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SCIENCE, MORALITY AND METHOD IN ENVIRONMENTAL DISCOURSE

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Abstract: The environmental crisis that faces the world today is sometimes seen to be the result of making wrong turns on the path to human development. This is especially so in terms of the technologies humans adopt, the way such technologies are powered, and the morality that is at the foundation of societies that develop and utilize such technologies. Humanity has come to the realization that the technologies that were ushered in with a fanfare and that may still enjoy considerable patronage sometimes have a darker side that may exact a costly price. The situation would probably have been different if there had been credible alternatives waiting in the wings, but no such alternatives exist and the path to such alternative technologies will probably be fraught with even more dangers. The view in this paper is that the current environmental crisis is not so much a problem of making wrong choices in technology as it is a problem with the nature of our science: a science which stifles the growth of views that contradict the opinion at the centre. It argues that the discouragement of adventitious ideas is responsible for the lack of credible alternatives to current technologies and therefore the inability to discard technologies that are considered anachronistic. In view of the above, the paper argues for a liberalisation of science through the tolerance of heretical scientific views as well as alternative knowledge systems. It questions the morality of subscribing to a single method of science in an era where alternatives exist to every other human facility and argues, following Mill and Feyerabend, not only for the proliferation of technologies but also for the proliferation of sciences as a safeguard against scientific lethargy.

Key words: climate change; moral failure; proliferation in science; scientism.

Introduction

The world has recently been witnessing strange and chaotic climatic patterns which scientist adjudge to be a departure from what has been considered normal since the

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keeping of climatic records began. Such strange climatic patterns include the increased incidence and severity of droughts resulting in growing desertification, extreme dry weather resulting in huge wild fires, storms and blizzards that completely paralyze human activity, rising sea levels that lead to the loss of human and animal habitats as well as other natural disasters that cause species extinction and loss of human life. The frequency of these cataclysmic events and the human suffering they generate is generally summed up as an "environmental crisis" and sometimes gives the impression that human beings are powerless in the face of such colossal forces of nature and that the world is hurtling towards some apocalyptic end. Around the world, humanitarian emergency response teams appear to be on constant alert as environmental catastrophes become more frequent and the human sufferings they unleash become more severe. Ordinary people appear perplexed and wonder why the forces of nature appear to be so overwhelmingly against the interest of men.

In the scientific community, there is near consensus on the view that these strange climate patterns are due to human activity even though there is a small and very vocal group that think that they are part of the normal cycle of nature. Scholars who trace the current problem to anthropogenic causes identify the emissions of heat-trapping gasses from industries, thermal power plants, aircraft engines and automobiles as the culprit and cite such phenomena as the stratospheric ozone pollution and depletion, the increase of ultra-violet chart radiation and ground level air pollution as their causes and identify illnesses, species extinction, smog, acid rain, poor visibility and general atmospheric ugliness as the consequences. On the other hand, the vocal climate denial lobby that attributes it to natural climate variability usually cites solar irradiance and Milankovitch cycles as the likely culprits. The dissonance in the scientific community notwithstanding, public opinion appears to be decisively tilted towards arguments for anthropogenic causes. Thanks to information technology, evidence of atmospheric pollution and the perilous state of the planet is no longer an abstract concept but a reality that is constantly forced on the consciousness of people around the world. Such images appear to have turned the tide in the argument such that the ranks of those who attribute these events to natural climate variability appear to be continually in the decline. For instance, governments that supported the sceptics and stood on the side-lines in Kyoto, sought some accommodation in Copenhagen and accepted (if only in principle) that something needs to be done urgently to mediate the effects of human activity on the environment. Thus since Copenhagen, the problem has no longer been whether there is a need for human intervention to save the environment but what type of intervention is necessary and how such an intervention should be managed to avoid even more serious problems.

This paper explores the different prescriptions for containing the current environmental crisis as well as for preventing future ones. It starts with an overview of the poor state of the world's environment and the solutions proffered by science for its rehabilitation. It highlights the inadequacy of current scientific opinion on the subject and the need to search for solutions beyond our current scientific paradigm. It argues against the strict gate-keeping by contemporary science which has resulted in a single methodological approach for solving the problem and urges the proliferation of methods and of sciences including the accommodation of hitherto heretical scientific doctrines.

The environmental crisis

In the search for solutions to the problems of the environment, human beings naturally expect science to lead the charge. This is mainly because of the general belief that since it is science and its by-product, technology, that has created the current mess and science that has made us aware of the seriousness of the crisis, it is logical to expect science and technology to find a solution to it. This expectation is not only born of out of the above deduction but could also be said to result from the long-standing belief of human beings in scientism; "the idea that any question that can be answered at all can best be answered by science" (Dupré, 2001, p. 2). Eric Voegelin offered what is perhaps the clearest definition of scientism when he identified the three tenets of scientism as:

(1) the assumption that the mathematized science of natural phenomena is a model science to which all other sciences ought to conform.
(2) that all realms of being are accessible to the methods of the sciences of phenomena
(3) that all reality that is not accessible to the sciences of phenomena is either irrelevant or, in the more radical form of the dogma, illusionary (Voegelin, 1948, p. 462).

