THE PROMETHEAN GALAXY

Andrew May

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Preface

The Earth is part of the Galaxy, but only a microscopically small part of it -- a tiny chunk of rock. We are chained to this rock and can only ever view the Galaxy from this one perspective. Why should we be interested in the Galaxy, and how can we ever hope to learn anything about it? These questions are addressed in this book, by drawing on an eclectic heritage of science, philosophy, mysticism, poetry and science fiction.

The book was first written in 1990, and revised extensively for internet publication in 2004.

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ENCYCLOPAEDIA GALACTICA

His knowledge measur'd to his state and place,
His time a moment, and a point his space.
Alexander Pope: *An Essay on Man* (1733)

A giant summary of all knowledge... an
Encyclopaedia Galactica
Isaac Asimov: *Foundation* (1951)

The impossible book

This book is about the Galaxy, but it is not the Encyclopaedia Galactica. That work cannot be written yet -- at least, not by anyone on Earth -- and may never be written. Isaac Asimov imagined a civilisation spanning the entire Galaxy, with rapid travel and communication from one end to the other. But in reality we are not so fortunate. Most of us are confined to the tiny compass of this planet, and even our most advanced space-probes cannot explore beyond our own solar system.

To put things in perspective, imagine what would happen if you could shrink the Galaxy down until it was the size of the Earth. Then the diameter of the Earth's orbit around the Sun -- about 300 million kilometres -- would be shrunk to just 4 millimetres. The Earth itself would be so small as to be invisible. Imagine being shrunk to such a minute speck: what could we hope to learn about the planet? What would we know of its geography and geology, its flora and fauna? If that's how we stand in relation to the Galaxy, what can we possibly hope to learn about it?

Actually, more or less everything we perceive, with our unaided senses, is in some way or another part of the Galaxy. The problem is that we get a hopelessly myopic view of it. The Earth around us, and the Sun, Moon and planets, are all parts of the solar system, which in turn is just one small part of the Galaxy. Most of the stars we can see at night are comparatively close in galactic terms. The great bulk of the Galaxy's stars are either too far away to be seen, or form part of the faint band across the night sky that we call the Milky Way. In fact, everything we see with the naked eye is inside the Galaxy, with the exception of two faint blurs in the southern sky called the Magellanic clouds, and an even fainter blur in the northern sky called the Andromeda nebula. These three objects are separate galaxies in

their own right.

Of course, we are no longer restricted to our natural senses, and we can learn a lot more about the Galaxy -- and what lies beyond it -- with the aid of telescopes and other scientific instruments. The Hubble Space Telescope can detect minute amounts of light trickling in from distant parts of space, thus providing us with information about the distribution, motion, and composition of stars throughout the Galaxy.

But if the Galaxy impinges so little on our everyday world, why should we want to study it in the first place? This question is one of the two main themes of the present book. The other is the epistemology of the Galaxy: how do we know what we know about the Galaxy?

In search of order

Why study the Galaxy, or indeed anything beyond the planet Earth, or beyond the ends of our noses? There are many reasons, some of which we will come to in time. But a good place to start is the belief that, if we cannot see ourselves in some kind of larger perspective, we are almost certain to misunderstand everything -- even what goes on in our own circumscribed little world.

Alexander Pope (1688 - 1744) was a physical dwarf who towered like an intellectual giant over the literary scene of eighteenth century England. He spent much of his time writing angry satires about the short-sighted society of his day: satires which unfortunately did nothing to dispel short-sightedness in the following centuries. His masterpiece, *An Essay on Man*, was published in 1733. In it -- influenced by the recent scientific discoveries of Sir Isaac Newton -- Pope argues that "Order is Heaven's first Law", and that any apparent anarchy in the terrestrial world is a consequence of our restricted viewpoint: "'Tis but a part we see, and not the whole..."

> Of Man, what see we but his station here,
> From which to reason, or to which refer?

whereas

> He, who through vast immensity can pierce,
> See worlds on worlds compose one universe,
> Observe how system into system runs,
> What other planets circle other suns,
> What varied beings people every star,
> May tell us why Heav'n has made us as we are.

Pope sees the world as "A mighty maze, but not without a plan", where

All nature is but art, unknown to thee;
All chance, direction, which thou canst not see;
All discord, harmony not understood;
All partial evil, universal good.

To Pope this is important, because he thinks human society should be modelled after nature -- complex, certainly, but ultimately ordered and not chaotic. His poetry too, is like a microcosm of this view of nature; expressing intricately flowing ideas within the formality of a regular verse structure.

This seems a noble enough motivation: to seek a grand cosmic order that transcends the ups and downs of daily life. And one thing is certain -- if we are to find such an order, we are more likely to find it by looking up at the stars, than by looking down at the ground.[1]

[1] The cover illustration is adapted from *The School of Athens* by Raphael (1483 - 1520). The mystical Greek philosopher Plato is pointing upwards to the heavens, while his contemporary Aristotle is gesturing downwards. Aristotle was a deeply flawed philosopher whose legacy held Western culture back for more than a thousand years.

Metaphors and analogues

How do we go about our search for galactic order? On Earth, we tend to compartmentalise intellectual efforts into categories like art, science and philosophy -- and all three might claim to be best suited to the purpose. So maybe we should use all three. We have a difficult task ahead of us, and we need all the help we can get.

It is important to understand from the start that all attempts to describe nature involve some kind of comparison. We can never say "A is B", even though we often seem to. We can only say "A is like B". Language itself only works because we understand words to represent certain objects and actions. We cannot describe an object or action for which we do not have a word.[2] Likewise art and science are full of comparisons. Poets use metaphors; scientists use mathematical analogues.

In the realm where art and science meet, a powerful form of metaphor is the science fiction story. The father of science fiction, in the modern sense, was the American magazine editor John W. Campbell (1910 - 1971). Campbell was fond of pointing out that, strictly speaking, English literature is a subdivision of science fiction, not vice versa -- since "SF deals with all places in the universe, and all times in eternity".[3] He also emphasised that the true role of SF was to portray "analogues" of reality -- in fact he changed the name of his magazine to *Analog* in 1960. But by that time fashion had overtaken Campbell; his golden age was the 1940s and 50s, when the magazine was called *Astounding Science Fiction* (a title which was not Campbell's choice, and

[2] According to the controversial Sapir-Whorf hypothesis, a person who speaks one language may be incapable of understanding an idea that can only be expressed in another language (the principle of linguistic relativity).

[3] From the introduction to the anthology *Analog 1* (Doubleday, 1963).

which he hated). Many of the great classics of science fiction first appeared in *Astounding*, including Asimov's *Foundation* stories.

An early precursor of science fiction is a short story called *Micromegas* (1752), by the French writer Voltaire (1694 - 1778). Like Pope in England, Voltaire expended much effort in attacking the stupidity and pettiness of the world around him. Needless to say, he was equally unsuccessful in changing anything. Although *Micromegas* is necessarily an analogical work, it contains an amusing warning about analogies themselves. The title character is a 24-mile high giant from "one of the planets that revolve around the star called Sirius." On being banished from home, Micromegas travels first to Saturn, where the inhabitants are not much more than two miles high. He gets into conversation with the secretary of the Saturnian Academy of Sciences.

> "It must be admitted," said Micromegas, "that nature is very varied."
>
> "Yes," said the Saturnian; "nature is like a garden, in which the flowers..."
>
> "Pah!" said the other. "Forget your garden."
>
> "It is," resumed the secretary, "like a gathering of blondes and brunettes..."
>
> "What do brunettes have to do with it?" said the other.
>
> "Then it is like a gallery of paintings, in which the features..."
>
> "No, no!" said the traveller, once again. "Nature is like nature. Why seek comparisons?"

As we have seen, we seek comparisons because we must; the alternative is to remain forever silent and ignorant. As long as we

understand the significance and limitations of the comparison, we can make progress. Of course, there is the danger that a term with an apparently clear-cut meaning may be used, in certain situations, to represent something quite different. This situation is sadly quite common in modern science: "black hole", "big bang" "chaos theory" and many other terms, conjure up quite the wrong image for the uninitiated. The situation is reminiscent of something Voltaire said on another occasion: "The body which called itself the Holy Roman Empire was in no manner holy, Roman, or an empire."

Perspectives

The more we study the Galaxy -- or even think about it -- the more we see ourselves in perspective. And the result is rarely flattering, since we cannot help but be reminded of our own smallness in the face of immensity. The contrast is particularly acute in "Micromegas", since the extraterrestrials are several miles taller than us. After leaving Saturn, Micromegas flies with the Saturnian to Earth. For a long time, as they walk over the tiny planet, they believe it to be uninhabited. Then, in the sea, they spot a little boat, almost invisible to their eyes. They fish it out.

The boat is manned by an assorted collection of philosophers: disciples of Aristotle, Descartes, Leibnitz, Locke and others. With the aid of hastily contrived microscopes and ear-trumpets, the two giant visitors start a conversation with the Earth people. They ask them about their souls, their ideas, and other things of interest to philosophers everywhere.

Suddenly, a small "animalcule" in a square hat pushes his way to the front, and interrupts. The answer to everything, he says, can be found in the *Summa Theologicae* of Saint Thomas Aquinas. "He looked from top to bottom at the two celestial beings; he asserted to them that their persons, their worlds, their suns, their stars, all was made uniquely for man." This revelation -- "to see that the infinitely small had a pride almost infinitely great" -- causes so much amusement in the giants that the Sirian drops the boat and it falls into a pocket of the Saturnian's trousers. Only after much fumbling is it retrieved, and the shaken philosophers returned to their wrangling.

Of course, there are two kinds of pride. There is the narrow-minded pride of the scholastic in this story, who wants to shrink the universe to fit his own parochial world.

This attitude is regrettably common. As Douglas Adams says in *The Restaurant at the End of the Universe:* "The universe, as has been observed before, is an unsettlingly big place; a fact which for the sake of a quiet life most people tend to ignore. Many would happily move to somewhere rather smaller of their own devising, and this is what most beings in fact do."

But there is another kind of pride that takes us in the opposite direction. It recognises the vastness, complexity and mystery of the cosmos, yet believes that in some way man belongs in it, and can expand out into it. Not physically, perhaps, but at least intellectually -- through the way of knowledge. Such pride is essential to survival; when we lose it, we become no better than animals or machines.

There can be no more graphic metaphor for Earth's small -- and yet significant -- place in the Galaxy, than in Asimov's *Foundation* series. Here he depicts a far future in which the present situation is exactly reversed. Man has gradually migrated outwards into the Galaxy, until he has colonised it from one end to the other. But, in all that immensity, the location of the Earth -- man's place of origin -- has been forgotten, lost in the mists of time. A large part of two of the later books in the series, *Foundation's Edge* (1982) and *Foundation and Earth* (1986), describes a Galaxy-wide search for the elusive planet.

Very few people -- two dozen or so -- have seen the Earth in any kind of perspective. These are the astronauts who have been to the Moon, either to orbit it or land on it. Most "space travellers", those on the American Space Shuttle or Russian Soyuz vehicles, for example, rise only a few hundred kilometres into "low Earth orbit" -- not far enough to see the Earth in its entirety as a planet.

