# FROM NEWTON TO CANTOR
# CONSIDERATIONS REGARDING
# 'CUM DEUS CALCULAT, FIT MUNDUS'

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## Abstract

There are many examples of situations in which philosophers and scientists (not that there is a great difference between them) confuse places or references they make to texts previous or contemporary to them. It happened in the Alexandrian Age and especially in the Middle Ages, when copying a manuscript was also both a canon and a punishment. The actual revenge of copyists consisted in the intentional mistaken reference to the texts of the classics. That explains how a specific reference to Plato was different in two different manuscripts. I find another occurrence of this phenomenon at the beginning of modernity and towards its end. I will refer explicitly to Newton and Cantor, especially to the latter, even if he does not do it in the revengeful manner of the medieval copyists. I will add Tarski, not guilty of the proximity with the other two – he never said anything about such intervention – especially that everything begins with a debate between Plato and Aristotle. The 'red thread' of the text is: the establishing of the starting point: 'Politeia' 595 b-c and the 'Nicomachean Ethics', 1096 a / Newton and 'his hew friends' (the reference is not to Plato and Aristotel, but to Hook) / Cantor and Tarski, the latter being more of a pretext of the same kind as 'Inimicus Plato sed magis inimica falsitas'. The relation between Theology and Science is at stake and, from Plato to Cantor and Newton, it is obvious that Mathematics is not indifferent to God, i.e. reason is not opposed to belief, but assures and comforts it/ 'ratio confortata fide'.

*Keywords:* Newton, Cantor, Tarski, truth, infinity

## 1. Ancient preliminaries

In a reference article, Professor Richard S. Westfall looks into Newton's notes when the latter was a Cambridge student, starting from 1661 [1]. Newton's notes are mainly from the *Organon*, the *Nicomachean Ethics* and from Johannes Magirus' *Physics*, a summary of Aristotle's *Physics* (*Physiologiae Peripateticae libri sex* - 1597, in fashion at that time). As from 1664, Newton begins to write down in *Quaestiones quaedam philosophicae* all kinds of ideas/notes under a

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motto such as: *Amicus Plato, amicus Aristoteles, magis amica veritas* (Plato is my friend, Aristotle is my friend, but my greatest friend is truth). Westfall tells us that *Amicus*...is a slogan and that Plato and Aristotle are no longer mentioned, although Newton found 'new friends' in those two. I fear the new 'friend' is in fact Hook and the quotation marks have their role here, which is not the case when I used them when speaking of Plato and Aristotle – there I used them only referring to Westfall. It is clear that, for his own purposes, Newton adapts a proverb that was well-known in the Middle Ages and the beginning of the Renaissance. What is Newton seeking in this adage? He is searching for the primacy of truth before authority, or friendship. What does a recent commentator, Henry Guerlac, find out? He sees that, in various occurrences that we are accustomed with, Socrates' name is substituted for Aristotle's, while Aristotle's name doesn't appear much more, despite the adage often being associated with Aristotle himself and the reference pointing to a familiar place in the *Nicomachean Ethics* (1096a) where we can read a reply to Plato: „Dismissing these views, then, we have now to consider the 'universal good', and to state the difficulties which it presents; though such an inquiry is not a pleasant task in view of our friendship for the authors of the doctrine of ideas. But we venture to think that this is the right course, and that in the interests of truth we ought to sacrifice even what is nearest to us, especially as we call ourselves philosophers. Both are dear to us, but it is a sacred duty to give the preference to truth." [2] Aristotle's reference is to the *Republic* by Plato, to an excerpt where Plato, through Socrates, says: „I must speak out, 'I said', though a certain love and reverence for Homer that has possessed me from a boy would stay me from speaking. For he appears to have been the first teacher and beginner of all these beauties of tragedy.  Yet all the same we must not honour a man above truth." [3]

## 2. Newton vs. Cantor

Returning to the point,  Newton's source at the time of the aforementioned notes (1661-1665) seems to have been a physician named Walter Charleton, a member of the Royal Society and the Royal College of Physicians, who, influenced by Hobbes, becomes a pioneer of the 'New Philosophy' (particularly Descartes and Gassendi). His writing – *Physiologia Epicuro-Gassendo-Charltoniana*: *a Fabrick of Science Natural Upon the Hypothesis of Atoms* (1654) will play an important role in spreading Gassendi's atomist 'gospel' to England. It is the first chapter of this work that Newton draws on in connection with the proverb mentioned before [4], adding that Socrates is missing in Charleton's statement.