The belief in scientism is itself part of the larger positivist movement which has been both the main driver behind science and driven by science. The belief that science has the answer to all the problems of humanity has grown despite such early warning as that by Weaver:

> we must stop thinking of science in terms of its spectacular successes in solving problems of simplicity. This means, among other things, that we must stop thinking of science in terms of gadgetry. Above all, science must not be thought of as a modern improved black magic capable of accomplishing anything and everything. (1948, p. 536)

The response by the defenders of science has been to ask "what we have we to show for non-scientific or pre-scientific good judgment, or common sense, or the insights gained through personal experience? …it is science or nothing" (Skinner, 1971, pp.152-3). Thus humanity continues to look upon science as improved black magic with the potential to solve every human problem including such as may appear as intractable as the current environmental crisis.

Although there is widespread acceptance that the destruction of the environment is primarily due to anthropogenic causes, there is no doubt that developments in science and technology have contributed more to it than any other human development. Global warming, resulting from heat-trapping greenhouse gases is commonly identified as the single most important cause of climate change with fossil fuel industries at the core of the problem. Greenhouse gases are also produced in large quantity during the manufacturing process and some countries account for a larger percentage of such gases than others. This notwithstanding, the diffused nature of the harm done on the environment by greenhouse gases makes it possible for even the worst culprits to repudiate responsibility. Such repudiation is sometimes aided by the vocal climate denial lobby and industry, whose sole purpose appears to be the protection of Big Oil, the governments that support them, the industries that rely on them and the banks that finance them. Thus whereas there is general agreement concerning the need to regulate greenhouse gases, the activities of this denial lobby and the confusion concerning responsibility that arises there from, help those who share greater responsibility for the problem to avoid contributing to the solution. Such denial of responsibility by governments and big corporations makes it harder for individuals and groups that contribute a smaller quota of greenhouse gases to act responsibly towards the environment. This is because responsibility in this case is diffused and "our capacities to think about diffused moral responsibility are not as well exercised as our ability to think about individual moral responsibility" (Thompson, 2009, p. 80). Thus whereas there is general concern about melting icecaps and the disappearing livelihood of people in flooded coastal regions, there is still a reluctance to connect such events to individual attitudes towards the environment. But even where such a connection is made, the belief in scientism makes it possible for people to disassociate themselves from the solution and look upon science as ultimately capable of providing an enduring solution to the problem. Scientism makes it possible for individuals to maintain and sometimes increase their carbon footprints while at the same time sustaining the vain belief that the apocalyptic predictions of environmentalists will not come to pass.

Environmentalists are united in their belief that urgent steps need to be taken to forestall the end of nature but they are not so united in their prescriptions. On top of their list of proffered solutions is the reduction of greenhouse gases through energy conservation and a switch to renewable energy. This prescription requires lifestyle changes by individuals and conscious energy frugality through the adoption of energy saving technologies by corporate consumers. Lempert (2016, p. 874) makes this point while reviewing the case for geo engineering, saying:

> in an ideal world, humanity might quickly eliminate its greenhouse gas emissions. But to do so would require a radical transformation of much of the world's economy, in particular its energy, transportation, and building infrastructure.

Some scientists, however, do not think that solving the problem necessarily requires lifestyle changes. George Monbiot (1999, p. ix) for instance, argues for investments in the development of carbon capture and storage (CCS) technologies as well as more efficient nuclear reactors. His suggestions form part of a broader range of technologically savvy strategies which include sequestration, the capture and storage of carbon emissions from the atmosphere in order to reverse or mitigate the high volume of anthropogenic carbon dioxide (CO_2) in the atmosphere; ocean fertilization, a type of carbon dioxide removal that "aims to increase $C0_2$ uptake by marine biological processes (the 'biological carbon pump'), in sufficient quantity to achieve climatically significant reduction in atmospheric levels," by either adding nutrients to the water or by "accelerating the natural cycle of nutrient supply from the deep ocean, called artificial upwelling" (Wilson, 2014, p. 515); engineered weathering, an engineering process which "accelerates weathering kinetics to industrial rates by replacing the ocean's weak carbonic acid with hydrochloric acid resulting in the use of between 100–400 kJ of work per mol of CO_2 captured and stored for relevant timescales" (House et al., 2007, p. 8464); and solar radiation management, which involves "injecting reflective particles of sulfuric acid into the upper atmosphere where they would scatter a tiny fraction of incoming sunlight back to space, creating a thin sunshade for the ground beneath" (Keith, 2013, p. ix).

