The Ecological Self

'Freya writes beautifully ... [She] illuminates the relationship between physics and metaphysics, and between knowledge and faith ... if one wanted a clear articulation of some aspects of Spinoza's notion of substance and Einstein's cosmology, here it is.'

— Habitat

'This is the book for which serious students of "deep" ecology have been waiting ... her treatment is outstandingly lucid, highly original and tightly argued.'

— Times Higher Education Supplement

'It should be read by everyone interested in environmental ethics and will be of interest to many others.'

— Australasian Journal of Philosophy

Environmental disasters, from wildfires and vanishing species to flooding and drought, have increased dramatically in recent years and debates about the environment are rarely far from the headlines. There is growing awareness that these disasters are connected – indeed, that in the fabric of nature everything is interconnected. However, until the publication of Freya Mathews' The Ecological Self, there had been remarkably few attempts to provide a conceptual foundation for such interconnectedness that brought together philosophy and science.

In this acclaimed book, Mathews skilfully weaves together a thought-provoking metaphysics of the environment. She connects the ideas of the seventeenth-century philosopher Spinoza with twentieth-century systems theory and Einstein's physics to argue that the atomistic cosmology inherited from Newton gave credence to a picture of the universe as fragmented, rather than as whole. Furthermore, it is such faulty thinking that presents human beings as similarly disconnected and individualistic, with the dire consequence that they regard nature as of purely instrumental rather than intrinsic value. She concludes by arguing for an ethics of ecological interdependence and for a basic egalitarianism among living species.

A compelling and fascinating account of how we must change our thinking about the environment, The Ecological Self is a classic of ecological and environmental thinking.

This Routledge Classics edition includes a substantial new Introduction by the author.

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Introduction to the Routledge Classics Edition

The Ecological Self, originally published thirty years ago in 1991, is first and foremost a work of metaphysics. It rests on the assumption that the way we understand our world, at the deepest metaphysical level, shapes how we live in it. Metaphysics, in other words, provides our ultimate framework for ethics, for our sense of the meaning and purpose of life. This was not a casual assumption on my part; it was for me the defining assumption of philosophy – an assumption I had absorbed and internalized from reading, as a twenty year old, Spinoza's magnificent seventeenth-century text the *Ethics*. The *Ethics*, arguably the most rigorous philosophy text ever written, 'demonstrates' in its first two Parts that reality in its entirety is a single substance, a total unity, as much mental in its fundamental nature as physical. The things that we see around us – the pebbles, trees, buildings, animals, stars, grains of sand, landscapes, cars, people – are not separate entities, substances in their own right, but mere 'modes' of this underlying unity, each, like that underlying substance itself, as much mental in its fundamental nature as physical. From this metaphysical 'demonstration' Spinoza infers, in the remaining Parts of his *Ethics*, how human beings, as modes of this great unity – which he calls interchangeably God or Nature – ought to live if they wish to become fully realized.

In the twentieth century such a conception of philosophy was unfashionable, to say the least; in this sense *The Ecological Self* (*ES*) was at the time an old-fashioned book. But as metaphysics itself has come back into academic vogue in the twenty-first century, this view of philosophy is, I think, gaining ground again, as I shall explain in the course of this Introduction.

The book opens with an exploration of the way in which the thinking of modern western civilization reflects at every level the materialist premise of classical science, which is to say the atomism and mechanism of the Newtonian physics of the seventeenth century. Social, political and especially environmental attitudes partake of this atomism and mechanism, manifesting as a dysfunctional individualism with respect to society and as brutal dualism and instrumentalism with respect to the natural world. The natural environment, understood in materialist terms, is seen as devoid of moral significance in its own right. Earth is accordingly considered as at our disposal to treat in whatever manner we see fit.

This proposition, that the thinking of the modern West is permeated at every level by the materialism and mechanism of the Newtonian paradigm, is commonplace today. In the 1980s, when I was writing *ES,* it was relatively new, though the idea of 'subverting the dominant paradigm' was already current enough to appear on bumper

stickers. Alternative, holistic scenarios, however, were generally sought in the physics of the quantum domain, where determinism and the hard edges of classical materialism – its ontology of inert, discrete, billiard-ball-type particles – broke down.[1]

HOLISM

I looked elsewhere for my holistic alternative – not to micro-physics but to cosmological physics, the physics of the universe at its largest scale. In Einstein's General Theory of Relativity, or at any rate in a speculative extension thereof, geometrodynamics, I found an ontology according to which space itself is the primordial substance. Space, from the geometrodynamic point of view, is like a vast ocean through which waves are forever passing and in whose depths local areas of turbulence, configured in the manner of complex whirlpools and standing waves, form and propagate, holding their shape for a time in complex patterns of interaction and diffraction. It is these local disturbances in the fabric of space that we perceive as *things*, as spatially demarcated physical objects intersecting causally with one another. The non-standing waves, endlessly rippling throughout the universe, are the gravitational and electromagnetic phenomena we detect with our instruments.

Here then, in geometrodynamics, was a truly holistic template that seemed to channel Spinoza directly into the twentieth century! The seeming 'nothingness' of space, which had been the unexamined background to matter in the Newtonian scenario, was now the primary datum, of which matter – the manifold of apparently distinct material entities – was merely a mode.

Having erased individuals as fundamental to the scheme of things and thereby transcended Newtonian atomism, however, I had to ask how we humans are to see ourselves and our relation to our world from this new perspective. Is individual identity simply an illusion? If so, what are we to do with our own seemingly individual lives with their insistent imperatives that direct our attention continuously back to our own needs? How are we and other organisms to live if not as individuals? Is there perhaps a *real though relative* criterion of individual identity, consistent with a geometrodynamical view of space as the primary and only substance, that could orient us within the new ontology?

CONATIVITY

By drawing on (but also extrapolating beyond) General Systems Theory, I found an answer to this question in the idea of the *self-realizing system*, defined as a system that actively seeks to create and maintain its own structure through time relative to a changing environment. Such a system could be viewed through a geometrodynamic lens as a special local pattern of disturbance within the larger geometrodynamic field, a pattern with a unique attribute, namely that it continually creates, renews and re-structures itself: by its own efforts it configures, preserves and perpetuates the self-organization that in turn enables those very efforts.

Surely then such self-realizing systems, even if subsisting only as modes of geometrodynamic space rather than as substances in their own right, really did qualify as individuals on account of their capacity and intent to distinguish themselves from their surroundings. The individuality of such systems, which I called *selves*, is not, from a systems perspective, a function of separateness or discreteness but of interconnection: they maintain their distinctness by continually exchanging energy with their environment. A paradigmatic instance of the self is clearly the organism. Other things, such as rocks, bricks, chairs and such like, might look to us like individuals but since they do not actively seek to differentiate themselves from their environment they do not count as true individuals from the geometrodynamic perspective. From that perspective they remain merely accidental crinkles or knots in space.

In defining selves in terms of their distinctively proactive and self-preserving capacity, I borrowed another category from Spinoza, that of *conatus* or conativity, which was defined by Spinoza as that 'endeavour, wherewith everything endeavours to persist in its own being'. For reasons that lie deep under the textual surface of the *Ethics*, Spinoza attributes conatus to all 'things', but I attributed it only to self-realizing systems or selves. Selves do not simply lie around like rocks or bricks or clods of clay, waiting to be worn away by wind and rain, but instead ceaselessly strive to persevere in an existence that is staked out and claimed by their own efforts. There is an intentionality to this effort, a sense that here is something that is known to itself and that matters to itself, that cannot be captured in the purely externalist terms of physics but implies phenomenology – an inner dimension of experience – as much as physics.

Conatus or conativity, as embedded in the conative theory of selfhood, is indeed the core category of *ES*. It brings in its train a basic suite of phenomenological categories that include, firstly, *telos*, inasmuch as the *aim* or *purpose* of a self is to maintain and increase its own existence; secondly, *self-value* (and hence *value* generally), inasmuch as the self matters to itself, its very existence being an expression of such self-mattering; and thirdly, *meaning*, since in relation to the self's goal of self-existence, elements of its environment become selectively meaningful for it – it has to discriminate between those that are conducive to its ends and those that are not, so on the bedrock of such discrimination into what matters and what does not, higher-level schemas of meaning can evolve. Other phenomenological categories are also implicated in the notion of conatus, but telos, value and meaning are key.[2]

Although organisms figured in *ES* as the paradigm instance of the self, they were by no means necessarily the only instance, and higher-order systems, such as ecosystems and indeed the biosphere as a whole, might also turn out to be self-realizing. Might even the universe itself, understood in geometrodynamic terms as the ultimate higher-order unity, qualify as a self?

As a necessarily self-creating, self-maintaining system, the universe does indeed appear to qualify as self-realizing and hence as a self, imbued with an inherent drive to persevere in and increase its existence. It is inevitably, of course, a self of a special kind – a Self – since it realizes itself not through exchange with an external environment,

there being no environment external to the universe, but through internal processes of expansion and self-differentiation. By its own efforts the universe expands and continually differentiates itself into ever more complex patterns of modes, including, as we have seen, modes that are themselves organized as smaller-scale selves, such as organisms and other living systems.

As a Self, imbued with a conative drive, this universe has not only an outer spatial aspect, as described by physics, but an inner or felt aspect: it experiences itself inwardly as a felt field of expansion. Its modes, as disturbances in the fabric of space, are likewise also experienced as felt disturbances or impulses in the inner field of Self.[3]

This is really the crux of *ES*. Today I would describe the book as essentially offering a conative theory of selfhood which is then applied not only to living systems in a biological sense but to the universe at large: as a locus of cosmo-conativity, the universe qualifies as a Self. In titling the book *The Ecological Self*, I was intending to signal not only that we and our fellow organisms here on Earth are ecological selves – a point already made by ecophilosopher Arne Naess (Naess 1985) – but that so, in an expanded sense of 'ecological' pertaining to the peculiar dynamics of selfhood, is the universe.

Having argued that the universe as a whole is a Self, a locus of cosmo-conativity, with the intrinsic self-meaning and self-value that that implies, I ask how we are to live in such a universe, and in particular how such an understanding of reality would transform our relationship with our natural environment. This is a question I have continued to pursue in all my later work. If the universe in which we find ourselves is not that presupposed by (both classical and post-classical) physics – a vast abyss of loneliness, at best sparsely lit by tiny glimmers of meaning and life – but a *living cosmos*, a Self within whose conativity our own conativity is inscribed, how does that alter our sense of the purpose of our own lives?

In the final pages of *ES*, an Indigenous cosmology is invoked, that of the Hopi of North America, which serves as an example of the kind of living cosmos prefigured in the notion of cosmo-conativity. I remark on their Law, which enjoins us, as humans, to participate in the cosmic conatus as a *sine qua non* of its renewal. This converges pretty much with my current thinking, thirty years on, so it might be appropriate at this point, since I have finished summarizing the main arguments of *ES*, to explain how the idea of cosmo-conativity first introduced in *ES* has evolved into a more fully articulated position, enriched by the recent blossoming of Indigenous scholarship around the world, that I today call *living cosmos panpsychism*. I did not use the term 'panpsychism' in *ES*, for reasons I shall explain, but it seems fitting now to describe the metaphysics of cosmo-conativity presented in *ES* as a version of panpsychism, and it is this version that I have elaborated under the title of living cosmos panpsychism.

I will first take a moment to review the role of panpsychism in recent philosophy, before turning to living cosmos panpsychism. I will conclude this Introduction with some thoughts on cosmological physics.

PANPSYCHISM

'Panpsychism' is the term traditionally adopted in the history of ideas to denote metaphysical outlooks that attribute mind or mind-likeness as a fundamental property to all matter. From the perspective of panpsychism, mental properties do not merely emerge from matter at some point in the evolution of life on Earth but have always been part of the fabric of matter *per se*.

Although the account of reality offered in *ES* was clearly panpsychist, I chose not to use the term at the time because, as I have already mentioned, metaphysics in the grand tradition was pretty much anathema in philosophical circles throughout the twentieth century, and panpsychism was particularly despised. I remember seminar rooms in which to say of any theory that it led to panpsychist conclusions was to dismiss it without further argument. Later in the 1990s, however, panpsychism made a come-back in analytical philosophy with the appearance of David Chalmers' 1996 book *The Conscious Mind*.