The first humans to see the Earth as it really is, were Frank Borman, James Lovell and William Anders, the crew of Apollo 8. The small Earth appeared in their windows on the twenty-third of December, 1968, as they turned their spacecraft around, prior

to entering lunar orbit. Lovell said to Borman: "Frank, what I keep imagining is if I am some lonely traveller from another planet, what I would think about the Earth at this altitude. Whether I think it would be inhabited or not".[4]. The next day Lovell described the Earth as "a grand oasis in the big vastness of space." This image -- now familiar the world over from photographs -- seems to have made a rapid transition into the collective consciousness of mankind. Nowadays everyone thinks of the Earth as a planet, in contrast to the situation in past centuries when a planet was a tiny light in the sky rather than the ground beneath our feet.

After the Apollo 8 mission, the *New York Times* gave the credit to "men of many countries and centuries -- Euclid, Archimedes, Newton, Kepler, Copernicus, Tsiolkovsky, Oberth, Goddard and many others." This is an crucial point, which illustrates another kind of perspective. Any great achievement is founded on a legacy accumulated over centuries and millennia, and without this backing we will never make progress. So before we go out into the Galaxy, we must begin at the beginning -- where does our knowledge come from?

[4] Quoted in J.N. Wilford: *We Reach the Moon* (Bantam books, 1969).

2

THE HIGH PRIORI ROAD

We nobly take the high Priori Road
And reason downward...
Alexander Pope: *The Dunciad* (1743)

How do you define real? If you're talking about what you can feel, what you can smell, what you can taste and see, then real is simply electrical signals interpreted by your brain.
A & L Wachowski: *The Matrix* (1999)

Two worlds

There is a fundamental dualism to human existence. We cannot know anything about an object in the external world -- whether a chair, or a tree, or a galaxy -- without using one or more of our five senses. Yet we cannot interpret the evidence of these senses without using the minds inside our heads. And therein lies the dualism: mind and sense, thought and perception, subject and object, inside and outside. It is as if we live in two worlds simultaneously.

If this dualism did not exist, or if it was fully explained in a "user's manual" provided at birth, our lives would be much simpler. As it is, philosophers have argued for centuries about the relative "reality" of these two aspects of existence, and about how they should be utilised to our best advantage. Many people -- materialists, empiricists, positivists -- have argued that the world of the senses is the only real world, while anything the mind tells us is an illusion. Many others -- Platonists, metaphysicians, mystics -- have argued the opposite case. This conflict of opinion has been going on for a long time; probably as long as people have been thinking. No doubt it will continue as long as we continue to think.

Under these circumstances, it seems wise to accept that a dualism exists, and to try to understand the strengths and limitations of both the mind and the senses.

The mind

We are now in the realm of philosophy, and specifically in that branch of philosophy known as metaphysics -- the study of the foundations of existence and knowledge. The father of modern Western metaphysics was the Frenchman René Descartes (1596 - 1650). In the centuries before Descartes, philosophers had put all their faith in the authority of ancient texts -- chiefly those of the hopelessly befuddled Aristotle. Descartes wanted to sweep all this aside, and to create a completely new philosophy.

One thing Descartes did keep from Aristotle was his method of reasoning, called *"a priori"* or deductive logic. This method starts with a generalised principle, and then argues "downwards" to one or more specific conclusions. Thus Descartes' first problem was to find a suitably general principle on which to found his new philosophy. He argued his way along a succession of doubts in search of this one fundamental truth. He doubted the authority of old texts; he doubted the evidence of his senses. After all, when we dream, we believe we are sensing things which, on waking, prove to be false.

> Thus, because our senses sometimes deceive us, I chose to suppose that nothing was the way they would lead us to imagine... But immediately upon this I realised that, while I was trying to think everything false, it must be that I, who was thinking this, was something. And observing that this truth, *"I think, therefore I am,"* was so solid and secure that the most extravagant suppositions of the sceptics could not overthrow it, I judged that I need have no scruple in accepting it as the first principle of philosophy that I was seeking.[5]

Unfortunately, while Descartes had succeeded in clearing away a lot of nonsense, he had also backed himself into a corner. He was

[5] From Part IV of *Le Discours de la Methode* (1637).

committed to the *a priori* method -- arguing logically from first principles -- but the only first principle he allowed himself was his own existence.[6] Everything else, including all the evidence of his senses, had been thrown away with his doubts. His only way out was to assume there was a divine providence watching over him, which would ensure his reasoning did not go astray. So, after ridding himself of all the Aristotelian nonsense, he could only create a new set of nonsense for himself.

Pure *a priori* reasoning of this type, sometimes called "the Cartesian method" after Descartes, is probably most famous for exactly this reason: It's a good idea, but it doesn't get you very far. As Pope says in a footnote to his satirical epic *The Dunciad:*

> "They who take this high Priori Road..., for one that goes right, ten lose themselves in mists, or ramble after visions."

Isaac Asimov satirised the Cartesian method in his short story *Reason*, published in *Astounding* in 1941. A new robot, called QT-1, is shipped up to a space station and put together there by two engineers, Powell and Donovan. The space station contains a solar energy converter, and the robot is intended to supervise the complex processes needed to direct the output to the Earth below. But there is something special about the robot -- it is the first to be built with a well-developed faculty for logical reasoning.

As soon as QT-1 is switched on, Powell and Donovan inform it of the situation. But the robot has doubts. Arguing logically from the evidence directly available to it, QT-1 finds it difficult to believe anything the humans tell it. It cannot believe the tiny

[6] Even Descartes' assertion "I think, therefore I am" is less secure than he believed it to be. In sharp contrast to the Western tradition, Buddhist philosophy is based on introspection and meditation, rather than deduction from first principles. Traditional Buddhism sees no evidence for the existence of an ultimate self, making "I think, therefore I am" meaningless. A Buddhist would simply say "Thought exists".

points of light beyond the windows are populated planets; it cannot believe it was constructed by the two engineers. Predictably, when asked what it does believe, the robot begins with "I, myself, exist, because I think." Eventually, it concludes that the energy converter is the Master, "and QT-1 is his Prophet." Nevertheless, the story has a happy ending: the robot's delusions do not prevent it from doing exactly what it was constructed to do.

The senses

Mind on its own is an untrustworthy tool. But in conjunction with our senses, might it not fare better? Yet our senses, too, cannot always be trusted. Descartes quite rightly started by doubting everything they tell us. They can be misled by dreams, hallucinations and even computer-generated Virtual Reality experiences.

The poet Tennyson (1809 - 1892) combined an interest in scientific affairs with a profoundly mystical philosophy Many of his poems feature dreams or hallucinations in one form or another. One example is *Lucretius* (1868), about an ancient Roman philosopher who was a follower of the Greek proto-scientists Democritus and Epicurus.

In Tennyson's poem, Lucretius spends so much time working that his wife thinks she must have a rival for his affections. She acquires a potion intended to "lead an errant passion home again", and administers it to him. But its effect is to give Lucretius hallucinatory visions, first of the material world he believes in...

> it seem'd
> A void was made in Nature; all her bonds
> Crack'd; and I saw the flaring atom-streams
> And torrents of her myriad universe...

...and then of those far less materialistic beings, the gods -- "who haunt / The lucid interspace of world and world." But

> If all be atoms, how then should the Gods
> Being atomic not be dissoluble,
> Not follow the great law?

Lucretius is driven mad, unable to reconcile the visions with his

scientific view of the world. "I thought I lived as securely as yourselves", he cries to the Gods:

> Nothing to mar the sober majesties
> Of settled, sweet, Epicurean life.
> But now it seems some unseen monster lays
> His vast and filthy hands upon my will,
> Wrenching it backward into his...

Finally, Lucretius asserts his independence in the only way left to him: by taking his own life.

Another fictional character who goes insane, and takes his own life, is the anonymous hero of Guy de Maupassant's short story, *The Horla*. Maupassant (1850 - 1893) was a master of the type of supernatural story in which nothing supernatural happens: it is all in the minds of his characters. *The Horla* (1887) is his masterpiece. Its hero becomes convinced of the existence of an invisible race of extraterrestrials who have invaded the Earth, and are attacking humans by driving them mad. Maupassant's hero has all the evidence he needs -- and yet, to the objective reader, we realise that the evidence is explained equally well by another hypothesis: the hero is simply insane.

First the hero becomes ill, has nightmares, believes he is constantly being followed. He feels there is an invisible parasite on him, draining him of his energies. He tries experiments, demonstrating that it is the creature -- the Horla -- that drinks water from a jug at night, and not himself. He sees a rose picked by an invisible hand, the pages of a book turned by an invisible reader. He discovers an article in an obscure journal about an epidemic of madness in Brazil, believed by experts to be governed by beings invisible yet tangible, just like his Horla.

The evidence becomes overwhelming. As a monk tells him:

> Do we see the hundred thousandth part of that which exists?

> Consider the wind which is the greatest force of nature, which throws men to the ground, destroys buildings... have you ever seen it and can you see it? It exists nevertheless!

In the end the hero realises the Horla has become part of himself, and he can only destroy it by destroying himself.

The Horla is a horror story -- not because we believe the Horla is real, but because we believe it is not. It is horrifying to see how easily the hero descends into madness -- how easily he can rationalise every occurrence in support of his delusion. We are all close to this situation. The question is, how close?

Dreams, madness, delusion... and these days we have Virtual Reality, too -- computer-aided hallucination. The characters in *The Matrix* are embedded in a machine-generated world that is real to them, and yet extends no further than their own wired-up brains.

The concept of Virtual Reality was being batted around in science fiction long before the term itself was coined. One writer who returned time and time again to the notion of fake reality was Philip K. Dick (1928 - 1982). Dick knew how easily the senses can be deceived, and in his stories things are rarely what they seem.

Dick's novel *A Maze of Death* was published in 1970. The majority of the action does not take place in the real world -- and yet it does not take place in the mind of a single individual, either. The crew of a spaceship, Persus 9, originally set out on a 20-year voyage -- but the ship became damaged and they are doomed to spend the rest of their lives drifting in space. What was intended as an "escape toy" for the trip becomes their only way out: a device which links them, via polyencephalic cylinders placed over their heads, with a computer which can construct a whole imaginary world from their unconscious minds. But to them, the imaginary world becomes as real as reality. Once

inside it, they never suspect its true nature. Their world has everything: mystery, adventure, intrigue -- even gods and mystical experiences.

> "God contains all categories of being. Therefore God can be absolutely-not-God, which transcends human reason and logic. But we intuitively feel it to be so…" He eyed her. "What do you think about that?" he asked, a little timidly.
>
> "I think it's wonderful," Susie said, with enthusiasm. "It must be so great to have trances and perceive what you perceive. You should write a book saying that what Specktowsky says is wrong."
>
> "It's not wrong," Tony said. "It's transcended by what I see. When you get to that level, two opposite things can be equal. That's what I'm trying to reveal."

