Jewish male babies, or Haman who wanted to kill all Jews, and Herod who had the children of Bethlehem murdered in order to get rid of the King of the Jews who had just been born. When these attempts have failed, the dragon focuses his wrath on the woman and her seed. I believe this includes Jews and Christians. A safe place is offered them in the desert, where they are hidden from the snake's view. They reach this place through faith and prayer. Only in the desert is the woman safe from the dragon.

The life of believers, then can be characterised as a desert life. The dragon knows that. He tries to get the woman out of the desert. How? He offers the woman more than a simple oasis in the desert: *a whole river*. The intention is clear. As a result of the river the desert ceases to be a desert. This is how the dragon tries to get the woman away from the place God has prepared for her and in which God wants to keep her and look after her ('feed'). The question, of course, is what this vision means for our attitude to science. Could it be that science (and technology) constitute an important part of the river in the vision? The devil seduced Eve with the promise of opened eyes through which she would gain access to new knowledge and through which she would be like God. Could it be that he is still suggesting the same to mankind, I mean, by way of science? Is there not limitless faith in the ability of science to give us knowledge that is not just reliable, but more reliable than God's Word? After all, our prosperity is a result of this knowledge, and so is the conviction that things are heading in the right direction thanks to evolution: we are becoming more and more intelligent, and life on earth will ultimately take on paradise-like qualities. Of course, we're not there yet, but that is a question

of time. What's more, there is already so much to enjoy in this world. This whole reasoning leads us to embrace the illusion of a paradise-like earth, on which life is comfortable and our awareness of our dependence on God disappears. Those who keep Gods commandments and have the testimony of Jesus Christ, become interested in a very different reality. They know that scientific knowledge is 'partial knowledge' seen through a glass, darkly - knowledge that will pass away when God's Kingdom comes. That is their home country, from which they know themselves to be governed. They are pilgrims looking forward to that land with eager expectation. They live in dependence on God, whom they not only honour as the Creator of heaven and earth, but also as their Saviour and Deliverer. They live on earth, but they are citizens of heaven. They live in their own home country, but as strangers. Every strange country is a home country to them and every home country a strange country.

Notes

[1] In which science is defined as 'the systematic ordered whole of knowledge and of the rules, laws, theories, hypotheses and systems through which further knowledge can be obtained' (free translation of the Dutch Van Dale dictionary definition).
[2] L. Wittgenstein. *Tractatus Logico Philosophicus*. Translated and provided with a postscript and notes by W. F. Hermans (Athenaeum-Polak and Van Gennep, Amsterdam, 1989).
[3] R. Monk, *Ludwig Wittgenstein - The biography* (Prometheus, Amsterdam, 2003).
[4] Id., p. 50.
[5] Id., p. 121.
[6] Id., p. 135.
[7] Id., p. 126.
[8] Id., p. 265.
[9] Id., p. 316.
[10] Id., p. 318.
[11] Id., p. 78.
[12] Id., p. 388.
[13] Id., p. 451.
[14] Id., p. 511.
[15] Jac. Kruidenier, *Understanding the Spirit of the Times - Historical Sketches of Philosophers from the New Time* (De Groot, Goudriaan Kampen, 1994, p. 51).
[16] *Ludwig Wittgenstein - The biography*, p. 179.

[17] Id., p. 403.
[18] Paradox in the sense of 'mathematical proposition for which both the confirmation and the denial lead to a contradiction' (Dutch Van Dale dictionary definition).
[19] K. Gödel, *Uber formal unentscheidbare Sätze der Principia Mathematica und verwandter Systeme I*, Monatshefte für Mathematik und Physik, 38:173-198, 1931.
[20] C. Steenblok, *Voetius and the Sabbath*, Ph.D. Thesis, VU, Amsterdam, 1941.
[21] C. J. B. Jongeneel, *The informatical world view - An inquiry into the methodology of computer science*, Thesis (Delft TU, June 1996.)
[22] W. Hendriksen, *Visions of the Completion* (Kok, Kampen, 1952). Originally: *More than conquerors* (Grand Rapids, 1939). Translation by P. Prins.