Chalmers introduced panpsychism in reply to materialist theories of mind. How, he asked, could the phenomenon of felt interiority, core to the experience of consciousness, ever arise from arrangements, however intricate, of sheer externalities? The evolutionary arguments on which materialists relied could not explain this phenomenon of inner-ness – of how bodies felt *from the inside* – given that, from the perspective of natural selection, organisms might have functioned perfectly successfully, zombie-style, as complex information-receiving and-processing mechanisms capable of developing adaptive behaviour in the absence of any inner aspect or faculty of subjective awareness. From a materialist perspective, in other words, consciousness seemed functionally superfluous. Yet its existence is irrefutable. A plausible explanation, Chalmers ventured, is that consciousness did not 'originate' in the first place – it must always have been already intrinsic to the nature of matter.

Most of the theorists who thereafter embraced this panpsychist argument, including Chalmers, envisioned the inherence of consciousness in matter in terms that followed the micro-analytical template of physics: consciousness must already belong to the basic constituents of matter – the micro-particles. Minds belonging to higher-level systems such as organisms must be 'built' out of these simpler instances of consciousness as macro-level objects are 'built' out of micro-particles. This approach, however, quickly encountered an intractable obstacle: the Combination Problem. How can minds – whether simple or complex – be said to combine? Minds are not like bricks that can be stacked side by side to make a wall. Bricks exist within a larger holding dimension – what we call space – within which they may be distinguished and counted. But minds exist in no such dimension. Each mind seems dimensionless, or, rather, each seems to internalize dimension *per se* into its own inner universe. There is no larger mental dimension in which individual minds might be stacked together to form a composite mind. The field of conscious experience, in other words, is qualitative rather than extensional. For this reason, mind seems ineligible to function aggregatively as the response of most panpsychists to the problem of consciousness required.

Perhaps the error in this approach, however, was indeed to presuppose the micro-analytical template of physics. If, as I argued in 2011, the starting point of analysis was

assumed to be not the micro-level but rather the cosmological level, then the Combination Problem would not arise: individual minds could be construed as local psycho-configurations within a larger field of consciousness, as per *ES* (Mathews 2011b). This way of addressing the Combination Problem has indeed seen the advent in recent years of several cosmological versions of panpsychism, dubbed 'cosmopsychist' as opposed to the 'micropsychism' of the earlier versions that unquestioningly adopted the particulate template of physics (Goff 2019; Nagasawa and Wager 2015; Shani 2015). Interesting lines of both micropsychist and cosmopsychist inquiry are currently being vigorously pursued, and this is opening up as a fruitful and exciting research programme not merely in the philosophy of consciousness but in metaphysics generally (Goff 2019; Seager 2019).

In any case, subsequent to the rise of panpsychism in the philosophy of consciousness, I felt comfortable using the term 'panpsychism' to describe my own position, and, as I say, I have continued to develop the theory of cosmo-conativity outlined in *ES* under the rubric of living cosmos panpsychism.

LIVING COSMOS PANPSYCHISM

How we as human beings are to live if the cosmos in which we find ourselves is not the purely externalist universe of physics but one which unfolds in accordance with an inner cosmo-conativity is, as I have mentioned, the question to which living cosmos panpsychism is addressed. In response it offers two key elaborations of cosmo-conativity further to the account offered in *ES* that deepen the normative significance of the category.

Firstly, as a locus of conativity the living cosmos is itself already organized around an axis of normativity: its self-structuring seeks to actualize a good, *viz.* its own self-perpetuation and self-increase. As modes of its conative fabric, finite selves must also play a role in that self-structuring: the purpose of their existence, within this larger scheme, must ultimately be to contribute to the overall cohering and enhancement of the cosmos. There is in this sense an 'ought' at the core of the living cosmos of which we, as finite selves, need to be mindful. This 'ought' or immanent normativity may be described as *Law* (Mathews 2019, 2021). I shall say more about Law below.

Secondly, as a further aspect or dimension of its self-increase, the living cosmos seeks communicative engagement with those of its self-realizing modes or selves that are capable of such engagement. Its reason for doing so, according to living cosmos panpsychism, is that self-increase proceeds not merely in extensional terms, as expansion in space, but in phenomenological terms, as the deepening of self-meaning, where this can perhaps only be achieved through communicative engagement with the subjectivity of others.

Let us briefly consider these two aspects of living cosmos panpsychism.

Law

Having once discovered the larger conative 'ought' that is core to the cosmos, it becomes incumbent on us to work out how we ourselves may contribute to it. A quick look at the ecological dynamics of life here on Earth gives us our clue.

In ecosystems certain dynamics may be identified that spontaneously assure the ongoing adaptivity and flourishing of those systems. These dynamics, long self-evident to forager peoples who depended upon them for their own material sustenance, may be summarized in terms of, firstly, the already much-mentioned *conativity*, and, secondly, the way in which conatus optimally fulfils itself, namely via a principle of *accommodation* and *least resistance*. When living systems or selves maintain themselves by processes of mutual conative accommodation, optimal conditions for the ongoing flourishing of life are achieved. I call this adaptive pattern of interactivity, *synergy* (Mathews 2011a).

Amongst living things conativity is qualified by the principle of accommodation and least resistance for the simple logical reason that organisms which *conserve their energy* by adapting their ends as far as possible to those of the organisms surrounding them will be naturally selected over organisms that needlessly provoke resistance and competition from others. In other words, by accommodating others, desiring what simultaneously serves the needs of those others rather than pitting oneself against them, one avoids unnecessarily squandering one's own energy – which is why this strategy may be described in terms of least resistance. In the struggle of organisms to preserve and increase their existence, such a strategy confers advantage.

Conflict, competition and predation do of course also occur in nature. Where the interests of particular species or individuals cannot achieve synergy with those of others, conflict will result. But such conflict will always entail an energy-cost for the species or individuals in question, and modes of conflict themselves will in turn be shaped by the principle of least resistance (by analogy with martial arts, in which the practitioner learns to conserve their own energy while turning the force used by opponents back against them). At the end of the day, the imperative to desire what others need one to desire will be what ensures that every living thing, in seeking its own self-existence, at the same time perpetuates the larger system (Mathews 2011a).

My favourite example of this logic of synergy, here in Australia, is the little truffle-loving bettong, a mini-kangaroo that acts as an ecological engineer in its woodland environment: in the process of digging for truffles, bettongs aerate and irrigate woodland soils and improve conditions for seed germination, thereby helping to assure the future of the woodlands on which bettongs themselves depend. In this manner, an attitude of accommodation – understood as adapting one's own conativity to that of others – assures the ongoing regeneration of life.

I have elsewhere explained in detail how this logic of synergy is enshrined in the belief systems of many Indigenous societies as Law (Mathews 2020). In Aboriginal Australia, Law is widely understood, across a variety of cultural frames, as a normative principle – describable in terms of relationality, reciprocity, mutuality and other categories aligned with synergy – that ensures the ongoing regeneration of the cosmos

while at the same time prescribing the Way for human life (Black 2011; Graham 2019; Rose 1992).

Panpsychism may in this sense be providing a western approximation to an outlook that non-Indigenous thinkers, blinded by colonial prejudice in favour of their own intellectual styles of thought, have long failed to recognize as profoundly philosophical. This blindness is part – perhaps the largest part – of our colonial legacy.

Communicativity

Conativity, as we have seen, is the will of a being not merely to persevere in but to *increase* its own existence. For systems intrinsically structured, as all conative systems are, via self-meaning, communication represents an inner horizon for self-increase. It is through communication with other selves, each possessed of their own distinctive viewpoint, that any given self can deepen and expand the reach of its own subjectivity. For the ultimate Self, the living cosmos, the only 'others' available for such communicative exchange are the finite selves that it is itself able to constitute through processes of self-differentiation. These selves then perhaps afford opportunities for communicative engagement that may enrich self-meaning at a cosmological level (Mathews 2003).

Wherever such communicative engagement is actualized, we might speak of a *poetic* order – an order of poetic revelation – unfolding alongside the *causal* order; such an order might exceed the causal order without in any way contradicting it. By 'poetic order' I mean an order of meaningful configurations of circumstances that constellate as a result of *invocation* on our part: when we invoke the world, in terms drawn from our own particular frames of reference, the world may respond by arranging itself to match those terms. The terms in question will be unavoidably *poetic*, in the sense of metaphorical, since the only 'language' available to the world is a language of *things.* The world cannot literally address us in speech but it can synchronistically arrange concrete particulars in meaningful configurations in the same way that poetry and dreams use imagery to create and convey meaning. Instances of such poetic engagement between self and world might be described as instances of *ontopoetics* (Mathews 2017).

Living in accordance with Law and engaging in ontopoetics may be seen as twin aspects of panpsychist culture: joining in the great synergistic endeavour of life locally under the guidance of Law, one becomes attuned to the internal as well as external dynamics of one's own living environment. Through such relations of attunement to local ecologies and sensitivity to the larger patterns of meaning they continuously generate, one finds oneself eventually inside an inner terrain of meaning of extraordinary depth, complexity and overall coherence. Such processes of sensitization progressively give rise to possibilities of communicative exchange with one's world until one eventually settles into an ongoing state of ontopoetic rapport. All this is commonplace within societies which have retained root philosophical connections to the kinds of foraging practices which require true ecological insight and understanding.

In the course of history, however, *agrarian* societies enabled people to depart from the logic of synergy by substituting external sources of power, such as domesticated animals, slaves and, more recently, fossil fuels, for the energy available to them from their own bodies. This has enabled us as humans – unlike other species who seek to pit themselves against others but suffer exhaustion and selective disadvantage as a result – to impose ourselves on our environment with impunity. Moreover, through our highly developed reflexivity – our capacity to reflect on and hence change our behaviour – we can also substitute arbitrary, culturally mediated ends and meanings for those revealed to us through an attitude of ecological and ontopoetic attunement. In consequence, we have largely stopped desiring what earth-others need us to desire and we have for the time being gotten away with it. But this breach of Law, this transgression of the logic of synergy, is now threatening our own future as the larger life system, no longer conatively renewed by us, unravels before our eyes.

It remains open to us, however, through the same channels of reflexivity that enabled us to depart from synergy in the first place, to review and revise our desires so as to align them anew with what our earth communities need us to want. When we are given revelatory glimpses of our place in the poetic fabric of a living cosmos, through ecological and ontopoetic encounter, then not only the threat of biosphere collapse but our own hearts may pull us back into Law.

COSMO-CONATIVITY AND COSMOLOGICAL PHYSICS TODAY

Living cosmos panpsychism, though originating in the metaphysics of cosmo-conativity outlined in *ES*, seems to have carried us far from the cosmological physics with which the theory originally sought consistency. So let us take a quick look at cosmological physics today in order to discover to what extent the metaphysics of cosmo-conativity continues to retain a basis in physics.

Thirty years ago theoretical physics was divided between the quantum domain and the domain of the General Theory of Relativity (GTR), and no-one knew how to reconcile the two, though many tried. It was because there was no agreed philosophical interpretation of quantum mechanics (QM) that I chose to base the 'metaphysic of interconnectedness' outlined in *ES* on GTR, which was at the time philosophically well understood. Today the impasse in theoretical physics has not been overcome; indeed the philosophical situation has worsened. Through the 1990s and into the 2000s, the requirement somehow to reconcile the quantum with the cosmological scale became more insistent. Everyone agreed that gravity had to be quantized: spacetime would turn out to be granular rather than smooth at the fundamental level. But physicists could not agree on how quantum gravity ought to be theorized. A great proliferation of increasingly speculative cosmological models has been the result. It seems now that GTR, in its forced marriage to QM, has become infected with the philosophical uncertainties of the latter: there is no clear physical interpretation of the proliferating formalisms (Ferreira 2014).

One type of cosmological model that seems currently much in favour, under a variety of different mathematical formulations, is that of the *multiverse*. According to

this account, our universe – the universe in which our own galaxy is situated – is merely one quantum bubble in a larger, higher-dimensional space containing an unimaginably large number (10^{500} is the preferred estimate) of other bubble universes (Al-Khalili 2020; Barrow 2012; Lindley 2020). All these universes are in principle locally self-contained and mutually inaccessible. Our universe, like the others, started as a quantum bubble in an original vacuum, a bubble that underwent rapid expansion to something short of its current proportions, after which expansion slowed to its present rate.