Philip K Dick espoused a philosophy known as Gnosticism. In this view, the world we live in is a second-rate fake created by a demented demi-god who usurped the true God. Gnosticism runs like a thread through all Dick's work, but is most clearly expounded in his masterpiece Valis (1981):

> Man and the true God are identical -- as the Logos and the true God are -- but a lunatic blind creator and his screwed-up world separate man from God. That the blind creator sincerely imagines that he is the true God only reveals the extent of his occlusion. This is Gnosticism. In Gnosticism, man belongs with God against the world and the creator of the world (both of which are crazy, whether they realize it or not).

Conciliations

We looked first at the mind and then at the senses, and found serious limitations in both. Yet they both have their strengths, too. In order to go any further, we need to make the two work together in a way that uses these strengths. Immanuel Kant (1724 - 1804) started his career as an astronomer, but it is as a philosopher that he is best remembered. Indeed, in this field he probably stands unsurpassed by anyone before or since.

Kant's most famous work is the *Critique of Pure Reason* (1781). The title is self-explanatory. Descartes tried "Pure Reason" a century earlier, and it hadn't worked. In particular, Kant saw that pure reason could never yield useful knowledge about the physical world. That can only come from experience: from the evidence of the senses. Kant had seen the success of the scientific method in the works of Newton; he was happy to leave the physical world to the scientists.

But science, and the senses, deal only with "phenomena" (the plural of "phenomenon" -- a Greek word meaning, roughly, "that which is perceived"). Kant argued that there must also be "things in themselves" -- which cannot be perceived with the senses, yet exist in reality, and can be thought or reasoned about. These "things in themselves" he called "noumena" -- the plural of "noumenon", meaning "that which is thought."

Thus Kant resolved the problem of mind/body dualism into phenomenon and noumenon. The senses, and the scientific method, are concerned with phenomena. The mind, and metaphysics, are concerned with noumena.

Prior to Kant, philosophers from Aristotle to Descartes had assumed that our way of looking at the world is conditioned by the world itself. In other words, we see the world exactly as it

really is. But Kant recognised the supreme arrogance of this, and pointed out that the reverse is a far more likely situation. *The world as we see it is conditioned by the way we look at it.* There is probably no more important statement in all of philosophy. Our view of the world is ultimately doomed to be subjective -- we can never perceive it in an absolute, objective way.

Thus there are with two worlds -- phenomenon and noumenon -- which are completely separate. Neither is more or less real than the other. And there is no common ground, no room for contention -- science can say nothing about noumena, metaphysics can say nothing about the physical world. We need both.

Kant made the distinction between physics and metaphysics very clear, although it had been recognised before. Francis Bacon, the founder of the scientific method, wrote as early as 1605 that

> Physics should handle that which supposeth in nature only a being and moving; and Metaphysics should handle that which supposeth further in nature a reason, understanding and platform.[7]

Despite this, most pre-Kantian philosophers mixed physics and metaphysics as though they were interchangeable. -- an error many people make to this day. Quoting again from Pope's *Dunciad:*

> Physic of Metaphysic begs defence,
> And Metaphysic calls for aid on sense!

We will try not to make this mistake in the present book. We shall treat the noumenal and phenomenal separately, and use both science and metaphysics to explore the Galaxy.

[7] From *The Advancement of Learning* (1605).

3

ART AND MYSTICISM

To persons standing alone on a hill during a clear midnight such as this, the roll of the world eastward is almost a palpable movement.

Thomas Hardy: *Far from the Madding Crowd* (1874)

Short-cuts to the truth

In the last chapter, we saw that Kant's noumenon is the "thing in itself" -- the inherent essence of an object which can be thought about, but not perceived with our senses. But what are noumena -- how can we learn about them? Two time-honoured methods exist: art and mysticism. Kant himself believed that the aesthetic sense -- the appreciation of art -- provided a direct link to the world of the noumenon. It was he who originated the idea that "sublimity is in the eye of the beholder". Although we perceive objects of art as phenomena, their aesthetic effect is in the mind.

This idea, that art provides a bridge between the mundane world and an underlying reality, is by no means new. A historian, writing about the gothic art of Plantagenet England, tells us that

> Symbols and signs were a bridge between things visible and things invisible... They were essential elements in comprehension, real links in the chain of realities.[8]

The first true Gothic building was the Abbey church of St Denis, in what is now a northern suburb of Paris. It was built under the direction of Abbot Suger (1081 - 1151), who was well aware of the sublime possibilities of art. In an oft-quoted passage, he wrote that

> when -- out of my delight in the beauty of the house of God -- the loveliness of the many-coloured gems has called me away from external cares, and worthy meditation has induced me to reflect, transferring that which is material to that which is immaterial, on the diversity of the sacred virtues: then it seems to me that I see myself dwelling, as it were, in some strange region of the universe which exists neither entirely in the slime of the earth, nor entirely in the purity of heaven; and that, by the

[8] From the catalogue to the exhibition *The Age of Chivalry,* held at the Royal Academy in 1987.

> grace of God, I can be transported in a mystical manner from the inferior to that higher world.[9]

More recently, Picasso remarked that

> I do not paint what I see, I paint what I know.

But aesthetic revelation is not restricted to the visual arts: Shelley claimed that poetry

> strips the veil of familiarity from the world, and lays bare the naked and sleeping beauty, which is the spirit of its form.[10]

The same could be said of music. Bettina von Arnim, writing to Goethe in 1810, quoted Beethoven as saying

> Speak to Goethe about me... tell him to hear my symphonies, and he will say that I am right in saying that music is the one incorporeal entrance into the higher world of knowledge which comprehends mankind, but which mankind cannot comprehend.[11]

This last quotation calls to mind the concept of a *mantra* -- a sound chanted in order to give access to the universe on a cosmic scale. Mantras are associated with the practice of mysticism, which is the second of our great pathways to the noumenon.

The English word "mysticism" sounds a bit like "misty" and "mysterious", but this is unfortunate because it has nothing to do with either of them. On the contrary, mysticism is all about clarity and lucidity.

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[9] From *A Documentary History of Art,* volume 1, edited by E.G. Holt (Doubleday, 1957).
[10] From *A Defence of Poetry* (1821).
[11] Quoted in *Beethoven: Impressions by his Contemporaries* (Dover books, 1967).

In the popular mind, mysticism is generally associated with Eastern religions, but it is practised in a similar form all over the world:

> It is recognised everywhere that through mystical experience men are brought into immediate contact with ultimate reality, and this contact is commonly described in terms both of vision and knowledge, and of union... For mystics of all religions, divine or ultimate reality is essentially transcendent of the world of space and time; but the affirmation of the divine transcendence is commonly accompanied by an equal stress on divine indwelling... a certain identification of the divine with the things of time and space.[12]

[12] S. Spencer: *Mysticism in World Religion* (Penguin books, 1963).

A sense of wonder

An attempt to define the roles of art and mysticism, within the tradition of western philosophy, was made by Arthur Schopenhauer (1788 - 1860). Schopenhauer went a step further than Kant, and argued that there can be only one noumenon -- not separate noumena corresponding to separate phenomena. Differentiation and multiplicity are merely properties of the physical world. In this conception of underlying reality as a unity, Schopenhauer is in agreement with the mystics. But Schopenhauer believed that the noumenon was an ultimately negative force, and that the highest goal was to transcend reality by denying it.[13]

Schopenhauer believed that the primary function of art is cognitive, not expressive. It does not merely describe phenomena; it conveys insight into the noumenon, and provides a temporary respite from its negativity. It gives us a sense of wonder. Schopenhauer had a profound influence on many artists in the following decades, including Guy de Maupassant, Thomas Hardy and, most of all, Richard Wagner.

There can be no more overt expression of Schopenhauer's philosophy than the lines Wagner (1813 - 1883) wrote to conclude his opera *Twilight of the Gods:*

> From the land of desire I depart,
> The land of illusion I flee forever;
> The open gates
> Of eternal becoming
> I close behind me.[14]

[13] cf. the Gnostic view of reality discussed in the previous chapter.

[14] Quoted in *I Saw the World End,* by Deryck. Cooke (Oxford University Press, 1979).

In the end, Wagner dropped these lines from the final version of the opera, since he felt they were adequately expressed in the music.

Someone else who was strongly influenced by Schopenhauer was the psychologist Carl Gustav Jung (1875 -1961). But Jung's view of the phenomenon/noumenon dualism was somewhat different form Schopenhauer's. Jung distinguished between the physical world of the senses, and the psychic world of the mind. The two worlds are equally real; separate yet overlapping:

> Both views, the materialistic as well as the spiritualistic, are metaphysical prejudices. It accords better with experience to suppose that living matter has a psychic aspect, and the psyche a physical aspect. But if we give due consideration to the facts of parapsychology, then the hypothesis of the psychic aspect must be extended beyond the sphere of biochemical processes to matter in general. In that case all reality would be grounded on an as yet unknown substrate possessing material and at the same time psychic qualities... The 'acausal' correspondences between mutually independent psychic and physical events, i.e. synchronistic phenomena, and in particular psychokinesis, would then become more understandable, for every physical event would involve a psychic one, and vice versa.[15]

[15] C.G. Jung: *Flying Saucers* (Routledge & Kegan Paul, 1959).

An intuitive Galaxy

What does the noumenon tell us about the Galaxy? If Schopenhauer is right and there is only one underlying "thing in itself", then in a fundamental sense we are one with the cosmos. And in Jung's view, too, there is an intimate connection between our inner selves and outer space:

> Psychic wholeness, as the historical testimonies show, has always been characterised by certain cosmic affinities: the individual soul was thought to be of 'heavenly' origin, a particle of the world soul, and hence a microcosm, a reflection of the macrocosm... The macrocosm is the starry world around us, which, appearing to the naive mind as spherical, gives the soul its traditional spherical form.[16]

So what does our intuition tell us about the universe? Sometimes listening to nature with an open mind can teach us as much -- or more -- than any amount of received opinion. Consider Thomas Hardy's insight about the spinning world the epigraph to this chapter. For millennia people believed that the Earth stood still and the stars revolved around it, because that was what their "reason" told them. Yet as Hardy points out, to someone standing quietly on a hill at night,

> the roll of the world eastward is almost a palpable movement. The sensation may be caused by the panoramic glide of the stars past earthly objects, which is perceptible in a few minutes of stillness... It is necessary to stand on a hill at a small hour of the night, and, having first expanded with a sense of difference from the mass of civilised mankind, long and quietly watch your stately progress through the stars. After such a nocturnal reconnoitre it is hard to get back to earth, and to believe that the consciousness of such majestic speeding is derived from a tiny

[16] Ibid.

human frame.[17]

Of course, Hardy already knew the Earth spun on its axis. But there are other occasions where literature -- by guesswork, intuition or inspiration -- appears to anticipate a fact subsequently discovered by science. One example occurs in Voltaire's short story *Micromegas*, already referred to in the first chapter of this book. On the trip from Saturn to Earth, Micromegas and his companion note in passing two tiny moons of Mars -- too small to have been detected by Earth's astronomers. That story was written in 1752 and the two moons of Mars were mentioned in a similar context in Jonathan Swift's *Gulliver's Travels* twenty-six years earlier. And Mars does have two tiny Moons -- but they were not discovered until 1877!

