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SHAPEJOURNAL

MAN & REALITY

COLLECTED BLOG SERIES ON PHILOSOPHY AND MATHEMATICS
THE TOOLBOX, THE GODHEAD AND THE DEEP BLUE SEA / GLORIANA / THE ROLE OF BELIEF

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Man & Reality

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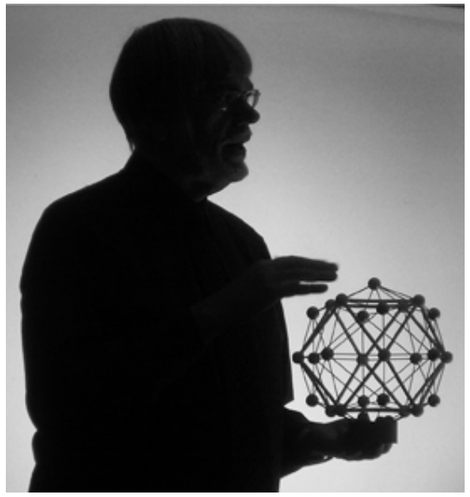
Introduction: a series for the blog



While *Man & Reality* was originally written nearly ten years ago, it is ideal for serialising on the SHAPE Blog. It fits the bill because it addresses basic questions at the heart of my work, and in a more accessible style than current writings do. So it has been divided into six instalments for posting one-a-week over six conseqcutive weeks.

The instalments will be:-

1. **Man & Reality I** consisting of Prelude; The toolbox, the Godhead & the Deep Blue Sea; Mathematics

2. **Man & Reality II**: The toolbox; Computers paper over the cracks

3. **Man & Reality III**: Pragmatism

4. **Man & Reality IV:** Mathematics – The Godhead; What is Scientific Explanation?

5. **Man & Reality V**: Gloriana; The Role of Belief

6. **Man & Reality VI**: Form; The Deep Blue Sea

Though, originally, it was a single paper of around 9000 words and 12 close packed pages of text, the six parts list above will each be about 1,500 words each.

The purpose of this is to get regular readers – that is people who check out what is happening every week. For, currently on the Blog, we get a spike when a new post has been put up and "broadcast", and very little in between.

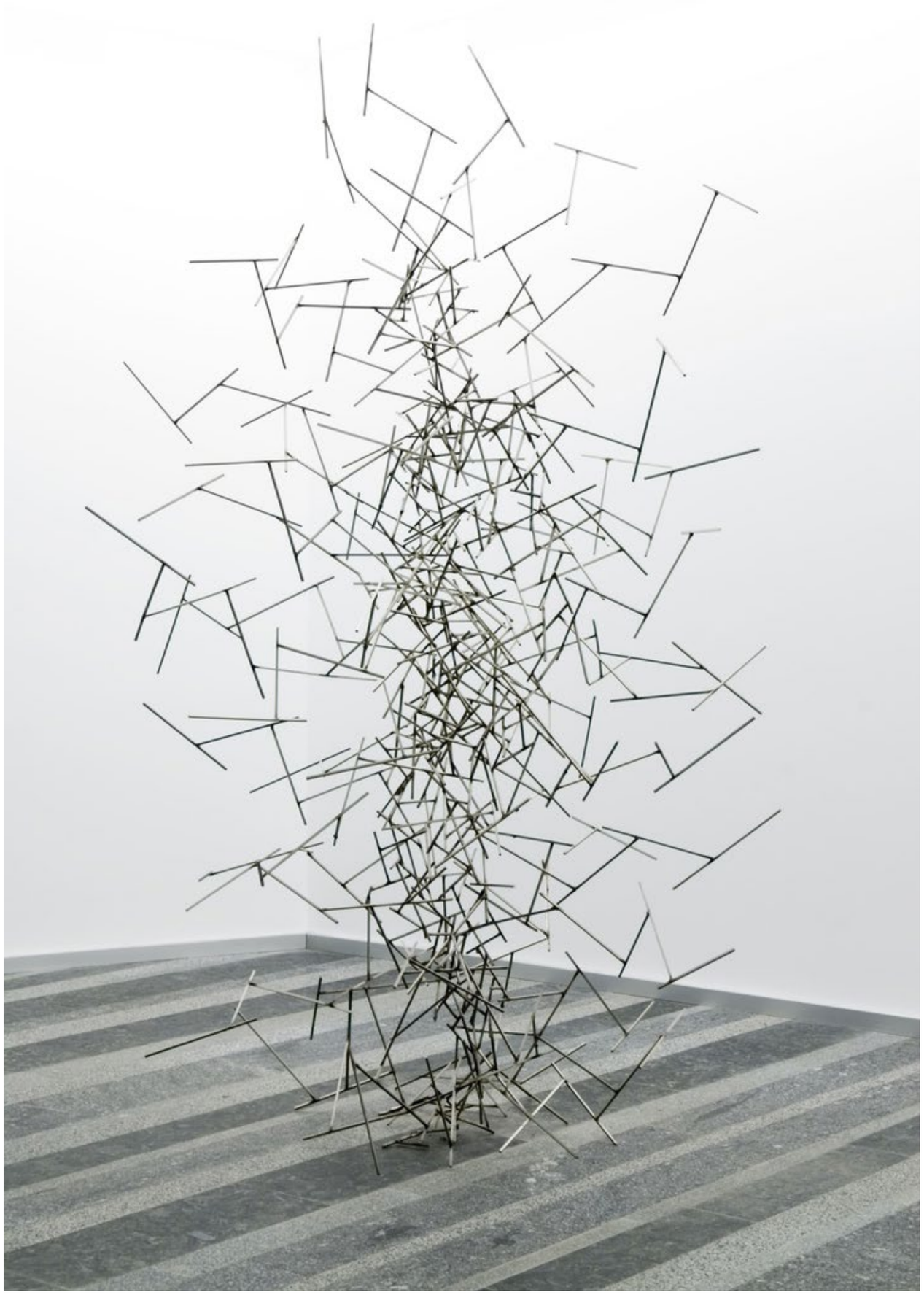
Secondly, we seem to do OK with philosophical posts and, certainly, with political posts. So, I aim to also make available individual political posts too. We should end up with elements of the series, political posts and pointers to Journal issues. Something for everybody most weeks!

I am keen to see how a regular series will work on the Blog. For, perhaps surprisingly, the distributed series in the early Journal Issues definitely recruited an ongoing readership.

My recent analysis of the statistics for the Journal reveals a large set of downloads of this type of article. Of 1017 downloads in the last 68 days of data, HALF of these were of those original distributed articles.

Let's see if we can grow a similar clientele for the Blog too.

Jim Schofield
Oct 2015



Man & Reality I

Prelude: The Recurring Dream!

A small, family group, constantly on the move, are struggling to survive as they slowly cross the raw, harsh landscape, only recently released from the iron grip of solid ice. Alone and vulnerable, they are surrounded on all sides by the hostility of the land, and the threat of its predators. But they are aware!

Everyday, glimpses of order momentarily shine through the hostile world, and they grasp for them. These evidently meaningful patterns seem to hold out the promise of understanding and control. And indeed they do! Step by step, small elements of the world are grasped and manipulated by the group to ensure their survival and growth.

The successes are initially modest, but fundamental. The world not only presents constant threats, but also a great deal of promise. Mankind began to mould his environment, at first marginally, and then significantly. There were clear indications that he could be King!