I continue with a text by P.T. Geach who tells us in its 'Preface' that he brings together in *Logic Matter* the articles in English, published previously in various journals, or collective volumes, and "not already collected or cannibalized in other books" [5]. I'm interested in Chapter 4 ('Intentionality'), especially subchapter 4.6 ('The Identity of Propositions'). The conclusion is:

starting from Kotarbinski's ontological reism and the rejection of all non-concrete objects (numbers, functions, classes, platonic ideas), P.T. Geach conjures up Tarski in favour of Kotarbinski, as Tarski is supposed to have once said (although nobody knows when or where!) the following: *Inimicus Plato sed magis inimica falsitas* (Plato is an enemy, but falsehood is yet a greater enemy), hence Tarski's reportedly anti-Platonism.

The question is more complex so let's see why and how.

*Inimicus Plato sed magis inimica falsitas* appears as a *motto* in William Kneale and Martha Kneale [6], beside other three maxims from Abelard, Leibniz and Cantor (Kneale doesn't give any indication about the place of the quotations, nor does Cantor earlier, which I will explain soon). The order of the maxims in Kneale is: Abelard, Leibniz, Cantor, Tarski. Thus, we have:

- Abelard: *Haec autem est dialectica, cui quidem omnis veritatis seu falsitatis discretio ita subiecta est, ut omnis philosophiae principatum dux universae doctrinae atque regimen possideat* / "But this is the logic [dialectic], the subject of which is truly, therefore, the distinction of any truth or falsehood, that it possesses like the leader of the entire philosophy which has precedence and dominion over the whole universal doctrine" [Abelard, *Dialectica. Pars Quarto, Liber Primus* (De Divisione Hypoteticarum Earumque Proprietaribus), *Prologus*];

- Leibniz: *Lockius allique qui sperunt non intelligunt* / "Locke and others who have hopes, don't understand" [7];

- Cantor: *Neque enim leges intellectui aut rebus damus ad arbitrium nostrum, sed ranquam scribae fideles ab ipsius naturae voce lata set prolatas excipimus et describimus* / "we do not assign laws to mind or to things according to our own will but, as careful scribes, we just register and write down the laws given and discovered to us by the nature itself".

- Tarski: *Inimicus Plato sed magis inimica falsitas* / „Plato is an enemy, but falsehood is yet a greater enemy".

This is the problem. Cantor didn't say, or, in any case, didn't write what Kneale claims in the *Development of Logic* that it would be a quotation from Cantor; the quote is not from Cantor, it is from somebody else, Kneale is wrong. Cantor's story is longer, I'm trying to sum it up. Cantor is convinced, as well as Pitagoras, Plato, Newton and Leibniz, that God thinks in a mathematical way and that world itself is the result of a divine *calculus*.

In 1895, Cantor publishes an article in *Mathematische Annalen*, XLVI, 1895, 481-512, titled 'Beiträge zur Begründung der transfiniten Mengenlehre' (Contribution in support of transfinite set theory). On page 481, as a sort of motto for his article, still without identification elements, Cantor uses three quotations as follows:

1. *Hypotehses non fingo*;
2. *Neque enim leges intellectui aut rebus damus ad arbitrium nostrum, sed tanquam scribae fideles ab ipsius naturae voce latas et prolatas excipimus et describimus*;

3. *Veniet tempus, quo ista quae nunc latent in lucem dies extrahat et longioris aevi diligentia*. (The time will come when these things which are non-hidden from will be brought into the light.)

Let's take them in turn.

### 2.1. Quotation 1

*Hypotheses non fingo* – "I feign no hypotheses"; "I frame no hypotheses", or "I contrive no hypotheses" is Newton's familiar formula that can be found in *Scholium Generale*, an addition to the second edition (1713) of *Principia Mathematica,* amended in the third edition (1726). It shouldn't be mistaken for *Scholium Generale* at the end of book 2, section 6, which discusses the pendulum experiment and air, water and other fluids resistance [8].

*Hypotheses non fingo* (*fingo* = "to fancy", "concoct", "imagine" – is more often translated by *feign* than by the traditional *frame* and we translate *feign* by "concoct", "invent" and *frame* by "propose", "suggest", and *contrive* by "invent", "concoct"). I make definitive reference to Newton: *Rationem vero harum gravitates proprietatum ex phaenomenis nondum potui deducere, & hypotheses non fingo. Quicquid enim ex phaenomenis non deducitur,* hypothesis *vocanda est*; & *hypotheses seu metaphisycae, seu physicae, seu qualitatum occultarum, seu mechanicae, in* philosophia experimentali *locum non habent. In hac philosophia propositiones deducuntur ex phaenomenis & redduntur generales per inductionem* [8, p. 530] /„But hithero I have not been able to discover the cause of those properties of gravity from phenomena is to be called an hypothesis; and hypotheses whether metaphysical or physical, whether of occult qualities or mechanical, have no place in experimental philosophy. In this philosophy particular propositions are inferred from the phaenomena, and afterwards rendered general by induction." [9]