In a similar vein, when Einstein was three years old, the audience at the first performance of Wagner's opera *Parsifal* (1882) were presented with a remarkable exposition of the theory of Relativity. As the hermit Gurnemanz is leading Parsifal towards the castle of the Grail, Parsifal says:

> I scarcely tread,
> Yet already I seem to have come far.

-- to which Gurnemanz answers:

> You see, my son,
> Time here becomes space.

Twenty-three years later Einstein showed exactly how time does become space (and vice versa).

Further back in history, the cosmological legends of ancient times often differed substantially from their modern scientific counterparts. In particular, there was a tendency to make the universe smaller and younger than it really is -- to scale it down

[17] From *Far from the Madding Crowd* (1874).

to less awesome proportions. But the cosmology of ancient India is an exception. In the Hindu tradition, the time between the creation and destruction of the world is called a kalpa, which is about 8.6 billion years. This is not far off the figure a modern scientist would give for the age of the universe -- certainly a lot closer than the six-thousand years that was believed for so long in the west.

A view widely held by artists and mystics is that reality is too complex to be put into words. Another form of communication -- another form of metaphor -- is needed. What about music? We have already seen how Wagner rejected the profound closing lines of *Twilight of the Gods* in favour of purely musical expression, and how Beethoven described music as an "incorporeal entrance into the higher world of knowledge."

Anton Webern (1883 - 1945) believed that music was an exact analogue of reality:

> It is for a later period to discover the closer unifying laws that are already present in the works themselves. When this true conception of art is achieved, then there will no longer be any possible distinction between science and inspired creation. The further one presses forward, the greater becomes the identity of everything, and finally we have the impression of being faced by a work not of man but of nature.[18]

Describing a work for two pianos entitled *Mantra*, the modern composer Karlheinz Stockhausen said

> As it stands, *Mantra* is a miniature of the way a galaxy is composed. When I was composing this work... it demanded itself, it just started blossoming. As it was being constructed through me, I somehow felt that it must be a very true picture of

[18] Quoted in *Stockhausen* by J. Cott (Robson books, 1974).

the way the cosmos is constructed.[19]

This last quotation deserves further analysis. Perhaps Stockhausen is right -- maybe *Mantra* is an exact analogue of the Galaxy. But we are still left with the problem of understanding *Mantra,* and then understanding just how this reads across to the real Galaxy. It is possible that truly inspired people -- artists and mystics -- may be able to delve into the deep truths of the universe. But can they communicate these truths to other people? Or is an intuitive Galaxy no more comprehensible than the original?

Still, we can dream of seeing the universe as it really is, in a form so clear that we can comprehend it. Tennyson wrote of such a dream in his first published poem, *Timbuctoo*. Standing at the straits of Gibraltar one night, the narrator is musing on the legend of lost Atlantis. Suddenly, a supernatural being appears before him, saying:

> There is no mightier spirit than I to sway
> The heart of man: and teach him to attain
> By shadowing forth the unattainable.
>
> ... I am the spirit,
> The permeating life which courseth through
> All th'intricate and labyrinthine veins
> Of the great vine of fable.

The being shows the narrator a vision of the world, from "the indistinctest atom in deep air" to

> ... the clear Galaxy
> Shorn of its hoary lustre, wonderful,
> Distinct and vivid with sharp points of light,
> Blaze within blaze, an unimagin'd depth
> And harmony of planet-girded suns

[19] Ibid.

And moon-encircled planets, wheel in wheel.

And there is a final surprise to come:

The hum of men,
Or other things talking in unknown tongues,
And notes of busy life in distant worlds
Beat like a far wave on my anxious ear.

4

SCIENCE AND ITS LIMITATIONS

I have proposed no hypotheses; because everything that cannot be deduced from the phenomena is an hypothesis, and hypotheses should not be contained in experimental philosophy. In this philosophy, we take the observed facts, and then, by inference, make them general.

Isaac Newton: *Principia* (1687)

The scientific method

The province of science is the world of phenomena: the information conveyed to us by our five senses. Or, increasingly, by scientific instruments which extend the power of these senses. Science should be purely descriptive -- it should not "make hypotheses", to use Newton's phrase. And science is subjective. As Kant pointed out, what we see is conditioned by how we look at it.

Science is not the all-powerful god it is often made out to be. It is strictly limited in role and scope, and it is important to understand these limitations. Science aims to describe complex phenomena in terms of simpler phenomena; by means of a process called *reductionism*. The power of science lies in its ability to predict the behaviour of things in the physical world. But science is not truth -- at best it is only a metaphor, or a model, of the truth.

The scientific method was worked out over many centuries, roughly from the thirteenth to the seventeenth. It involves a new kind of logical reasoning, called "inductive logic". We have already met deductive logic -- the process of reasoning *a priori* (from first principles) as used to no great effect by Aristotle and Descartes. In science we have to argue *a posteriori*, from the observed phenomena. Induction is the exact reverse of deduction. It starts with observed specific cases, and argues "upwards" to a generalised principle.

Inductive logic was put on a respectable footing by the philosopher Francis Bacon (1561 - 1626). In the *Novum Organum* (1620), he spelt out the first full programme for a scientific method, to be based on experiment and induction. The title of the work was a deliberate contrast to Aristotle's *Organon*, which had originally expounded the deductive method. Bacon

believed that deduction -- reasoning from generalities to specifics -- was useless for anything but the most abstract situations, such as pure mathematics.

Bacon had already presented some of ideas in an earlier work, *The Advancement of Learning* (1605). Here, on the subject of deduction, he says:

> Allow some principles or axioms were rightly induced, yet nevertheless certain is it that middle propositions cannot be deduced from them in subject of nature by syllogism[20]... The subtlety of nature and operations will not be enchained in these bonds.

On the other hand, induction may fare better:

> He that shall attentively observe how the mind doth gather this excellent dew of knowledge... distilling and contriving it out of particulars natural and artificial, as the flowers of the field and garden, shall find that the mind of herself by nature doth manage and act an induction.

In combining direct observation with the inductive method, science provides a powerful tool. But its effectiveness depends on being able to make the right observations -- on having the right viewpoint. If a key element of the universe is forever beyond the horizon, we will never understand it, no matter how good we are at science. An interesting analogue of this situation is provided in Tom Stoppard's play *Rosencrantz and Guildenstern are Dead* (1967).

The world of Rosencrantz and Guildenstern is not the real world; it is the smaller and better defined world of Shakespeare's *Hamlet*. In Shakespeare's play, Rosencrantz and Guildenstern are minor characters, on the edge of the action. Stoppard's play is coextensive in time with Shakespeare's; it tells the story from

[20] "Syllogism" is another word for deduction.

Rosencrantz and Guildenstern's point of view. As portrayed in the later play, our heroes would make good modern scientists. They want to understand what is going on; they make experiments, ask questions, reason impeccably.

Yet they are doomed to failure -- they cannot overcome the fact that, in the great drama around them, they are still basically minor characters, forever on the edge of the real action. As Guildenstern, the more philosophical of the two, notes:

> What a fine persecution -- to be kept intrigued without ever quite being enlightened.

The tragedy of Rosencrantz and Guildenstern is that they fully recognise their own impotence. As Guildenstern says later:

> Wheels have been set in motion, and they have their own pace, to which we are condemned. Each move is dictated by the previous one... If we happened, just happened to discover, or even suspect, that our spontaneity was part of their order, we'd know that we were lost.

The audience, of course, understands the reason for Rosencrantz and Guildenstern's predicament. They are characters in a play that has gone through the same motions, time after time, for four centuries. Rosencrantz and Guildenstern can never see what Shakespeare did not describe them as seeing; they can never be where he did not describe them as being. Fortunately, in the real world, we have more freedom -- or do we? How would we know? As Shakespeare said in another play: *All the world's a stage...*

The limitations of science

The aim of science is to describe nature. But to describe something entails making a comparison, or using a metaphor. Science has its own metaphorical language -- the language of mathematics. This has become so deeply entrenched in modern science that some scientists think that the physical work and a mathematical theory are one and the same thing. But mathematics is only an analogue, and a true statement about mathematics may be a false statement about the reality it is used to represent. As Einstein said, "I do not believe in mathematics".

Science aims to describe phenomena in terms of fundamental principles. But how fundamental? Often we can peel back layer after layer of description, each more "fundamental" than the last. For example, in the seventeenth century, Newton explained the bending of light rays by a prism in terms of "geometrical optics". But to understand what the light rays are, and how they travel through glass and air, we must turn to the theory of electromagnetism -- which was not worked out until the nineteenth century. And to describe how light is produced, and how it interacts with the atoms of the glass, requires twentieth century: quantum theory. As for the next step -- a unified theory of everything... that still lies in the future.

Even a cursory glance at the current state of science will show that it is far from complete. It is full of gaps and inconsistencies. The two most fundamental branches of physics -- Quantum Theory and General Relativity -- are incompatible with each other. Terms like time and space have one meaning in Quantum Theory and a different meaning in General Relativity. Basic concepts like gravity, mass and inertia are easy to define yet barely understood.

One of the greatest weaknesses of science stems from its

uncompromisingly reductionist approach. The principle is well-established: to seek ultimate truth by analysing complex phenomena into ever simpler components. Chemicals into molecules, molecules into atoms, atoms into protons, neutrons and electrons. But what if this is throwing the baby out with the bathwater? There is strong evidence for the existence of *emergent phenomena*, which are properties of complex systems but not of their basic components -- the whole is greater than the sum of its parts. Human consciousness may be an example of an emergent phenomenon.

Science is subject to its own version of the Sapir-Whorf hypothesis -- scientists are incapable of conceiving of something that cannot be expressed within the bounds of their theories. Every now and then these bounds are broken and a new kind of science emerges, but such revolutions are the exception rather than the rule.

In 1962, Thomas Kuhn wrote an enormously important book called *The Structure of Scientific Revolutions* Kuhn recognised that the overwhelming majority of all scientific endeavour is fundamentally conservative and resistant to change. At any given time, all the major parameters of a particular field will be laid out in a standard textbook (real or notional), which Kuhn refers to as a *paradigm*. The paradigm is the accepted "truth", and the role of a scientist is to work within the paradigm and build it up, rather than shattering it.

> Normal science, the activity in which most scientists inevitably spend almost all their time, is predicated on the assumption that the scientific community knows what the world is like. Much of the success of the enterprise derives from the community's willingness to defend that assumption, if necessary at considerable cost. Normal science, for example, often suppresses fundamental novelties because they are necessarily

subversive of its basic commitments.[21]

It is only when overwhelming evidence has built up that scientists relinquish their belief in the old paradigm and a revolution occurs. Kuhn's phrase "paradigm shift" has entered the language, even among people who have no idea what it means!