Out of these beginnings, Mankind began the imperceptible ascent to gradually dominate the landscape, and to lead to the unsurpassed expansion of his species across the whole planet. His effective stone tools and weapons were refined over millennia, and his mental and social developments crucially equipped him to survive and prosper. Step-by-step mankind wrested more and more fragments of evident order from nature, though they could initially only be conceived of as almost magical knowledge, and each new morsel was bedecked with elaborate ritual to ensure its continued success, and guarantee its handing down to future generations. Man's increasing realisation of his own potential grew apace, but was still embedded in the evident reality of his own inadequacies and physical weakness, so the potential was externalised into a conception of a superman as the epitome all possible knowledge and power. Locally this led to the necessary rise of the leader, the chief, but also to something magical & embedded in the detail and wonder of the world itself - to a power beyond you and me – the mind who is responsible for this comprehensible world – the superman who knows all!

So, in parallel with his slow, and sometimes halting, climb to truth, there was also held dear the promise of the generosity and wisdom of the Creator. These necessary elements didn't always pull in the same direction, and some groupings and clans realised that they could take short cuts in this climb by appropriating the achievements of others by force. Of course, such moves were always excused by the need to increase the glory of their own Gods.

This is, of course, the stuff of history, and the remit of specialists in the field. But, a requirement here is to reveal the motive forces behind certain crucially recurrent patterns in man's struggle for knowledge and power. What more and more began to be the biggest promise in fragments of nature was the discovery of quantitative relations. From calendars to metallurgy, precise measurements led to recipes which delivered miraculous results. But these did not wrest mankind from its religions. They in fact entrenched them (at least at first). The miracle that is God showed himself in all these things. Indeed, as the investigation of nature became more organised and sophisticated, ever more wondrous and steadfast relations were revealed. What could explain such a wealth of order other than the designing mind of our creator? Now this persistence of man's view of himself and reality could do no other than show itself even in the most "scientific" of his endeavours, as we shall see.

The Toolbox, the Godhead and the Deep Blue Sea: What is Mathematics?

The trajectory of coming to grips with a profound aspect of man's struggle to understand the world is never a smooth arc to truth. And, neither can it be otherwise, because such an area is always full of contradictions, breathtaking potentials and precipitous pitfalls. The famous zigzag prevails (as elsewhere when no direct path can be plotted) first waxing lyrical in a given direction, then "correcting" like mad the consequences of that sudden rush of blood, and inevitable careering too far in the opposite direction.

If the situation were a simple two-sided contradiction, then a resolution could be seen to be possible, at least

some time in the future, but if the contending forces are many and various, the battle can seem endless, and perhaps it is!

I am in the midst of an extensive study of Abstraction – not as an academic undertaking, where I present a many-sided, even-handed view, but, on the contrary, I am obsessed with the path to truth. I want to understand the methods that mankind has invented and developed which can take him incessantly along this long and difficult path, and equip him to both interact with Reality (i.e. manipulate reality), and understand it.

It is a tall order, but it is difficult to imagine a more worthwhile undertaking.

Without such a study, most things become pedestrian. "History" contains NO "guiding wisdom!" "Science" contains no real understanding, and "mathematics" becomes a worship of techniques! And it is with Mathematics that I must begin.

Mathematics

I was showing a colleague some of my research into the beautiful features of tessellation families that occur in re-entrant polyhedra, and elicited only the response, "But, what use is it? What can you do with it?"
And I found myself saying that it was not undertaken with use in mind. It was, in fact, Pure Mathematics, and it was an area that obviously needed study. The eyes of my questioner glazed over, and it was clear that my studies were considered to be self-indulgent, and useless! Now as someone who has spent most of my life fighting the dangers of mathematical idealism, that reaction stopped me in my tracks. It was quite evident that I had been pigeon-holed as a typical ivory-tower academic (at least in regard to this work), which I knew to be totally untrue.
So, in the light of my well established position with regard to the philosophical ground of mathematics, why do I do this very abstract research? The elements of my studies in this area certainly don't lie around in nature. They are in fact entirely absent! They are incapable of occurring by natural processes in the real world. In the form that I am taking the studies, they are a figment of my imagination, so how am I energised in this study? What possible truth am I struggling to reveal, and why?

The reader may think that the stated quandary is nothing new, and that all serious academics come across it everyday and deal with it without much concern. Now I could, at this point trot out the usual high-sounding reasons for such intellectual activities, but I don't believe that it would get us anywhere. Also such platitudes would be totally ignoring the context of my wide range of studies that have got me to this point, and determine the reasons for all my studies.

For example, I have spent many years fighting the consensus in my own specialist areas – Science and Mathematics. I am an enemy of String Theory and much of what is termed Modern Physics. I condemn the dumping of scientific explanation for mathematical formulae, and the amazing speculations of the heroes of Cosmology. My most unwavering criticisms I marshal against the "mystification" of mathematics that takes it as the very essence of reality – "the mind of God" to use Hawking's famous quote. Nonetheless, you can find me quietly working with pencil and paper for hours, days and even years at a most abstract area of mathematics – and I know that I am right to do so! Why?

Be Patient! I'm afraid that a direct, brief answer to this question would be inappropriate at this juncture. I must explain Mathematics, and use a broad brush, for mathematics is a diverse area with many different uses and purposes. Let us start with the "Toolbox!"

Man & Reality II

Applied Mathematics - The Toolbox!

Though it is rarely evident in the teaching of the subject, there are very different roles for maths in the modern world. Perhaps the first historically, and the most prosaic, is its use in production – in manufacture of all types. When relationships were detected in nature, the requirement was to find-and-fit a mathematical form to the revealed relation to allow quantitative questions to be asked and answered easily. Such "fitting" did not require any theory to be elaborated. No philosophy was involved. A mathematical artisan could rummage around in his toolbox of forms and find a rough fit, then use a few modifications and adjustments to effect a pretty useful final result. The maths would then be indispensable in the effective use of the revealed relation in diverse ways. Over what amounts to millennia, mankind developed a wide range of techniques which facilitated such undertakings, using every conceivable mathematical invention to purely practical ends.

This cycle of discovery, fitting of maths forms and USE has developed into a clearly delineated area, which keeps clear of theory (except as a source of yet more tools) and engages in practical tasks.

We call it Technology, or even Engineering, and its "fitting" activities are often very pragmatic, while being at variance with the concerns of pure scientists, who demand answers to the question "Why?" The pragmatists of concrete world problems are much more interested in the question "How?"

And the incessant clamour for the maths to facilitate their labours has led to a rich set of techniques which could only rarely be said to help in understanding. These techniques basically are superlative "fitting" methods. A few examples will give the clearest idea of what they are like. The most famous is the method of "Equating Coefficients" in generalised polynomial equations. Such generalised polynomials can have no theoretical basis, but can be put forward as the first pragmatic step in covering a well researched relationship (liberally supplied with data) in Nature.

So general, in fact, is this form that every single term is given an unknown constant – not much good so far! But with sufficient sets of related data from the real world, these can be substituted into the polynomial for a number of different cases, and the result can be a coherent set of simultaneous equations in the unknown "constants". With these, there are algebraic methods (and later on determinants) that enable the solution of these equations involving the exact values of these unknowns. And when these are substituted back into the general polynomial, we end up with a mathematical formula that fits the facts.