One of the main drivers towards the multiverse is the problem of 'arbitrary numbers'. In his 1999 book *Just Six Numbers*, Martin Rees identifies six parameters of cosmological physics whose values seem arbitrary relative to the laws of physics. To assign these constants and other parameters different values, however, would be to rule out the emergence of conditions necessary for life to evolve. Since life does exist, this implies that our universe is, relative to a base of agreed laws, improbable. But physics is meant to *explain* the universe. If it ends up representing our universe as improbable, this seems unsatisfactory. The multiverse hypothesis dissolves this unsatisfactoriness simply by actualizing – as bubble universes within the multiverse – all universes mathematically consistent with the base of agreed laws: our own universe is actual, despite its improbability, simply because all possible universes, however improbable, are actual (Lindley 2020).

But what can physicists mean by 'actual' in this context? Philosophers have long puzzled over the enigma of the possible versus the actual. We all understand intuitively what it is for something to count as actual – it is actual if it is part of our world in the sense that we could, if we travelled far and wide enough, encounter it empirically: it could present itself to our senses. By the same token, 'our world' consists in everything that we could in principle encounter in this way – every situation or state of affairs that is causally accessible to us. The merely possible, or counterfactual, on the other hand, cannot so present itself to our senses: it exists only in abstract.[4] Since the bubble universes proposed by multiverse theorists are in principle causally inaccessible to one another, we could never, however far and wide we travelled, find ourselves inside any other universe than our own. How then can it be said of the vast multitude of bubble universes that they are actual rather than merely possible? And if they cannot be shown to be actual, then the multiverse collapses back into our own singular universe, and the problem of the improbability of our universe, relative to a base of agreed laws of physics, remains unsolved.

Some multiverse theorists seem unfazed by this problem. Happy to drop the intuitive relationship between the real and the empirical, they conceive of reality in primarily abstract – logical and mathematical – terms. Such logical and abstract structures are considered by them to be antecedent to whatever can be encountered through the senses. To discover the true nature of reality then, from this point of view, we must rely not on the evidence of our senses but on reason. Such a view of reality is traceable back to Plato's Theory of Forms and is therefore often dubbed Platonism. For Plato the abstract Forms, including logical and mathematical principles, antedate, as

well as legislating for, whatever can be known through the senses. They exist, in other words, independently of the physical world and of whether or not we, as knowers, ever discover them: they afford the abstract template for whatever can exist or be known.

A proclivity towards Platonism – and in this sense avowedly towards metaphysics – is currently increasingly in evidence in physics (Al-Khalali 2020; Lindley 2020). Although not all multiverse theorists would agree with Max Tegmark, who, in his 2014 manifesto, *Our Mathematical Universe*, unabashedly embraced the view that reality is not merely described by mathematics but *is* mathematics, a shift in thinking is clearly under way. Such resort to Platonism, however, is not in itself resulting in consensus: divergent mathematical models equally consistent with available evidence continue to be generated. The whole discourse is assuming an increasingly scholastic air, the number 10^{500} looking a lot like an answer to the classic question of medieval scholasticism: how many angels can dance on the head of a pin? Does such a plethora of undecidable models suggest that physics is currently in a cul-de-sac, that it cannot answer its own basic questions? May it need in consequence to review its root presuppositions?

Perhaps the deepest of these is the dogma of the aggregate-able *unit*, the assumption that reality may be fully analysed in terms of these, whether in the form of physically discrete units, such as particles, or of determinably distinct intervals or lengths, as are presupposed by metrics. It is only by way of aggregate-able units that metrical and mathematical formalism is attainable. But categories with a phenomenological aspect, inasmuch as they are tied to meaning rather than merely to extension, can never be analysed purely in terms of units. It was this intuition, I think, that underlay my refusal of atomism in *ES*: an approach to reality which starts with units and hence metrics can never encompass mental, let alone normative, dimensions of reality. They are ruled out from the start. The object of inquiry is indeed prefigured by the metrical method as an 'object', devoid, for the purposes of the inquiry, of subjectivity. Value neutrality, the defining epistemic stance of science, is built into this approach: as a mere externality, the object affords no opportunity for communicative or affective engagement. The scientist thus has no choice but to assume the posture of the detached observer, viewing the object from the far side of the subject–object divide. Starting with the atomistic approach then, one can only deliver back at the end of the day the externalist – metrical and mathematical – tools and assumptions with which one began. This point is dramatically illustrated by the way that the physics of the multiverse turns the universe itself into an atom within a higher, purely mathematical order.

In this deeper, methodological as well as ontological sense, then, atomism undergirds the Cartesian dualism – the dualism of matter and mind, fact and value, 'is' and 'ought' – in which so much of modern western consciousness is rooted, and towards the critique and deconstruction of which so much philosophical thought over the last forty or more years has been directed.

An alternative starting point for inquiry into the nature of reality, evident in the episteme of many an Indigenous society, is to anticipate that the world is structured

not merely metrically, in terms of countable units, but by its own immanent meanings. If we and other finite selves (whether human or nonhuman), co-conformed with Self to contribute to its larger meanings, are the only true individuals in this field of meaning and hence the principal ontological protagonists, are we not the logical starting point for inquiry? In focusing merely on extension, on the background manifold of physical differentia – and hence on extensional metrics: the very small and the very large – have physicists all along been mistaking the main locus of ontological significance? Indeed, may extension *per se* only acquire determinacy relative to *perspective* – relative to the point of view of a living cosmos, the Self, configuring itself around its axis of self-meaning? Is reality only an extensional manifold, amenable to measurement, rather than an extensionless singularity, because it is already a Self, relative to which a determinate schema of self-discrimination can be established (Mathews 2019)?

So the question I would ask of a physicist that may arguably have run itself into a cul-de-sac is this: if physicists are ready to follow their mathematical models deep into the terrain of (Platonist) metaphysics, as is happening today at the frontiers of cosmological theory, why not also be open to metaphysical possibilities that point in the opposite direction, so to speak, in the direction away from the abstract and towards a deeper – more noumenal, if you like – form of concreteness via panpsychism? A panpsychist universe is more deeply and fully concrete than even a conventionally materialist universe because, being noumenally 'in itself' and 'for itself', in the sense of being actively self-present, it exists from the inside and not merely under an external, let alone merely abstract, aspect.

Indeed, why not look to panpsychism to explain central puzzles in physics, such as that of the already mentioned cosmological constant in GTR? Why does the cosmological constant take the particular value it does, the value that happens to be 'just right' for the evolution of living systems? Multiverse theorists, as we have seen, explain the puzzle of the observed value of this constant by way of the extravagant ontological inflation that their hypothesis entails. But an alternative, non-inflationary explanation is available via the theory of cosmo-conativity: as a Self, the cosmos seeks self-increase on its inner conative axis via communicative engagement with sentient selves. The value of the cosmological constant must accordingly be consistent with the evolution of such selves. In this sense, the cosmological constant stands as an outer reading of a perfectly intelligible inner unfolding.

Both the multiverse hypothesis and living cosmos panpsychism then require extrapolation from empirical or experimental evidence, and in this sense venture into metaphysics. But which of these models is the more parsimonious, the more in accord with Occam's Razor? On the side of the multiverse we end up with 10^{500} abstract universes, with the actuality of even our own universe in doubt; on the panpsychist side we end up with just our plain but real universe, familiar to us from observation, with the proviso only that this universe has an inner – conative – as well as an extensional aspect.

Is it only cosmo-conativity *per se* that offers guidelines in physics? Might the immanent logic of conatus unfolding at the level of finite selves – the logic of synergy I

have here termed Law – also provide pointers to cosmological dynamics? Resonances show up between synergy as a strategy for overall conative increase and recent developments in cosmological information theory, as explained, for instance, by quantum gravity theorist Carlo Rovelli (2017). According to Rovelli, information is a function of the reciprocal interaction of systems. Is synergy implicated in this generative process? It is much too early to speculate on such indications here, but emerging affinities between information theory and fundamental physics may again be pointing to a dimension of meaning as inherent in the cosmos.

Indeed, the traditional riddle of the intelligibility of the universe generally, as evidenced in Einstein's remark, 'The eternal mystery of the world is its comprehensibility',[5] is readily explicable from the perspective of living cosmos panpsychism. The universe is intelligible, from this perspective, for the simple reason that it is the outer manifestation of an inner field of meaning, a field with which our own sense of meaning, including mathematics, is joined at the root.

Paying attention, phenomenologically, to the 'structure' of this inner field of meaning in ourselves might furthermore reveal the misguidedness of expecting the outer field to be exhaustively determinable. The inner or subjectival field in which meaning-making takes place in ourselves exhibits background and foreground aspects but is, so to speak, fuzzy at the edges. In the foreground, meanings constellate; they emerge from the background and become determinate. Though always inter-permeable, so that a degree of uncertainty and non-locality will figure even in the foreground (as per QM), meanings do determinably explicate themselves. (Shades here of David Bohm's notion of the way things become 'explicated' under certain conditions relative to the background or 'implicate' order (Bohm 1983).) But in the background the subjectival field is much less determinate: at its 'edges' it just fades away. Applying this phenomenological finding to the cosmological scale might suggest the futility of endlessly probing the realm of the very small and the very large: there may simply be nothing determinate there to probe. The prime locus of meaning may reside in the realm of selves, in the order of self-realization that must unfold amongst selves in accordance with Law if the living cosmos is to remain on track.

To adopt a panpsychist approach to the question of intelligibility in physics then may be to understand 'intelligibility' in more than mathematical terms. It may be to tie it back ultimately to the nature of meaning itself as it primordially arises within the field of cosmo-conativity. In this sense again, 'particles' might not be the point; the point of any investigation into the ultimate nature of reality might not be to delve ever deeper into the bottomless 'fabric' of space or out into its infinitely expanding reaches but to plumb its existential logic.

To plumb this existential logic, however, physics alone will probably never suffice, thoroughly self-defined as it is by its metrical method. An alternative and complementary epistemology may be required – an epistemology of communicative engagement with both selves and Self. Again, many traditional, basically forager societies have devised such epistemologies and we may look to them for guidance. I have written elsewhere about epistemologies that prevailed for millennia in Aboriginal

Australia. Such ways of knowing cannot be extricated from *feeling*. One arrives at this kind of knowledge not by adopting the stance of the detached observer, but by, as one Senior Lawman, David Mowaljarlai, explains, *addressing* the land as a *collaborator* that can and will join forces with us in some vital project (Mathews 2021). In thus 'walking the land', one begins to discover its self-meaning and its capacity for responsiveness, where doing so cannot leave one other than profoundly moved: one experiences a kind of *feeling* – a blend of awareness and deep engagement – that Aboriginal people have been trying to convey to settler societies for many years. Once we have discovered this way of knowing, there will be no question of remaining morally blind to our natural environment. To care for it will be as natural as doing so is for Aboriginal people, because caring for it will be what makes us feel attuned and alive ourselves.

Living cosmos panpsychism then revises the premises of physics but also calls for alternative epistemologies that pull us into communicative and Lawful engagement with reality rather than distancing us from it as strictly disinterested observers. This is by no means of course to suggest a wholesale repudiation of science – nothing could be less desirable at a time, such as now, of raging populist anti-rationalism. But it does invite us to open up the 'imaginary', so to speak, of reason, so that conventional rationalist disciplines, such as science, may be integrated with alternative cognitive modalities. We cannot pretend that metaphysics, generously construed, is not core to both science and such alternatives. In this sense panpsychism may perhaps provide a bridge between them.

Freya Mathews, 2020

NOTES

1 Influential popular treatments of the two paradigms included Capra 1983; Zukav 1980; Berman 1981.

2 Other such categories include *freedom*, because conativity in the sense of will is only required if the end willed – in this case, self-existence – is not assured, is not given as a necessity; *directionality*, because conativity is essentially addressed to the *future*, to the ongoing unfolding of the self's own existence; and *possibility*, since will is exercised only in this space of future possibility – at bottom, the possibility of either continuing to exist or ceasing to exist, where this is the condition that definitively shapes the self's endeavour.

3 To distinguish 'inner' and 'outer' in this connection is tricky: to say of the Self that it can be viewed 'outwardly' is to say that from the perspective of those of its modes that are also selves, and can hence function as observers, it is perceived as external. Because such selves configure themselves as self-realizing structures, they experience themselves inwardly as conative centres, with the result that the larger field appears to them as external. The distinction between 'inner' and 'outer' is, in other words, internal to the Self but is nevertheless perfectly determinate relative to the Self's conative dynamics.