A decade before the first publication of Kuhn's book, Isaac Asimov wrote a short story called *Belief*, which was published in *Astounding* in October 1953. It deals with the archetypal paradigm shift -- the discovery of anti-gravity.

> "I tell you I can levitate," shouted Roger.
>
> Dr Morton turned red. "Look, Toomey, let's not discuss it. I don't care if you fly up in the air right this minute."
>
> "You mean seeing isn't believing as far as you're concerned?"
>
> "Levitation? Of course not." The department chairman was bellowing. "If I saw you fly, I'd see an optometrist or a psychiatrist. I'd sooner believe myself insane than that the laws of physics - " He caught himself, harumphed loudly. "Well, as I said, let's not discuss it."

[21] T.S. Kuhn: *The structure of scientific revolutions* (Third edition, University of Chicago Press, 1996).

5

EXPLORING THE GALAXY

Space is filled with myriads of stars, and the Milky Way is but a vast conglomeration of distant stars.

Democritus (c. 470 - 380 BC)

The discovery of the Galaxy

The word "Galaxy" is derived from the Greek for "Milky Way". Indeed, Galaxy" and "Milky Way" are synonymous, although the former is more commonly used for the star system as a whole, and the latter for the faint band of light in the night sky, which is all that can be seen of most of the stars from the Earth. The word "galaxy", uncapitalised, is used for any of the billions of similar star systems beyond our own.

The Greek philosopher Democritus, in the fifth century BC, was the first person to record the opinion that the Milky Way consists of stars. But he must have spoken from intuition, not experience. To the naked eye, the Milky Way is just a blur; no stars can be seen. Yet the same intuition seems to have prevailed in later generations. By 1610, when Galileo pointed his telescope at the Milky Way and saw that it really did contain stars, no-one was particularly surprised.

The idea that we live in a vast stellar system -- of which the Sun, the naked-eye stars and the Milky Way are just a part -- really started to take hold in the early 18th century. This was in the immediate aftermath of Newton's theory of gravitation, which finally established the modern sun-centred view of the solar system.

Interestingly, the notion of a galactic system was first put forward in quasi-metaphysical terms, by the mystic Emmanuel Swedenborg (1688 - 1772) and others. But the first scientific theory of the Galaxy came from none other than Immanuel Kant. As a philosopher, Kant was the hero of our second chapter. But before he turned to philosophy, he was a scientist -- what would now be called a theoretical astrophysicist. His most important work in the field was *A General Natural History and Theory of the Heavens,* published in 1755.

Kant's conception of the Galaxy was based on Newton's laws of motion. It had many features in common with our present picture. It was disc-shaped, and the stars were in a state of rotation about the centre. Kant also proposed that the nebulae -- a number of diffuse patches of light visible through telescopes -- were "island universes": external galaxies similar to our own. And he suggested that these galaxies in turn might be clustered into groups, in a hierarchical system. All these ideas have been borne out by subsequent developments, although to Kant they were little more than speculations.

Systematic observations of the structure and motion of the Galaxy had to wait until the twentieth century. The rotation of the galactic disc, first suggested by Kant almost two hundred years earlier, was finally confirmed by J.H. Oort in 1927. Oort found that the rotation is fastest at the centre, and becomes slower the further out you go. A few years later, it was discovered that the Galaxy has a spiral structure, similar to that seen in about two-thirds of external galaxies. Spiral galaxies consist of a flattened disc of stars with a rounder central bulge. The oldest stars are found in the region of the central bulge -- the original nucleus of the Galaxy. The disc stars formed later, condensing out of residual gases. The Sun is one of the stars in the galactic disc.

The Galaxy is so vast that everyday length-scales like miles or kilometres are meaningless. A new term is required. As anyone who has seen *Star Wars* will know, the basic unit of galactic distance is the parsec.[22] This is roughly the distance from here to Alpha Centauri, which is the next nearest star after the Sun. Most of the stars in the night sky are within a hundred parsecs or so. In contrast, the diameter of the galactic disc is enormously greater than this -- about thirty thousand parsecs. The galactic centre is about nine thousand parsecs away, in the direction of the

[22] The light-year, which is about a third of a parsec, is also used. A light-year is the distance that light travels in a year.

constellation Sagittarius.

The Sun orbits around the centre of the Galaxy at a speed of just over two hundred parsecs per million years. That sounds astronomically fast, but it isn't really. It's a very big distance travelled in a very long time, which is the same as a modest distance travelled in a modest time. A speed of one parsec per million years is roughly the same as one kilometre per second, or three times the speed of sound. The SR-71A reconnaissance aircraft travels at that sort of speed. In contrast, the speed of light is three hundred thousand kilometres per second, or three hundred thousand parsecs per million years!

Theory or faith?

The Galaxy is very big, and it changes very slowly. These facts make galactic exploration an almost impossible task. How can we hope to find anything out about it? We only ever see the Galaxy from this one viewpoint, frozen in a single moment of galactic time. Even if we could travel at the speed of light, it would take sixty thousand years to travel to the galactic centre and back. And if we wanted to see any real change in its appearance, we would have to wait even longer -- more than 250 million years for one galactic rotation. That's the time since the late Palaeozoic era, before the dinosaurs!

The vast scale of the Galaxy -- both in space and time -- means there is no hope of exploring it by observation alone. The solution adopted by science is to combine the observations with theory. This combination allows us to infer much more about the nature and structure of the Galaxy than we could glean from the observations on their own.

The approach that modern scientists use to explore the Galaxy was originally developed by Copernicus (1473 - 1543) and Newton (1642 -1727), who applied it to the case of the Solar System. Prior to Copernicus, everyone thought the Earth stood still and the Sun and planets went around it. The observations were fully consistent with that model, but in order to fit the model to the observations it had to be made horrendously complicated. Copernicus showed that the observations could be explained equally well by a much simpler model, if the Sun was at the centre and the Earth orbited the Sun just like the other planets. There was nothing special about the position of the Earth within the Solar System.

The model developed by Copernicus described *how* the planets moved, but not *why*. The *why* of the Solar System was explained

two centuries later by Sir Isaac Newton. Everyone knew that there was a natural force that caused bodies to fall towards the Earth, but it was Newton who developed the idea of Universal Gravitation -- the same force that operates on Earth also holds the planets in their orbits around the Sun. Like Copernicus, it was Newton's assumption that *there is nothing special about the Earth* -- the same scientific laws apply in outer space as down here on the ground.

Science has progressed since Newton's time, and his theory of gravitation has been superseded by Einstein's theory of General Relativity. But the basic "Copernican" principle still holds -- the laws of physics are assumed to be the same throughout in the Universe. With this assumption, we can make progress in understanding the Galaxy... without it, we could not. The Copernican principle is an act of faith, not a scientific theory.

Faith in the Copernican principle can lead to ludicrous situations. One property of the Galaxy -- or of any other galaxy -- that scientists can measure with modern instruments is its speed of rotation. This measurement can be used, together with the theory of gravity, to calculate the mass of the galaxy. And it turns out there is a huge discrepancy between the calculated mass and the number of stars that are visible through telescopes. The rotation measurements imply there is much more matter than we can see -- perhaps ten times as much or even more.

This discrepancy is traditionally explained by positing a huge quantity of "dark matter" -- material that is present throughout the galaxy but completely undetectable by any means other than its gravitational effect. The dark matter would have to outweigh visible matter by a factor of ten to one. There is an alternative, of course. The theory might be wrong and the observations might be right -- the visible matter might be all there is. But scientists are bluntly dismissive of such a notion. They would rather imagine there is ten times as much matter in the universe than they can see, than that their theory of gravity might be wrong!

Ultimately, everything we know about the universe beyond the Earth itself is a matter of faith. We make observations, but the observations are subject to multiple interpretations. We select the interpretation that fits the theory.

In Asimov's short story *Ideas Die Hard* (Galaxy, October 1957), two astronauts are on the first trip to the Moon. As they travel away from the Earth, they speculate that everything they were taught on Earth might be wrong. The Earth might be flat, it might only be a few thousand years old, and the Moon might be a small clockwork fake. They review the masses of scientific evidence in favour of the establishment view, and realise just how flimsy it is.

> There are a billion light-years ahead of us. Only, for all we know, there's a solid black wall instead, just on the other side of the Moon, with stars painted on it and planets moving all squint-eyed so that smart cockerels on Earth can figure out all sorts of fancy orbits and theories of gravitation out of it.

In the story, the trip into space was part an elaborate psychological experiment, and the Moon the astronauts saw actually was a fake. Nowadays, astronauts really have been to the Moon, so we know it's there. Or do we? Many people believe NASA faked the Moon landings, and it's almost impossible to prove one way or the other. It's all a matter of faith!

The interactive Galaxy

If the Galaxy is so vast, what relevance does it have to the planet Earth? Well, quite a lot, really. The Earth had a galactic origin. All the atoms that go to make up the planet, and everything on it, condensed from the primordial gas that permeates interstellar space. Just as the oxygen cycle on Earth recycles molecules through the oceans, atmosphere and living organisms, so our atoms have been recycled time and again through the Galaxy.

In their book *Evolution from Space* (Dent, 1981), Fred Hoyle and Chandra Wickramasinghe went a step further. They proposed that life itself comes from space. There is strong evidence suggesting that comets contain basic organic molecules, and a steady rain of cometary debris would naturally bring these molecules to the Earth. But Hoyle and Wickramasinghe don't stop at molecules -- they claim that viruses and even complex life-forms such as insects may have fallen to Earth encased in cometary debris.

What do comets have to do with the Galaxy? The answer lies in the nature of comets. Although normally thought of as members of the solar system, comets probably originate in interstellar space. Theory predicts their arrival *en masse* every time we pass through a dense region of interstellar gas. According to Hoyle and Wickramasinghe, that's when new viruses and new life-forms rain down onto Earth.

Comets may be the bringers of death as well as life. Throughout the fossil record geologists see discontinuities where large numbers of species suddenly became extinct. The most famous of these extinctions was the one that wiped out the dinosaurs sixty-five million years ago. Catastrophes of this kind are widely believed to be caused by giant comets or asteroids, crashing into the Earth with devastating effects.

Mass extinctions do not occur randomly, but at regular intervals throughout the geological record. The spacing between the extinctions is about thirty-three million years. This is the time it take the Solar System to oscillate up and down through the galactic plane. In other words, through the region of the Galaxy containing the densest concentration of interstellar gas -- and hence potential cometary material.

The implication is that it was the motion of the Solar System through the Galaxy that was directly responsible for the extinction that wiped out the dinosaurs. Some people have speculated that just before this extinction, one species of dinosaur may have evolved human-like intelligence. If so, and if they had set out for the centre of the Galaxy and used the gravitational slingshot effect of the galactic nucleus as a means of returning to Earth, then they would be due back just about now!

6

THE GALAXY AND THE EARTH

It is the stars,
The stars above us, govern our conditions
Shakespeare: *King Lear*

Looking upwards

Human beings have always looked at the stars. In past times, the stars were viewed as having a mystical significance that is belittled these days. People like Robert Bauval and Graham Hancock have uncovered persuasive evidence that the builders of the Egyptian pyramids viewed the stars as home to the gods, and reflected this in the structures they built. The pyramids of the Giza plateau are a mirror image of the constellation of Orion.