Notice the total absence of explanation in these processes. They established a solid cycle between experimental data and mathematical expressions that can, and do, produce powerful, useable formulae.

Another similar process is the so-called "Fourier Analysis", where almost any time based repeated pattern in nature can be "fitted up" by the addition of multiple "sine waves" suitably weighted. The method does work, but it would be incorrect to say that it throws any real light at all on the actual causality of the situation being modelled – quite the reverse. If anything such a method hides the causality. It is interesting to see that a modern example of such an approach is actually used to produce a so-called "theory". This is the renowned String Theory which turns out to be of exactly the same ilk. There, oscillations of strings (?) are added together to produce Everything (?) in the Universe. And, if we are trotting out famous examples we must not omit the enduring Ptolemaic Theory of the heavens, which matched the recorded data with the ever more complex addition of epicycles to model the movements of planets, sun and moon as observed.

These are a few examples of the power (and weaknesses) of "fitting". Mankind was not able to refine the Ptolemaic Theory until it arrived at the Copernican System, was it? For over a thousand years the former had held sway, AND was a barrier to a better theory. A revolution in thinking (and, I believe, in society) was necessary before this edifice was pulled down and something nearer the truth erected.

Perhaps I should include one final example. I am sure that I have made the point I wish to make, but I feel that this last inclusion is nonetheless unavoidable. It involves that icon of technology – the computer. Many calculations and manipulations in mathematics proved to be long-winded and tedious, and it soon became cleat that such tasks would perhaps best be carried out by some mechanistic aid – such as computers. These tireless mechanisms, given an effective algorithm (computer program or set of instructions) could trawl through the data until an acceptably accurate result was achieved. The very inclusion of the computer, though, caused an interesting regression in techniques. Over the centuries many, almost mindless, iterative techniques had been developed for finding the quantitative information required without understanding the causal features involved. These had not been attractive to human employment because of the mind-numbing boredom of repeated application, but also because they added nothing to our understanding. Computers, as you may guess, changed all that. Pragmatists wanting numbers to a certain accuracy were quite happy to consign the job to a computer program, which could churn away at lightning speed, and produce exactly what was required. The era of "the computer says" was born.

Computers paper over the cracks

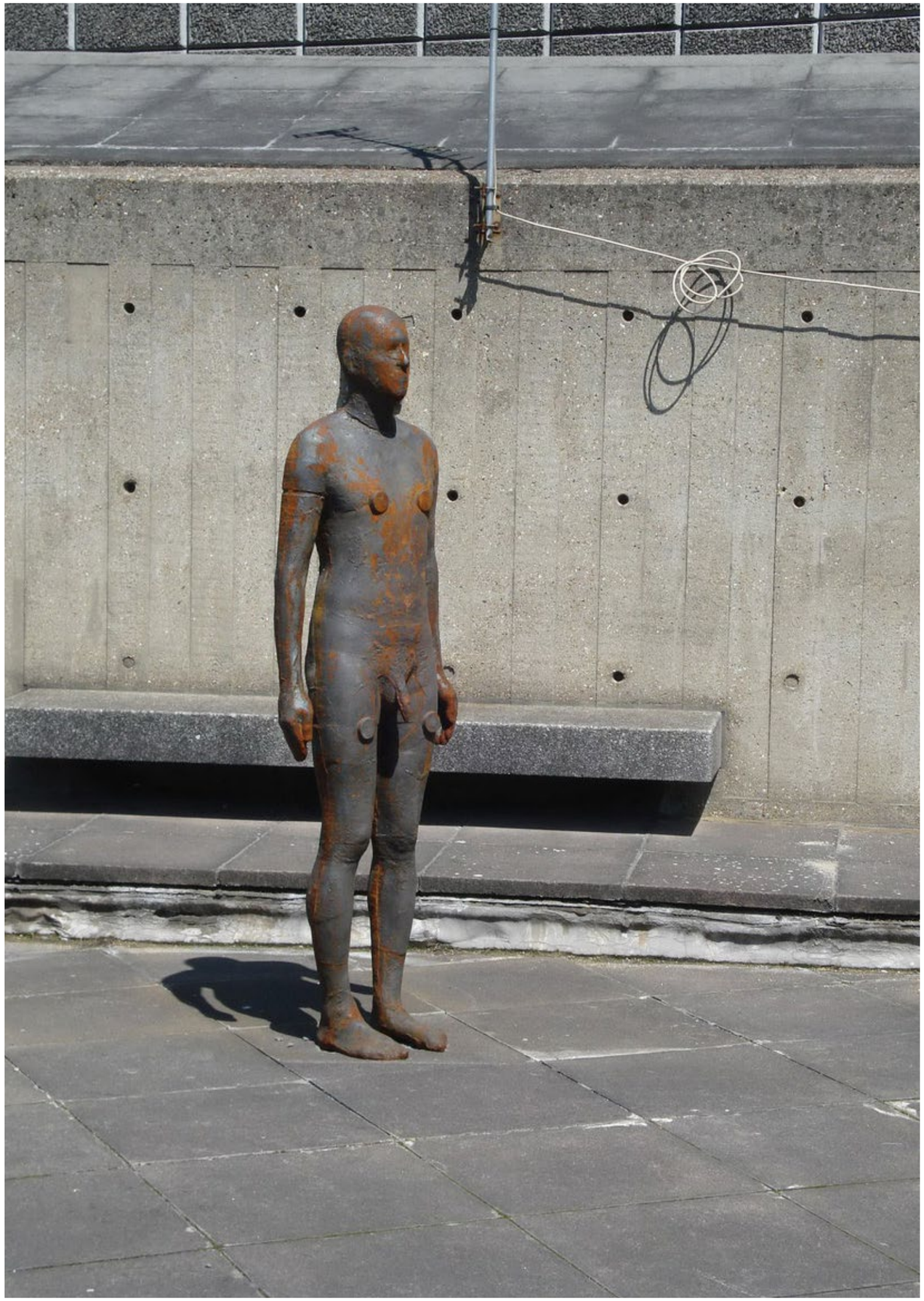
Computers had another significant effect on the modelling of reality. The inevitable breakdown of individual formulae at domain boundaries was obviously a major problem in constructing effective computer-based models, and restricted such models to very limited context. But there was a way round this difficulty! Computer scientists had been including tests in programs since the beginning, and re-routing the path to different sets of instructions. But, normal procedural languages involved detailed programming of all the tests and switches, and because instructions were only obeyed sequentially, there were often delays until the requisite tests had been made. The solution was a new breed of computer languages called Object Orientated Programming Systems (OOPS!) These languages were effectively "interrupt driven". They could be given rules that were of general significance, and could be kept separately from sequences of instructions. These rules encapsulated the precise conditions when one domain had become defunct and another had to be set up with its own, and different, instruction sequences. These were handled so that they were ever-available. This meant that the language implemented a runtime version in which the "house-keeping" roles CAME FIRST. That is, the rules were tested out at every single time-slot cycle. A positive result would mean that the current sequences of instructions would be interrupted and the switch in mode effected.

These features effectively papered over the cracks between different domains. As soon as the conditions for a change were encountered the switch was implemented. No understanding of why the switch was necessary - was involved. Some threshold or set of thresholds were designated as sufficient to implement the change. Significantly, the transition seemed "seamless" and "natural". How lovely!

