# Wittgenstein's Philosophy of Mathematics and the Search for Extraterrestrial Intelligence

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## I

Humanity, its scientific members in particular, has long been fascinated by the possibility of extraterrestrial intelligence. Although the idea of creatures inhabiting nearby heavenly bodies lost credence after expeditions to the Moon and Mars, several members of the SETI Institute (the institute for the search of extraterrestrial intelligence) still maintain on statistical grounds that "alien civilizations in the galaxy are likely to number anywhere from 10,000 to one million" (Broad 1998).

But, what does it mean: "extraterrestrial intelligence"? The first association most readers will probably have is the prototype of a Martian: a green, and slimy creature in which all sorts of human traces, mental as well as physiological, can be discerned. Furthermore, this creature - let us call him Joe - is very intelligent; in particular, he excels in mathematics. In fact, the very way in which we got in contact with Joe was by means of mathematics: large radiotelescopes picked up sequences of prime numbers, which we returned with part of the sequence of Fibonacci numbers… and he arrived on earth.

There is an underlying assumption of tremendous importance: mathematics is a language shared by all civilizations, it is a universal language, so to speak. This assumption has had enormous consequences for the SETI project. It has restricted the definition of "extraterrestrial intelligence" in the same way as old-fashioned IQ tests have done with the notion of *human* intelligence: intelligence is equated with the outcome of the test, discarding the possibility of an external criterion for the correctness of the test; analogously, "extraterrestrial intelligence" has been declared equivalent to "possession of mathematical abilities similar to ours." But, why would extraterrestrial civilizations have the same mathematics as we do? Is not a different mathematics possible? That is, how can we be sure that the above definition of "extraterrestrial intelligence" does not exclude civilizations that do their math in a different way, but are interesting to get in contact with anyway? Do such civilizations exist? *Can* such civilizations exist?

In this paper, I will argue that Wittgenstein's philosophy of mathematics provides an interesting view on the assumption that mathematics is a universal language. The argument as I give it here will probably not convince someone who is not familiar with

Wittgenstein's thought. For a different audience, I would have elaborated on different points. Furthermore, I have not dwelt upon any connections with, say, the problems of other minds and cultures, relativism, and the like. Altogether, it is only a short note on what I think is not an unimportant issue.[1]

## II

*The Assumption: Mathematics is a universal language, and hence forms the most plausible way to get into contact with extraterrestrial intelligence.*

*First Problem: Mathematics Is Not Universal.*

*Why would anyone think that?* A possible defense of the claim may run like this. After all, it seems very appealing to consider mathematics as a universal language. Thinking about mathematical statements, it is just too hard to doubt the truth of statements like 2x2=5. We simply cannot imagine mathematics to be false. If prompted to answer why not, people tend to tell you that it cannot be imagined that twice combining two apples would give you five apples, and that, hence, no counter-example to the mathematical statement can be thought of. And therefore, they would continue, even though at different planets they may have different fruits, still if they twice combine two pieces of them they will end up with four, not five. Or briefly: mathematical statements are true everywhere, and hence mathematics is universal.

*What is wrong with this argument?* Again briefly: it neglects the fact that mathematics, in order to be universal in any meaningful sense, has to be universally *used* as well. In order for mathematics to be the right tool to talk to foreign species, it is at least necessary that they have it in their tool kit. And now the question becomes whether the (if you wish) universal *truth* of mathematical statements implies its universal usage. I will argue that Wittgenstein's philosophy of mathematics casts severe doubt on this. The following quote from the fourth of the *Lectures on the Foundations of Mathematics* makes this quite clear.

> [A mathematical statement is i]ndependent of experience because nothing which happens will ever make us call it false or give it up. Dependent on experience because you wouldn't use this calculation if things were different. (Wittgenstein, 1976, 41-2)

The first sentence states very clearly in what sense we could call mathematics universally true. No experiments will ever be able to falsify mathematical statements, and hence, in every out of the way corner of the cosmos, they will be true. But, that corner may be so different from our world, that our mathematics would not arise there. If the world is too different, the math will be different.

Wittgenstein argues for this by means of "fictitious natural history" (*Phil. Inv*. xii). That is, he constructs thought experiments, or scenarios, describing how particular (mathematical) practices came into existence. Let us - only to get some idea of his argument - distinguish two kinds of scenarios. The first one is situated in a really fictitious environment, quite different from ours. Usually, we are asked to imagine an *only slightly* different culture, where, for instance, the price of timber is not related to *volume*, but to the *surface* it covers, and quite often, Wittgenstein makes it plausible that in such a culture different mathematics would arise. Or at least, he shows that it is hard to imagine that in such a culture *our* mathematics would find a place.

For a start it seems as if we can make good sense of these thought experiments because the differences with our own situation are only small. Thinking things through, however, we quite quickly get the feeling that we can only give such small deviations a consistent place if a whole lot more in our idea of the fictional culture is changed. We need to allow for more than *only slight* differences between them and us. At the end we might even say that Wittgenstein has only given us the *suggestion* of a different culture rather than a consistent and convincing description. I will not go into that question - especially since it has provoked discussion at several other places.[2] However, if we do not think that the above argument is even serious as an attempted proof - the idea of course being that in all those fictional cultures mathematics will not be ours - another line of reasoning can be found in Wittgenstein's writings.