If we are to arrive where we should, *Hypotheses non fingo* is nothing else but Newton's reply to Robert Hooke [10]. What is it about? It is about the law of gravitation and an accusation of plagiarism that Hooke brings against Newton. Robert Hooke publishes *System of the World* in 1660, then, he reads *On gravity* (1666) in front of the Royal Society. His communication did not offer 'mathematical demonstrations', Hooke himself says that he didn't check anything by experiment, that he is making 'suppositions'. While Newton states in *Principia Mathematica* (1687) that he 'explains', 'infers', that he 'frames no hypotheses', Hooke often uses the words 'guess', 'putting suppositions' (that is 'framing hypotheses') in his exposition. Newton catches him and counterstrokes. Both of them were wrong. Hooke needed Newton's mathematical support; the latter didn't recognize any merit to Hooke in developing the theory of gravitation. Hooke was President of the Royal Society before Newton; Newton succeeded him and removed any trace of the former president. Hooke was nicknamed 'the mechanic', Newton was 'Sir', the former is defeated, yet both of them are losers for the posterity, at least from a moral point of view. In his correspondence, Newton admits Hooke's contribution, then he finds out about

the latter's claim to priority and in the next editions of *Principia Mathematica* he eliminates any positive references. The very same correspondence, especially the one with Halley, seems to do justice to Newton: "So then in this theory I am plainly before Mr. Hook" [11; N. Sfetcu, *Controversa dintre Isaac Newton şi Robert Hooke despre prioritatea în legea gravitaţiei (The Controversy between Isaac Newton and Robert Hooke over their Priority as to the Law of Gravitation)*, https://www.academia.edu/35292050/Controversa_dintre_Isaac_ Newton_%C8%99i_Robert_Hooke_despre_prioritatea_%C3%AEn_legea_gravi ta%C8%9Biei, 1-14]. And Newton inexpugnably concludes: *numero pondere et mensura Deus omnia condidit* ('God created everything by number, weight and measure', which is another note from a 'student notebook'). Moreover, the phrase appears in the penultimate paragraph of *Principia Mathematica*, where Newton shows clearly that he no longer wants to continue discussing with Hooke.

### 2.2. Quotation 2

Concerning the quotation that Kneale ascribes to Cantor, my opinion is that it doesn't belong to Cantor but to Francis Bacon: - *Neque enim leges intellectui aut rebus damus ad arbitrium nostrum, sed tanquam scribae fideles ab ipsius naturae voce latas et prolatas excipimus et describimus* [12]. The first quotation was easy to be attributed, as well at the third; not being able to identify the second, Kneale attributed it wrongly to Cantor.

### 2.3. Quotation 3

The quoatation 3 from Cantor's article is: *Veniet tempus, quo ista quae nunc latent in lucem dies extrahat et longioris aevi diligentia*. Cantor gives the impression that it is from Saint Paul, 1 Corinthians 4, 5. I found it in Seneca: "The time will come when diligent research over long periods will bring to light things which now lie hidden" [13]. I find the accurate reference to Seneca in at least two places, in a translation by Sweenborg [14] and in John Edwin Sandys [15] where we learn that Roger Bacon himself quotes Seneca about the place in question in *Naturales Quaestiones*. It is true that something similar can be found in Saint Paul's letters, even in 1 Corinthians 4-5: *Taque nolite ante tempus judicare, quoadusque veniat Dominus*: *qui et illuminabit abscondita tenebrarum, et manifestabit consilia cordium* (Therefore judge nothing before the time, until the Lord come, who both will bring to light the hidden things of darkness, and will make manifest the counsels of the hearts). The places are very close in their content, however, it is not Seneca whom Cantor wants to invoke, instead his favourite is Saint Paul and he has personal reasons to prefer Paul and to compare to him. Things are in this way.

When he speaks about Cantor's transfinite mathematics and manic depression moods, referring exactly to 'Beiträge', Joseph W. Dauben [16] points out that these episodes were productive for Cantor, his ideas coming from the

loneliness of the asylum or the peace at home. This is how Cantor's belief that the idea of transfinite numbers was communicated straight to him by God can be understood. Dauben, too, links this issue to the quotation from Seneca, referring to 1 Corinthians. Cantor was convinced that he was an instrument of the revelation, hence his often allusions to the Church Fathers and Saint Thomas particularly.

Dauben dealt with the same problem before [17]. The text highlights Cantor's endeavour to show that there is no incompatibility between his ideas and the Catholic dogma. Dauben wants to emphasize two aspects which pertain to Cantor's personality and which should follow the agreement between his ideas and those of the encyclical *Aeterni Patris*, issued by Pope Leo XIII on the 4th of August, 1879.

