BRAINWAVES REPORT BW/004[1]

GOD, MATHS AND PLATO

An exercise in metaphysics

WHAT IS METAPHYSICS?

I once asked a colleague whether he supposed that life was meant to be an exercise in thinking. He reflected for a moment. ‘Doesn’t seem probable,’ he replied sagely. ‘Too many people never give it a try!’

METAPHYSICS is all about how we think. It shows how our various departments of knowledge and experience relate to each other as a single unity in which they find their meaning.

These departments in my belief meet like the spokes at the hub of a bicycle wheel. Metaphysics is then the study of this hub, which is God. If God really exists, the spokes are interconnected. So in the jingle,

> To correlate is all our aim,
> Link Latin on to statics;
> Co-ordinate theology
> With higher mathematics. (Anon)[2]

The postmodern, materialist view is that this can’t be done. No such unity exists. There is no ultimate meaning, no interconnections, no metanarrative. Metaphysics is nonsense. And there is emphatically no God.

Perhaps we need to do some thinking about what we are actually looking for and where we expect to find it. Let us try.

MYSTERY, PERSONALITY AND NUMBER

According to one possible approach to metaphysics, which I rather like, there are three fundamental concepts: *MYSTERY, PERSONALITY*, and *NUMBER*. Let us take them in order.

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[1] Edited notes of a talk given to staff and pupils in the Philosophical Society of Monkton Combe School, Somerset on 22 September 2006.

[2] I understand that this rhyme first appeared in the Croydon High School Magazine, long ago.

(1) MYSTERY is what makes certain things and people *special.* For example, gold, royalty, and Shakespeare. There will always be people who insist that nothing is special and everything must be as drab as everything else. (In my experience these are usually atheists!) Anything or anyone out of line is condemned by them as 'superstition', 'elitist', 'privileged', 'outmoded' etc. But it is the *special* things that add colour to life and make it interesting for everyone.

MYSTERY also incorporates *paradox*, which is to be found wherever we discover two apparent opposites, both of which we want to affirm. It is common in theology, where most notoriously the free will of man and the sovereignty of God appear to be in total conflict. We find it also in physics, in which light sometimes seems to behave as particles and sometimes as waves, which again appears to be a flat contradiction. Exploring how we maintain both always presents a fruitful challenge to our intellects. Conversely, if we by-pass the MYSTERY by rejecting one or other of the opposing truths and so pretending it doesn't exist, life suddenly becomes boring. Further, the MYSTERY always comes back to bite you later on. It reasserts itself. If we do not ask the fundamental questions we are unlikely to come up with the fundamental answers; but somebody else will!

(2) PERSONALITY: I think of this as being characterised particularly by the ability to *communicate.*

(3) NUMBER: We will come to this.

One can see God in each of these three concepts, and in the interplay between them.

In fact, the trio can prove very powerful in analysing different belief systems:

For instance the *Old Testament Jews* were strong on both MYSTERY and PERSONALITY. So Yahweh can speak: 'I AM WHO I AM' (Exodus 3:14); 'I love you' (cf. Isaiah 43:1-7). Yet they were hopeless on NUMBER (1 Kings 7:23 effectively gives π as 3 - the least accurate value assigned to it by any known ancient civilisation).

The *Greeks* by contrast were strong on NUMBER - they gave us mathematics as a reasoned, structured discipline.

The *great oriental faiths* of Hinduism and Buddhism are strong on MYSTERY but weaker on God as PERSONALITY.

Protestantism - especially Reformation Protestantism or evangelicalism - is weak on MYSTERY and on the whole deeply suspicious of anything that could be deemed superstition. But it is strong on PERSONALITY, with a penchant for hymns like J. M. Scriven's ‘What a friend we have in Jesus’.

FIRST LAW OF METAPHYSICS

I offer then as the first law of our metaphysics the proposition that *GOD EXISTS*. There is a hub to our bicycle wheel. All other laws of metaphysics either derive from this or are equivalent. How would we set about validating it? This takes us into the branch of metaphysics called *ONTOLOGY*, which is concerned with questions like, In what different ways can things *exist*?