The dynamic content that always accompanies such changes was, of course, totally absent from these transitions. It was thresholds – Switch! I feel impelled at this point to bring in my evergreen anecdote about reaction fronts in liquids.

From time immemorial, budding scientists had been told to "stir well" and wait for equilibrium conditions before any meaningful data could be taken from an experiment. Breaking this rule led to all sorts of inexplicable data, and no conclusions could be drawn. In the 1980s I was lucky enough to work with some researchers who consciously disobeyed this rule. They wanted to study the reaction fronts when two different liquids reacted chemically. They never stirred! They almost forgot to breathe, as the slightest disturbance would ruin their experiments. They also chose a situation where a reversible reaction could be quite easily be caused to oscillate to and fro between the products at each end of the reversible reaction. They also carefully chose a situation where the products were of significantly different colours. The test tubes unfolded beautiful, striped structures as the oscillation proceeded, and the reaction fronts were clearly shown to be TOROIDAL SCROLLS. So much for stirring and equilibrium then!

Innumerable further examples could be put forward here, but I am sure that the point has been established. But, "Is that all there is?", as they say. No, it isn't! The methods described above use mathematics that was disinterestedly developed by pure mathematicians, but to purely pragmatic ends. Indeed this approach has been consolidated into, what may be called a philosophy. The philosophy of Pragmatism.



Man & Reality III

Pragmatism

Let us attempt to define the philosophical position that currently dominates the widespread everyday attitude to Science and its role in society, not only in the technology dealt with above but in Science itself.

Elsewhere, I have established that "Technology rules OK", and is often mis-named "Science"! Its productions abound! From space rockets to television, mobile phones to digital cameras, and washing machines to computers – everywhere these products seem to define the main thrust of society. But, what exactly is Technology? How does it relate to Science, and how have its worship, and its effect on the general world view developed to its present state? The essence to these questions must be at least started with the explanation of the relationship between Science & Technology.

It is clear that Science is about "Why?", while Technology is about "How?"

Early in their development these two things had a different relationship to that they hold today. Long ago as soon as some "useful" thing or process was discovered, it was immediately "put to use" without any real explanation. But there was a danger in this lack of a meaningful explanation. The process was therefore all the more difficult to remember and pass on to the next generation, because it couldn't be easily explained. So there developed a sort of "apology" for an explanation which often took the form of a quasi-religious or magical ritual, with associated mumbo-jumbo. There is little doubt that such closed shop procedures were in fact quite effective. Without understanding, practitioners were still able to maintain and pass on their powerful techniques.
So, it seems that Technology preceded Science but was maintained by the mystical garb of myth. So, obviously, someone, somewhere actually, by chance or design, actually discovered the useful kernel that was later entrenched in the above performances, and indeed, this has to be seen as a kind of "embryo Science", but any clear essential explanation was at this point absent. The process had mostly involved intelligent observation and realisation rather than any structured scientific activity.

So, from early in the history of modern man, the "practical" use of discoveries was established.

Now this paper is not meant as a history, especially as I am in no position to give chapter and verse on the detailed processes and development of this nascent Science. That is a task for someone better qualified than I in objectively interpreting and delivering History. But, if we are to understand the position as it stands today, we must at least give some time to seeing how that grew from its ground in man's past. By the time of the Greeks, the situation had become noticeably more rich and complex. The beginnings of detailed observation, Mathematics, Logic and Philosophy were by then established as study-able categories, and the earliest "explanations" (in the modern scientific sense) were attempted. This was the start of true Science, but we would be very hard put to recognise it as such. With basic "elements" such as Earth, Fire, Water and Air, we find it hard to give any credence to it as what we would call explanation, but in an important sense we would be mistaken. It was an intelligent attempt. Its explanations were not stupid AND contained morsels of the truth. Our modern way of putting this would be to say that these concoctions STILL contained some objective content, even though they were wrapped up in mistaken definitions and understandings. None-the-less, for the first time it did put explanation "on the agenda" as a worthwhile undertaking.

By the time of the Industrial Revolution, all sides of the study and use of aspects of Nature had exploded into myriads of lines of development, and new forms of Abstraction had led to the birth of true Mathematics, as well as a range of separate sciences, and sophisticated technological methods of producing things for use. Though the Giants of Culture at this time were often "renaissance men" in that they participated in everything, the various subjects were becoming separately defined, and while Engineers built roads and locomotives, ships and bridges, Scientists attempted to get to the heart of things and explain WHY things performed as they did.
By the time of Edison, the inventor/technologist was becoming separated from the pure investigating scientist in that his overriding question was not WHY? But HOW? And his purpose was the employment of discovery in

commerce. That is the conversion of knowledge into saleable devices. The public more and more associated "science" with its use in readily acquirable devices and facilities. Those investigative workers, asking the question WHY? were relegated in public consciousness to the ivory towers of Universities where they could ponder the explanation of the world, while the real "useful" people were conceived of as the engineers and technologists.