Although some of these solutions are still in their formative stages, they are already raising considerable concern as scientists, environmentalists and other stakeholders ponder their consequences. Referring to them as

> sets of unconventional, untested, and risky proposals for the 'engineering' of physical or chemical processes at a planetary scale to counter the consequences of elevated atmospheric concentrations of greenhouse gases in the wake of the collective failure so far to mitigate greenhouse gas emissions,

Lin (2013, p. 673) raises the concern that they run the risk of "undermining climate mitigation and adaptation efforts." This is especially so for geological sequestration, where the sticking point "is the potential leakage of the stored CO_2 which could impair the effectiveness of the CO_2 confinement and eventually lead to such serious consequences on the surrounding environments as acidification and pollution induced by the mobilization of heavy metals" (Leung, 2014, p. 436). Moreover, the process of carbon capture and storage incurs an energy penalty which might lead to an increase in the production of greenhouse gases. This is because

> each stage of the carbon capture and storage process (separation, transport and storage) requires energy, and that energy must be deducted from the output of the plants whose CO_2 is being captured. This has led to the view that the process merely provides us with a way of justifying our ongoing use and reliance on fossil fuelled energy sources. (Medvecky et al., 2014, p. 1123)

But there are also concerns regarding such processes as ocean fertilization for which successful field experiments have been conducted. This is because

> the in-situ fertilization experiments tested primarily whether and to what extent storage of atmospheric carbon dioxide in the oceans can be artificially increased for the purpose of stimulating the growth of phytoplankton and thereby increase fish stock and not as a geoengineering technique for climate change mitigation. (Ginzky & Frost, 2014, p. 83)

This is more so since it involves the "remediation of one pollutant by introducing a second pollutant into a system that has already been damaged, threatened, or altered". The concern being that such remediation "proposes, not strictly to clean up carbon emissions, but actually to move the universe to some future, unknown state". (Hale & Dilling, 2011, p. 190)

Solar radiation management is sometimes said to avoid the pitfalls of these other processes in the sense that it does not introduce pollutants into the system but merely generates a cooling effect that counters the effect of greenhouse gasses. Lempert (2016, p. 874) observes that it is both so intriguing and frightening because it is potentially so inexpensive (a few hundred millions) and fast-acting that (beginning within weeks) it could reverse a significant fraction of the global warming caused by the last two centuries of human emissions." But despite

> scoring most highly of all the geoengineering technologies evaluated by the Royal Society's 2009 report, against the criteria of 'effectiveness', 'affordability' and 'timeliness', it merely gained a 'low' score with respect to 'safety' and unlike other solar radiation management technologies, however, and certainly in comparison with carbon dioxide removal, has no

> societal or ecological co-benefits to offer alongside the primary objective of adjusting the radiative balance of the planet. (Hulme, 2012, p. 702)

Also this cooling of the stratosphere is alleged to be accompanied by a weakening of the hydrological cycle and this suggests that

> it is not sufficient to focus on surface temperature changes alone, but it is important to study the effects of geoengineering schemes on individual components (e.g. hydrology, stratospheric chemistry, ocean chemistry, terrestrial carbon cycle, etc.) of the climate system. Surface temperature change alone is not the 'only' proper metric to measure climate change. (Bala, 2009, p. 46)

Moreover, being so cheap and so effective they can become addictive and may result in us forgetting the progress needed to reduce our CO_2 and greenhouse gas emissions (Ming et al., 2014, p. 825).

Of science and method

An important characteristic of science which becomes apparent in the above response to the environmental crisis is the proliferation of ideas on how the crisis could be tackled. Scientists are not only allowed but are required to explore a multiplicity of options in response to issues of scientific interest, even when their ideas are at variance with what is respectable or popular. According to Feyerabend, "the invention of alternatives to the view at the centre of discussion constitutes an essential part of the empirical method" (Feyerabend, 2002, p. 29). This is based on the supposition that the next big thing in science may actually come out of ideas and presuppositions that are unorthodox and at variance to the idea at the centre. Thus, even when science comes up with such a prognosis as the colossal altering of the chemical composition of oceans, the idea is given a hearing, though most scientists will balk at the notion of actualizing such a prescription.

The proliferation of ideas, which has come to be recognised as the hallmark of scientific enterprise, is possible because scientific freedom is highly valued and jealously guarded by the scientific community. Whenever an attempt is made to curb a particular trend in scientific experimentation, as was attempted by the American government under George Bush in relation to stem-cell research, scientists are quick to rally against such objections under the banner of scientific freedom. Again, where the ghost of Frankenstein makes a particular trend in scientific research objectionable, as has been the case with human cloning, the sanctity of scientific freedom is invoked as the primary justification for the continuation of the trend. Here again, the understanding is that such freedom is necessary for the accumulation of knowledge and the multiplication of ideas. The ideas so accumulated need not be completely orthodox, for according to Spinoza (1866, p. 89), the right to intellectual freedom, is also "understood as the right to make any question the topic of deliberation and therefore also the right to come to unorthodox results." Thus, in a multi-pronged pursuit of scientific innovation, it is generally understood that some products of such an endeavour may be unusable or even unpalatable despite the fact that the scientists who pioneered them had noble intentions and started out with the reasonable expectation that their results would be beneficial.

