Mr G's Little Book of

Personal

Reminices

on

Life, The Universe and Everything

Introduction

Do we live in a designed universe and if so who designed it? If I say God that almost seems to be a bit derogatory because I've already relegated him to a puzzle solver. I can take pride in completing the most fiendish Sudoku but I'm still one step below the person who actually designed it. What freedom did God have to choose the various constants of nature, for example the speed of light? A photon can whip round the earth seven times a second if so inclined. Would eight times be OK? Would six times suffice? I just know it has to be really fast compared to our rather sedentary way of life but are their more specific constraints?

There are others though more critical that I know of, particularly one termed Planck's constant. It's a unit of "action" and has dimensions of energy × time. It's very small but then just big enough. Any smaller and we'd live in a sterile universe. Nothing would happen. No chemical reactions, no evolution, no development from chaos to order. But too big and the universe would be chaotic – no stability and no order. It has to be the value it is.

There's another one called the fine structure constant and it crops up everywhere. Eddington thought the value exactly 137 though it's actually slightly bigger. He got 137 by taking $2^3 + 2^7$. That that only sums to 136 gave him a problem and he invoked a concept called packing density to squeeze out another "one" and ended up with the nickname Arthur Addingone.

Did God have to apply similar fiddles to get His equations to balance or was He already working within existing constraints. If so how did these constraints arise?

Early Years

I like my birthday. It's 30th June 1950. To a five year old that's half way through the year and my age always steps with the year. So I always knew in 2000 I would be 50 and to make a 100 I have to last until 2050. I went to primary school from

1955 to 1961. In those days you didn't ask questions but had plenty of time to think. Nowadays kids do nothing but ask questions but have no time to think. I preferred the old ways.

I remember my first day. My friend John Chambers cried. "Why's he crying" I ask my mum apprehensively. I'd been looking forward to school. Did he know something I didn't? "He doesn't want to say goodbye to his mum?" she ventured. Sorry, but even at five that still didn't compute.

I loved the classroom. There were number displays all around. Patterns of animals. One elephant, two ducks, three cats. Some patterns I liked – seven always fascinated me because I could fit six coins exactly round one coin. Was that a coincidence? A bit of luck? Pre-ordained? Eleven just didn't grab me at all. However you arranged eleven there was always one left over. Twelve I loved because you could arrange that into two different rectangles.

So by looking at the pictures I'd pretty much figured out arithmetic and English all in one go. I certainly never remember being taught anything and thought I was doing pretty well. Then one day I got a shock. The Head walked in a said *"The following students stand up please"*. A few names were read out and I mentally prepared myself for maybe the ruler across the hand. We were marched into the next classroom and sat down. Nothing else seemed to happen so I got on with my daydreaming and looking around at whatever was on the shelves. It must have been years later before it dawned on me I'd been moved up a set but no-one thought it necessary to explain such things in those days.

I remember shortly afterwards sitting at my desk waiting to go up and read to the new teacher. The book was Old Lob. He was a farmer. The kid before would be stuttering away. *"Ol Ol Old Lo Lo Lob fee feeds the p i g pig!"* I had my head in my hands. *"Come on – there's even*

a picture of the guy feeding the pig –
it's not exactly rocket science". Well
maybe I didn't exactly say the last
bit.

I never really listened to the teacher.
Nothing personal it was just they
didn't seem to be telling me anything
interesting. OK so the River Trent
might be 100 miles long – so what?
It could be any length. I did take an
interest in the longest, biggest,
fastest concept and the Guinness
Book of Records was a staple
Christmas present from 1959
onwards but that was about it. I just
spent my time looking around the
classroom studying everything I
could see.