4 Relative to this account, questions immediately arise as to the actuality of the past, since even if we travel from one end of our world to the other we cannot empirically encounter the past. I cannot here discuss this or indeed any of the other related issues that arise in the philosophy of modal logic (the logic of possibility and necessity). My purpose is merely to indicate that a proposition such as that of the multiverse is mixed up with major metaphysical issues which it needs to address before it can claim coherence for itself.

5 *Journal of the Franklin Institute*, March 1936, www.oxfordreference.com/view/10.1093/acref/9780191826719.001.0001/q-oro-ed4-00003988

REFERENCES

Berman, Morris (1981) *The Re-enchantment of the World*, Cornell University Press, New York.

Black, Christine F. (2011) *The Land Is the Source of the Law*, Routledge, London.

Bohm, David (1983) *Wholeness and the Implicate Order*, Ark, London and New York.

Capra, Fritjof (1983) *The Turning Point*, Fontana, London.

Chalmers, David (1996) *The Conscious Mind*, Oxford University Press, Oxford.

Ferreira, Pedro G. (2014) *The Perfect Theory: a Century of Geniuses and the Battle over General Relativity*, Little, Brown, London.

Goff, Philip (2019) *Galileo's Error: Foundations for a New Science of Consciousness*, Pantheon, New York.

Graham, Mary (2019) 'A Relationist Ethos: Aboriginal Law and Ethics', in Michelle Maloney, Julia Grieves, Brian Adams and Emma Brindal (eds), *Inspiring Earth Ethics: Linking Values and Actions*, Australian Earth Laws Alliance, Brisbane.

Lindley, David (2020) *The Dream Universe*, Doubleday, New York.

Mathews, Freya (2003) *For Love of Matter: a Contemporary Panpsychism*, SUNY Press, Albany, NY.

Mathews, Freya (2020) 'From Wilderness Preservation to the Fight for Lawlands', in Robyn Bartel, Marty Branagan, Fiona Utley and Stephen Harris (eds), *Rethinking Wilderness and the Wild: Conflict, Conservation and Co-existence*, Routledge, New York, 254–273.

Mathews, Freya (2021) 'Law in the Living Cosmos: the "Ought" that is Core to the "Is"', in Joshua Farris and Benedikt Goeke (eds), *Routledge Handbook on Idealism and Immaterialism*, Routledge, New York.

Mathews, Freya (2019) 'Living Cosmos Panpsychism', in William Seager (ed), *Routledge Handbook on Panpsychism*, Routledge, New York, 131–143.

Mathews, Freya (2017) 'Panpsychism: Position Statement', in Graham Oppy and Nicholas Trakakis (eds), *Inter-religious Philosophical Dialogues*, Routledge, London, 45–71.

Mathews, Freya (2011a) 'Towards a Deeper Philosophy of Biomimicry', *Organization and Environment*, 24 (4), 364–387.

Mathews, Freya (2011b) 'Panpsychism as Paradigm?' in Michael Blamauer (ed), *The Mental as Fundamental*, Ontos Verlag, Frankfurt, 141–156.

Naess, Arne (1985) 'Identification as a Source of Deep Ecological Attitudes', in Michael Tobias (ed), *Deep Ecology*, Avant Books, San Diego, CA.

Nagasawa, Yujin and Wager, Khai (2016) 'Panpsychism and Priority Cosmopsychism', in Godehard Bruentrup and Ludwig Jaskola (eds), *Panpsychism*, Oxford University Press, Oxford, 113–129.

Rees, Martin (1999) *Just Six Numbers*, Weidenfeld & Nicholson, London.

Rose, Deborah Bird (1992) *Dingo Makes Us Human*, Cambridge University Press, Cambridge.

Rovelli, Carlo (2017) *Reality Is Not What It Seems*, Penguin Publishing Group, London.

Seager, William (ed) (2019) *Routledge Handbook on Panpsychism*, Routledge, New York.

Shani, Itay (2015) 'Cosmopsychism: a Holistic Approach to the Metaphysics of Experience', *Philosophical Papers*, 44 (3), 389–437.

Spinoza, Benedict de (1955) *The Ethics*, translated by R. H. L. Elwes, Dover, New York.

Tegmark, Max (2014) *Our Mathematical Universe*, Vintage, New York.

Zukav, Gary (1980) *The Dancing Wu Li Masters*, Fontana, Glasgow.

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Freya Mathews
Murdoch University 1989

Introductory remarks

This book began life a long time ago, in the mid-seventies, when, as a graduate student in London, I discovered twentieth-century physics, and was immediately galvanized by its philosophical implications. I remember delivering a paper entitled 'Persons from the viewpoint of a unified field theory' to a rather stunned philosophy seminar at Bedford College. The whole question of a new emerging paradigm and the ideological implications of physical theories was not at that time on the philosophical agenda, and my paper, my first step in what was to prove a long intellectual journey, was greeted with polite incredulity.

This book to a certain extent recapitulates that journey. Central to its entire argument is the thought of Benedict Spinoza, of which I have been a student and by which I have been enriched from my earliest philosophical days. It was Spinoza above all who demonstrated the link between metaphysics and ethics, and for whom the whole point and goal of metaphysics was moral and spiritual edification. The very structure of his masterpiece, the *Ethics,* is illustrative of the view that ethics must be grounded in metaphysics. Such a view is of course deeply alien to contemporary philosophical thought, which sees questions of metaphysics and cosmology as generally belonging to the realm of fact, and thereby quite divorced from questions of value. I was never persuaded of this divorce. It always seemed plain to me, intuitively, that the way we conceived of reality and of our place in the scheme of things was central to questions about the meaning and the ends of life. Cosmology was the basis of our worldview, but our worldview was informed with value. This view, so spurned throughout most of the twentieth century, has, since the early eighties, been beginning to gain ground again. Everybody is now talking about 'the new paradigm', and they don't mean 'paradigm' in the original, restricted Kuhnian sense which applied only to scientific models, but in a sense more connotative of 'world-view'—a way of viewing the world which has a normative as well as a scientific dimension.

Part of what excited me so much about contemporary physics, when I discovered it, was that it provided a far more sympathetic framework for Spinoza's monistic theory of substance than classical physics had done. For it was not only Spinoza's demonstration of the link between metaphysics and ethics that attracted me to his philosophy; it was also his monism, which promised to give content to the notion that 'all is One', that everything is interconnected. This was an intuitive belief in which I already had a strong emotional investment. It seemed to me ethically and aesthetically satisfying and 'right'. I wanted to see it theoretically spelt out, but I eschewed those eastern philosophies and spiritual traditions which were premised on this insight. It

seemed to me, as I explain in the text, that if this insight were to be usable by us it would have to have grown out of our own cultural experience.

There was of course no perfect match between the metaphysics of Spinoza and the implications of twentieth-century physics. But there was a demonstrably strong rapport between Spinoza's thought and at least one strand of the latter, namely the cosmology of Einstein. Einstein's cosmology appeared to be implicitly monistic, and it therefore, like Spinoza's theory, seemed to provide a suitable foundation for the kinds of ethical ideas I wanted to develop. But what about quantum mechanics? If I was prepared to look to physics to provide my metaphysical model, how could I ignore quantum mechanics and elementary particle theory? These are the physical theories which have caused the greatest philosophical upheaval in the last fifty years, and in any case, any appeal to physics obviously must take account of them.

My response to this—which, again, I explain in the text—is that while quantum mechanics does offer some promise of providing support for a metaphysic of interconnectedness, I think that the interpretation of quantum mechanics and the 'new physics' in general is still incomplete. The interpretation of Einstein's General Theory of Relativity and its speculative extension, geometrodynamics, is, in contrast, comparatively straightforward: any final picture of the universe will presumably include these well-understood relativistic features. Such a picture will not necessarily, however, include the philosophical ideas of quantum mechanics, since those ideas are still in flux. In my view it is too early to draw any final philosophical conclusions from quantum mechanics and the 'new physics': physicists themselves admit that they are still far from understanding what it all really means.

My project, then, was to find a metaphysical and ethical expression for the intuition of 'oneness' and interconnectedness, and Spinoza and Einstein provided a starting point. My next big step in this endeavour was my discovery of both systems theory and the new thinking in environmental philosophy. Systems theory provided a way of understanding individuality in a context of interconnectedness. Environmental philosophy revealed the significance of the concept of ecology as both a metaphysical and an ethical model, and in ecophilosophy, and particularly in that area of ecophilosophy known as 'Deep Ecology', all the ideas with which I had been working were pulled together, and their normative implications drawn out in some detail. It was thereafter a relief to have a label to attach to my research: when people asked me what I was working on, I could say 'the foundations of Deep Ecology'! However, in Deep Ecology the notions of interconnectedness, and of our identification with other beings and with wider wholes in Nature, tended to be highly schematic, and to be presented as axiomatic. So although my work had found a kind of intuitive and spiritual resting place in Deep Ecology, this new area of thinking had not provided me with a significant articulation and justification of a metaphysic of interconnectedness.

Such articulation and justification as I have been able to provide is presented in this book. I have related this autobiographical background because it throws light on both the structure and the method of the book. The structure, as I have said, basically recapitulates the journey. It starts with an historical and philosophical examination of

the ideological implications of that arch-metaphysic of disconnectedness, atomism. It then charts the development of twentieth-century cosmology in order to arrive at a scientifically plausible metaphysic of interconnectedness, which it discovers in the shape of the theory known as geometrodynamics. The affinities between this theory and Spinoza's are tracked, and some *a priori* arguments in favour of a geometrodynamic-style metaphysic are advanced. In the next chapter a criterion of individuation is borrowed from systems theory, and used to develop a notion of individuality, or 'selfhood', which is consistent with interconnectedness. In the final chapter the significance of this context of interconnectedness for our normative attitudes to Nature is explored. Its implications for our conception of the scope of the human self, and for the meaning of self-realization or fulfilment, are also spelt out.

On the matter of method, however, I feel some explanatory remarks are called for. I have not attempted to give a full analytical justification of every idea or hypothesis I have advanced in the text. My methodology is thus only partly analytical. It is also synthetic and holistic. To show this, the method may be broken down into the following steps.

i. I assume certain hypotheses, X, Y, Z, drawn from widely different disciplines.
ii. I show that these hypotheses are rationally plausible by providing analytical arguments in support of them. This is the analytical step. I do not claim, however, that these arguments are in every case conclusive.
iii. I illuminate the connections between X, Y, Z, and show how they all fit together to form a particular picture, P, of reality and of our place within it. Although I call such a picture a 'worldview', P is not intended to be any kind of 'total' metaphysic or world system. I am in fact concerned only with that aspect of reality that I have called its interconnectedness. P can be seen as a study in the logic and ethics of such interconnectedness. This process of fitting ideas together is the synthetic step, and it is important in its own right, even if there were no immediate evidence or justification for the hypotheses X, Y, Z.
iv. I demonstrate that P dissolves certain problems which were intractable under other models of reality. This provides a form of justification for P analogous to that which attaches to a new Kuhnian paradigm when it solves some of the anomalies of the old paradigm.
v. I leave it to the reader to decide whether P 'makes sense of things', in the sense of providing a satisfying account of our life experience. It may be that P is capable of achieving this even though the independent evidence for X, Y, Z, is inconclusive. What it is that makes a metaphysical theory or worldview such as P satisfying may ultimately have to do with aesthetic and even ethical considerations. Rival theories which are equally consistent with the 'appearances', the empirical evidence, may ultimately need to be judged according to the same sorts of principles which mathematicians and physicists invoke, those of beauty and simplicity. And since theories such as P have a normative dimension, even the ethical 'goodness' of the theory may be relevant to its acceptability. In any case it is likely to be in some

larger-than-empiricist sense that a theory such as P is felt to 'make sense of things' or not. If it is felt to do so, then P is accepted for its own sake rather than for the sake of the independent plausibility of its components. In this case we can say that the 'whole', P, validates the 'parts', X, Y, Z. This is the holistic step.

Philosophical works in the English-speaking world today tend to be read and judged from an exclusively analytical perspective. This reflects the reductive and 'atomistic' perspective of which, I would say, philosophy is still very much in the grip. But it is becoming apparent that the analytical method will have to be complemented with synthetic and holistic perspectives if the scope of philosophy is to be broadened to include the larger themes which are of such urgent importance to our endangered and endangering culture. In any case the synthetic and holistic methods with which I complement analysis in the present text reflect the anti-atomistic message of the book itself.