But although science is sometimes willing to condone alternatives to the paradigmatic view from within its ranks, it is not always so willing to consider such views from outside mainstream science. This is strange given the fact that science suffered sustained disparagement and suppression from the church fathers at its origin and as such ought to be sympathetic to the plight of emerging modes of enquiry. Indeed,

> the principle of scientific freedom emerged from the historical experience of hindrance and oppression by state and church; and it owes its constitutional safeguarding to the same political movement that through arduous negotiations established the current freedom of opinion, thought, the press, religion and art. (Bayertz, 2006, p. 385)

But despite its history of struggle, science has, perhaps, at its moment of triumph, become as bad a taskmaster as church and state combined. For not only does it wield enormous clout on issues of state to the point of determining state policies but, as Von Weizsäcker (1964, p. 12) puts it, has become the "religion of our time". In this exalted position, science does not accommodate alternative doctrines, neither does it condone scientific heresies or any ideas that it considers to be apocryphal.

Thomas Kuhn, in his seminal work on the Philosophy of Science (*The Structure of Scientific Revolutions,* 1996), attributes the intolerance of science to the fact that it operates within paradigms, with the reigning paradigm determining the theoretical framework, preliminary assumptions and orientation towards the problems of science. Thus, a paradigm "acts like a cultural grid or filter ... it allows some aspect of reality to be seen more clearly at the expense of hiding others" (Burke, 2008, p. 244). According to Kuhn, "tightly organized communities of specialist, not individual minds, were the central actors in scientific development" (Hollinger, 2003, p. 183) and it is this group that determines the life span of paradigms based on their explanatory coherence. Towards the end of the life span of a paradigm, Kuhn maintains that science enters a revolutionary phase where the old paradigm progressively loses following and alternative paradigms that purport to be superior to it spring up. The alternative paradigms compete with one another for the attention of the scientific community until one is selected as a new paradigm based on its ability to explain a wider variety of phenomena and projections of the scientific community concerning its future utility. In this choice, however, the old paradigm still plays a role since it is what the scientific community is most familiar with. What this means is that, any competing paradigm that strays too far from what is common knowledge may not be favoured as a new paradigm. Whatever new paradigm emerges from this revolution continues the gate keeping functions of the obsolete paradigm, making sure that ideas that veer too far away from the new centre are kept at bay.

Although "most philosophers and historians of science soon came to the conclusion that Kuhn's signature concept of the paradigm was frustratingly vague" and "generally agreed that his pivotal distinction between revolutionary and normal science was hard to sustain" (Hollinger, 2003, p. 184) his work is still important for focussing attention on the social aspects of science especially on the role of such social phenomena as traditions, peers and consensus within the process of science and a fortiori on the influence of pre-conceived ideas on science. Thus, the importance of Kuhn's work is not whether the great revolutions in biology and physics fit into his mono paradigmatic model of scientific change but that he assimilated "the behaviour of scientific communities into popularly understood theories of dynamics of other human communities" (Hollinger, 2003, p. 185) and the consequent demystification of science. In other words, if scientific communities behave like other human communities, it follows that the objectivity that we routinely attribute to science is not without blemish. What this means is that scientific communities, like other human communities, are subject to social control and are therefore not completely free to pursue their ideals. Thus, whereas Kuhn argued that it is the dominant scientific paradigm (a purely scientific event) that curbs scientific adventurism, it is in reality the conservatism in scientific communities (a purely social event) that performs this function. This realization that the limits to scientific freedom are social rather than scientific entails that our belief in scientism is misplaced especially within the context of a paradigmatic science.

Social conservatism has for a long time been disguised as scientific conservatism and Kuhn identifies the Copernican world view as an early example of a scientific innovation that was suppressed by social conservatism and deemed socially dangerous by those in power. Also, Robert Proctor refers to this conservatism when he recalls the statutes of Oxford University which, prior to the seventeenth century imposed a fine of five shillings per point of divergence, on any Bachelors or Masters that did not follow Aristotle faithfully and for every fault committed against the logic of the Organon (Proctor, 1991, p. 38). Again, we are all too familiar with the English Chemist, J. J. Waterston, whose ground-breaking work on the development of thermodynamics was excluded from the Proceedings of the Royal Society because its referees thought the paper was nonsensical. The idea had to wait forty-five years until John Raleigh discovered the paper and set out to popularise its findings. The same fate befell Alexander Fleming's work on Penicillin, which languished in the archives of the Royal Society from 1929 until it was resurrected by Howard Florey in 1939. These show that the tradition of censorship has a long history and may probably have a long future in science and in contemporary times its infrastructure may contain institutionalized racism, colonialism, neo-colonialism and bias. The intriguing aspect of this censorship, however, is that it transcends individual scientific paradigms and is even exercised where no particular paradigms are in control; an indication that such gate-keeping is not scientific but social.