This second kind of thought stays within our own culture and only asks us to reflect on the origin of our mathematics. Near the argument of the wood sellers, for example, we find in the *Remarks on the Foundations of Mathematics* a wonderfully short sentence expressing a hint at the origin of multiplication.

> We teach someone a method of sharing out nuts among people; a part of this method is multiplying two numbers in the decimal system (*Remarks*, Part I, 142).

Of course, Wittgenstein did not intend this as a serious contribution to the history of mathematics. As it stands, it is very possibly even false. The point is, however, that he draws our attention to the way in which a particular mathematical practice is so to speak implicit in the way we do things. Arithmetic grew out of, say, "sharing nuts." Geometry from dividing land. And that connection is essential for the development of mathematics. This line of reasoning is perhaps best brought out by a quote from again the *Lectures*:

> All the calculi in mathematics have been invented to suit experience and then made independent of experience (Wittgenstein 1976, 43).

*Second Problem: Mathematics Is Not A Language*

*Why would anyone think that?* I think that this position is often confounded with the

alleged universal character of mathematics, and thus defended along the lines sketched above: mathematics is true everywhere, so it is perfectly suitable as an *Esperanto* for the whole universe. A more sophisticated defense is this. Mathematics has proved extremely useful in describing the important physical characteristics of our planetary system, the milky way, the structure of the atom, and so on, and so forth. Now, one of the first things that we would like to communicate to alien civilizations is exactly how our physical environment looks like. So mathematics is a straightforward option.

*What is wrong with this view?* To see why this is false, we only need to inspect Wittgenstein's well-known argument against the picture theory of meaning. Were the meaning of a word or sentence a picture, then we would need to know how to interpret that picture. But such an interpretation would stand in need of an interpretation itself, and so an infinite regress would arise. Of course, the reason why we know the meaning of a sentence is that we have learned how to use our language.

Let us with this caricatured version of Wittgenstein in mind look more closely at an example. Suppose we would like to send a message that tells any receiving - and as yet unknown - civilization how our planetary system looks like.[3] The idea is to cut the message into two parts. The first part presents a logic with operators for notions like "planet," "star," "inhabitable object," etc. The second part gives a description of our planetary system in terms of this logic. The receiver is now supposed to apply the first part of the message first, and give a representation of his own planetary system in terms of this logic. Then, having found the meaning of the operators, he will be able to interpret the second part of the message and so get to know something about *our* planetary system.

It is clear that the designers of such systems have realized that straightforward message sending is probably not going to work because the receivers will not know how to interpret the messages. That is, sending "images" (depicting the human body, the structure of the Helium atom, the planetary system, etc.) is not an option. The novel idea is to send messages that have built in a device that allows the receiver to construct the right interpretation without ending up in a Wittgensteinian regress. Sure, that is quite sophisticated. But, I think, a variant of the infinite regress will appear anyway, just at a different level. Indeed, how does the receiver know that this is a message, and not something else; and even if he does, how does he know that its first part gives a partial key to the second part, and that he has to look at his planetary system (rather than the structure of the Helium atom or so) in order to find the full key? The message is so constructed that once he has decoded the first part, he will have the semantics for the second. But what guarantee do we have that he will ever get the semantics of the first part? He would need a key to the *whole* message, too. And a key to that key, and so on.

## III

I have sketched how two fundamental problems permeate the search for extraterrestrial intelligence, and I admit to have presented them in a rather blunt way. In this last section, I will try to formulate some implications. But first, let me set something right.

In the literature (the technical, not the popular) there is a tightly felt distinction between two projects: the *search* for extraterrestrial intelligence, and the *communication* with extraterrestrial intelligence. Perhaps in its early days, the SETI Institute had a more ambitious program, but right now, the first goal is to search for constant or slowly pulsing narrow-band signals (called "carriers"; think of a constant flute-tone). They do not scan for signals that rapidly modulate (like a rhythmic melody); not for *messages* so to speak. Yet, witness the example above, *communication* is studied at other departments, and the arguments I have sketched are in the first place directed at such an enterprise.

Now about the argument. I have certainly not presented an argument that shows that the search for extraterrestrial intelligence is a hopeless and doomed to fail. I think, however, that this argument shows that we should not expect that we will get into contact with intelligence that is too different from ours. Not surprisingly, the popular image of extraterrestrial intelligence is the thoroughly anthropomorphic Martian rather than one inspired on Stanislaw Lem's *Solaris*. At the end, then, one could say that we will not be able to go beyond the anthropomorphic. The search for extraterrestrial intelligence is a search for extraterrestrial human beings.

## References

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## Endnotes

1 Another critical argument is (Rescher 1984). A staunch defense is (Minsky 1985).

2 An interesting paper is (Gasking 1953), who explicitly acknowledges that his "debts to the lectures of Wisdom and Wittgenstein, in writing this paper, is very great."

3 This is not a fictitious example. The idea to do this kind of stuff started, if I am right, with the Dutch mathematician Hans Freudenthal's "Lingua Cosmica" in the 1960's; see his (Freudenthal 1960). For more recent work related to the above example, see, for instance, (Ollongren 2000).)