Establishment academics scoff at theories like this. They say that the stars are only of interest to astrologers, science fiction fans and UFO believers. Normal people never look at the stars. But this misses the point. Four and a half millennia ago, the world was a different place. Modern concepts of astrophysics were unknown in those days, and in consequence astrological or mystical interpretations weren't considered crackpot "fringe theories" in the way they are now. And the night skies of the ancient world weren't obscured by electric street lights, so the people of that time had a much clearer view of the stars than anyone has today.

As time has gone on and scientific ideas have hardened, unorthodox views of the stars have become increasingly frowned on. Astrology is still around, but its detractors are quick to point out the ludicrousness of assuming a relationship between planetary alignments and human affairs. As is so often the case when scientists make grandiose pronouncements about subjects other than science, this *misses the point.*

Astrology works *even though* there is no relationship between the planets and human affairs. There is no cause and effect, because there doesn't have to be. Astrology is about people, not about science. A skilful astrologer can provide sound advice and relate it to the client's star-chart, just as a skilful card-reader can

provide sound advice and relate it to a Tarot spread. The star-chart or the Tarot spread are just used as cues -- the skill is in the person, not the stage props they use.

If the stars don't literally "govern our conditions" in the astrological sense, do they govern it in any other sense? In the previous chapter, we saw how cometary collisions in the distant past may have been responsible for the extinction of dinosaurs and other fossil species. But could similar collisions have occurred within the span of human history? That was what Immanuel Velikovsky claimed in his classic book *Worlds in Collision* (1950), but the idea goes back much further than that.

As long ago as the fourth century BC, the great Greek philosopher Plato made the connection between Earthly catastrophes and the motions of astronomical bodies. In his book *Timaeus,*[23] Plato quotes a remark supposedly made by an Egyptian priest to the Greek Solon:

> Your own story of how Phaethon, child of the Sun, harnessed his father's chariot, but was unable to guide it along his father's course and so burnt up things on Earth, and was himself destroyed by a thunderbolt, is a mythical version of the truth that there is at long intervals a variation in the course of the heavenly bodies, and a consequent widespread destruction by fire of things on Earth.

A similar idea was expressed two thousand years later by Edmond Halley (1656 - 1742), the discoverer of the famous comet named after him. Halley described how a cometary impact could have caused the phenomenon recorded in the Bible as Noah's flood:

> I have proposed the casual shock of a comet, or other transient body, as an expedient to change instantly the poles and diurnal

[23] Plato is depicted holding a copy of *Timaeus* in Raphael's painting *The School of Athens* (see front cover).

rotation of the globe... Such a shock impelling the solid parts would occasion the waters... to run violently towards the part of the globe where the blow was received; and that with force sufficient to rake with it the whole bottom of the ocean, and to carry it upon the land; heaping up into mountains the earthy parts it had borne away with it.[24]

[24] *Some Considerations about the Cause of the Universal Deluge,* Phil. Trans. Roy. Soc., vol. 33, p. 118, 1724.

Galactic visitors

The quotations by Plato and Halley at the end of the previous section suggest that some myths may be distorted records of real historical events. A similar idea can be found in the "ancient astronaut" theories of Erich von Daniken and his followers. According to von Daniken, it is not just inanimate comets that come from space, but intelligent beings in space-ships.

Von Daniken points out the close similarities between myths originating in different parts of the world. Many different cultures have strangely similar myths concerning floods and other disasters, or a golden age when men were like gods, or ancient technology such as flying machines, electricity, robots and sophisticated weapons. Von Daniken also points to a precocious knowledge in areas such as astronomy and geography, and to legends of unknown visitors bringing wisdom from the sky.

Myths such as these can be explained in a number of ways. They may come from von Daniken's extraterrestrials, or from an earthly but now forgotten civilisation such as Atlantis. Or they may simply be the product of the imagination. Which of these explanations is true may never be known -- the evidence is ultimately inconclusive.

Von Daniken's main lesson is that there is a lot we do not know about our own past. Countless books and records have been lost forever -- through accidents or deliberate acts of destruction -- in libraries from Alexandria to Mexico. And, of what remains, how do we tell what is myth and what is fact? The truth is often couched in poetic language -- comprehensible to the readers of the time, but frustratingly obscure to future generations. The classic example is the case of the Trojan War. Fought around 1200 BC, its memory was handed down orally for four centuries,

until it was finally recorded in poetic form in Homer's *Iliad*. For two millennia the *Iliad* was believed to be pure myth, until Heinrich Schliemann excavated the city of Troy in 1871. Thanks to Schliemann, Homer's account is now known to be based in fact. Could the same be true of von Daniken's astronauts?

Of course, there is widespread evidence that aliens from outer space still visit us today. But UFOs are strange things. They rarely behave like real, physical, nuts-and-bolts space vehicles. They leave no physical traces, and they move in ways that defy the laws of motion and common sense. The same is true of their occupants, who may have more in common with fairies, ghosts or angels than with organic creatures. Witnesses to UFO sightings often feel strong emotional effects -- such as anxiety or mystical serenity, or a trance-like feeling of unreality. Facts like these suggest that UFOs are not physical objects at all, but a psychological or paranormal phenomenon: effects of the mind rather than an alien technology.

From the majority of UFO witness reports, it seems the aliens are not really all that alien. They are different from us, but not that different -- more advanced, but not by that much. They share many of our preoccupations, particularly sex and reproduction. In the heyday of UFO contacts during the 1950s, the aliens had a cold-war obsession with nuclear weapons.

Maybe the aliens that visit the Earth are peculiarly earth-like, but there is no reason to suppose that the same will be true in the wider Galaxy. On the contrary, it is almost certain that the aliens will be nothing like us. They may be more civilised than us, or less civilised, but they will be different. In the TV series *Star Trek,* Mr Spock is different from us and the Klingons are different from us. In the early episode *Errand of Mercy* (1967), the crew of the Enterprise come face to face with the Klingons for the first time on a planet called Organia. The native Organians turn out to be a race of almost omnipotent pure-energy beings, the result of millions of years of evolution. As Mr

Spock observes, the Organians are "as far above ourselves, as we are above an amoeba."

Between the extremes of our own biochemical selves, and the incorporeal Organians, it is possible to conceive of a huge range of life-forms, each adapted to their own physical environment. A few examples taken from the pages of *Astounding Science Fiction* illustrate the point -- extremely tenuous, gaseous creatures, living in the interior of the Sun (Hal Clement: *Proof,* June 1942), electromagnetic creatures, living in empty space (Frederic Brown: *The Waveries,* January 1945), or more-or-less normal humanoids living at a glacial pace on a planet with an extremely long rotation period (Eric Frank Russell: *The Waitabits,* July 1955).

But science fiction has a more profound message about extraterrestrials, beyond a simple catalogue of alternative biology. Even if the aliens are physically similar to us, how can we hope to understand their point of view? It is difficult enough to understand different cultures on Earth, so what of someone from a different planet?

In the episode of *Star Trek: The Next Generation* entitled *Darmok* (1991), Captain Picard is faced with the ultimate problem in cultural relativism. The Enterprise encounters a race called the Children of Tama -- a race known to be advanced, civilised and friendly, but with whom all previous attempts at communication have failed. Individual words can be translated, but the way these words are put together into sentences is incomprehensible. Eventually, Picard solves the mystery -- the aliens communicate in metaphors based on abstract imagery taken from their folklore.

Before we leave the subject of extraterrestrials, there is one final possibility -- and a rather disturbing one at that. Suppose that Erich von Daniken's ancient astronauts did visit us in the past, bringing knowledge to help us along the evolutionary path. The

implication is that we are not genuinely free agents -- we are being controlled by someone else. If this were the case, they would go to great lengths to make sure never found out. That would leave us no better off than Tom Stoppard's Rosencrantz and Guildenstern, whom we met in Chapter 4. As we asked then, we can ask again, "How would we know?"

The idea of mankind as the "pets" of some higher race goes back to Charles Fort (1874 - 1932), that great pioneer of the unexplained. In Chapter XII of *The Book of the Damned* (Boni & Liveright, 1919) , he wrote:

> I think we're property.
>
> I should say we belong to something:
>
> That once upon a time, this earth was No-man's Land, that other worlds explored and colonised here, and fought among themselves for possession, but that now it's owned by something:
>
> That something owns this earth--all others warned off.

The science fiction writer Eric Frank Russell took up Fort's theme in his novel *Sinister Barrier,* published in *Astounding*'s sister magazine *Unknown* in March 1939:

> Beyond that sinister barrier of our limitations, outside that poor, footling range of vision, bossing every one of us from the cradle to the grave, invisibly preying on us, are our malicious, all-powerful lords and masters, the creatures who really own the Earth.

A human Galaxy

If visitors from elsewhere in the Galaxy have come to Earth, then sooner or later people from Earth will no doubt go out into the Galaxy. In Chapter 1 we referred to Asimov's *Foundation* stories, set in a far distant future in which humanity has expanded out into a Galaxy-spanning empire. This expansion was originally driven by technology, but as the stories progress there is a turning away from technology towards the development of the human mind. By the fifth book, *Foundation and Earth* (1986), a new concept appears on the horizon: "Galaxia" -- a Galaxy-wide web of humanity, linked telepathically into what is virtually a single organism. A human Galaxy indeed.

Concepts like Galaxia, or a Galactic empire, have a serious practical limitation. According to Einstein's theory of relativity, nothing can exceed the speed of light. And light takes three years to reach the nearest star, and a hundred thousand years to cross the Galaxy. If Einstein is right, then everything is subject to the speed-of-light restriction. Much greater beings than mere humanity would be inconvenienced, as Arthur C. Clarke pointed out in an essay entitled *God and Einstein*.[25]

Fortunately, the situation may not be as bad as it appears. While Einstein's equations are clear enough mathematically, their interpretation is subject to debate. It may even be that relativistic effects conspire to get us to our destination sooner than we expected. We would still not be travelling faster than light, but the speed of light would effectively be infinite so there would be no problem.

Even within the standard interpretation of relativity, there are theoretical ways of getting virtually instantaneously from A to B,

[25] In *Report on Planet Three* (Gollancz, 1972).

such as warp drive and wormholes. Although the term "warp drive" originated in *Star Trek* in the 1960s, it has since been put on a firmer scientific footing. In 1994, the theoretical physicist Miguel Alcubierre published an academic paper entitled *The warp-drive: hyper-fast travel within General Relativity.*[26] In his paper, Alcubierre derived a self-consistent solution of Einstein's equations, which would theoretically permit faster-than-light travel by distorting a bubble of space around the spacecraft.