There are various implications of this conservatism for the current environmental crisis, especially as it relates to the steps that could be taken towards its resolution. For instance, one can argue that it is social conservatism that has limited the capacity of science to fashion out viable alternatives technologies. This is because the scientific gate-keeping that results from it has made sure that the solutions that are proffered to the current crisis do not veer too far away from the accepted norms of the science that created the crisis in the first place. Thus, whereas the problem of our environment is vastly attributed to the use of fossil fuels to power our technologies, alternative suggestions, like switching to bio-fuels merely follow the same tired approach and may in the long run be equally, if not more, destructive. For instance,

> It has become more and more evident that biofuels are not always beneficial for the environment. Intensive agriculture with the use of large quantities of fertilizers and protecting agents demands considerable energetic input and produces high degree of pollution. The actual reduction of greenhouse gases emissions is often modest or sometimes even doubtful. According to some estimation certain kinds of biofuels even produce higher degree of

> greenhouse gases emissions than fossil fuels. In addition, some other negative environmental as well as social and economic consequences appear such as soil and ground water pollution, diminished biodiversity, increasing food prices and aggravating of starvation problems in the third world countries. (Senegacnik et al., 2011, p. 64)

Indeed, a study in the US has shown that on time scales relevant for avoiding severe climate change effects, clearing and ploughing virgin land to grow biofuel crops releases more carbon than would be saved by the biofuels made from those crops (Holzman, 2008, p. 248). Thus, switching to biofuels may not be the solution that the world is looking for. Alternate technologies such as wind power may also be riddled with problems. For instance, it is not clear what consequences the blocking of the natural flow of the wind with giant wind farms will have for weather patterns and environments of the future. These dangers notwithstanding, scientists do not appear to think beyond the dictates of current technologies; they have not come up with a radically different way of powering future technologies.

Proliferation and science

A common thread that runs through the different prescriptions offered by scientists for the health of the environment is the absence of credible alternatives to fossil fuels and the myth of their inevitability as a source of energy at least in the near future. This assumption is symptomatic of what is wrong with current science and the conservatism within our scientific communities. If, as Aristotle said; "All men by nature desire to know. An indication of this is the delight we take in our senses; for even apart from their usefulness they are loved for themselves" (Aristotle, 2009, 1.980a), then the current restrictions to adventitious thinking in science as well as the general deficiency in radical innovation is only explainable in terms of the restrictions that govern scientific communities. Such self-censorship appears to have been even more successful in retarding innovation than Kuhn's mythical scientific paradigm. Bayertz confirmed this restriction when he observed, "viewing the scientific business as a whole, one cannot overlook the steadily dwindling latitude available to those in its fields and departments for producing knowledge relevant to enlightenment aims" (Bayertz, 2006, p. 387). Reference to 'enlightenment aims' here is important and is meant to emphasize the point that, even though contemporary science could be said to have made significant contributions to knowledge, the type of knowledge it produces does not objectify the knowledge envisaged by the purveyors of the enlightenment. Again, the fact that current scientific research mostly takes place within scientific institutions, which by their nature are answerable to their stakeholders, sets the stage for self-censorship. This is because their research interests are governed by the practical expediency of answering to such stakeholders, including funding agencies. Such practical realities may not permit scientific adventurism and the pursuit of the type of revolutionary research goals set during the enlightenment.

One can argue that the above criticism of science is misplaced, especially in the face of the enormous achievements of science and the benefits accruing to humanity from the products of science. Indeed, it has been argued that "science is the one area of human experience that constitutes, on the whole, a vast, almost unqualified, epistemological success" (Dupré, 2001, p. 114). It could also be argued that this success is sufficient evidence that the methods and processes of science are adequate and that there is no need to do science differently. Again, it could be argued that the long tradition of censorship based on the coherence of new ideas with existing scientific knowledge is indeed necessary to focus attention on trends in scientific research that are more likely to be fruitful and has in fact contributed to the success of science. In other words, one could argue that entertaining adventitious ideas merely dissipates the resources available to scientists and distracts the scientific community from time-tested methods and procedures. Thus, the gate-keeping of science is important and actually necessary for its progress and continued success in service to humanity.

The above arguments are valid and there is no disputing the fact that science has contributed greatly towards improving the human quality of life. But there is also no disputing the fact that science has furthered the possibility of an apocalyptic end to human existence in a way that no other human endeavour has. Science may have very good reasons for its careful gate-keeping but that does not stop us from wondering what could have been if science was not so vociferous in attacking what it considers to be pseudoscience or non-scientific approaches to knowledge. This is especially so when we consider the fact that scientific criticism is based on an approach to human knowledge that is distinctly different from those of the so-called pseudoscientific endeavours. Scientific criticism of these other approaches to knowledge has never been constructive—aimed at aiding their development—but has focused instead on thwarting their progress and eventually destroying them. The medical field provides an excellent example of this: for a long time Western orthodox medicine has been fighting to keep alternative medicine out of business. Alternative medical practices such as chiropractic medicine, naturopathic medicine and the traditional medicine of various indigenous peoples have been variously referred to as quackery, a sham and unethical by the Western scientific community. When we consider that Western orthodox medicine started out with bizarre medical practices such as blood-letting, purging and the administration of such poisonous substances as opium and arsenic but through trial and error developed into its current state, one could argue that given an identical degree of tolerance, these alternative medical practices could grow or at least conclusively prove themselves to be ineffective.