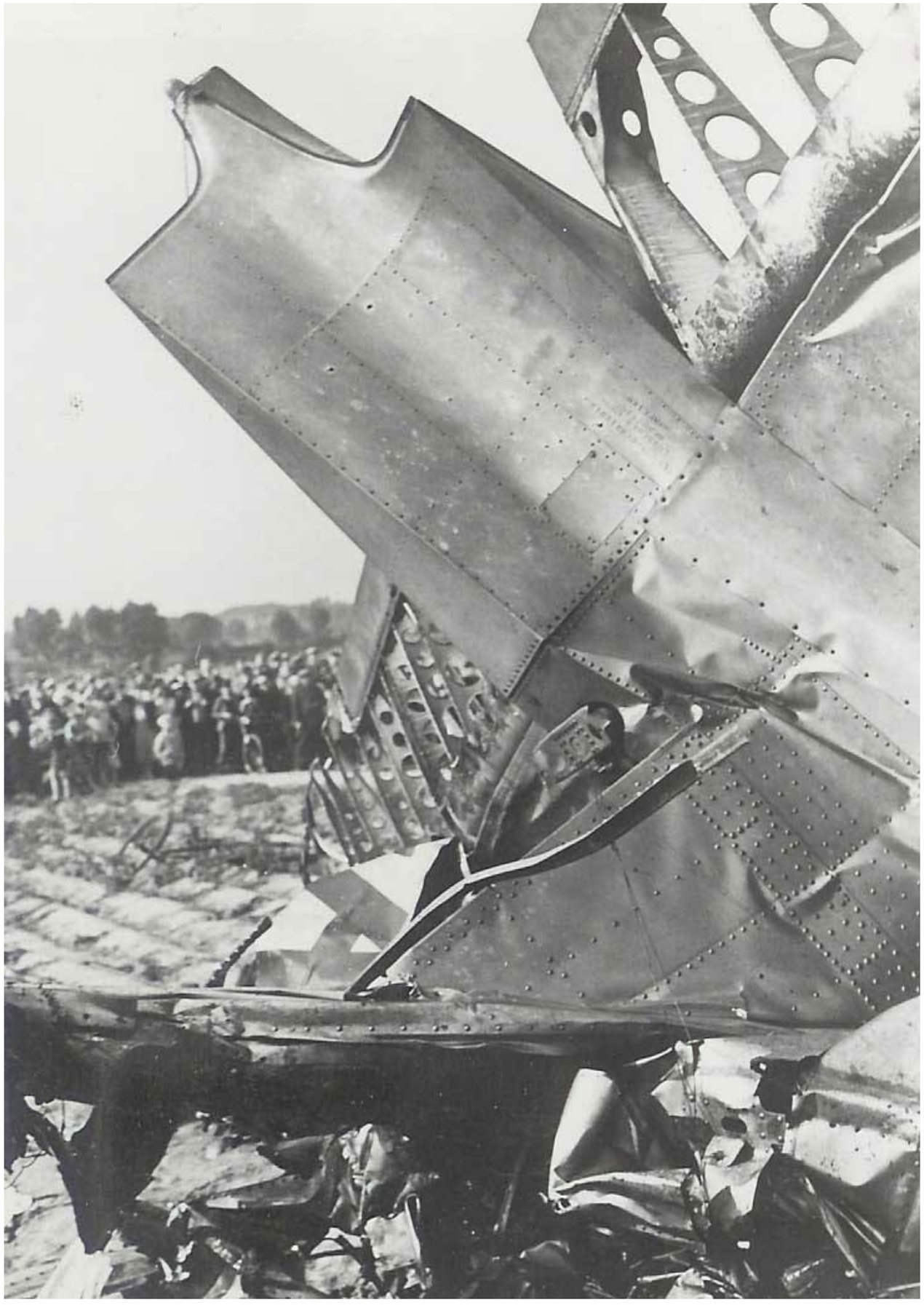
A peculiar form of "research" began to develop that was not carried out by scientists, but by inventors and technologists, who KNEW the available science, but required outcomes that were immediately reproducible and acquirable by the population at large. This form can best be called "suck-it-and-see". It involved using what science had discovered but with very different purposes. Every conceivable trick was used to find cheap and effective ways of delivery of what had been shown to be possible. Such DIRECTED experiments had reversed the priority relation with scientists. Most discoveries were now made by "disinterested" scientists, while the employment of these in everyday devices was carried out by technologists, involved NO new understanding, no new explanations, but it could reveal effective answers to practical employment and use. Thus occasionally things were made which led to catastrophic consequences, such as all the passengers on a train being suffocated as it passed through a tunnel. There had been nothing wrong with the underlying science. The engine chugged on through the tunnels and emerged unscathed, but no science had been done on how passengers would be expected to react within a tunnel and they all perished. But, though the human cost was very high, the methods of the technologists, after multiple tries, did usually, in the end, provide working solutions. This method has often been termed Pragmatism – "If it works – it is right! The "god" of pragmatism was undoubtedly Thomas Elvar Edison who, in the USA in the 19th century invented functioning electric light, phonographs and many others with the sole purpose of delivering them as saleable products on the market. His objective was to turn scientific discoveries into saleable commodities to millions of customers and thus amass a fortune. Yet Edison was no scientist, he was certainly a technologist.
My favourite example of this approach was the saga of the Douglas DC3 airliner/cargo carrier of the 1940s. This aircraft was thrown together and catapulted into its first test flight resulting in an immediate crash. But if you believe in "suck-it-and-see" it is clear what you do next. The fragments were gathered together and studied with a view to correcting the fault, and a new version was quickly completed and again immediately test flown. It crashed again! The process was then repeated many times at great expense and some considerable loss of life. BUT, the final product turned out to be a masterpiece! It became the backbone of military transport during the Second World War from packets to paratroopers, and continued after the war to serve airlines throughout the world for many decades. The DC3 was therefore produced by pragmatic methods and proved that they do deliver.

Now this experience, particularly in the USA, led to a philosophical position also, which embodied exactly the same approach – "If it works – it is right!" or "Suck-it-and-see!" "Let's try it for Christ's sake!" –"Don't constantly think about it. DO IT!" And this rather lightweight philosophy was justified by success in commercial and economic terms. The total dominance across the world of American capitalism validated their home-bred, macho philosophy and was overlaid with high sounding conceptions such as "Democracy", "Liberty" and "Economic Success!"

Now a particular effect of this has been a deification of technology as a panacea for all problems. Technology has been turned into "science", and is repeatedly called Science. Its practitioners are always called "scientists", and its achievements are credited with scientific qualities and merits, such as "explaining" the origins of the Universe, or revealing the mechanisms of Nature. An example of this is how the technology of video photography, radio communications and image post-processing (all pure technology) are said to SOLVE problems of the true nature of Jupiter's moons and many other similar cases. But, of course, what is happening is that uninformed speculation is simply being demolished by new evidence, made available by technology. Technology doesn't present alternative explanations. It is incapable of such tasks. It merely delivers the data for scientists to interpret and explain. The prevailing attitude to Technology is, of course, so much twaddle. Technology is not Science and as such makes NO contributions to understanding the world.

Such claims are like commending the piano for the creation of a Beethoven Piano Concerto.

What utter nonsense!



Now the establishment of technology as "the most important activity in the world today" has been entrenched also by the role of Mathematics as a quantitative tool in technological achievements and problem solving. Unlike scientific qualitative explanations and theories, technology's ever-present bed-fellow is Mathematics. The relationship between the two is also the epitome of pragmatism. The limited, yet quantitative aspect of maths formulae fits like a glove with pragmatic technology. Formulae are used until they fail at some domain boundary, thereafter being replaced pragmatically by other more appropriate ones without compunction. No technologist feels any guilt at such suck-it-and-see procedures. They are, after all, his philosophical ground. "If it works – It is right! If it fails, dump it and instead use one that works!" Thus the quantitative and pragmatic aspects of functional mathematics, is the perfect partner to "problem-solving" technology. As long as Science provides the working theories, and maths maps these onto working formulae, technology can march ahead and deliver the goods.

The social basis for Pragmatism is also of significance. Both the current dominance of the USA and the preceding dominance of the British Empire underwrote a pragmatic view of the world. The standard of living at the centre of the dominant culture was always predicated on the extraction of profits from the rest of the world, and these were rapidly taken as being natural consequences of the superiority of the prevailing pragmatic ethos of the empire builders and corporate giants. So, if such a system could provide such elevated levels for most of its general population, its methods must be correct. At the same time the demise of the Eastern Block – simultaneously with this dominance - undercut the currency of socialism, and its place as the future of the world was replaced by a "property-owning democracy" or some other euphemism for the privileges of dominance.

Now, so far we have been concentrating solely on Applied Mathematics, and it is obviously vital in all industry throughout the world. But it doesn't exactly "thrill you to bits" does it? It is the "toolbox" conception of mathematics. Perhaps that alternative ivory tower area of the subject needs a more detailed look. After all, it seems to be the source of all maths techniques, even those used in the above pragmatic ways. What is its remit and purpose?

Man & Reality IV

Pure Mathematics - The Godhead!

Now, in my studies into Abstraction, the above techniques turned out to be a very small part of the area as a whole. The majority, and more important parts, of the system of processes were those concerned with modelling with a view to understanding reality. There seemed to be TWO main routes through to worthwhile results. Both of these were, of course, predicated on the initial steps in the processes outlined above. That is in the distillation of relations from the real world phenomena, and the attempts to fit these to some underlying form. When this was taken as answering the question "Why?" we move into this much wider area.

These two alternatives could be clearly categorised as Explanation and Mathematics.