On the shelf was a balance with
hooks equally spaced along the arms
numbered on each side 1, 2, 3 etc.
and a pile of washers hanging off the
"1" on each side. I thought about
that a lot. Was it a way of
representing multiplication. If I hung
a washer on the "3" and another on
the "2" would a washer on the "6"
on the other arm balance out? I
soon discounted that. Hanging a "1"

and "2" washer on one side
wouldn't balance a "2" on the other.
So it must be addition. "2" and "3"
on one side would be balanced by a
"5" on the other. But it sort of did
cover multiplication. What if I hung
five washers on "5"? I then tried to
dream up a way of subtraction.
Perhaps you could position powerful
magnets above the arms and the
more weights you put on the less
the pull downwards? Strangely what
was totally forbidden was to actually
ask the teacher a question about this
bit of kit. It just stayed there on the
shelf to be admired or ignored
depending on your predisposition.

I did occasionally ask questions but
usually didn't get an answer. I asked
my mum once *"If the Queen were a*
man would the Queen Mother be called
the King mother?" My mum gave me
a withering look. *"But the Queen isn't*
a man, darling". It wasn't until she
died – Elizabeth Bowes-Lyon that is
not my mother - when a newscaster
commented that she chose the title
"Queen mother" instead of
"Dowager Queen" which sounded

old and cobwebby. And she was the mother of the country; nothing to do with being the mother of the next Queen.

One day I came home and mum and dad were putting on their hat and coats. Mum explained *"Penny* (my older sister) *is getting your tea."*

"So where are you going?" I asked. *"To see your head"* they explained. *"Why?"*. *"Well you know – to find out why you're – well why you don't – oh you know"* which I certainly didn't. I believe the Head did actually put in a good word for me and told my parents not to worry.

Back to rocket science. I was in fact quite interested in that subject and that led to my first big question. I had a book at seven called *"My First Book of Space Travel"*. It explained rockets and spacesuits and then moved onto astronauts circling the earth being "weightless". Then it got ambitious and there were pictures of spacemen with rocket packs moving around giant girders building a space station. *"Look how they move them around with ease –*

remember – weightless!" That just gave me a sense of unease. I could imagine pushing two girders together and getting my finger trapped between them and knowing it would hurt. How did that stack up with weightless?

The next big question was my imagined toy helicopter. That idea came from a character called Alfie "General Jumbo" Johnson in the Beano whose father had built him a remote controlled miniature army that he operated form a wrist controller It was the helicopters that fascinated me. When my dad bought a new Ford Consul and we had that parked outside our terrace house I knew we were on the up and up. So I was sitting in the front seat imagining my toy helicopter on the floor and making it take off. And a thought struck me. *"Dad, if the car's travelling along at 60 miles an hour and my toy helicopter takes off* (OK he couldn't see a toy helicopter but no matter) *why doesn't it immediately rush to the back of the car."* My dad thought hard about

this for a moment or two and said *"Because the air in the car carries everything in the car forward"*. Well that seemed a reasonable answer. Certainly I could imagine myself on an open flatbed truck rushing along at sixty miles an hour and we'd all be hanging on for dear life yet I was still nonplussed. I subsequently read Feynman asked his father the very same question when he was about 8 as well relating to his toy brick truck and got the correct answer. For me it set me back about 5 years but all forgiven now.

In the next class I remember looking at pulley on the shelf with weights on either side joined by a piece string. It just sat there and **didn't** move which fascinated me. By now I knew that all objects fell at the same rate – a ten pound weight will fall at the same rate as a six pound weight. So if there were such weights on either side why didn't the net weight of four pounds still fall at the same rate? [1] Of course that made no sense anyway because there would always be some minute difference in weight but that wouldn't mean one side immediately plummeting to the ground. Clearly the rate of fall was a function of the weight difference.

So why do all weights (or masses) fall at the same rate? On the face of it the heavy weight is certainly being dragged toward the ground with the greater force. However because there is more mass it takes more effort to get the body moving – and the two exactly cancel out. That is there are two different concepts going on here – gravitational mass and inertial mass. That the two are identical Einstein termed "a conspiracy" and ultimately that led to his General Theory of Relativity. Could the Universe be any different?