The scientific community constitutes an insignificant percentage of the world's population and its ratio to the world population is not likely to increase significantly despite the impact of science on everyday life. This means that the pool of intellectual resources available for research cannot be exhausted by current science and that the world can afford many more approaches to knowledge than current scientific enquiry. Again, if it is indeed true that competition breeds innovation and efficiency, then having an alternative to the sciences will not only be good for the advancement of human knowledge in other directions but will also be beneficial to current science. In view of this, it would appear that there should be room to explore other ways of doing science or even some non-scientific or unorthodox approaches to knowledge. Competition between different approaches to science may bring rewards to humanity, in terms of innovative products and services. It could also make current science more innovative and efficient in the sense that it will be competing for consumer space against other sciences and in doing so will strive to outdo them. Science may have made enormous progress but it is not evident that science is remotely close to exhausting its capacity for innovation. A challenge to its supremacy may be the catalyst that science needs to move into an even higher level of achievement.

The idea that gate-keeping in science is necessary to keep out oddities is difficult for the ordinary person and perhaps some scientists to understand. This is because, the specialization and the adoption of technical jargon in every science puts it in a situation where its claims appear odd to those that have not been properly inducted. For instance, for non-inductees, much of the grammar of science is odd and many scientific claims are nonsensical. One such 'nonsense' is Quantum Theory which, according to Dawkins

> is counter-intuitive to a point where the physicist sometimes seems to be battling insanity. We are asked to believe that a single quantum behaves like a particle in going through one hole instead of another, but simultaneously behaves like a wave in interfering with a non-existent copy of itself if another hole is opened through which that non-existent copy could have travelled (if it had existed). (Dawkins, 2003, p. 18)

From the point of view of common sense, it is odd that a quantum should exhibit two different behaviours at the same time, especially when the second behaviour is in reaction to a non-existent copy of itself. In a common-sense world, it is only a rational being that is expected to react to the non-existent and that is because it has imagination. To credit a quantum with the capacity to react to a copy of itself is tantamount to attributing rationality to it and that is nonsensical. It is therefore to be expected that some of the claims by unorthodox scientists or those who work in alternative knowledge systems should be unintelligible to scientists who have not been inducted into such knowledge systems. It would be counter-productive to use the scientific method and its verification principle as a standard for evaluating alternative knowledge systems, as well as those scientific trends that veer off from mainstream science. One can, however, argue that the oddities of common sense are not what are referred to here, rather, reference is made to things that appear odd from the point of view of existing scientific knowledge.

The above definition of scientific oddities notwithstanding, it could still be maintained that science has been consorting with oddities for a long time and that it is actually the scientific oddities of one era that translates into the technological innovation of the next. Nowhere else is this more apparent than in the relationship between science and science fiction, where the futuristic gadgets of science fiction point the way to future scientific innovation and development. For instance, the Black Smoke and Heat-Ray that started out as futuristic weapons in the Martians' arsenal in H. G. Wells' *The War of the Worlds*, has often been associated with the development of chemical and laser weapons during World War I and beyond. Since the appeal of science fiction lies in its realistic presentation of futuristic objects and events in a coherent and entertaining manner, one would excuse a contemporary reader of Wells for seeing nothing futuristic and imaginative about the book. It could therefore be argued that every ground-breaking innovation in science begins its journey into the scientific world as an oddity and merely loses this status as its acceptance margin grows. If it is indeed true that ideas that were once considered to be odd sometimes find their way into mainstream science, it would appear that the stringent gate-keeping of science is not to exclude odd ideas from its ranks but rather to trim the number of such ideas that make it into the mainstream. In other words, scientific gate-keeping merely replicates the Darwinian jungle in which only the best theories survive.

The good intentions of this gate-keeping notwithstanding, one could argue that a number of good ideas that had no vociferous advocates may have been screened-out through this process and that scientific diversity and versatility have sometimes been undermined by it. It is because of this that arguments for the proliferation of ideas were made, first by Mill and later by Feyerabend. In arguing for this diversity, Mill observes, among others, that the possibility "that the received opinion may be false, and some other opinion, consequently, true; or that, the received opinion being true, a conflict with the opposite error is essential to a clear apprehension and deep feeling of its truth" (Mill, 1923, p. 85), makes intellectual diversity inevitable. In reviewing Mill's arguments, Feyerabend observes that "using 'science' to denigrate and perhaps even to eliminate all alternatives means using a well-deserved reputation to sustain a dogmatism, contrary to the spirit of those who earned it" (Feyerabend, 1987, p. 34). Although there may be people who object to the views of Mill and Feyerabend, there is no doubt that diversity is good, whether such diversity has to do with the opinions of people concerning the world or even with events in the world. If as scientists say, diversity is necessary for the survival of species, it should also be important for intellectual progress. Again, if indeed we subscribe to the views of Francis Bacon (1960, p. 15) that progress is only possible on the basis of free research, such freedom should not only exist within a particular scientific paradigm but should also be extended to those who seek alternatives to such paradigms.