In particular, what can the word ‘exist’ mean when applied to God? Is it even a legitimate usage? Does our bicycle wheel have a hub?

I propose a TEST CASE. Two very prominent and contrasting spokes in our wheel of knowledge are *FAITH* and *REASON*. Are these contradictory? Or are they complementary, opposite sides of the same coin? If we can demonstrate that they meet, we shall have found the hub, and so vindicated our First Law.

Let us imagine ourselves to be on a clifftop on a foggy day. Ahead of us, over the sea, lies the “Cloud of Unknowing”, which we may term the “Fog of Unthinking”.

Two direction-finding radars, some distance apart on the clifftop, point out to sea in search of Ultimate Truth, Absolute Reality, God (not necessarily Christian). Is there anything there, in the fog? The radar beams are, as just named:

(1) FAITH, the path of religion, which for today's purposes we shall think of as monotheist (e.g. Christian, Jewish, or Islamic). This beam supplies meaning to our term ‘GOD’. It has in each case its own book: the Bible (or some other such as the Koran). This beam gives us one steer into the fog.

(2) REASON, the path of abstract thought. This supples meaning to our term ‘EXISTS’. It too has a book, which I nominate as Plato’s *Republic.* This beam gives us another steer into the fog.

Do these two beams converge? If FAITH and REASON meet, we may reasonably claim that a (monotheistic) GOD EXISTS.

THE BEAM OF *FAITH*

> [Here we view the slide listing the 'photofit' (mostly) ontological characteristics of God as suggested by FAITH (appended)]

THE BEAM OF *REASON*

PLATO (*c*.429-347 BC) was a pupil and admirer of Socrates, the father of western philosophy. He wrote a series of *dialogues*, consisting of conversations between Socrates and his fellow-Athenians on topics of philosophical interest. The early dialogues are probably historical. The later ones, such as *The Republic*, use the same format as a vehicle for what is generally considered to be Plato's own thought as he developed it.

The Republic (*c*.375 B.C.) is arguably the greatest and most influential non-religious book on metaphysics - and so on learning to think - ever written: It takes the form of a discussion about *justice* - in the abstract, in the individual and in the state. The world, says Plato, will become just when philosophers (thinkers) become kings. This raises the question, How do we train the philosophers? Using Socrates as a mouthpiece, Plato lays down a programme of education designed to teach them to work with *abstracts*.

Here in *The Republic* and in his other dialogues, Plato considers just what are the *essences, essentials* of things, which he calls *forms* or *ideas*? These forms exist in a realm of their own, being in his view *more real* than the objects of sensation in our physical world, which actually owe their very existence and characteristics to the forms. They are apprehended by the *mind*.

We are introduced to the forms through our attempts to define material objects such as tables and chairs. Then we progress upwards to moral concepts such as courage, holiness, justice etc, and ultimately towards a supreme *Form of Goodness* (by analogy, the sun) from which all else derives.

Today this sounds a little quaint. Or does it? For one intermediate rung on Plato's ladder, essential to the training of the thinker, is *mathematics*.[3] Mathematics is by its very nature

[3] *Republic* VII, 522-30.

concerned with abstracts. The numbers which are the subject matter of *arithmetic* are not just quantities of things but abstractions, of interest in their own right.[4] The triangles and circles that we look at when we study *geometry* are but imperfect images of their abstract forms.[5] Can it be said with Plato that such mathematical objects *exist*?

IS MATHEMATICS DISCOVERED OR INVENTED?

This brings us to the central issue in the philosophy of mathematics: *Is mathematics discovered or invented?*[6] This in turn leads us into two fields:

> (1) *Psychology* - of art, creativity, inspiration, brainwaves. This relates to the domain of PERSONALITY; we will bypass it today.[7]
>
> (2) *Ontology* - in this case the existential status of mathematics. Here we are in the domain of NUMBER, which we will explore.