A few comments on the relation between physics and metaphysics in the text might also be in order here. To explain the geometrodynamical theory, even in its qualitative, thoroughly non-technical outlines, it is necessary, in Chapter 2, to trace its origins in the General Theory of Relativity. Geometrodynamics has not been experimentally confirmed, though General Relativity is of course experimentally very well established. Indeed, in certain of its mathematical formulations, geometrodynamics has even been falsified. However, it is in its qualitative, nontechnical outlines that I am interested in geometrodynamics, for in this form it provides a metaphysical blueprint or model for a physical theory. As such a blueprint or model, geometrodynamics is still eminently viable: the experimental indications within physics at present are broadly promising for a geometrodynamic-type theory, though not for the specific geometrodynamic calculi that have hitherto been tested.

This contrast between a theory considered as a metaphysic and the same theory considered as a part of physics may be illustrated by the case of atomism. Atomism as a blueprint or model had of course been articulated almost two thousand years before it became a scientific theory in the hands of Newton and others. And as a blueprint atomism exerts its influence again at new levels of physical theory, for example at the elementary particle level. In other words, as a metaphysic, atomism is not exhausted by any particular mathematico-physical presentation or calculus. It is my intention to use the basic ideas of geometrodynamics in this way in the text, on the one hand as providing a possible blueprint for an indefinite number of physical theories, but on the other hand as having a metaphysical significance and interest of its own. In the latter capacity geometrodynamics may have plausibility independently of whether or not it is supported by current trends in theoretical physics. I argue for its explanatory power at a metaphysical level—it is shown to dissolve the Humean problem of causation and to demonstrate the substantivality of space. And I mount what I consider to be a strong *a priori* argument in support of it—an argument deriving from the Principle of Sufficient Reason. Thus, while the support of current physics is persuasive, the lack of such support would not be fatal to geometrodynamics considered in its metaphysical aspect. There might well be independent grounds for accepting it. So my purpose in

this part of the book is not the illegitimate one of constructing physical hypotheses by *a priori* methods: physics has its own methods, and pure *a priori* reasoning has little place amongst them. Of course, if *a priori* arguments can be devised to demonstrate the metaphysical truth of geometrodynamics, then physicists should indeed take note of them. But the metaphysic thereby verified would not become physics until it was established by the methods of physics.

At the very end of his book, *The Return to Cosmology: Postmodern Science and the Theology of Nature,* Stephen Toulmin ponders the following question:

> Just how far, then, can the natural reason alone inform us in detail about what the overall scheme of things—the cosmos, or Creation—really is? Just how far can it tell us how we ought to act toward the other kinds of creatures that have their own proper places in that scheme—toward whooping cranes or smallpox viruses, toward sign-using chimpanzees or the fish of Lake Erie?[1]

In this book I take 'natural reason'—under which Toulmin subsumes *a posteriori* as well as *a priori* forms of reasoning—as far as I can in addressing the sorts of large and small concerns that he enumerates. But the answers that I give will ultimately depend for their acceptability upon the elusive aesthetic, even ethical—but by no means for that reason arbitrary or subjective—'satisfactoriness' of the overall vision of Nature that I try to express.

NOTE

1 Stephen Toulmin, *The Return to Cosmology*, University of California Press, Berkeley, 1982, p. 274.

1

ATOMISM AND ITS IDEOLOGICAL IMPLICATIONS

1. TWO METAPHYSICAL ARCHETYPES

As I sit writing this I gaze from time to time out of my study window. My study is in the old quarter of the university, and overlooks a pleasant quadrangle. A magnificent African Cussonia tree dominates the scene, its large sprays of leaves massing layer upon layer right up to the eaves of the sandstone buildings. Yet the leaves are individually delineated, if I take the trouble to pay attention to them—thousands and thousands of them clearly outlined one against another. The blocks of sandstone, too, in the walls of the building opposite, are well-defined, as are the slate tiles that make up the roof. Stray petals from a large blossoming prunus tree just out of view float past the window, dusky pink against the sky. At first I think they are butterflies, but no, they are petals, turning over and over as they find their way to the ground. Through the windows on the opposite side of the quad I can see books standing in line along snatches of shelves, and below, the cracks in the pavement indicating the boundaries of the stone slabs, the individual planks and lengths of metal piping that make up the scaffolding on which a man is standing, chisel in hand. The university is forever engaged in restoration. There are many, many petals lying flattened on the ground.

It is a world of things, objects, individuals—manifold in their forms, variegated in their hues, intricate in their arrangement, yet none the less invariably ultimately individuated. If I look closely enough I can always find the boundaries, the outlines, the petal that has its separate being within the heart of the flower.

Such, at any rate, has been the presupposition of our thinking, of western thought in general, and of our philosophy in particular: that the world is made up of a plurality of discrete individual substances: the world has been viewed, since classical times, as an array of individual objects which are logically mutually independent but bound in a web of causal ties. That this individualistic bias is merely a contingency of our culture is evidenced by the fact that in many human cultures it has been transcended: ideological, or perhaps experiential, factors have inclined these cultures to a flow view of things—the familiar eastern view of the world as a unity in which the appearances of

plurality and diversity are no more than ripples on the surface of an oceanic continuum.

The ideological correlates of these two opposing views of the structure of reality will, in this and later chapters, come under scrutiny, and elements of the ideological motivation for the individualism espoused by western culture will be disclosed. It is not within the scope of this book to examine in any detail eastern systems of thought *per se,* and their ideological origins and implications. But it is my basic aim to articulate, in a purely western idiom and frame of reference, certain insights which, while typically associated with eastern metaphysics, are now germinating independently in western soil.

Individualism, or, as I shall call it, substance pluralism, is a metaphysical archetype, an archetypal representation of the basic structure of the world. It portrays the world as a set of discrete, logically and ontologically autonomous substances. Its rival is the archetype which represents the world as a single universal substance—substance monism. Both of these archetypes are founded on the presupposition that the world is substantival, where by 'substantival' I mean that it is 'substantial', concrete, that it is not an abstraction or a phantasm, but an actual, physical (though not necessarily material) reality. The notion of substance which is central to both these archetypes then has a double aspect: to qualify as a substance a thing must be substantival, must exist in the concrete as opposed to the merely abstract mode; furthermore it must be capable of so existing independently of any other thing. A substance is a thing which is ontologically autonomous, capable of 'standing alone', its identity in no way logically interconnected with the identities of other things—all others could fail to exist without this in any way affecting the identity of the substance in question. It is in this sense that a substance is capable of 'standing alone'—it is capable of existing in an otherwise empty possible world. To say what a given substance essentially is, which is to say, to identify it, thus involves no reference to other substances.

Substances may be simple or compounded out of other, constituent substances. A simple substance is one which cannot be divided into parts which themselves qualify as substances. A simple substance is necessarily an ontological unity: it is indivisible. Simple substances may be considered the units of substantival reality.

Individual substances are, clearly, to be distinguished from logical individuals in general. A logical individual is anything that can be picked out as a logical subject of predication: instances would include not only ordinary material objects, but waves, properties, states, styles and abstract entities such as numbers and sets. Since material objects, as ordinarily understood, are logically though not causally mutually independent, they would appear paradigmatically to satisfy the criterion of ontological independence. Provided the logical possibility of a closed material system, for example a particle in inertial motion, is allowed, no additional problem attends the logical possibility of a universe consisting of just that particle. Such a particle qualifies for substance status. Contrast this apparent autonomy of material objects with the ontological status of other logical individuals. However: a particular wave crest could not exist independently of the wave, or the field, which subtends it. Particular

properties cannot achieve instantiation in isolation, but only in nexes, so properties do not satisfy the criterion of logical autonomy. Nor do states, since the states of systems cannot be actualized independently of systems. And styles could scarcely be realized in a universe from which their exemplifiers were absent. On the face of it then, the candidate most likely to succeed in the substance stakes is the material body.

In accordance with these considerations, the substance-pluralism archetype tends to be read as an ontology of material bodies. The complex substances are the macro-bodies of the sensible realm, the simple substances are the indivisible units of which these bodies are constituted, the tiny parcels of matter known since classical times as 'atoms'. Atoms stand in causal relations to one another, but these relations are logically contingent, imposed from without; the atoms themselves could exist independently of such relations. Relatedness does not, in other words, belong to their essence. Logically speaking, the entire universe could consist of a single atom, and its uniqueness would make no difference to its identity. Relations between the atoms, and their arrangement in space and time, are contingent. Order may be superimposed on the atomistic manifold, but no order is logically implicit in the manifold itself. Not only are the atoms not intrinsically related to one another, they are intrinsically inert: they embody no intrinsic principle of motion, motion being imposed on the atomistic manifold from without.

Atomism, then, is the traditional theoretical elaboration of the substance pluralism which is so entrenched in common sense that it is not generally recognized as a metaphysical presupposition at all. It has served as the unquestioned metaphysical framework both for ordinary thinking and for classical science. Its assumptions so saturate our western way of thinking that they have scarcely been formulated, let alone challenged, by philosophers: philosophy itself has been, and continues to be, carried out largely within a broadly atomistic framework. It is for this reason that I focus my attention, in this book, on traditional atomism, rather than on other logically possible elaborations of pluralism. I shall content myself with seeking to demonstrate some of the metaphysical and ideological inadequacies of this dominant pluralist theory, rather than attempting to refute the possibility of any variant of pluralism whatsoever. The principal aim of this book, however, is to explore the philosophical implications of the alternative—monistic—metaphysical archetype. The implications of monism have been so neglected in our philosophical tradition that I think this exercise would be a worthy one even if there were no independent grounds for accepting monism and rejecting pluralism. As it is, I think there are such grounds, though I do not think they are necessarily conclusive. In this first chapter I try, as I have already indicated, to highlight the metaphysical and ideological inadequacies of at least the dominant version of substance pluralism, and in Chapter 2 I provide both scientific and metaphysical arguments in favour of a particular version of substance monism.

It is to be the thesis of this chapter that the pluralist bias which was already present in the western outlook received its definitive authorization through the atomism of Newtonian science. And it is a further thesis that such atomism has, and has historically been taken to have, certain social and normative implications. We shall

look at these implications, both as they have been historically perceived and as I take them actually to be—where these two sets of propositions do not always coincide. But before launching into this investigation of the Newtonian worldview, I would like to consider in general terms the relation between metaphysics, or cosmology, on the one hand, and ideology, or normative thinking, on the other.

2. THE ROLE OF COSMOLOGIES IN A CULTURE

What, in the first place, distinguishes cosmology from metaphysics? Cosmologies depict the large-scale structure, origin and evolution of the concrete world. The domain of cosmology is the *actual* world, and then only the actual world *in its outlines*. In so far as an entity is capable of being actual, it may be included in a cosmology. For example, cosmologies may include not only ordinary concrete items such as material objects, but also forces, fields, minds, spirits, even deities, since all these entities are capable of being actual, of constituting an actual world. The domain of metaphysics, in contrast, ranges over not only the actual world, but also any abstract and possible and ideal realms which may exist. A metaphysic tells of the layering of reality, where the actual may be only one of the layers, others being the abstract, possible, perhaps even spiritual layers transcending the realm of the actual. Questions about the relation of universals to particulars, the ontological status of numbers, the status of possible and necessary beings, problems concerning the classification of substances, belong to metaphysics. Questions about the constitution and structure of the actual world belong to cosmology. A metaphysic and a cosmology may overlap, since the identification of the substances that constitute the actual world is part of the programme of a comprehensive metaphysic, and it is this metaphysic of the actual world, this general outline of a cosmology, which is, I think, relevant to culture.

Is there a perennial human need, which cosmology can meet, and which, unmet, may lead to dangerous cultural dislocations? Is cosmology integral to the worldview a culture embodies, where the currency of such a worldview is a prerequisite of social and psychological integrity within that culture?

Cosmologies have in the present century been dismissed by social critics, particularly those in a broadly Marxian tradition, who have lumped them together with religions and mythologies as outmoded instruments for the ideological legitimation of social orders. Cosmology has likewise been rejected on empiricist grounds—as being beyond the scope of verification procedures—by analytical philosophers in the empiricist tradition of Hume, Russell, Carnap, Ayer, *et al.* For both these parties, though for different reasons, the rise of science and of scientific methodology has spelt the extinction of cosmology as a cultural force. This is ironical, because science itself has seen a renaissance of cosmological speculation in the second half of the twentieth century, a renaissance the implications of which social critics and philosophers alike have underrated.