Morality, rationality and scientific conservatism

The solutions proposed by science to combat the current environmental challenge sometimes give the impression that the problem is beyond the capacity of science. This is because the solutions they proffer do not completely remove the heat-trapping greenhouse gases and yet may negatively impact the very foundations of life or drastically change the environment and its capacity to sustain life. This gives the impression that the solution to this crisis may lie outside current science, for as Robert Proctor argues "if our science gives us no answers, it is not because answers are impossible but because our science is the wrong one" (Proctor, 1991, p. 152). In the current context, this could be regarded as a call for a new science or at the very least, a new approach to the way science is done. But although it is easy to blame current science and see the potential for success in other approaches to knowledge, one should keep in mind that any new approach that may be adopted may be fraught with its own dangers and there is a possibility that the planet may come out of such an adventure with even worse consequences than those that are likely to come with even the most macabre prescriptions of current science. Current science, has a host of practitioners and a vast reservoir of knowledge which makes it possible for scientists to detect the impending danger in certain scientific trends and react to them as appropriate; facilities which may not be available to a new science. This however, does not make current science any safer since such early warning systems cannot detect every possible danger and raise the necessary alarm. This is to say that neither the accumulated knowledge of science nor the diversity of its practitioners makes its prescriptions any safer for humanity than those of any new science that may arise. This means that it is not the capacity of a new science to wreak havoc on humanity that makes the scientific community hesitate when asked to open itself up for competition, but what Klaus Fischer refers to as the malfunctions of science:

> deception; subordination to dominant spirit and paradigms of the times; impacts of dogmatism and social interests; ingroup-outgroup behaviour and other effects of the social structure of science; inappropriate peer review and malfunctions of prevailing academic review system; misappreciation of innovative research; impact of networking and loyalties on scientific progress; impact of economic interests and liaisons; pathological interpretations of scienticity and validity of scientific results; defects of scientometric measures as indicators of achievement, as a manifestation of the impact of medial code on science; trustworthiness or lack thereof of Science Citation Index as measure of research and scientific achievement. (Fischer, 2008, p. 1)

The harm that the malfunction of science has done to science is nothing compared to what it has done to alternative knowledge systems, which it often dismisses as myth, superstition and old wives' tales. Yet the same science is always too ready to appropriate the products of such knowledge systems. A case in point is the corporate colonization of indigenous knowledge through biopiracy, whereby big pharmaceutical and food companies sponsor bioprospecting expeditions into local communities in the hope of getting information that will lead to new products, for example novel drugs, from the biological resources they collect. The availability of such biological resources in local communities presupposes the existence of knowledge systems which, rather than being assimilated into Western knowledge systems, could be developed along a trajectory that is different from Western science. Such new methods of knowing could complement Western science and serve as an alternative to it, where the need arises. The proliferation of such alternative sciences is supported by Bacon's view that

> it is idle to expect any great advancement in science from the super inducing and engrafting of new things upon old. We must begin anew from the very foundations, unless we would revolve for ever in a circle with mean and contemptible progress. (Bacon, 1960, p. 46)

Indeed, such alternatives may yet extend the frontiers of science by bringing new insights to scientific practice or at least demonstrate the folly of such new enterprises. It would follow Mill's exhortation that we conflict true knowledge with an erroneous one in order to ascertain its truth (Mill, 2012, II. I). The possibility of new sciences developing from alternative knowledge systems should not only be seen through the lens of such sciences competing with current science but should also be seen as creating an opportunity for cooperation between the sciences and, possibly, for the emergence of a mega-science.

Insisting on a singular approach to doing science when the world has nothing to lose but may actually gain from encouraging new scientific adventurism would appear to be a case of deliberate self-harm since it involves failing to take advantage of new knowledge opportunities and thereby letting potentially preventable harm happen. The scientific community could be said to be harming itself and everyone else in the same way that individuals with psychological problems deliberately self-harm through self-cutting, self-poisoning, over-eating, under-eating, self-burning, overdosing, excessive exercising, and so forth. But self-harm may not adequately define the circumstance of current science since it does not entail what is narrowly defined in psychiatry as involving “visibly distressing instances of self-destructive or inflicted behaviour” (Gray, 2008, p. 151). In self-harm, the agent does not usually have control over his/her actions and is therefore not nominally responsible for them; rather, such actions are usually held to emanate from irrational and often uncontrollable impulses. The circumstance of current science appears to be more related to morality than to mental health and thus falls within the ambits of ethics rather than psychiatry.