There are two main accounts of mathematics:

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[4] E.g. *Republic* VII, 525d:

> 'I mean that arithmetic has, in a marked degree, that elevating effect of which we were speaking, compelling the soul to reason about abstract number, and rebelling against the introduction of numbers which have visible or tangible bodies into the argument.' (tr. Benjamin Jowett, 1871)

[5] E.g. *Republic* VI, 510d-e:

> 'And do you not know also that although they make use of the [geometrical] forms and reason about them, they are thinking not of these, but of *the ideals which they resemble*; not of the figures which they draw, but of *the absolute square and the absolute diameter*, and so on - the forms which they draw and make, and which themselves have shadows and reflections in water, are in turn converted by them into images; *for they are really seeking to behold the things themselves, which can only be seen with the eye of the mind*?' (tr. Jowett; cf. 527b)

[6] 'Is mathematics an act of creation or a discovery? Many mathematicians fluctuate between feeling they are being creative and a sense they are discovering absolute scientific truths. Mathematical ideas can often appear very personal and dependent on the creative mind that conceived them. Yet that is balanced by the belief that its logical character means that every mathematician is living in the same mathematical world that is full of immutable truths. These truths are simply waiting to be unearthed, and no amount of creative thinking will undermine their existence.' - Marcus du Sautoy, *The Music of the Primes: Why an Unsolved Problem in Mathematics Matters* (London: Fourth Estate, 2003), pp.33-4.

[7] The clearest expression of this process that I know is given by Professor Andrew Wiles, who in 1994 astonished the mathematical world with his proof of Fermat's Last Theorem:

> 'Then I just had to find something completely new - it's a mystery where that comes from.
>
> 'Basically it's just a matter of thinking. Often you write something down to clarify your thoughts, but not necessarily. In particular when you've reached a real impasse, when there's a real problem that you want to overcome, then the routine kind of mathematical thinking is of no use to you. Leading up to that kind of new idea there has to be a long period of tremendous focus on the problem without any distraction. You really have to think about nothing but that problem - just concentrate on it. Then you stop. Afterwards there seems to be a kind of period of relaxation during which the subconscious appears to take over and it's during that time that some new insight comes.'

Quoted in Simon Singh, *Fermat's Last Theorem: The Story of a Riddle that Confounded the World's Greatest Minds for 358 Years* (London: Fourth Estate, 1997) p.228.

(a) Platonism

When not on the defensive against philosophers, most mathematicians speak, write and act as though they live corporately in a shared world of absolute truths which are there for them to discover and which are common ground between them.[8] So in practice, *most mathematicians are Platonists most of the time*.

(b) Formalism

When challenged to justify their Platonism by modern day philosophers mathematicians often get embarrassed, taking refuge in *formalism*: This is the doctrine that mathematics is *no more than* the process of deducing conclusions from premises - proving *theorems* from *axioms*. The axioms themselves are generally held to be either self-evident or otherwise chosen for their mathematical convenience. So starting from the geometrical axioms of Euclid (*c*.300 BC) we can prove Pythagoras' theorem. If we started with different axioms (as has been done), we would reach different conclusions. Hence according to formalism, the theorem is just spelling out in longhand something that was already implicit in the axioms, no more than a tautology (and not only a tautology; it says the same thing twice!). It says nothing about the real world that we didn't in principle know already. All we are doing is manipulating concepts which have no necessary reference to the physical world at all, let alone an invisible world of abstracts with a special mode of existence. Proof is simply following the rules. 'Meaning' is an irrelevance which it is futile to explore.

Formalism is the principal alternative to Platonism. Under Plato, the truths and objects of mathematics *are there* somewhere, waiting to be discovered. The theorems are already true; by proving them we are just demonstrating what is actually the case. Formalism maintains they aren't anywhere: we just invent them as we go along by deducing them from axioms we have ourselves chosen.

What is at stake? If Plato is right about mathematics, there really *exists* a world of (mathematical, at least) abstracts for the radar beam of REASON to lock on to. The metaphysician is in business. If not, he is chasing after wind.