Now the reader may feel that I have already covered something of mathematics with my discussions on Technology and Engineering, but the asking of "Why?" did NOT emerge at all in the methods studied there. If this question is taken to be central, the mathematics involved changes profoundly, and the philosophies implied by the two alternatives become significantly different, even contradictory. The wished-for myth stated by many scientists and mathematicians that the roles of scientific explanation and formulaic mathematics would turn out to be entirely complementary has only rarely been established.

Indeed, the "grounding" role of scientific explanation, on the stratospheric flights of idealist mathematics was a much more realistic picture. And, in the modern era, this role has been eroded to almost nothing in areas like Modern Physics. It would be much nearer the truth to say that idealist (Platonic) mathematics now dominates in these areas, and scientific explanation there is maybe in terminal decline.

What is Scientific Explanation?

To correctly deal with the relationship between mathematics and its clear alternative – scientific explanation - in the processes of Abstraction, it is imperative that the nature of this scientific explanation be carefully investigated and established here. Without some understanding of the alternatives, how can they be effectively compared and related?

The initial, straight-forward description of scientific explanation could be that some analogy is found somewhere in the real world that can be said to fairly closely reflect the new area being studied. That is a sound, established situation from one part of reality is mapped onto another.

What would be the content of such an explanation? Well, the scientist does not pick any "old", unsubstantiated analogue to use. That would not be explanation but speculation! Quite the reverse is attempted! An example is chosen because it immediately comes to mind as "resonating" with the new area, but also it must be "well established", and in its own area generally accepted as an accurate description.. Now this requirement guarantees that embedded within it is an already undisputed "objective content".

Now, Science is not like mathematics. Whereas a Mathematical Proof has to be a logically established, 100% certain truth, Science is more about the preponderance of evidence. If an experiment is repeated innumerable times, and always gives the exact same result, then the scientific community accepts the processes involved as established, and the situation is "marked down" as the "current" truth! Such "truths" are always provisional, and can be conceived of being modified, or even overturned, at some point in the light of new evidence.

But, in addition, scientists always want their "truths" to be bases from which they can build, so that they can take each well established situation as a GIVEN in their subsequent researches and theorising. Their "elements" must be capable of such constructions.

So, we have established that the carried-over analogy is backed with previous evidence and confirmatory experience. Then, it is applied in the new situation, first of all as a place to "start" from, and then carefully investigated to allow a sound fit. The thing being carried

over is NEVER a quantitatively and precisely defined entity, and the mapping is never expected to be a case of absolute identity. NO, it is instead a case of the qualities and processes that are considered to be essential in the mapping. The dynamics of the situation, its developments and transitions, its stabilities and instabilities are the essential ingredients that are carried over.
This is crucial!

An explanation is NOT a one-to-one mapping in a tiny, precisely defined situation. It is a broad, system-type mapping, where the trajectories of change and the plateaus of stabilities are "mirrored" in the two situations. Explanation is FULL of experience from the world as already understood, and finds that qualities and their inter-relationships recur throughout reality.

The confidence in such a scientific explanation has TWO foundations. The FIRST consists of repeatedly revealed evidence in proper, scientifically set up experiments. And SECONDLY, in the coherence and consonance of qualitative dynamics and inter-relationships. Such resonances are NOT quantitative, neither can they be! The demands of an analogue model full of qualities and change will always PROHIBIT an exact quantitative match. The best that can be achieved is the identification of intrinsically similar systems in quite DISTINCT situations. Now, even when a scientific analogy has been achieved, the process is, as yet, incomplete! A qualitatively similar situation can give a sound feel for what is going on in the new situation, BUT, the physical features involved can be very different. To go from a suitable analogy to a Scientific Theory needs a series of extra steps to be taken.

The "elements" of the new situation, that are seen to have similar, corresponding "elements" in the original model, must be identified as real physical entities, and named. Gradually, a detailed version of the analogue is built up into a FULL theory to cover the new situation. Such a result is NEVER a mere speculation. It is imbued with "objective content" from both ends, and these have been established by rigorous experiment. The mappings are never identical, but the dynamics and feel of the situation are RIGHT. The new model or Theory is a significant step forwards.

Notice, at this point NO quantitative side has been established in the forms described above, and sometimes this is the unavoidable order of events. Frequently however, particularly in the latter period of scientific research (since Newton, say) the overarching theories do not come first! Observation can lead to inklings that quantitative relations are present in a given real world situation, and scientists will then structure a carefully designed experiment to constrain most variables and effectively reveal clearly the surmised relation (often between only two variables). The result is a quantitative relation, which can be turned into an accurate mathematical formula. Notice though that the mechanism here is very different from the one described above. Instead of broad area dynamics, we have a severely constrained quantitative relation.

At the heart of the process is a contradiction. The derived formula is NEVER all embracing and overarching. It is always narrow and particular. The so-called Laws that are erected based on such quantitative experiments are inappropriately named. They are not LAWS – surely that is much too grand a name. Consider, for example, Boyle's Law PV = CONST. for gases. This relation is true in very rigidly constrained situations, but is scarcely a profound theory. It is a relation, crystallised into a useable quantitative formula, but to use it, the conditions of the area of application must be constrained exactly as in the original experiment. "No problem1", I hear you say. "We can do that!" And you would of course be correct. The industrial revolution was precisely the process of setting up such situations – BIG! Relations could be used in manufacture, and thus become powerful tools in the hands of mankind. So, why do we need scientific theory too? Won't simple relations turned into dependable and useable equations be quite sufficient?
The answer is definitely NO!

To follow the above policy, mankind would end up with an enormous bag of particular relations, and NO understanding at all would be involved. To go from PV = Const. and the inverse proportionality of the pressure and volume of a given mass of gas in quite controlled conditions to an understanding of "WHY?" requires a broader and quality-full context to be established. In the above case a whole "story" about what a gas is, what energy is, and what temperature is, is necessary to explain the above relation. So quantitative relations alone can only give rise to technology. To weld such particulars into a "general" understanding requires qualitative theories – requires scientific explanation. Now, no matter what present-day mathematical "scientists" may say about this, they cannot dispute that some form of wide, qualitative

context is necessary. And, if that is not to be achieved by the above described method of scientific explanation, then what does provide it? The answer is that apart from enormous borrowings from past scientifically established entities, the modern answer is invariably Speculation! We will not go into the various forms of speculation at this point, because the issue here is clearly "What is the nature of Scientific Explanation?" It will be dealt with in detail elsewhere, BUT at this stage it is crucial to totally distinguish it from scientific explanation. Modern speculation is a trajectory from quantitative relations TO definitions of "possible" entities TO co-ordinating theories. An entirely different sequence to that for scientific explanation.

Indeed, throughout both Science and Technology, theory is essential! WHY? You can only take the cumulative effect of multiple quantitative formulae so far. All technologists and engineers, and so-called mathematical physicists NEED an overarching, comprehensive context for their wealth of particulars. They need a co-ordinating matrix to relate the parts to some whole. They need GROUND! That ground must be scientific explanation.

Let us return to the subject of Pure Mathematics.

Man & Reality V

Gloriana!

So, mathematics is a great deal more than a mere toolbox. It is not just a rag-bag of pragmatic techniques. Then what is it?

My admission that I can spend major tracts of my life doing pure mathematics, doesn't gel very well with it being a theory-less, quality-less and mightily abstract, yet man-made construction, does it? So, let us leave the pragmatic, head-down, carpet-fitting behind us and climb into the high uplands to breathe in the grandeur of true mathematics. To realise its qualities we have to reveal exactly what mathematics is really about.