The concept of a wormhole -- a short-cut from one part of the universe to another -- is as much a consequence of General Relativity as Alcubierre's warp drive. The idea is relatively new, although it was clearly foreshadowed in H.P. Lovecraft's horror story *The Dreams in the Witch-House,* first published in *Weird Tales* in July 1933:

> One afternoon there was a discussion of possible freakish curvatures in space, and of theoretical points of approach or even contact between our part of the cosmos and various other regions as distant as the farthest stars or the transgalactic gulfs themselves -- or even as fabulously remote as the tentatively conceivable cosmic units beyond the whole Einsteinian space-time continuum... What made the students shake their heads was his sober theory that a man might -- given mathematical knowledge admittedly beyond all likelihood of human acquirement -- step deliberately from the Earth to any other celestial body which might lie at one of an infinity of specific points in the cosmic pattern.

It was pointed out in Chapter 4 that there are incompatibilities between General Relativity and Quantum Theory. The speed-of-light restriction demanded by relativity is no exception. In Quantum Theory there is a phenomenon known as *entanglement,* in which the quantum states of two separate objects are linked to each other, even though the two objects may be spatially separated by a large distance. If one of the two objects changes

[26] *Classical and Quantum Gravity,* vol. 11, page L73 (1994).

state, then the other does so at the same instant -- there is no speed of light delay.

It is possible that large numbers of objects have become entangled with each other during the long course of the universe's history. Even though these objects may now be widely separated, there is still an intimate link between them. This is getting close to the mystical view, described in Chapter 3, of the universe as a single interconnected unity.

If the universe is a single unity, then the human mind is part of that unity. This presents another possible route to exploring the Galaxy. The concept of bodiless "astral travel" to other planets goes back to the theosophists and occultists of the late nineteenth and early twentieth centuries. More recently, so-called "remote viewers" working for the US government and other agencies have observed planets such as Mars and Jupiter by purely mental means. Their results are sometimes consistent with data from space probes, and sometimes inconsistent.

Ian Watson's bizarre novel *Alien Embassy* (1977) describes a vision of the future in which physical space travel has been supplanted by a form of astral projection derived from Tibetan mysticism:

> OM! boomed the greatest mantra of all; and the central bindu point exploded. It novaed out around me, sucking me down into the blaze of stars. Stars swept past me, forming into a great ring -- a torus of light from which "hook rays" of silver and saffron and sapphire light beckoned, each photon promising to expand into a separate star, a world, a haven. The whole galaxy condensed into the ring of light, through the centre of which I flew, from one darkness towards another darkness... The point novaed out again, engulfing me in light. In daylight. The daylight of another sun.

... and it's as simple as that! Meditation, chanting -- and you're there. The ultimate easy ride to the stars!

7

BEYOND THE GALAXY

What profiteth a man to flee his fate?
For, he shall surely find Worlds within Worlds!
Lee & Kirby: *The Fantastic Four* 75 (1968)

The expanding universe

Beyond the Galaxy there are other galaxies. The universe contains worlds upon worlds, and worlds within worlds. Below the scale of the Galaxy, there is the solar system, and atoms and subatomic particles. And above the scale of the Galaxy, there are clusters and superclusters of galaxies, and the whole expanding universe.

The expansion of the universe was discovered in the 1920s by Hubble -- the man, not the Space Telescope. Hubble found that the distant galaxies are receding -- the further away the galaxy, the faster its speed of recession. At the time Hubble made his discovery, there was already a theory to explain it. An expanding universe is one of the solutions to Einstein's equations of General Relativity.

Cosmology is the name given to the study of the universe as a whole. Of necessity, it is a highly speculative subject. One particular area of speculation is why the universe takes the form it does, rather than any other equally probable form. The physical properties of the universe are extremely finely balanced. If they were changed just slightly, the universe would be completely different, and we would not exist in it.

The most obvious answer is that our universe is one of countless universes, and we just happen to be in the one we fit into. A *Many Worlds Hypothesis* of this type is useful in Quantum Theory as well as cosmology. The world of Quantum Theory is ruled by chance -- a system does not have a single deterministic state, but a number of different states with different probabilities. But if we observe the system in one state, what has happened to all the other possible states? According to the Many Worlds Hypothesis, the unchosen probabilities branch off into other universes.

But where are these other universes, if they exist? If they are completely separate universes, then they are not "before" or "after" us in time, or "elsewhere" in space. So are they totally unknowable, or could there be some kind of bridge from our universe to the others? This is the premise of the TV series *Sliders:*

> What if you found a portal to a parallel universe? What if you could slide into a thousand different worlds? Where it's the same year and you're the same person, but everything else is different?

Sliding from one universe to another is just like time travel, or space travel, but in the direction of possibility rather than time or space. This concept is described graphically by Robert A. Heinlein in his short story *Elsewhen:*[27]

> Most people think of time as a track that they run on from birth to death as inexorably as a train follows its rails -- they feel instinctively that time follows a straight line, the past lying behind, the future lying in front. Now I have reason to believe -- to know -- that time is analogous to a surface rather than a line, and a rolling hilly surface at that. Think of this track we follow on the surface of time as a winding road cut through hills. Every little way the road branches and the branches follow side canyons. At these branches the crucial decisions of your life take place. You can turn right or left into entirely different futures. Occasionally there is a switchback where one can scramble up or down a bank and skip over a few thousand or million years -- if you don't have your eyes so fixed on the road that you miss the short cut.
>
> Once in a while another road crosses yours. Neither its past nor its future has any connection whatsoever with the world we know . If you happened to take that turn you might find yourself

[27] First published under the pseudonym Caleb Saunders, and with the title *Elsewhere,* in the September 1941 issue of *Astounding Science Fiction.*

> on another planet in another space -time with nothing left of you or your world but the continuity of your ego.

If time and possibility are two further dimensions in addition to the three we normally think of, how many other dimensions may there be? Modern theories of *hyperspace*[28] often talk in terms of ten dimensions or more. Are the other dimensions real, or are they just mathematical or metaphysical speculations?

The easiest way to think about higher dimensions is by using an analogy. How would the third dimension appear to a two-dimensional creature? As Sir James Jeans put it:

> Just as shadows on a wall form the projection of a three-dimensional reality into two dimensions, so the phenomena of the space-time continuum may be four-dimensional projections of realities which occupy more than four dimensions.[29]

This quote by Jeans opens up the possibility of a whole new world just beyond our reach. By coincidence, the same idea cropped up two years earlier in the form of a science fiction story by Miles J. Breuer, M.D. called *The Captured Cross-Section,* which appeared in the February 1929 issue of *Amazing Stories.*

In this story, a scientist uses an electromagnetic field to "rotate" the four-dimensional continuum through forty-five degrees. As a result, a portion of our own space is rotated outside the space we know, while a portion of unknown space is rotated into it. And the "new" space is not empty; it contains the trapped "cross-section" of a four-dimensional being, which -- because the scientist only sees three dimensions of it -- seems to behave in an exceedingly erratic manner. It changes size and shape, vanishes and reappears, splits into parts and reforms again.

The behaviour of Breuer's "captured cross-section" calls to mind

[28] Michio Kaku: *Hyperspace* (Oxford University Press, 1994).
[29] From *The Mysterious Universe* (Cambridge University Press, 1931).

the unpredictable, science-defying antics of UFOs and other paranormal phenomena. So maybe UFOs aren't spacecraft from another planet after all -- maybe they're objects from a higher dimension that occasionally intrude into our own world.

Inner space

After exploring outer space and other dimensions, we turn now to the inner space of the human mind. In a sense, this is where we started out, back in Chapter 2, with Descartes' musings on Pure Reason. We have talked about the duality of mind and matter, and seen how the psychologist C.G. Jung pictured the universe as part physical and part psychic. The psychic aspects may play a role in everything from UFOs and other paranormal phenomena to bodiless "astral travel" to the planets and beyond.

The human mind -- and the phenomenon of consciousness in particular -- is a problem for science. It was suggested in Chapter 4 that consciousness may be an "emergent phenomenon" -- a property of the whole and not the parts. Or it may be a consequence of some as-yet-undiscovered law of nature. The scientist Roger Penrose[30] has suggested that consciousness can only by explained by the long-sought-for unification of Quantum Theory and General Relativity.

Another scientist who is studying the physics of consciousness is Professor Brian Josephson, who runs the Mind-Matter Unification Project at the University of Cambridge. Josephson, a Nobel-prizewinner, is particuarly interested in the phenomena of parapsychology (or *psi*) -- phenomena such as telepathy, clairvoyance, precognition and telekinesis. There is overwhelming experimental evidence that such phenomena exist, but they are largely ignored by mainstream scientists because they lie outside the established Kuhnian paradigm (cf. Chapter 4).

In Chapter 1, we quoted from the poem *Essay on Man,* written in 1733 by Alexander Pope. In the poem, Pope wrote:

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[30] *The Emperor's New Mind* (Oxford University Press, 1989).

What thin partitions sense from thought divide;

More than two hundred years later, the science fiction author Mark Clifton produced a pair of short stories called *What Thin Partitions* and *Sense from Thought Divide,* published in Astounding in September 1953 and March 1955 respectively.[31] These stories describe a classic Kuhnian paradigm shift, in which psi powers are demonstrated to exist and to be storable in small chemical cylinders. When "activated" by a poltergeist, the cylinders fall upwards instead of down. The following is taken from *What Thin Partitions:*

> "Let us," I began in a dry classroom manner, assume, for sake of discussion, that your cylinder can store impulses."
>
> He nodded, as if it were a safe enough assumption. It was a hopeful sign that I was getting through to him.
>
> "It wouldn't know, of itself, which was up and which was down," I pursued.
>
> "Gravity is a real world condition," he started answering now. "Not dependent upon knowledge. It works whether we know it or not."
>
> "Well, that's a point which has been debated for the last several thousand years to no conclusion," I disagreed.

The narrator goes on to describe the concept of paradigms, or frameworks, and then continues:

> "It leaves us with the conception that there may be any number of frameworks, separated from one another by perhaps the thinnest of partitions, each containing its own set of real world conditions, natural laws, consistent with itself, obeying its own logic, having its own peculiar cause-effect sequences."

[31] *What Thin Partitions* was written in collaboration with Alex Apostolides.

"And one of these substitutes down for up?" he asked sceptically.

"Some of the most noted thinkers the world has ever produced contend that the mind is the only reality," I said slowly.

In Clifton's stories, it is not just the scientists who resist the paradigm shift, but the believers as well. The driving force behind belief is Mystery, and the last thing believers want is to dispel the Mystery. The following comes from *Sense from Thought Divide:*

"Do you realize, Swami," I asked, "that the one great drawback throughout the ages to a full acceptance of psi is the lack of permanent evidence? It has always been evanescent, perishable. It always rests solely upon the word of witnesses..."

I opened my lower desk drawer and pulled out a couple of the Auerbach cylinders which we had used the night before. I laid them on top of the desk.

"These cylinders," I said, "act like photographic film. They will record, in permanent form, the psi effects you command. At last, for all mankind the doubt will be stilled; man will at once know the truth; and you will take you place among the immortals."