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[8] 'For me, and I suppose for most mathematicians, there is another reality, which I will call "mathematical reality"....I believe that mathematical reality lies outside us, that our function is to discover or *observe* it, and that the theorems which we prove, and which we descrbe grandiloquently as our "creations", are simply the notes of our observations. This view has been held, in one form or another, by many philosophers of high reputation from Plato onwards.' - G.H. Hardy, *A Mathematician's Apology* (1940; Cambridge: CUP 1992) pp.123-4; emphasis original.

CRITIQUE OF FORMALISM

(1) In practice, formalism is seldom what actually happens.[9] Mathematicians do not generally sit down with a set of axioms in front of them in order to see what follows. Far more often, they work at the 'business end' of mathematics, and tie up the nuts and bolts (if at all) afterwards. So in the late seventeenth century, both Newton and Leibniz independently came up with the calculus. It was not for another 140 years that the calculus was made rigorous by *analysis* (by Cauchy, 1821-3, and others).

(2) Formalism gives no adequate account of why, if mathematics has no meaning or reference to the real world, *applied mathematics almost universally forms the basis of science*. When scientists want to begin a conceptual revolution, they look often for fresh mathematics in order to describe it. So Einstein based his theory of relativity on non-Euclidean geometry which had been developed in the previous half-century. When Heisenberg in 1925 needed a non-commutative multiplication to support quantum mechanics, he turned to matrices (developed by the Englishman Cayley *c.*1858). So we require a connection between pure mathematics and the physical sciences which formalism by its nature does not offer and cannot explain.

One way out of this (adopted by Kline[10]) is to minimise the role of *pure* mathematics, so important to formalism, and see mathematics rather as a purely *human invention* developed in order to meet the needs (eg military or artistic) of society at given times.[11] 'Mainstream' mathematics is then by its nature *applied*. This may be truer to life than formalism as an account of what happens, but is open to a fatal objection which we will give below.

(3) Formalism cannot explain the massively documented experience of mathematicians that in practice they do occupy a *shared world* in which their concepts are really there to be examined by them and their colleagues. They *assume* the reality of their subject matter

[9] So R.G.D. Allen, *Basic Mathematics* (London: Macmillan, 1962), pp.2-7, gives an excellent, mainline description of the formalist 'axiomatic approach' to modern mathematics, only to undermine it fatally in a concluding footnote (p.7): 'A formal system developed strictly on the axiomatic method would be highly symbolised and a rather arid affair. Here we compromise in order to provide a general exposition which explains what is going on. It might be described as "informal axiomatics".' So as an account of what mathematicians actually do, formalism cannot be made good even by a professed believer in it!

[10] Morris Kline, *Mathematics for the Nonmathematician* (New York: Dover, 1985).

[11] So also Lancelot Hogben, in his stimulating book, *Mathematics for the Million*, third edition (London: George Allen & Unwin, 1951), presents mathematics in terms of its social dimension. 'Without a knowledge of mathematics, the grammar of size and order, we cannot plan the rational society in which there will be leisure for all and poverty for none.' (p.20). For his failure to appreciate 'real' mathematics, or any mathematics at all above 'school' level, he is roundly castigated by Hardy (op. cit. pp.137-8). Kline's retort (op. cit. p.556) that we should 'keep a copious quantity of salt on hand' while reading *A Mathematician's Apology* tells us more about Kline than it does about Hardy.

whenever they communicate with their fellows, even if they cannot justify it. Otherwise they would have nothing in common to talk about.

Such concepts include mathematical *structures* such as finite simple groups. Mathematicians have spent years classifying these as lepidopterists classify butterflies.[12] Again, mathematicians investigating the Riemann Hypothesis, by computing the zeros of the zeta function, have uncovered an infinite and unpredictable mathematical 'landscape' of hills and valleys, billions of which are being investigated every day by computer in search of a particular (ir)regularity.[13] It seems a little odd to maintain that such things in no way 'exist'. If they did not, why would anyone bother?

As an alternative to Platonism, formalism fails because it does not describe what mathematicians actually do, and cannot justify the practical use of mathematics made by scientists.

THE CASE FOR PLATONISM

Can Platonism be made good in its own right? Let us consider.