Do cultures in general then *need* to be informed with cosmologies? The anthropological record suggests that cultures do invariably compose stories to account for the origin and nature of the universe. Such cosmologies have typically been cast in

animistic form, and so have fallen within the classifications of religion and mythology. The pre-Socratic culture of ancient Greece was the first to depart from this anthropological norm, and to frame its cosmologies in purely materialist, non-animistic idiom. The post-Hellenic epochs of western culture have witnessed the gradual rise to dominance of this materialist view. But materialist or not, the cosmological impulse has been active in our culture as in others. Its apparent universality suggests that it is innate to human culture, and presumably then of evolutionary significance. What could its adaptive function be? Primarily, perhaps, one of orientation—a cosmology serves to orient a community to its world, in the sense that it defines, for the community in question, the place of humankind in the cosmic scheme of things. Such cosmic orientation tells the members of the community, in the broadest possible terms, who they are and where they stand in relation to the rest of creation. Some conception of a cosmic scheme of things is active too in the prescription of a system of norms, or at least in contributing to the normative tone of the community. For its system of norms circumscribes the aspirations of the community, and aspirations are proportional to expectations. Expectations, in turn, depend in part upon information, the conception of the environment. The conception of the local, empirically accessible environment helps to shape expectations in perfectly obvious ways, but since the nature and stability of the local environment depends on more remote, cosmological factors, the shaping of expectations is not independent of cosmological considerations either.

Consider, for instance, a community in the grip of a cosmology which represents the world as hostile to human interests: this world is represented as inhabited, say, by powerful and malevolent spirits which are nourished on the energies of their human playthings. The degraded status of human beings within such a scheme of things could not fail to influence the normative thinking of its unfortunate denizens: they could be expected to be pessimistic characters, with low individual and collective self-esteem, low expectations of successful interaction with the environment, and low standards of happiness, excellence and self-realization. Appeasement and placation strategies would be likely to dominate their normative thinking. Now compare such a cosmologically discouraged community with one to whom the world is represented as hospitable to human interests. Perhaps it even incorporates a positive design for the human race. At any rate, humanity is shown as standing at, or close to, the apex of creation. Such a community undoubtedly has a headstart over the other in developing enviable morale and an optimistic, expansive spirit. Its expectations of successful interaction with the environment and its standards of happiness, excellence and self-realization will likewise be high. In its canons of morality, qualities such as strength, courage and highmindedness are likely to be emphasized, and set above more ingratiating characteristics.

Cosmologies are not of course pulled out of the air to suit the convenience of the communities to which they are attached. They are conditioned by many and various historical, environmental, technological, psychological and social factors. A flourishing community is likely to evolve a bright, self-affirming cosmology, and a languishing

community is likely to see the world in darker shades. But my point here is that cosmology is not a cultural epiphenomenon; once it has taken hold of the communal imagination, it can on the one hand serve the community, tiding it through periods of material adversity, or on the other hand disserve it, undermining its morale even when material conditions improve and permit expansion. A good cosmology, in other words, is good for its adherents, and a bad cosmology predictably has the reverse effect. This is not to say however that even a bad cosmology may not be preferable to no cosmology at all. In the face of a world believed to be antagonistic, one can at least plan strategies and develop a defensive persona; one knows where one stands, and to that extent one has a sense of one's identity in relation to the world. But a culture deprived of any symbolic representation of the universe and of its own relation to it will be a culture of nonplussed, unmotivated individuals, set down inescapably in a world which makes no sense to them, and which accordingly baffles their agency. What are they to do in this world to which they do not belong? No natural directives appoint themselves. Self-interest is the only rational motive. Any other values smack of arbitrariness. Vocationless, such individuals must sink eventually into apathy and alienation, or into the mindless and joyless pursuit of material ends. With no cosmological foundation for their identity, they invent precarious individual self-pictures, self-stories, ego-images, but their sense of who they are is tenuous. Metaphysically adrift, these individuals experience insecurity; unless united by an external power, such a group does not offer the best prospect for stable community.

In the pages which follow I plan to unravel the major normative implications of the conventional atomistic cosmology as it informs modern western consciousness. That it is a 'bad' cosmology—representing Nature not as hostile but as indifferent to our interests—will be my conclusion. But our position is in fact even worse than this, for while atomism flourished into the early twentieth century, and has left us its legacy to the present day, the members of the more informed strata of present western society are now aware that atomism has been scientifically superseded. On the question of successor cosmologies however, science has been tight-lipped, or at best indecipherable. We are accordingly left in the position of a culture which clings to an outworn cosmology for fear of slipping into the even worse condition of cosmological deprivation. That many westerners have already individually slipped into this worse condition is poignantly apparent.

Science, like the rest of our thought, has developed within the framework of substance pluralism. By affirming our pluralistic intuitions its theories won an acceptance and credibility that would have been more difficult to attain had they run crossgrain to common sense. With the affirmation of science, those pluralistic intuitions were in turn reinforced, to the point where they became an un-challenged presupposition of thought.

3 THE ORIGINS OF NEWTONIAN ATOMISM

The scientific theory in which substance pluralism first came fully to flower was, of course, the prototype of all classical scientific theories, Newtonian physics. In

Newtonian physics, atomism was mathematically and conceptually articulated. The scope of the theory was cosmological: its application extended to the universe as a whole. Its significance was metaphysical in that it purported to identify the ultimate units of physical reality—the simple substances—where, as has already been observed, to do so is to delineate the metaphysical structure of the physical world.

Atomism did not of course spring freshly formed from Newton's brow: in Newtonian physics a philosophical tradition of long descent and several strands is realized. It is Gassendi who is credited in the official histories with reviving the atomism of the ancients, Democritus and Lucretius, but atomism was primarily developed, at this time, in the context of mechanism. Kepler is credited with establishing measurement and mathematics as the method for investigating Nature, and thereby breaking with the Aristotelian method, which characterized Nature in terms of forms, functions, essences: a thing was known and individuated by its qualities. For Kepler, matter, understood purely quantitatively, served as the principle of individuation. 'To me differentiation in created things seems to come nowhere else than from matter or on the occasion of matter. But where there is matter, there is geometry.'[1] He is most firmly persuaded, he says, 'that the causes of natural things are constituted by mathematics,...because God the creator had mathematics as the archetype with him from eternity in most simple and divine abstraction from quantities materially considered'.[2]

Using this quantitative method, Galileo was able to lay the foundations for the science of mechanics. But it has been suggested, notably by Pierre Duhem and his successors, that mechanistic physics did not originate even with Galileo and Kepler, but was in fact anticipated by the schoolmen of Paris in the fourteenth century.

> The science of mechanics, inaugurated by Galileo, by his rivals, by his disciples, is not a creation. The modern mind did not produce it at once and altogether as soon as the reading of Archimedes had revealed to it the art of applying geometry to natural effects. The mathematical skill acquired by acquaintance with the geometers of antiquity was used by Galileo and his contemporaries to develop and make exact a science of mechanics whose principles had been laid down and whose most essential propositions had been formulated by the Christian Middle Ages. This mechanics was taught by the physicists at the University of Paris in the fourteenth century.[3]

It is a point of controversy within the history of science to what extent the mechanistic view was really thus anticipated by the Schoolmen—whether of Paris, or of the Oxford of the early fourteenth century. The evidence does demonstrate that mechanistic ideas were in the air before they were articulated by Galileo, but it was with Galileo that they emerged as a clearly defined rival to the Aristotelian view.

The components of the mechanistic view included the mathematical methodology developed by Kepler and the atomism of the ancients, Democritus and Lucretius—where this entailed the view that there is a distinction to be made between properties

which really inhere in objects, such as figure, size, motion, and properties which only appear to observers to do so, being the product of perception, or more accurately, of the action of objects on the perceptual organs. Of these Galileo remarks, 'tastes, odours and colours and so on are no more than mere names so far as the object in which we place them is concerned, and...they reside only in the consciousness'.[4] The specifically mechanistic component of the new view consisted in the theses that all phenomena were explicable, in the sense of being governed by laws, and that those laws were mechanistic: they fell under the twin principles of matter and motion. According to this view, then, the universe would be regarded as a cosmic piece of clockwork—it and all its constituents were no more than complicated machines.

Such a view was plainly reductive, in that it reduced the variegated world of appearances to a uniform one of matter in motion. This clockwork model of the universe contradicted the medieval model, which was a blend of ideas from various different traditions. Lewis Beck gives the following account of the workaday universe of the Middle Ages:

> The universe consisted of concentric spheres of material substance, with the earth at the centre. The moon rotated about the earth on the nearest sphere, and all the gross matter in the universe was in the sublunar region, the realm of the corruptible and the changeable. Above that sphere were eight others, one for each of the known planets, for the sun, for the fixed stars, and for the *primum mobile* which, like Aristotle's God, imparted motion to the inscribed spheres. Above that sphere was the immovable Empyrean, or Paradise. Below the sphere of the moon was Purgatory and the earthly paradise; on the underside of the world was hell. Each of the spheres rotated about the earth each day...[s]uperimposed on the geometrical order was a value hierarchy. It was...a thoroughly teleological order both in its original design and in its day-by-day operation. This universe, an amalgam of Aristotelian, Arabian, neo-Platonic and Christian elements, was the universe of the theologian who read Aquinas and of the layman who read Dante.[5]

It was in Descartes' thought that mechanism was raised to the status of a philosophy, a worldview encompassing all that is real. As Randall puts it, Descartes

> set forth the idea of an exclusively mechanistic world.... Gone was the Neoplatonic hierarchy of forms; gone were all natural teleology, all final causes, all functional structure, all forms and species. Gone were 'spirits' and action at a distance. In changing natural explanation from the 'souls' of the Renaissance to the 'force' of the seventeenth century, men gained a corporeal and mechanical conception of nature in place of a 'spiritual' one. All causation is efficient, or mechanical, all is capable of geometrical formulation.... The world is no longer to be seen as a living organism, it has become a clockwork. This Cartesian revolution left a single purpose in the universe, the will of God, whose decrees must be learned by patient investigation.... And one alien substance was left in the universe, the human mind.[6]

In Descartes the reductivism of mechanistic philosophy was elevated to a principle of method, the method of reductive analysis, according to which the whole could be explained exhaustively in terms of the behaviour of its separate parts—where this contrasted with the Aristotelian method of functional analysis, according to which the parts were to be explained in terms of their relation to the whole.

The crux of mechanism is its view of the origin of motion, where it is to the motion of the particles that all material form and process is due. A particle is set in motion solely under the action of an external force and its motion may be altered only in the same fashion. The only 'force' allowed within the mechanistic framework is that of kinetic energy—the energy of motion by contact—all other purported forces, including action at a distance, being regarded as occult. Forces and particles are logically mutually independent, in the sense that the particles are not self-moving, and are not *necessarily* subject to motion. An atomistic ontology is not, we ought to note, necessarily mechanistic: it would be logically permissible to postulate particles which embody a principle of dynamism, which are self-starters and self-movers, from whose own intrinsic nature motion springs. It is also logically possible that particles should exist outside the governance of laws at all—whose motion, if it occurs, is purely random, undetermined. But the modern formulations and implementations of atomism have been emphatically mechanistic, and it is to this conventional mechanistic conception of atomism that the present critique is addressed.

The insistence on mechanism, along with the emphasis on the primary/secondary quality distinction in the Cartesian philosophy, produces a consistent effect in the portrayal of matter: matter is seen as 'dead'—as inert, passive, homogeneous stuff endowed with no inner principle of action. This version of matter receives its definitive expression in Descartes' famous mind/body dualism, a doctrine whose ramifications saturate every aspect of our western culture.[7] As Descartes sees it, mind and matter are distinct substances, logically mutually independent: mind can exist in the absence of matter, and matter in the absence of mind. Each depends for its existence only on a transcendent creator. Mind is the theatre of reason and telos, the screen or sensorium on which colours, scents, sounds, tastes have their ghostly being. Human bodies are the machines which serve as transport for these spirit minds, the only machines in fact which do so, the bodies of animals not being similarly honoured. (Descartes declared all nonhuman animals to be non-sentient robots.) The tie between body and mind in the human individual is contingent and distinctly tenuous. The locus of agency, of the power of the mind to move the body, is anatomically specific—the pineal gland. But the mechanism whereby the interaction between two distinct logical categories of being is effected is not detailed with any precision. Throughout the Cartesian philosophy there is an adamant identification of the self with the mind or spirit as opposed to the body; their association seems to be viewed by Descartes as an unfortunate contingency, the burden of the human condition.