Mathematics is the *Science of Form!*

Quite distinct from subject-centred studies such as Physics, Chemistry, Biology and the rest, it is not concerned with the causality of the world. It is concerned with disembodied Pattern! It isolates significant pattern from reality, or even from our own inventions, and finds its universal formal properties. It is the Logic of Pattern.

This isolating process refines the patterns to their minimal configurations, their ubiquitous essence, and allows their study without the confusing and inessential clutter of multiple overlays that abound in nature. Thus the idealisation of relations into mathematical forms (or formulae) is its essential feature. It is no wonder that Plato and other Greek philosophers waxed lyrical about ideal shapes and forms. Reality, as is, does not give up its secrets easily. They are hidden in a confusing matrix of contending forces, and a fog of what we would today call "noise". But, nevertheless, constant glimpses (to tempt the curious) of significant relations were always being momentarily revealed and the extraction of these "truths" became, in time, an enticing mistress.

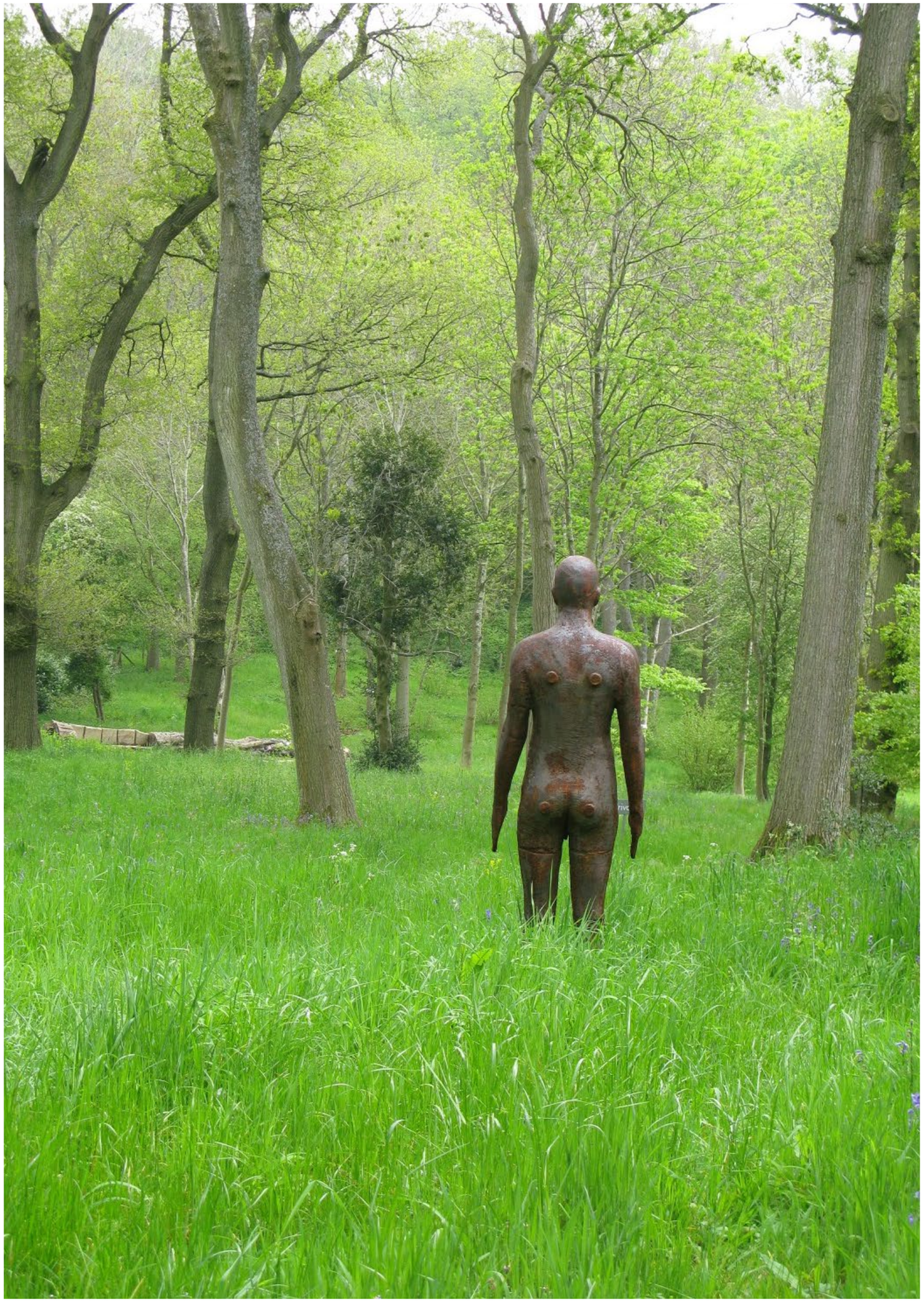
Exactly what these relations were caused by was not clear, though throughout mankind's conscious history it has always been the question.

Nonetheless, millennia rolled by in which these magical relations were put down to gods and devils, and the never-ending detours of ritual appeasement of these forces were embarked upon. The clear social advantages of such co-operative and consensus beliefs entrenched the explanations, and mankind's techniques and current knowledge always seemed incapable of an alternative approach. "You can't pull yourself up by your own boot-laces", as they say!

The Role of Belief

The processes involved were by no means scientific. The consensus belief system "seemed" to be confirmed by the society's continued success and growth, but the coherence involved in a shared belief system was perhaps more significant than the contents of these beliefs in ensuring continued confidence and co-operation, and thus success in their endeavours. What always amazed me about the situation in the Second World War was the dedication and valour of the Japanese and Germans. In spite of seemingly insupportable reasons for going to war, and a twisted and reprehensible fascist ethos in both these countries, their soldiers sacrificed themselves in inordinate numbers for "Der Fuhrer", or "The Emperor", or even the "Fatherland". How could this be? I think the answer is contained in my initial point about the strength and confidence imbued by a general and elitist belief system. Other examples litter history. The aggressors are invariably more radical in the way they carried out the business of war, and more confident, while the aggressed against fall away in disarray. All, I believe for the same reasons - a belief system. A primitive society exposed to the world for the first time, in a way that has its ideology, religion and self-belief shattered, dissolves into mediocrity and weakness. "Any coherent, confident belief system is better than none" - from a survival point of view.

However, by the time of the ancient Greeks things began to change. They were the first to see the possibility of another way. Without any of the modern techniques of scientific investigation, they nonetheless made profound gains. And where did they make them? In Mathematics! As a boy just started in Grammar school, I was introduced to the Geometry of Euclid, and was seduced by it. It was a surprising entity! Totally impossible abstractions



were refined out of an "imperfect" reality, and studied in an ideal form. Circles were perfectly round, made of lines of zero thickness, while planes were perfectly flat and extended in all directions to infinity. Yet, a coherent structure could be erected on a handful of such assumptions. Mathematics had its first triumph! Form had been extracted and studied and shown to be good! And, all you needed to study it was paper and a pen (or in the Greek's case – a sandy floor and a bit of twig). Yet, these same Greeks, also saw the pitfalls from the outset. It was Zeno who clearly revealed the dangers of idealised assumptions, and the consequences of their application to the limit. In spite of their epoch-making contribution, the Greeks could not develop their inventions without restriction. They were, so to speak, ahead of their time, and quickly found themselves in the same morass of spiritual causes as everyone else. Profound contributions were a long time coming after the Greeks.