(1) We have just argued that some mathematical structures lay a claim to 'existence'. The formalist would not agree, since these are defined by *axioms* which have been selected by *people*. They have no external reference. Suppose we grant this. Are there any areas of mathematical research which are *not* dependent upon axioms? Orthodoxy says no, but I think there are: NUMBERS. The concept of NUMBER is one of our three fundamentals (in spite of failed attempts by Frege (late nineteenth century) and others to define numbers in terms of sets). *NUMBERS HAVE PROPERTIES* in their own right which are independent of axioms. For instance:

> (a) *PRIME NUMBERS* - whole numbers (greater than 1) which have no factors other than 1 and themselves - simply are what they are by their own very nature.[14] They owe nothing to axioms. They are probably the most intriguing and most intensely researched topic in mathematics today.[15]

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[12] Philip J. Davis and Reuben Hersh, *The Mathematical Experience* (Harmondsworth: Pelican, 1981), pp.203-09.

[13] See Marcus du Sautoy, op. cit.

[14] 'Pure mathematics...seems to me a rock on which all idealism founders: 317 is a prime, not because we think so, or because our minds are shaped in one way or another, but *because it is so*, because mathematical reality is built that way.' - G.H. Hardy, op. cit. p.130; emphasis original.

[15] See David Wells, *Prime Numbers: The Most Mysterious Figures in Math* (Hoboken, NJ: Wiley, 2005).

(b) *CONSTANTS* such as π and *e* are phenomenally important to all manner of mathematics.[16] They crop up everywhere. Without them mathematics would be impossible. Being therefore totally independent of axioms, they constitute in themselves a full refutation of formalism. Likewise Kline's view that mathematics is a purely human invention falls to the ground when we ask, which human being determined that π and *e* should have the values that they do? If their values are not objectively determined by factors beyond the human ambit, as under Platonism, why are we unable to change them at will?[17]

This takes us to bedrock. Numbers are not defined by axioms, yet have immutable and objective properties in their own right which can be investigated.[18] Hence, as held by Plato, *numbers must* exist *in a significant, non-trivial way.*

(2) Euler in 1748 demonstrated the unity of the 'core mathematics' of his day: trigonometry (founded upon π), complex numbers (founded upon *i*, the square root of minus one), exponentials and logarithms (both founded upon *e*), together with a whole mass of infinite series. Every particle and every wave pulse everywhere and at all times in the universe exemplify the core truths represented in Euler's Identities,[19] just as every cell in our bodies exhibits our personal DNA. We have just seen that the constants *e* and π are essential to mathematics. It is now clear that they are essential to physics as well. Without them no physical universe would be even imaginable.[20] (Contrast the physical constants: we could at least imagine a universe in which gravity or the other physical forces had different strengths, even if it did not last very long or could not produce life.) So *mathematics is neither a mere*

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[16] π and *e* are respectively introduced as the ratio of a circle's circumference to its diameter (about 3.14159), and the base of natural logarithms (about 2.71828). On π see David Blatner's delightful little compendium, *The Joy of* π (Harmondsworth: Penguin, 1997). An entertaining introduction to *e* is to be found in Martin Gardner, *Further Mathematical Diversions* (Harmondsworth: Pelican, 1977), Chapter 3, 'The Transcendental Number *e'*, pp.34-42.

[17] ''Tis a favourite project of mine,
A new value of π to assign.
I'd fix it at 3,
For that's simpler you see
Than 3 point 1 4 1 5 9.'

- Harvey L. Carter, Professor of History at Colorado College, quoted in W.S. Baring-Gould, *The Lure of the Limerick* (Panther, 1970).

[18] See David Wells' fascinating compendium, *The Penguin Dictionary of Curious and Interesting Numbers*, Revised Edition (London: Penguin, 1997). Not many of them in my judgement owe their inclusion to prior axioms.

[19] Euler's Identities: $e^{ix} \equiv \cos x + i \sin x$; $e^{-ix} \equiv \cos x - i \sin x$.