The recognition of matter as a substance in its own right, devoid of any principle of activity—a recognition which had begun with Kepler's quantitative conception of matter—is given final expression in the mind/body dualism of Descartes. Form,

function, quality, agency, are the province of mind, inertia and mechanical motion that of matter.

It was in this Cartesian climate, which was already informed with the thought of Galileo and his predecessors, that the Newtonian worldview was forged. Newton affirmed the Cartesian vision of a universal mathematics, and was certain of the seminal tenets of Descartes' view of matter. This is not to say that there were not major discrepancies between their respective accounts of matter. According to Descartes, the essence of matter was extension, whereas Newton declared it to be mass. The Cartesian definition fails to distinguish matter from space, nor does it entail corpuscularianism, though Descartes did postulate, in somewhat ad hoc fashion, that matter was composed of particles of variable extension. Newton's view, in contrast, is essentially atomistic, and it is in terms of mass rather than extension that the 'atoms' or particles are characterized. This recognition of mass as integral to the nature of matter—where mass was a property unknown to Descartes—served definitively to distinguish matter from space, where the essence of space was agreed to be extension.

The Cartesian *physics* is entirely different from the physics of Newton, and was explicity repudiated by him. Cartesian physics was a vortex theory: space was considered a plenum, in which the only possible form of motion was circular—vortices or 'tourbillons'. The universe was set in motion by a First Cause, and the arrangement of matter therein was due to the effect of the vortices—the particles of matter being swept into vortices, where the larger, heavier particles were pushed to the centre, the smaller, subtler ones pushing in on them from the outer edges. In this way dense bodies such as the earth and the heavenly bodies were formed. Newton eliminated the plenum, the vortices, and the particles of variable diameter. Nevertheless the basic conceptual features of the Cartesian view of matter were retained by him: mechanism, reductivism and the insistence on the mathematical method (which Descartes himself had failed to implement in the development of his physics).[8]

Moreover, as I have already remarked, although in mathematical terms the Newtonian particles were unextended, the general interpretation of Newtonian physics—and that in which Newton himself concurred most of the time—was corpuscularian: the atoms were thought *really* to be tiny, solid particles possessed of certain primary properties and aggregatively responsible for the rest. As Newton himself put it, in a by now much quoted passage,

> it seems probable to me that God in the beginning formed matter in solid, massy, hard, impenetrable, moveable particles, of such sizes and figures, and with such other properties, and in such proportion to space, as most conduced to the end for which he formed them; and that these primitive particles, being solids, are incomparably harder than any porous bodies compounded of them; even so very hard as never to wear or break in pieces: no ordinary power being able to divide what God himself made one in the first creation.[9]

The corpuscularianism of Newtonian physics proved fruitful for other sciences, suggesting a kinetic theory of gases and making a truly quantitative chemistry finally

feasible. In due course, this corpuscular atomism became the paradigm for science as a whole, and it was in this form, infused with mechanism and the degraded dualist conception of matter, that it infiltrated our culture as 'Newtonian atomism'.

> In Newtonian atomism then, the world of matter was presented as a world possessing mathematical characteristics fundamentally. It was composed ultimately of absolutely hard, indestructible particles, equipped with the same characteristics which had now become familiar under the head of primary qualities.... All changes in nature are to be regarded as separations, associations and motions of these permanent atoms.[10]

The spectacular success of the Newtonian physics, its immense authority, and the vast currency which it gained, as well as the simplicity of its first principles, have ensured it an historical dominance which has resulted in the firm entrenchment of this atomistic metaphysic in 'common sense'. The Newtonian worldview has filtered into the culture at large in a fashion which has not been repeated. It is worth taking a look at the ways in which this infiltration was achieved.

4. THE CULTURAL ASSIMILATION OF NEWTONIANISM

How then did atomism make the transition from the difficult technical realm of the exact sciences to that of the popular imagination? The first factor to point to in answer to this question is the educational climate of Europe in the late seventeenth and early eighteenth centuries. It was a climate characterized by its catholicism in learning, its lack of specialization and professionalization. An educated person of the day would typically have interests ranging from the sciences through philosophy to the humanities, arts and theology. To the extent that the educated elite shaped popular consciousness—through literature, entertainment, the arts, journalism and the pulpit—its understanding of the basic tenets of the Newtonian metaphysic flowed into the general culture.

It was not only the amateur status of science, and its fascination for the reading public, that fostered the process of assimilation. Randall tells us that by 1789 not only had eighteen editions of the *Principia* been published, but so also had a flood of popularizations of the Newtonian philosophy—forty in English, seventeen in French, eleven in Latin, three in German, and one each in Italian and in Portuguese. And the most popular of all, he remarks, was Count Alogrotti's *Newtonianism for Ladies*.[11]

Philosophy too was crucial as a bridge from the technical treatises of the new science to the humanistic and literary culture—just as it was crucial in bringing the new science itself to realization. We have seen how Descartes had elaborated and expounded a mechanistic philosophy, tempered by a separate principle of mind to account for human agency. Hobbes was concerned with drawing out the moral and political implications of an even stricter mechanistic materialism, derived by generalizing from Galilean mechanics:

> the universe, that is, the whole mass of all things that are...is corporeal, that is to say, body; and hath the dimensions of magnitude, namely length, breadth and depth: also, every part of body, is likewise body...and that which is not body is no part of the universe: and because the universe is all, that which is no part of it, is nothing....[12]

But it was Locke, later in the seventeenth century, who was preeminent in establishing the new corpuscularian viewpoint as the basis for philosophical reflection. Locke refined the analysis of the primary/secondary quality distinction, and demonstrated its relevance to the problems of perception and epistemology. He did this by showing how this distinction, in a corpuscularian context, together with a mechanistic principle of causation, could ground epistemology, by furnishing a *mechanism* for the production of ideas which represent external objects. The atomism of the seventeenth century is in this way, in Buchdahl's phrase, 'built into the very bones of Locke's theory of knowledge'.[13] Locke also makes full use of the corpuscularian model in demystifying and rationalizing—'demetaphysicalizing'—some of the central mysteries of scholastic thought, for example the notions of substance, cause, and real and nominal essence.

An indefinite amount could of course be written on the influence of Newtonianism on the philosophy of the eighteenth and nineteenth, and even twentieth, centuries. Suffice it to say here that it was partly through the spontaneous agency of the philosophers that the Newtonian world-picture came to be assimilated by the literate populations of Europe. But the dissemination of Newtonianism was not achieved solely through such spontaneous means; conscious propaganda was also involved. The purveyors of the propaganda, in England, were a group of thinkers—known as the latitudinarians—who represented an ascendant power group within the Church of England. In 1691 the Boyle lectureship was established in England with the express intention of 'proving the Christian religion, against notorious Infidels', as Boyle himself expressed it in his will. The idea was to popularize the Newtonian worldview as the foundation for a new 'natural religion', as this was understood by the latitudinarian apologists. The thinking behind the attempt to develop such a 'natural religion' was that, after the political and religious upheavals of the seventeenth century—the English Revolution, the Commonwealth, the restitution of the monarchy—the Church needed to re-establish its authority by appeal to some broad principles on which all 'reasonable and sober' men could agree, regardless of their sectarian affiliations. It was hoped that Newtonianism could provide these principles.

The thinking of these apologists was explicitly political: the intention was to use the Newtonian philosophy to provide a fresh legitimation for a particular political institution *viz.* the Church, and, more generally, for the new emerging socio-economic order embodied in the commerce of the middle class. This, at any rate, is the thesis persuasively argued by Margaret Jacob in her book, *The Newtonians and the English Revolution 1689–1720*. In the Boyle lectures, she writes,

> the Newtonian natural philosophy received its first and highly simplified explanation aimed at a non-specialist audience, most if not all of whom, like the

> lecturer, could never have followed the mathematical reasoning inherent in Newton's *Principia*.[14]

She further remarks

> Without their lectures, the new Newtonian philosophy would not have existed by the 18th century as a coherent system to be understood by anyone outside the rather small circle of Newton's scientifically trained followers.[15]

For a decade or so after the establishment of the lectureship, a generation of latitudinarian churchmen—including Richard Bentley, Samuel Clarke, John Harris and William Derham—managed, by way of their widely read lectures, to infuse English culture with the elements of mechano-atomistic thinking. Their strategy was to *pre-empt* the threat of materialism—embodied, to their mind, most notably and shockingly in Hobbes—by appropriating the ideas of the new science for their cause. In this they enjoyed the huge advantage of having the allegiance of Newton himself. Nevertheless, with historical hindsight, it is possible to see that, in the long term, the attempt largely misfired. Their efforts to reconcile mechanistic atomism with theological orthodoxy provided a temporary confidence in the new vision of Nature, but in the long run it served to demonstrate the difficulty of bringing off such a reconciliation. In the process of the attempted legitimation, however, their audiences were being diligently instructed in the tenets of materialism, and they were, ultimately, to draw their own, less optimistic, conclusions. It does seem, in retrospect, that the attempt profited the cause of atheism more than it did their own.

In these various ways, then, Newtonianism filtered into and transformed popular consciousness.[16] But this transformation was equivocal in nature. The official Newtonian philosophies were optimistic and reassuring, but, I would contend, popular consciousness was shaping itself to the natural implications of the mechanistic worldview, and these were far from optimistic and reassuring.

The first demonstrably ideological interpretation of Newtonianism was, as I have just explained, that offered by the latitudinarian Boyle lecturers. How exactly did they construe the new science as underpinning the ideology of free enterprise and middle-class commerce? According to Jacob, their arguments hinged on a Newtonian interpretation of providence, or of a providential deity. Since from within the Newtonian system matter in itself is regarded as inert and passive, motion has to be conferred on it by means of an external, extra-material source.

> The Vis inertiae is a passive Principle by which Bodies persist in their Motion or Rest, receive Motion in proportion to the Force impressing it, and resist as much as they are resisted. By this Principle alone there never could have been any Motion in the World.[17]

The extra-material source of motion is, of course, supposed to be God. Moreover, the gravitational force between particles creates an order which is the manifestation of a

divine providential design: the law of universal attraction is the expression of God's will. God is therefore responsible both for the origin and maintenance of order in the world.[18] That He is a providential God is evidenced by the fact that the order manifested in the world is admirable:

> what a noble Contrivance this [Gravity] is of keeping the several Globes of the Universe from shattering to Pieces, as they evidently must do in a little Time by their swift Rotation round their own Axes.[19]

What is true of the material order, the Newtonians argued, is likewise true of the social order. Or rather, the material order provides an ideal model which it is our duty to seek to bring to realization in the social system. In the social context, God had delegated his creative power—his power to move passive matter—to us; we inherit the power to shape the social system in accordance with the materially manifested natural order.

How is this natural order to be imitated in the social sphere? As long as each individual pursues his or her own path, and obeys his or her own 'law', *viz.* the law of self-interest, subject to certain outer social and legal constraints, then, the Newtonians attest, 'order' will spontaneously establish itself at the collective level. This is the promise that animates the faith in providence: it is God's providence, manifested in the material order, that guarantees that the system whereby each individual looks to his own concerns will emanate in an ultimate, optimal social order. In this way, the latitudinarians conferred the sanction not only of Newton, but of God Himself, on the idea of a free market economy in which individuals would pursue their own material interests subject only to minimal legal constraints.

To the extent that the arguments of the Boyle lecturers serve to *legitimate* the emerging individualistic and competitive commercial order, they depend upon the soundness of the argument that the order of Nature is manifestly of *providential* design. The argument that gravitation was the expression of the will of God was incidental to the main thesis of the providentiality manifest in the natural order. But the notion of providence is in this connection ambiguous: is the duty of a providential deity to create the best possible universe with the happiest of denizens, or is it to provide the conditions for the creation and maintenance of ourselves, however imperfect these conditions, and however defective we ourselves, may be. If the latter purely anthropocentric notion of providence is assumed, then any laws which guarantee the world as it is are expressions of divine providence, since they guarantee the conditions for our own existence. But this would be so no matter how inferior the world in which we found ourselves happened to be. So this is hardly a theologically respectable notion of providence. Taking the more objective point of view however, it is by no means clear that a different world order, one which was non-mechanistic, perhaps non-atomistic and in which the principle of gravitation was different, would not be superior to the actual one, and supportive of more perfect life-forms.