I thought it was pretty good, and that, with his overweening ego, it would surely do the trick. But the Swami was staring at the cylinders first in fascination, then fear, then in horror. He jumped to his feet, without bothering to swirl his robe majestically, rushed over to the door, fumbled with the knob as if he were in a burning room, managed to get the door open, and rushed outside...

I drew a deep breath, and exhaled it audibly. My testing procedures hadn't produced the results I'd expected, but the last one had revealed something else.

The Swami believed himself to be a fraud!

The mysteries of the mind far exceed the mysteries of the physical world. This is something Pope expressed in his *Essay on Man* -- the poem from which Clifton took the titles of his stories:

> Could he, whose rules the rapid comet bind,
> Describe or fix one movement of his mind?
> Who saw its fires here rise, and there descend,
> Explain his own beginning, or his end?

8

PROMETHEUS

He gave Man speech, and speech created thought,
Which is the measure of the universe
P.B. Shelley: *Prometheus Unbound* (1820)

The myth

According to Greek legend, Prometheus was the wisest of the race of Titans, and the creator and benefactor of mankind. For his efforts on our behalf, Prometheus was sentenced by the god Zeus to be chained to a rock in eternal punishment. Prometheus personified the human qualities of curiosity, invention and the desire for freedom -- exactly those qualities which inspire us to explore the Galaxy. If this book has a guiding spirit, it is the spirit of Prometheus.

The story of Prometheus is an ancient myth. But, in recent years, we have made our own myths, for a new technological age -- in novels, movies, television and comics. One of the greatest modern myth-makers was the "king" of American comic-books, Jack Kirby. For more than forty years, either on his own or with Joe Simon or Stan Lee, Kirby created characters of mythic proportions -- heroes like Captain America, the Fantastic Four and the Incredible Hulk; villains like Doctor Doom, Galactus and Darkseid. In his masterpiece, *The New Gods,*[32] Kirby gave us a whole new pantheon -- a race as much at home in the Galaxy as we are on Earth.

In the prologue to issue five of *The New Gods,* we witness the scene which gives the present book its title. Metron, the New God symbolising man's scientific spirit, is exploring the deepest mysteries of the universe. Soaring freely through space in his Moebius chair, he finally encounters an impenetrable barrier. Beyond it lies the Source -- the ultimate force of the universe. At this Final Barrier "all things begin to lose perspective, and all roads to the Source come to an end."

But Metron is not alone. He is surrounded by vast, asteroid-like rocks, orbiting around the Source -- and bearing huge, rocky

[32] DC Comics, 1971 - 1972.

creatures, chained and immobile, frozen in postures of anguish. Metron exclaims:

> The Promethean Galaxy -- the place of giants! Alive -- chained to the fragments of the devices they used, in their attempts to smash the Final Barrier!

The caption tells us that:

> ...There were others with Metron's boldness and hunger. This one tried to engulf the barrier, by enlarging his atomic structure. What happened is not known. He failed. He drifts endlessly, larger than a star-cluster -- fused, living, taking a billion Earth years to feel one heartbeat.

Metron continues:

> Shattered, motionless giants -- intellects that equal my own! I can feel them invading my thoughts, crying out in eternal humiliation!

The Promethean Galaxy: the name is apt. Like Prometheus, Kirby's giants have pushed the scientific quest to its limit -- and yet, like Prometheus, they end up chained and immobile. And the image is apt for us, too. As we have seen, from a galactic perspective we too are confined to a single point -- chained to a tiny rock. Yet we are forever striving after knowledge. Like Kirby's giants, we can only make progress with excruciating slowness. Little by little, over the centuries, we build up an understanding of the world around us. It is the net result of the efforts of countless individuals, working with different and increasingly complex methods. We cannot see the Source -- we cannot even see the Final Barrier -- yet we press on with our search for cosmic significance.

The future

In the end, Prometheus will be freed. The story of his release was told by the English poet Percy Bysshe Shelley (1792 - 1822), in his magnum opus *Prometheus Unbound* (1820). Like Tennyson after him, Shelley was one of the few poets with a genuine enthusiasm for science -- he has been called a "Newton among poets". At the same time, and again like Tennyson, Shelley had a strong, almost mystical, sense of the underlying oneness of reality. In *Prometheus Unbound,* Shelley integrated his views on science and philosophy into the ancient Greek legend of Prometheus.

Shelley portrays the freeing of Prometheus as taking place at some time in the future. The event heralds a new "Promethean age", in which time ceases to flow, men merge into Man, and minds coalesce into Mind. Man pervades the universe, through a combination of art...

> lovely apparitions, dim at first,
> Then radiant...
> Shall visit us, the progeny immortal
> Of painting, sculpture and rapt poesy,
> And arts, though unimagined, yet to be.

...and science:

> The lightning is his slave; heaven's utmost deep
> Gives up her stars, and like a flock of sheep
> They pass before his eye, are numbered, and roll on.
> The tempest is his steed -- he strides the air;
> And the abyss shouts from her depth laid bare,
> Heaven, hast thou secrets? Man unveils me; I have none.

Shelley was one of the first people to speculate on the future evolution of humanity into more advanced forms. As such, he foreshadowed concepts such as Asimov's Galaxia and the

bodiless intelligences of *Star Trek,* which we met in Chapter 6. Although speculative, this subject is fundamental to the theme of this book. Our future evolution may take us out into the Galaxy -- and even if it does not, it is certain to alter the way we perceive the universe.

The concept of the "superman" -- a being more evolved than ourselves -- was originated by the German philosopher, F.W. Nietzsche (1844 - 1900). As a young man, Nietzsche had been greatly impressed by Shelley's *Prometheus Unbound.* Concerning the poem, Nietzsche wrote that "I bow deeply before one who can experience this within himself, and is capable of bodying it forth".[33]

Nietzsche's idea of the superman is nothing like the Man of Steel from the comic books. In Nietzsche's view, the future of the human race lies in the development of the mind, not the body. His superman is a being of uninhibited consciousness -- the antithesis of mediocrity. Nietzsche viewed present-day humanity as "a rope, tied between animal and superman." Yet the superman is already implicit in ourselves: "Your true self lies immeasurably above that which you usually take to be yourself."[34]

Nietzsche was different from the majority of Western philosophers before him, in that he did not believe in the existence of eternal or absolute truths. To Nietzsche, there was no deep meaning in the universe to be got at by pure reason or any other method. He took to heart Kant's dictum that the world we perceive is conditioned by our ability to perceive it, and not the other way around (cf. Chapter 2). But once this fact is recognised, Nietzsche realised that it is a strength and not a weakness. It leads the way to the Superman.

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[33] Quoted in J.P. Stern: *Nietzsche* (Fontana Press, 1978).
[34] Ibid.

By discarding the concept of ultimate Truth, Nietzsche freed his mind. Like the early Buddhists before him, he realised that the notion of "Self" is a myth, and he saw the folly of Descartes' "I think, therefore I am". Nietzsche also recognised that language is necessarily metaphorical and relative, foreshadowing the Sapir-Whorf hypothesis of the twentieth century. Relativism holds the key to everything: the Superman must find his own rules, rather than blindly following someone else's. Uniformity kills off evolution -- it leads to stagnation and the tyranny of the lowest common denominator.

The futures envisaged by Shelley and Nietzsche have much in common with each other. They both dispense with the traditional pigeonholes of human existence -- the distinctions between life and art, art and science, science and mysticism. The superman of the future will be master of all these things.

The present

The superman lies in the far future. For the present, we must be content to continue our cosmic search as mere humans. But given the huge difficulties involved, why should we bother? We asked this question at the start of the book, and in the intervening chapters we have encountered many answers. We explore the Galaxy in search of a cosmic order -- an order we can never find within the narrow confines of our planet. We need to see ourselves in perspective, in the context of the Galaxy and the universe beyond it.

There are other reasons for wanting to go forward and experience a sense of wonder. The simplest reason of all is "because it's there". When John F. Kennedy announced the project to send men to the Moon and return them to Earth, he said that we must do these things "not because they are easy, but because they are hard."

Like the hero of Tennyson's *Ulysses* (1842), we strive

> To follow knowledge like a sinking star,
> Beyond the utmost bound of human thought.

And, like a sinking star, knowledge recedes from us as we approach it. As Tennyson goes on to say:

> Yet all experience is an arch wherethrough
> Gleams that untravell'd world, whose margin fades
> Forever and forever when I move.

The more we find out about the universe, the stranger and more wonderful it becomes. We unfold mysteries to reveal more mysteries; the universe does not have the solubility of a detective story. Not even an extremely complex one, like Jorge Luis Borges' *Ibn Hakkan al-Bokhari, Dead in his Labyrinth* (1951). In

this story, the amateur detective, Unwin, is trying to ascertain the facts from his friend Dunraven.

> "Don't go multiplying the mysteries," he said. "They should be kept simple. Bear in mind Poe's purloined letter; bear in mind Zangwill's locked room."
>
> "Or made complex," replied Dunraven. "Bear in mind the universe."

With any murder mystery, no matter how complicated, there is ultimately a solution. But with the universe, there is no ultimate solution. In a post-Kantian, post-Nietzschean world, the results of our searching must always be metaphors. They may be metaphors of language or art, or of science or mathematics. But they remain metaphors -- we can never reach the underlying truth, because there is none to reach. In *Prometheus Unbound,* this ultimate barrier is personified in the figure of Demogorgon, who refuses to answer all questions:

> The deep truth is imageless;
> For what would it avail to bid thee gaze
> On the revolving world?

So our answers must remain incomplete. All we have to measure them against is ourselves. In Pope's words, we are the

> Sole judge of truth, in endless error hurl'd
> The glory, jest and riddle of the world!

Nevertheless, we must go forward. Robert Sheckley presented an allegory on humanity's cosmic search in his novel *Dimension of Miracles* (1968). In the novel, a present-day Earthman named Thomas Carmody finds that -- due to a computer error -- he has been awarded a prize in the Intergalactic Sweepstakes. He is taken to the Galactic centre, where the mistake is discovered -- but he is allowed to keep the Prize, anyway. And that is fortunate, because the Prize is an intelligent, talking gadget that

can help him with the problem he is now faced with -- how to get back to Earth.

Carmody's long journey home is divided into three parts: *Where is Earth?, When is Earth?* and *Which is Earth?* First Carmody has to locate the Earth in space, then in time, and finally in probability -- from among the countless alternate realities. At long last, Carmody arrives in what appears to be a familiar version of Earth. Yet he is still not satisfied, and he moves on with his talking Prize.

> The Prize chided him, saying, "That was your own world you abandoned, Carmody! Are you aware of that?"
>
> "Yes, I am aware of it," Carmody said.
>
> "And now there can be no return."
>
> "I am aware of that, too."
>
> "The fact is that you have lost everything," said the Prize.
>
> "I don't agree," Carmody said. "Permit me to point out that I am at present still alive."
>
> "Agreed. But only for the moment."
>
> "I have always been alive only for the moment," Carmody said. "I could never count on more. It was my error to expect more."
>
> "Then what do you hope to achieve with your moment?"
>
> "Nothing," Carmody said. "Everything."

THE END