[20] On the fundamental difference between operations, which are dependent upon axioms, and constants, which are not:

> 'I recall a distinguished professor explaining how different would be the ordinary life of a race of beings for whom the fundamental processes of arithmetic, algebra and geometry were different from those which seem to us to be so evident; but, he added, it is impossible to conceive of a universe in which *e* and π should not exist.' - W.W. Rouse Ball & H.S.M. Coxeter, *Mathematical Recreations and Essays*, Twelfth Edition (Toronto: University of Toronto Press, 1974) p.348.

invention of the human mind, nor a collection of meaningless tautologies: its truths are essential to the very existence of the universe. They are objective.

(3) It is inherent in mathematics that any theorem, once proved, is known to be universally valid. We do not have to travel to the moon or to the far side of the universe in order to retest its validity there: we *know* it will be valid. (We may pause to reflect *how* we know this; but know it we do.) *Mathematics is independent of place.*

(4) Correspondingly, mathematical truths, if true at all, will have been true before the big bang (forgive the inadequacy of language) and will go on being true after the 'big crunch' (or whatever else ends the universe): *they are timeless,* with no beginning or end, *and actually independent of the universe altogether.* They would have been true had there never been a universe. (Under what circumstances would two and two not have equalled four?)

(5) Any attempt to locate the concepts of mathematics in the minds that share them[21] runs instantly into the problem of continuity: what happens when the owners of those minds die? Do their theorems cease to be true?

We recall the ancient conumdrum, how do we know that things exist when no one is perceiving them? - and Bishop Berkeley's answer that all things exist in the mind of God.[22] This gave rise to a celebrated limerick by Ronald Knox (1924), of which a variant reads,

> There once was a man who said, 'God,
> I find it exceedingly odd
> That the sycamore tree
> Should continue to be
> When there's no one about in the Quad.'[23]

To which came the equally celebrated anonymous reply,

> Dear Sir,
> Your astonishment's odd:
> *I* am always about in the Quad.
> And that's why the tree
> Will continue to be,
> Since observed by,

[21] As Davis and Hersh, op. cit. pp.397-9.

[22] Bishop George Berkeley (1685-1753) maintained the idealist philosophical vew that *esse est percipi vel percipere* ('to be is to be perceived or a peceiver'). He also produced some strong and very just criticisms of the calculus in the form in which Newton had cast it, which were not resolved until the development of analysis as mentioned above.

[23] Another variant of this limerick, with the reply, is attributed in a similar context to the great Hungarian number theorist Paul Erdős by his biographer Paul Hoffman, in *The Man Who Loved Only Numbers* (London: Fourth Estate, 1998), p.26.

> Yours faithfully,
> God.

While perhaps, like Plato's forms, this may be a little unconvincing in respect of material objects like tables and chairs and trees, it does give one pause for thought in respect of the objects of mathematics, and a clue as to their nature.[24]

Mathematics is therefore discovered, not invented. Plato was right. We may contrast *language*, which by common consent exists purely by convention. Developments in language have no known implications anywhere in the universe beyond planet Earth.

THE BEAUTY OF MATHEMATICS

Further, mathematics is by the universal consent of its practitioners capable of great *beauty*. Indeed as G.H. Hardy (1877-1947), credited as the founder of modern analytic number theory, put it,

> Beauty is the first test [of good mathematics]: there is no permanent place in the world for ugly mathematics.[25]

It is the beauty of mathematics which attracts many of its practitioners in the first place. I had a colleague who was converted to mathematics when he first discovered that most beautiful and surprising of all equations,

$$e^{i\pi} = -1 \quad \text{(or,} \qquad e^{i\pi} + 1 = 0\text{),}$$

which follows directly from Euler's Identities mentioned above. One could write an entire book about that equation, and all that it carries with it. (Actually , I have.[26])

The delight with which mathematics inspires in its captivated worshippers has seldom been better exemplified than in the life of the perpetually boyish 'mathematical monk', Hungarian-born number theorist Paul Erdős (1913-1996), whose love of the subject, and the happiness it inspired in him, were simply infectious.[27]

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[24] So the devout HIndu Srinivasa Ramanujan (1887-1920), probably the greatest intuitive mathematician of all time, maintained, 'An equation means nothing to me unless it expresses a thought of God.' (du Sautoy, op. cit. p.132). See du Sautoy's whole Chapter 6 on 'Ramanujan, the Mathematical Mystic', which begins with this quotation.