That the design exhibited in the material order is reflected in the 'world politick' in the form of an individualistic and competitive economic system, however, is a

conclusion with which, for reasons I shall detail shortly, we can agree. But the conclusion that this is a *desirable* state of affairs—the conclusion which motivated the arguments of the latitudinarians and the later generations of the Enlightenment—did not follow from Newtonian premises.

The philosopher whose spectre most threatened the latitudinarian cause at this time was Hobbes. The latitudinarians had simply assumed that the physical universe, whose materiality they were otherwise prepared to concede, could not include the human mind or spirit amongst its material contents: if 'man' were made up exclusively of atoms, they asserted, it would be impossible to imagine that he could 'invent arts and sciences,...institute society and government,...make leagues and confederacies,... devise methods of peace and stratagems of war'.[20] Hobbes, however, had already presented a consistent picture of both the physical and social worlds in purely materialist terms. The human being that Hobbes presents to us in the opening chapters of *The Leviathan* is a machine. It is a machine of a very special sort, in that it is self-moving and self-directed, but it is entirely explainable in machine-terms none the less. Built into the human machine, according to Hobbes, are certain kinds of apparatus by which it alters its motion in response on the one hand to differences in material input, and on the other hand to the impact of external matter on it. The machine is even, by way of this apparatus, able to anticipate such impact, and deflect its own motion to avoid it. It seeks to persevere in its motion, moving towards those things which it registers as being conducive to its continued motion, and away from those things which appear to it as not so conducive. It is, as we would say today, *programmed* to seek whatever furthers its self-preservation, and to avoid whatever would obstruct that end. It is a machine for self-preservation.

Hobbes calls the movement toward whatever furthers the machine's existence desire, and the movement away from whatever obstructs it aversion. The human machine is thus driven by desire and aversion in its quest for self-preservation. This makes for a purely self-interested, or egoistic, psychology, and hence for a purely prudential morality. For when all motivation is reducible to an interest in self-preservation, then the only reasons for acting in the interests of others will be prudential ones: it will only be rational to serve the interests of others when one stands to increase one's own chances of survival by doing so. Hobbes is, then, as we would expect, a subjectivist about ethics: a thing is to be judged good or bad, or an action right or wrong, just to the extent that it benefits or harms the person making the judgement. There is no objective standard of moral goodness, but only the conflicting judgements born of different individuals' desires and passions. There is no common conception of 'the good' or 'the good life' that could unite people in a social order the purpose of which was the realization of such a 'good'. Human nature then is to be understood ultimately in terms of the material interests of self-maintaining machines.

Hobbes captures this highly reductive picture of human nature in his famous image of the 'state of nature'. The state of nature, according to Hobbes, is the state in which men would live if they were not subject to the constraints of civilization. In such a

state men, helplessly driven by their appetites and desires, and at the mercy of their entirely self-interested machine natures, would compete ruthlessly with one another for the goods that would benefit them. (Hobbes includes property amongst these goods.) They would in fact be in a perpetual state of war—a war of every man against every other man. In such a condition, Hobbes says,

> there is no place for industry; because the fruit thereof is uncertain: and consequently no culture of the earth; no navigation, nor use of the commodities that may be imported by sea: no commodious building; no instruments of moving, and removing, such things as require much force; no knowledge of the face of the earth; no account of time; no arts; no letters; no society; and, which is worst of all, continual fear, and danger of violent death; and the life of man, solitary, poor, nasty, brutish, and short.[21]

It is Hobbes who arrives at the central insight that, in the state of nature, all men are equal. They are equal in their capacity to kill one another (as he points out, even the strongest have to sleep). They are equal in wisdom, since wisdom is a function of experience, and experience is common to all men. And they are equal in their desire to preserve their own lives, since this impulse is, as we have seen, the essence of the human machine. It is precisely this natural equality, however, which leads in the state of nature to the war of all against all.

This then is the picture of social life that results from Hobbes' attempt both to derive a theory of human nature from a mechanistic metaphysic, and to apply the mechanistic principle of analysis to society. Since, as we have noted, this mechanistic principle of analysis always yields indivisible units of analysis, its application to social reality has the same effect. 'Whereas in natural philosophy', writes historian Collins,

> this leads usually to some form of physical atomism, in civil philosophy it leads Hobbes to a form of *social atomism*. The bedrock of social analysis is the isolated, solitary, self-enclosed *individual man*. The main problem is to discover how a number of such atomic units can be led to form a commonwealth. Hobbes denies that man is by nature a political animal, even though he needs some meeting ground with others of his kind. The individual never ceases to concentrate upon seeking his own good and satisfying his own irreducible, unassimilable endeavour.... His *fellow men* constitute his fate, his ill condition.[22]

Hobbes of course recommends that we try to transcend our 'natural estate', but he does not try to justify his recipe for 'commonwealth' by appeal to its naturalness.

That social atomism is an implication of Newtonianism was acknowledged by apologists and pessimists alike. But whereas in Hobbes the individualism implicit in social atomism is perceived as a grim and inescapable fact, in later thinkers it is transformed into a value which is to be proclaimed and celebrated. In the political philosophy of Locke, for instance, the state of nature is conceived as one in which 'men' live as equal and separate units. 'The figure of the Individual—seated on his

desert pillar—this, in brief, is the symbol with which we are left, alike by the *Essay* and the *Two Treatises*.'[23] The body politic is, for Locke, 'an aggregate of consenting individuals'. Social atomism has become, for him, a presupposition of political thought, but the isolation of the individual is not regretted by him. On the contrary, the individual has become invested with a supreme social value, an almost hallowed status expressed in the doctrine of the sacred and inalienable rights of the individual (where these include the right of property). These rights, possessed by all men, mutually limit the freedom of each man to impinge on the person and property of others. (The continual use of 'man' for 'humankind', and 'men' for 'people' or 'human beings' here merely reflects the original statement of these doctrines which arguably apply only to male human beings in any case, and therefore cannot accurately be reformulated in gender-neutral terms.[24]) The unpalatable aspects of mechanistic social atomism, so apparent in Hobbes, are thereby mitigated in Locke. But Locke's softening, indeed celebration, of individualism depends on a vision of the natural or intrinsic value of the individual, a vision which does not sit comfortably with mechano-atomistic principles. Locke was ameliorating the more strictly mechanistic vision of Hobbes with a particular kind of sentiment; he had in him, as Barker puts it,

> the great Puritan sense of the supreme importance of the individual soul; the Puritan feeling for the soul's right to determine its own relations to God, and to enjoy, at the least, toleration from the State and from all authority in doing so.[25]

This veritable institutionalization of the individual, premised on a belief in the supreme importance of the individual soul, was of course consistent with the outlook of Cartesian dualism, according to which matter was the arena of inert, concrete existence and spirit the repository of value. This essentially Cartesian view of the individual—atomistic and dualistic—blossomed into the liberal tradition, notably exemplified in Mill, a tradition which served as the ideology for an economics of *laissez-faire* and free enterprise. In the light of this, we can understand Randall's remark that

> the Enlightenment really meant the rapid spread of the aims and ideals of business enterprise and of the intellectual tests and method and model of Newtonian mechanics.... It meant that a definite and intellectually imposing expression was given to middle class ideals, which gained all the prestige accruing from the success of mathematical physics.[26]

In such ways then was the metaphysic underlying the new science used to *legitimate* the new, emerging, socio-economic order. In the case of the Boyle lecturers, the legitimating intention was conscious; in the case of the later liberal political thinkers, it is doubtful that it was so. Legitimation must be understood in the present connection in two senses: the apologists sought to show that an atomistic social order was *natural* and that it was *good,* in the sense of being beneficial to its members. Of any given social order, it may be possible to show that it is natural without showing that it is good.

(Hobbes showed that the 'state of nature', understood in accordance with strictly mechanistic principles, was far from good.) On the other hand, it may be possible to show that a given social order is good, in the sense that it serves the interests of its members, without being able to show that it is natural. But there is nevertheless a powerful incentive for political apologists to show that their favoured political systems are natural, for if they are natural, then people are likely to accept them and not protest against them. If it can be shown that a certain social system is natural, then people are less likely to blame their rulers for it, no matter how onerous they find it. If, on the other hand, a system demonstrably benefits its members, but can be shown to be out of phase with the general scheme of things, then people will tend to lack faith in it, will expect it to collapse. For this reason a thoroughgoing legitimation will seek to demonstrate not only that the system in question is good, but that it is natural.

I have no quarrel, in principle, with the ideological implementation of cosmology or metaphysics. On the contrary, as I indicated at the beginning of the chapter, I think that cosmology furnishes the indispensable context for the formulation of social and ethical norms, and a culture deprived of a cosmology will fail fully to engage with its world. However I do have a quarrel with those ideologues who sought to show that the atomistic social order implicit in Newtonianism was not only natural, but good, that is of overall benefit to its members. I shall, in the remainder of this chapter, offer an analytical—as opposed to historical—account of the social and ethical implications of Newtonianism. Such implications, as I see them, are a lot closer to those drawn by Hobbes than to those drawn by Locke and the latitudinarians. And it is the unsugarcoated implications that our culture has in fact absorbed and built into its normative structure. If Newtonianism did indeed reflect the world as it really is, then a Newtonian social system would indeed be natural, and to that extent legitimate. We would have to lump it, or struggle against the metaphysical grain in order to improve our estate. But it is clear now that Newtonianism does not reflect the world as it really is, so that we have for several centuries been labouring under a social system which is neither natural, nor, I shall contend, good.

5. THE SOCIAL IMPLICATIONS OF NEWTONIANISM

Switching then from an historical to an analytical perspective, let us try to identify those features of the Newtonian metaphysic that are truly seminal for social and environmental thought. The first thing to note is that the Boyle lecturers had focused their attention on the gravitational aspects of the Newtonian order, but that in so far as this order is first and foremost a mechano-atomistic order, gravitation is contingent to it. It is the atoms which have logical priority, in any account of the Newtonian metaphysic, because the atoms are the *sine qua non* of the entire system. Without the atoms there would be nothing upon which introduced forces, such as gravitation, could act. The world could, in other words, consist of atoms minus gravitation, but not gravitation minus atoms. It is in this sense that gravitation is contingent to the Newtonian world order. The fundamental feature of mechano-atomism, logically and metaphysically speaking, then, is that it is an ontology of discrete material substances

—atoms—which are in themselves inert, that is they embody no principle of agency: their motion is imparted to them via the agency of external forces, and in no way represents an 'unfolding' of their own inner nature. Their own inner nature is strictly passive, and is determined independently of the presence or absence of external motion. Such a basic mechanistic metaphysic may be causally embroidered in all kinds of ways, by the addition of law-governed forces and agencies. It is by way of such contingent causal elaborations that a fully-fledged physics may be constructed out of the metaphysical ground plan. But such contingent causal addenda hardly rank as seminal features of the metaphysic proper to be reflected in its social corollaries or applications.

It is worth noting, in passing, that Newton himself was well aware of the contingency of gravitation to a mechanistic order. He admitted as much in the second edition of his *Opticks:*

> To show that I do not take gravity for an essential property of bodies, I have added one question concerning its cause, choosing to propose it by way of a question, because I am not yet satisfied about it for want of experiments. (*Opticks*, Advertisement II)[27]

In fact, although the traditional role assigned to Newton is that of the father of mechanistic science (and it is in this traditional sense that I have here used the tag, 'Newtonianism'), it has now become clear that Newton himself, despite the place assigned to him by history, was far from satisfied with mechanism as an exhaustive model of the world order. Historian Carolyn Merchant quotes Newton from draft documents in the Cambridge University Library as follows:

> Matter is a passive principle and cannot move itself. It continues in its state of moving or resting unless disturbed. It receives motion proportional to the force impressing it. And resists as much as it is resisted. These are passive laws, and to affirm that there are no other is to speak against experience for we find in ourselves a power of moving our bodies by our thought. Life and will are active principles by which we move our bodies and thence arise other laws of motion unknown to us.[28]

Newton himself, then, recognized the contingency of gravitation to the mechano-atomistic world order (the order that has historically come to bear his name). Despite received historical interpretation, Newton himself did not consider this a point against gravitation, but rather a point against mechanism. He went so far as to postulate a further non-mechanistic principle, *viz.* that of fermentation, to explain the apparent dynamism of life processes. To return to our argument however, and to the historical use of the tag 'Newtonianism' to refer to the mechanistic view, we can see that, stripped to its logical and metaphysical bones, the Newtonian vision is one of a world of atoms whirling along predetermined trajectories in an absolute void. The original source of motion may be transcendent, but by no means necessarily divine. Newton