The first aspect: Cantor believes in mathematicians' freedom; Philosophy and Theology have nothing to do with the truth of mathematical theories. Mathematics has its own mechanisms meant to avoid errors. Cantor's ideas about the existence of mathematical objects show up in paragraph 8 of *Grundlagen einer allgemeinen Mannigfaltigkeitslehre* (1883), where he differentiates between 'immanent reality' and 'transsubjective reality'.

The second aspect: his mystic vocation to devote his life to mathematicians, as results from a letter addressed to his father in 1862. He follows his vocation and considers himself to be 'chosen'. Is like a Saint Paul who passed through a mathematical transfiguration. Transfinite numbers are not offensive to the Catholic faith and Cantor harbours no doubt about the truth of transfinites, which, he says, were identified by him with the help of God and God cannot reveal what He does not love. He doesn't hesitate to use theological arguments to support his theses or to introduce distinctions such as *Transfinitum vs. Absolutum*, this is because he was accused of Pantheism. The deep connection between Cantor's mathematical work and his faith can be seen exactly in the quotation from Seneca and Saint Paul. Both speak about revealing of what is hidden in the darkness, which is not given to anyone; but Cantor thinks of himself that he is meant to be the subject of this revealing act.

## 3. Conclusions

God loves mathematics, and of this fact Cantor never doubted. Plato was sure that God spent much time in dealing with geometry and Leibniz, following Newton (*numero pondere et mensura Deus omnia condidit* - God created everything by number, weight and measure), or maybe on a par with him, said that the world was the result of a divine calculation: *Cum Deus calculat et cogitatione exercet, fit mundus*. The occurrence, added to the margin of a short *Dialogus* (1677), turns out to be one of the most debated of Leibniz's obscure places. Couturat 'abbreviated' it: *Cum Deus calculat, fit mundus* (When God calculates, the world arises) [18]. Cantor is convinced that Mathematics owes nothing to moral philosophy, that it does nothing else but brings about axioms, theories and solves equations. Pierre Thuillier [19] goes to the length of

attributing to the friendship with Leo XIII (who, in *Aeterni Patris*, urges to a rapprochement between religion and science, just like John Paul II afterwards in the encyclical *Fides et Ratio*: „Faith and reason are like two wings on which the human spirit rises to the contemplation of truth" [http:/www.catholic-pages.com/]) what he calls Cantor's obscurantism, the latter being 'le dernier des obscurantistes'. Cantor seems to give in to the divine possession when he says that, for the first time and owing only to him, Christian philosophy has a true theory of infinity. The Church is reserved about this. Infinity is a paradox that less and less people doubt about, Cantor says, the Church invokes Thomas according to whom God is infinite and perfect - *manifestum est quod ipse Deus sit infinitus et perfectus*, Cantor goes back and makes the difference between God's absolute infinity (*Infinitum aeternam increatum sive Absolutum*) and the actual infinity of mathematicians (*Infinitum cratoegus sive Transfinitum*). That means that the second one, the transfinite infinity, is not infinite (this happened after some Christian theologians, especially Neo-Scholastic, regarded Cantor's work as a challenge to the uniqueness of the absolute infinity in God's nature, equating the transfinite number theory to Pantheism, an idea that Cantor had always rejected).

It is now, at around the age of 40, that the depression period starts and it will last until the end of Cantor's life. It also now, at the beginning of his breakdown, that, in order to defend his theses, he will say in his correspondence that he has merely written them down, God inspiring him (Cantor says it like a devoted Lutheran) and Saint Paul said the same and it wasn't easy to either of them and the world felt free to abhor them. Dauben tells us in his studies that Cantor's ideas were considered "a serious disease", that Cantor was regarded as a "metaphysical charlatan", "scientific charlatan", a "renegade" and a "corrupter of youth", among other things. Some important names said the same thing: Henri Poincare, Leopold Kronecker, Wittgenstein. Hilbert defends him later on: *Aus dem Paradies, das Cantor uns geschaffen, soll uns niemand vertreiben können* / "In front of his Paradise, which Cantor unveiled to us, we hold our breath in wonder, knowing that we won't be able to leave him" [20].

In 1911, Cantor was invited to participate in the 500th anniversary of the establishment of the University of St. Andrews in Scotland. He participated, hoping to meet Russell, who, in his recently published *Principia Mathematica*, repeatedly quoted his work. It wasn't meant to be. Next year, he was awarded the honorary degree of Doctor of Laws by the same university but his disease prevented him from receiving the title in person. He retired in 1913, lived in poverty, and suffered from hunger during World War I. The public celebration of his 70th birthday was cancelled because of the war. He died from a heart attack in January 6, 1918, in the sanatorium where he spent the last year of his life. He strove to show one thing in the end: how mathematics can reveal God's existence.

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