It would appear that the reluctance of science to consider alternatives to its current method may also not be given a moral interpretation because “moral blame typically rests upon awareness of wrongdoing” and this “depends upon some degree of malice or negligence on the part of mentally competent actors, resulting in harm to others” (Bruhn et al., 2002, p. 476) Apportioning moral blame to science would require incontrovertible evidence that science, its institutions and its practitioners, being fully conscious of the gains accruable from the liberalization of methods and approaches to science, deliberately thwart some approaches with the intention of depriving the world of their benefits. This, however, has never been the claim of the advocates of the proliferation of sciences. Neither are such advocates willing to accuse scientists of deliberately obstructing the development of potentially beneficial science. On the contrary, it could be argued that such advocates of proliferation are aware that the caution with which scientists approach liberalization follows science’s general objective of shielding society from adventitious quacks and protecting the populace from being made the guinea pigs of eccentric scientists. Thus, if, like Bernard Gert, one accepts that “that the goal or purpose of morality is to lessen the amount of evil or harm suffered” (Brock, 2001, p. 435), one cannot legitimately adjudge their behaviour in this regard to be immoral.

The above notwithstanding, it is still possible to pass moral judgment on the conservatism of science, by regarding it as a moral failure. Unlike proving immorality, which entails showing that the agent deliberately transgressed a moral law or principle, proving moral failure does not require showing that the agent deliberately did something evil or failed to do something good; rather, it entails showing that his/her actions are negatively evaluated by the society. We may be adjudged to have failed morally when “despite our best intentions, we sometimes fail to be honest, trustworthy, or fair. Such moral failures are central to our social image because they sour others’ evaluations of us” (Gausel & Leach, 2011, p. 468). In other words, the agent ends up being seen as dishonest, untrustworthy and unfair, not because of his/her evil intentions but because his/her actions are negatively evaluated by the community. Thus, even when an agent has very good reasons for acting, such actions may constitute a moral failure if “there is a mismatch between the agent’s reasons for action and the content of morality” (McCarthy, 2002, p. 629). Thus, in answer to the question of whether it is moral to continue with a single method and approach to science in a time of great crisis, one could argue that moral wrong-doing in this case does not consist of a deliberate transgression of moral law but of being seen to be omitting to do that which is likely to be beneficial. This conclusion becomes even more relevant in the light of Tannenbaum’s view that

> good intentions, care and effort are not sufficient for satisfying an obligation. It is possible to adopt the proper end, sincerely pursue it, take care while doing so, and yet merely fail to satisfy the obligation. …we can be put in a position where effort, care and good intentions are insufficient to compensate for our human limitations. (2005, p. 76)

Thus, in failing to acknowledge gains that could potentially accrue to humanity from alternative sciences or by actively working to undermine the proliferation of such sciences, scientists could be said to have morally failed in their obligations to the world community.

Conclusion

The argument for the proliferation of sciences could, perhaps, have been more convincing if it could point to a particular alternative knowledge system or heretical science that holds the promise of developing into a new science. This, however, is not possible, as years of oppression and disparagement have made non-Western knowledge systems unattractive and therefore so bereft of practitioners that the literature on such knowledge systems is not readily available for citing. This notwithstanding, one cannot help but wonder about the science behind the ancient trephination surgical technique that was commonly practiced in Peru 2500 years ago and the tragedy that its loss has been to the world (Rifkinson-Mann, 1988). Also, one cannot fail but wonder about the science behind the vast astronomical knowledge of the Dogon, which led them to the knowledge of Sirius B, the dark and invisible companion star which orbits Sirius A every 50 years (Griaule, 1975) and what such a science could have accomplished today if it had not been violently disrupted by outside influence. The fact that revaluation field work by Walter van Beck in the 1970s could not replicate the findings of Griaule (van Beek, 1991, p. 148) tells us more about how much knowledge the Dogon and the world have lost, than it disproves the work of Griaule. There is, however, no doubt that such knowledge systems still exist at the fringes of human cultural knowledge and that a little legitimizing could bring them to the mainstream of human culture. The need for such a legitimization and the proliferation that is expected to result therefrom, is not merely for the sake of creating new spectacles for idle amusement but is, rather, an attempt at ensuring the survival and the quality of life of our species. Although some scientists do not believe that condoning heretical scientific doctrines could, in any way, save our world; one could point to the stance of the church fathers at the onset of current science and argue that neither did they believe that science would amount to anything other than a distraction from the truths of God. The scientists' argument that heretical scientific doctrines merely distract scientists from viable research and thereby dissipate the energy and resources available to mainstream science cannot be sustained. This is because the history of science is littered with such heretical doctrines as Phrenology, Fleischmann and Pons' Cold Fusion and Einstein's Static Universe which, despite being shown to have been scientific distractions, have enriched science and contributed to the expansion of knowledge. The energy dissipated in pursuit of alternatives to science is not usually drawn from mainstream science but comes either from those already disaffected with contemporary science or from those who have never found themselves within the structures of current science. The world cannot have enough ideas and there is no doubt that the same is true of contemporary science.

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