NOTE: As each new abstraction was distilled from reality, and then investigated as an ideal system, the richness contained within what at first seemed to be quite modest assumptions, thrilled the practitioners and seduced them into seeing all as evidence of a co-ordinating mind. Certain areas were remarkable in that they did not seem available in nature at all. Figures, derived by mathematicians, such as the dodecahedron and the icosahedron were breathtaking constructions of order and beauty, yet they didn't exist in nature. But surely, they couldn't be pure invention. They had to express some profound, but hidden aspect of the world. Thus the mystification of mathematics was unavoidable, and the Pythagoreans spent lifetimes explaining the world in terms of their figures and forms.

In a surprising way, it was the emergence of proper measurement and experiment that allowed the break-through. These techniques revealed significant relations at every turn, and produced an avalanche of forms for mathematicians to extract and study. Though these developments led initially to the Sciences, they also "created" both Mathematics and mathematicians, and it was the latter who seemed to be dealing with the nitty-gritty of reality. Give them an inch and they regularly took a mile.

They had the advantage of not being shackled to demanding experiment and long-winded collection of data. Once delivered of a form, they could investigate the idealised version to their heart's content. They even took to "creating" forms to investigate, and quickly showed that such studies were indeed possible. From quite early on, they embarked upon Number Theory – the most abstract aspect of mathematics, which studied Number itself, and led to the definition of Prime numbers, and the formulation of "rules" such as Fermat's Last Theorem. Perhaps the most important feature of their "artificial" flights of fancy of mathematics, was their subsequent role in "fitting" these to new, "inexplicable" relations revealed by scientific experiment. Areas that were generally considered to be total inventions were found to "map" onto aspects of reality. This inversion of the normal relationship between maths and reality posed a new question. Could mathematics be the true essence of the Universe?

Mathematicians soon became so confident in their ability to supply forms for every situation, that they embarked upon what can only be called maths-based speculation. They worked FROM maths forms to attempt "explanations" on a Cosmic Scale. The famed "Theory of Everything" is the current pinnacle of this line of work. From basic forms to do with oscillations of all kinds, arose the conception of "Strings". These would be physically existing entities would could take on almost any oscillating mode. Like the old Fourier Analysis, it was postulated that these "entities" could then come together to produce the Universe, all by themselves! Now this aspect is not the only one in a breath-takingly broad phenomenon. In addition, maths formulae began to replace scientific explanation over an increasing range of situations. In particular, where analogous explanations seemed very difficult, or even impossible, they were immediately replaced by "reliable" formulae. "I don't know why, but I certainly know how!" "I can tell you exactly what will happen in a given situation! Do I need an explanatory theory? Are they not always constructs anyway?"

Could not the universal forms of mathematics actually be the essence of reality? A world encapsulated in pure mathematical formulae might well be the epitome of Science.

Man & Reality VI

FORM

If mathematics is being considered as the essence of reality, perhaps the time has arrived when the question, "What is Form?" is clearly addressed. The problem arises because it seems to be independent of reality! Form itself cannot be said to derive from situations in reality because few, if any, such cases of our versions seem to exist there in isolation. I must not allow this conclusion to obscure the fact that the realisation that Form exists could only initially have come from investigations into reality, but the point of my previous statement is that nowhere in reality could any of the forms be seen in total isolation from any other integrated "mixed-in" features. We can therefore say that NO pure forms exist in nature.

Note: a few trivial exceptions can be put forward without in any way invalidating these conclusions. These are to do with extremely quality-less things such as "counting numbers", and even examples of these can be undermined by the decay of individual items into multiple something-elses.

But Form, though within a richer mix is found to be "extractible". With sufficient "farming" of the context, and rigid control, quite clear examples can be revealed. But, it is never, in this real world, part of a complex whole that is investigated together including the example of Form. Quite the reverse, the form is always surgically removed from that concrete ground in reality, and placed pristine and eternal in an invented, pure absolute world, which I am impelled to call Ideality. Once there, the Form can be safely manipulated, analysed, graphed and re-structured to the mathematician's content. Once extracted, it is found to be universal, in that other occurrences in quite different matrixes of real world configurations can be readily discovered, such that once it also has been extracted and totally divorced from its real world matrix, can be seen to be exactly like the first Form, along with many others like it. I cannot stress enough the difference between the concrete occurrences in nature and the idealised version in Ideality. The former can, and do, develop and change into a variety of subsequent structures and forms, whereas the later extracted versions have no past and no future. They seem eternal, but they are not. Reality itself indicates when a given extracted perfect form is no longer applicable, and must be dumped and replaced by another.

The mathematician thus becomes the guardian and expert on universal form, and takes on the mantel of being in touch with something approaching "essence" of the world (!) The spell must be broken of course. Form, is the most abstract thing that can be derived from reality, and as such it has no permanent activity. It cannot be said to explain processes and events, and certainly not predict significant qualitative change. Indeed though it is regarded as the basis for computer models used for prediction, the "foretelling" of the future is purely retrospective – effectively extrapolating from multitudinous past occurrences to statistical predictions of similar outcomes. Functional explanation for significant change has nothing to do with mathematical form, which is generally about stable, or equilibrium conditions. The most important changes – those that deliver the entirely NEW, produce ZERO out of a hundred in effective prediction by mathematical form. These points may seem very dismissive, but that doesn't stop them from being true. The one excellent contribution to real understanding that mathematical form can provide is in its "flagging" of analogous situations in entirely different contexts, which can direct researchers to the explanations that may be available in the parallel situation. Thus we can say that the extension of effective scientific explanations to give a model for use in quite different, but formally identical situations can help considerably. In such cases the quality-less, mathematical form is a good indicator accompaniment to the quality-full scientific explanations associated with equivalent forms elsewhere.

NOTE: An important contradiction was the obvious existence of clear, purely abstract relations at the very heart of man's most sophisticated concrete discoveries. Now, these were mathematical relations, the most abstract possible relations that could exist, and whereas functional (causal) relations could be seen as concrete properties of matter itself, abstract relations could not – they were disembodied! So the step from the concrete to the spiritual was involved - as it had been

throughout man's history in his religious ideas. Non material "things" had directed the material world! Now it could be possible to see these quantitative relations as being part of the properties of matter and due entirely to functional imperatives within matter itself. But, that was not what was happening. The mathematical relations were considered "fundamental" (or primary) – They directed the whole show – like a spiritual, non-material God!

Mathematical rules such as symmetry were put forward as "explanations" of phenomena. Not "such and such a phenomenon showed symmetry because of the following causes", but, on the contrary, "these phenomena had these features BECAUSE of symmetry".

The Deep Blue Sea

So, we have dealt with the Toolbox and the Godhead in regard to mathematics – what on earth, then, is "The Deep, Blue Sea"?

Well, it isn't Mathematics! But all of mathematics is part of it!

The Deep Blue Sea is what it sounds like - an enormous, all-enveloping mantle of richness and potentiality from which all life came. It is the constructor of rocks, and the creator of climate. It is the source of all things on our earth, and through its productions, of everything in the Universe. Instead of Pragmatism of the Toolbox, and the self-worship of idealist mathematics, we have before us, Reality! That is the Deep, Blue Sea, and its study, using all the disciplines of mankind is our real purpose.