Imagine Tom can run 100 yards in 10 seconds but Dick takes 20 seconds? How fast could they run a 100 yards if tied together at the wrist? Well you might imagine that Dick would hold back Tom but Tom would drag Dick along a bit faster – so maybe 12 seconds on balance. But that would never work if you stuck two different lumps of blue

tack together. You'd have a chaotic universe with some extremely complex and unpredictable rule for the rate objects fell to earth. Inertial mass and gravitational mass have to be identical. God had no choice in the matter.

Number Patterns

I completed a degree in Systems Engineering which was heavily mathematical but geared toward the solution of practical problems. So it was all about Fourier and Laplace transforms, the solution of differential equations and the response of systems to various inputs; impact, ramp, sinusoidal etc. I was 50 years old before I really started to explore pure mathematics when I retrained as a teacher.

I sat there in the classroom and the teacher training me wrote the following sums on the board "1+3", "1+3+5", "1+3+5+7" and asked the class to investigate. My jaw dropped. Why had I never seen this before? Why had no-one told me this? Sequences of odd numbers add to square numbers which actually seems quite a reasonable concept. I immediately set about investigating the whole subject.

Starting with "1+2+3" and longer you get the triangular numbers. Add two successive triangular numbers together and you get square numbers. Back to my coin patterns if you add successive rings round a central coin you produce what I now know to be "centred hexagonal numbers". Add the sequence of those and you get the cubed numbers. Add the cubed numbers together and the sum is the square of the triangular numbers. The patterns are endless. Later I discovered how to derive the formula for one power series from the next lower and doggedly took the pattern up to $1^{12} + 2^{12} + 3^{12}$ discovering what are called Bernoulli numbers along the way. Even the point in history was lucky for me because this was just before the internet really exploded as a database of all knowledge. Had it already been in existence I would never had had the patience. I'd just

have just taken the easy way out and looked up the answer.

I investigated a problem I called "Postman Plod names the babies". How many ways can a postman misdeliver say 4 letters to 4 houses? He can't get just one letter wrong (why not?) but there are so many ways he can get two or three letters wrong. Getting every letter wrong is called a rencontre. That led to a myriad of number patterns just at the time a project called "Sloane's Number Sequences" was gaining momentum on-line. So I quickly registered three patterns before Mr. Sloane called time on what I was doing. Yes you heard right. You can be the registered holder of a number sequence. My first one was 0, 0, 0, 0, 44, 264, 924, 2464 etc. If you use this number sequence anywhere you have to pay me a royalty – maybe.

My next discovery came while investigating shaking dice with quite a challenging set in Maths. They were enjoying it and so was I especially when we got up to 4 dice and a particular pattern just appeared before my eyes. Look up the sequence 1, 7, 28, 84, 210, 462 on the internet and it's all there and again never use it without paying me first. It's also registered on a gambling site somewhere because you can use it to work out the probability of throwing any particular total with any number of dice.

But what is the point of these stories? Is God initially bound by these number patterns? Are they already "in existence" out there not even in space but some sort of pre-existence continuum before God even set about creation. Did He ordain and create them? It seems hard to conceptualise why he was not already bound by them but whenever I engage another Christian on the matter I usually get a variant of Kronecker's "*God created the integers, all the rest is the work of man.*" which I don't find that enlightening.

It could be that whatever we start with – even a concept beyond what

we term numbers – then the natural order is for patterns to arise and that order is created by God. But is it that we just focus on the patterns and ignore the non patterns? Here's an example.

At some point I came across Kaprekar's numbers – for three digits its 495 and for four it's 6174. I investigated them thoroughly mainly because it gave an interesting puzzle sheet for kids struggling with numeracy. Take any 4 digit number make the biggest number you can and the smallest and take the smaller from the larger. Repeat as often as necessary and you'll always end up with 6174 because 7641 – 1467 = 6174.

Why does this work? When God created the numbers did he immediately realise this and think "Hey that's neat?" Why is there just one number that has this property? Why not two different numbers? Was that a lucky break for God or preordained or something He engineered? Could the universe have been different and unique

Kaprekar numbers not exist? And this is just one example of thousands that arise in mathematics.