[25] G.H. Hardy, op. cit. p.85.

[26] Martin Mosse, *e, i & π: A Mathematical Drama in Three Acts* (unpublished). So, in somewhat greater depth, has Paul J. Nahin: see his *Dr. Euler's Fabulous Formula Cures Many Mathematical IIlls* (Princeton: Princeton University Press, 2006).

[27] See - with my strong recommendation - his biography by Paul Hoffman (details in n.23).

THE MYSTERY OF MATHEMATICS

The *MYSTERY* of mathematics is well pinpointed by Gian-Carlo Rota:

> 'The mystery of mathematics...is that conclusions originating in the play of the mind do have striking practical applications.'[28]

Or, as Einstein put it,

> 'How can it be that mathematics, being after all a product of human thought independent of experience, is so admirably adapted to the objects of reality?'[29]

Mathematics is on the one hand abstract, a set of concepts we apprehend and manipulate with our minds as formalism describes. On the other hand, its truths are external and independent of us, being inherent in the entire structure of the universe; the starting point of science. These two characteristics seem irreconcilable. Does mathematics or does it not have external reference? So at the heart of mathematics lies a MYSTERY.

CONVERGENCE

We have now fully vindicated Plato's case for the *independent existence of a world of abstracts* in which the truths, structures and objects of mathematics are to be found, and are available to all who seek them. They emerge as objective, absolute, timeless and universal, exactly as Plato held. They are nevertheless essential to any scientific description of the universe and permeate it throughout. Without them no universe could exist or be even imaginable. Yet they are independent of it - transcend it - and have in addition a beauty which entrances the beholder and a MYSTERY which defies explanation. We have discovered all this with the radar beam of REASON.

This being so, it renders invalid objections to belief in God on the grounds that He cannot be perceived by our five senses. Such an objection would reject also the whole of mathematics, which would be an 'eet' (opposite of T for truth) or logical banana: intellectual suicide.

Further, revisiting our slide, we see that in mathematics we have discovered something which is admirably described by the 'photofit' picture of God which we gave at the beginning from the beam of FAITH. Think about it. There is at least one entity possessing all the properties

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[28] Gian-Carlo Rota, Introduction to Davis and Hersh, op. cit. p.xix.

[29] Albert Einstein (1879-1955), quoted in J. Havil, *Gamma: Exploring Euler's Constant* (Princeton: Princeton Universiity Press, 2003).

that on the basis of FAITH we formerly assigned to God. So the radar beam of FAITH has scored a hit! *FAITH and REASON have therefore converged*. They complement each other, as opposite sides of the same coin. Our bicycle wheel has a hub, which is what we set out to demonstrate. Ergo, we claim a validation of our First Law of Metaphysics: GOD EXISTS. Q.E.D. (!)

And every time we discover that two spokes of our personal bicycle wheel converge at the hub, we reaffirm the same Law.

ENDNOTE: WHY CHRISTIANITY?

‘In the beginning was the *Logos*. And the *Logos* was with God. And the *Logos* was God.’ (John 1:1)

Logos, the name given here to Christ, has two clusters of meaning. First, it means *a word, speech, or communication*. We recall our concept of PERSONALITY: One who is personal and can reveal himself personally and verbally, as in the Judaeo-Christian revelation recorded in the Bible and recognised by FAITH.

Second, it means *a computation, reckoning, account, the statement of a theory, an argument, principle or reason*. From it comes indirectly our word *logic*. We recall our concept of NUMBER, including mathematics, which meets John’s description of the *Logos*, ‘through which all things were made and without which was not anything made that was made’ (John 1:3); so One who may be recognised by REASON, along the lines opened up by Plato’s *Republic*.

St John identifies the convergence of both the *subject of FAITH* and the *object of REASON* in the person of *Jesus of Nazareth, the Word made flesh and the Light of the World*. To whom be all glory and honour, Amen.