Infinities

Now we attribute to God three qualities, omnipresent omnipotent and omniscient. Take omnipresence. People sometimes claim the Devil is tempting them. The Devil isn't omnipresent. He can only be in one place at a time. So in my logic you have to be fairly high up the food chain to worry about coming into contact with him. Let the Pope and the Archbishop of Canterbury worry about that one. Omnipotent doesn't give me much of a conceptual problem either. If you created the universe then it seems reasonable you can do anything you like with it – or not as the case may be. It's omniscience that gives me the real problem. Is it possible to know everything?

Infinity's a good starting point. I could treat the word as purely poetic when describing God's power but mathematicians aren't so easily convinced. Cantor thought about

the existence of "numbers" greater than infinity. Having first dismissed the idea as ridiculous and then proved their existence he took the only possible way out and went mad. In fact there is an infinity of numbers bigger than infinity, each bigger than the previous though we have to be a bit careful with the concepts of number and "bigger than".

I'm not sure myself whether there are more than an infinity of transfinite numbers. The way it was initially explained to me was to consider missionaries feeding a tribe who can't count beyond three. Just set out some plates. If there's a plate left over after lunch then there are more plates than people. And you can perform the same trick with sets of numbers. For example even numbers and integers have the same cardinality. Although both sets are infinite, you can always match up a number in the integer set uniquely with an even number in the other set just by doubling it. Every number in the even set also has a partner – just halve. And every

number in each set has a partner with no numbers left over in either set. Case proved!

However here's the clever bit. Although you can match up rational numbers with real numbers it's possible to create real numbers that have no partners in the rational set. So there are more reals than rationals – in fact infinitely more.

Truth

You'd think mathematicians would have got this weighed up by now. That is until along came the British codebreaker Alan Turing and his German counterpart Kurt Gödel who usually gets more credit. Amateurs quoting Gödel are on thin ice but I'll have a go. Within any system powerful enough to generate ordinary numbers a statement can be generated within the system that can be assumed true or false – it cannot be proved one way or the other. Even if you're not too unhappy with one exception to the rule a problem arises with the new expanded system. With the assumed truth or otherwise added in the

system can now generate another statement with the same issue. So we get a never ending creation of new "truths" from the existing ensemble and you can never draw a line under the lot and breath "at last it's finished".

Godel's first theorem only demonstrates the existence of such a concept. The only certain candidate so far for the first exception is called the continuum hypothesis – how many points are there on a straight line. For sure it's more than an infinity of them but is the number aleph-one (2^{∞}) or something between termed c. Who knows and most importantly does God know?

Quantum Indeterminacy

There is perhaps one last area where I can take refuge. If you pass what you think is a continuous wave of light through certain crystals the light can be split into two beams and a bit of simple geometry determines the intensity of each beam.

However light is made up of individual photons so how does each photon "know" what to do? There doesn't seem space for any structure within the photon for a mechanism and what's more baffling it's actual impossible even to design a mechanism that gives the "right" answer for every situation. If there are millions of photons all jostling with each other then the patterns are "obvious". But send a photon on its ownsome through the apparatus and it'll still conveniently line up in the correct pattern – before the pattern's even formed! It's as if they know not only what all their predecessors have done but even what their future colleagues will be doing at some later date.

For the diehard physicist there are three ways out of the problem. The first is to believe Einstein is wrong and particles can communicate with each other at faster than light speeds. Now to physicists Einstein is God so that idea usually gets short shrift[②]. The next is to assume everything is pre-ordained – that's termed superdeterminism. That takes away free will and physicists

don't like to admit they're robots. The only third way out is "many worlds". That means we accept an infinity of universes where everything possible happens and whatever does happen just happens to be in the universe we're living in. A more depressing concept it would be difficult to imagine but as it also side steps the designer problem it's actually quite a popular idea.

I sort of have this crazy idea of God chairing a design committee surrounded by the archangels. Anyway Gabriel gets the job of designing light and off he goes with a sub-committee of angels. Michael gets a conceptual job of designing basic structures and comes up with the idea of the quantum of action. It's only when they come together for a design review that they realise the two concepts are fundamentally incompatible. Anyway Michael and Gabriel are both adamant that only their particular design will work and argue endlessly until God eventually says "Don't worry about it lads – it'll be alright in the end – Leave it to

me. I'll fix it." - bit like Marlon Brando in the Godfather.

That's really the fourth way out of the problem. That's the way the universe is. There is no explanation. Get over it. The maths works and that is all there is to it. You can't translate the maths into a "model". That's called the Copenhagen interpretation and it comes into play when you try and formulate a model to explain a particular equation called "Bell's inequality".

I remember being taught about atoms and electron orbits in secondary school. The standard method is to say that electrons going round nuclei is a bit like planets going round the sun. Much later you realise that's complete nonsense[3]. For a start planets are made out of atoms. So you're using a model to describe itself - it's self-referential. Later you come across a concept called spin. But I was actually relieved when I eventually read in a paper "Don't ever imagine that something is actually spinning?". It's just a convenient word to

describe a property called angular momentum that arises from the mathematics.

We can't "see" atoms because light is to coarse to identify the structure. They have no structure. What we know is only what the mathematics tells us. Electrons are supposed to go round in circular orbits or figures of eight or clover leafs or the dumbbells with the little halo in the middle but these are just our physical descriptions from the solutions of equations forced upon us from what we can observe. What the electrons are actually doing we have no idea. Never did and never will.

Eddington understood this. He realised our very brains are mechanisms within the universe that we are trying to understand. That therefore places a limitation on what can actually be achieved. I leave it for another paper to discuss where the spirit, soul and consciousness reside if not in the physical structure of the brain.

But does God know what the individual electrons are up to? That's where I have the difficulty. Our belief structure requires that He knows everything but there are things that it is just impossible for us to know. It's not a lack of knowledge or just that we're not clever enough. It's just forever beyond us in a way that transcends every concept. And that's a very hard concept to grasp.

Robert Goodhand

Footnotes

[1] *The answer is simple. The string connects the two weights so the total mass is 15 pounds but the pull is only 4 pounds so the two masses – gravitational and inertial – no longer balance and the rate of descent is proportionately slower. But I had to wait ten years before that explanation was forthcoming.*

Which reminds me of the joke of the musician that goes to heaven. At the pearly gates he can hear this fantastic drumming coming from inside. "So Buddy Rich made it then?" he says to Peter. "No that's just God playing" sighs Peter. "But he thinks he's Buddy Rich"

[3] *To be fair to teachers sometimes they have no choice. I used to explain fractions like this to sets you have to convince $^3/_4 + ^2/_3$ doesn't equal $^5/_7$. I'd start by asking if they got 1 merit in Maths, 2 in English and 3 in science how many merits did they have? If I got the answer 6 then we're off first base. Then I'd ask "If in the end of year examines you came 1st in Maths, 2nd in English and 3rd in Science where would you be overall. That would usually lead to a good debate with the conclusion probably 1st overall but certainly better than 6th. Then I'd tell them I was letting them into a big secret. There are actually two types of numbers. The top numbers of the fraction are our usual cardinal numbers , the ones that count. The bottom numbers are "ordinal" numbers – the ones that order – and you can never mix them up.*

The problem with this explanation is that it's complete nonsense. Later on when you have to calculate $^2/_3 \div ^4/_5$ you give them the craziest instruction. Change the $\div$ to a $\times$ and swap over the 4 and 5 in the second fraction to $^5/_4$. So $^2/_3 \div ^4/_5 = ^2/_3 \times ^5/_4 = ^5/_6$. I mean where's the logic in that having previously told them to keep cardinals and ordinals strictly separate? The answer is that both the top and bottom number are actually cardinal numbers – forget the ordinal explanation – it's wrong.

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