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Towards a non-violent discourse in science

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It is most appropriate to raise critical questions about science in the context of Pugwash. It was, after all, the most enlightened and aware of the physical scientists who devoted their talents to the defeat of Fascism, and who then discovered that they had spawned a monster: atomic, then nuclear weapons. In the age when thermonuclear warfare was a constant threat, those Pugwash meetings of a few brave scientists from both sides were one of the main sources of hope that sanity might yet prevail. Needless to say, the problems are different now, still quite threatening but more diffuse. We cannot even identify the two sides who should send their scientists into dialogue. The tasks for scientists have changed. Science is still part of the problem, since the environmental crisis has been greatly aggravated by the 'wastes' of our high-technology industry and lifestyle. Can it be part of the solution? How can alternative discourses be created within science? To what extent must science itself be modified if it is to contribute to meeting the new challenges to sustainability and survival?

Here I will first discuss why science must be changed, to include alternative discourses. I illustrate the old faith in science, enunciated by Galileo, and explore alternatives through the concept of Post-Normal Science. For further support, I consider some varieties of scientific experience, and describe innovations in an important social science. On that basis I can offer

some speculations as to what a non-violent would look like, and offer them to the Pugwash movement.

Why should science be changed?

First, we must recognize our debt to modern science. Over the past few centuries, the applications of science and the scientific approach to problems has brought unprecedented welfare to great masses of people. We should never forget the struggles of the scholars of the Enlightenment against dogma and superstition, fed by ignorance and maintained by suppression of free thought. Now we have a productive technology that enables us to consider a truly 'human use of human beings' (in the prophetic words of Norbert Wiener (1950)). It is no longer necessary to subject the mass of people to brutalized conditions at work and in the home for the sake of comfort for a few. This diffusion of humanity enables, and also demands, the extension of citizenship to all who are capable, no longer excluding the poor and the female as in all times past. The extension of compassion over the past half-century has been astonishingly rapid. It has become unacceptable to oppress or exclude people on the grounds of their age, gender, colour, religion, or other signifiers of the 'other'. We even worry about the welfare of other sentient beings, saving whales and protecting non-vertebrates from unnecessary pain.

For all those previous centuries, the advocates of progress never imagined that it had a price. Nature was there to be controlled, dominated, exploited or expropriated. There was implicitly assumed to be an infinite source for our raw materials, and an infinite sink for our wastes. The idea of respect or reverence for Nature was a relic of old magical or superstitious ways of thought. Now, quite suddenly in the perspective of human history, we have learned better. We know that we live in great peril, probably brought about as a product of that very science-based agriculture and industry that has given us all those benefits. Moreover, when we open a debate on those issues of long-

term survival, we find that science does not provide us with answers that are either simple or conclusive. We are led to wonder whether, and in what ways, science itself must be transformed, if it is to serve the cause of sustainability and survival.

If we think of the ways that science must be modified from its present condition, the prospect is quite staggering. For science has never existed outside society, and any reform of science will need to be part of a general reform of the way we see and act in relation to each other and the world around us. The wonderful ideal of 'pure science' was a very special cultural product of the Universities, first of Germany in the nineteenth century and then mainly of the U.S.A. in the twentieth. Before then, 'natural philosophers' and 'inventors' worked for patrons of various sorts, making themselves useful for warfare, industry or prestige. Now, as a result of the co-ordinated pressures of industry and the state, the scientific enterprise is increasingly closely harnessed to the advancement, and protection, of profit, power and privilege. The academic ideal of 'public knowledge' is steadily displaced by the realities of 'corporate know-how'. How could it be otherwise? In the modern state, either nominally capitalist or nominally socialist, the elites of power, wealth and status have control over resources for science that varies from the strong to the total.

To understand our predicament, we must start with the paradox that while spokesmen for science have always claimed that it is the true embodiment of the Enlightenment values of openness and tolerance, the reality is in some important respects otherwise. To start with, the teaching of science is, as Thomas Kuhn said (1962) as dogmatic as traditional theology. For every problem there is one and only one correct answer; teacher and textbook are never wrong. Also, the name of Science has been used to establish dominating and exclusive discourses in many fields of the study of humanity. This is most obvious, and most dangerous, in mainstream economics and the disciplines that take their lead from it. And although researchers are willing to follow any lead that leads to successful problem-solving within their paradigm, on many big

issues, within science and in relation to its social role, the practice of science offers no protection against power games and obscurantism.

It could be tempting to settle back and accept the great benefits of science, and to leave the tasks of reform to another generation. But now we have come to realise that, thanks to the progress of science itself, the situation has become unsustainable. Our modern science-based civilisation now faces two sorts of root contradictions. The more obvious one concerns lifestyle. It is now accepted by nearly all civilised people that our present lifestyle is unsustainable, even for the 'golden billion'. The environment can simply not take the damage we are inflicting on it. But there are a few billion more knocking on the door. What right do we have to preach the virtues of poverty to the poor? But, can technology be transformed quickly enough to enable them all to have cars and air-conditioners without causing our fragile environment to implode? These ethical issues concerning wealth and poverty, which had previously been a matter for politics, have now become the salient issues of policy for science, technology and survival.

The other contradiction lies in the processes of science itself. Now that science has come out of the lab, into the worlds of people, economies and nature, its effects can no longer be contained or predicted. Hence we now live in an age of awareness of 'unanticipated consequences', of 'unknown unknowns', when we simply cannot afford to do business, or science, as usual. It could be said that whereas the twentieth was the century of Einstein, for good and for evil, the twenty-first will be century of Murphy, the legendary creator of the Law that whatever can go wrong, will. Our conception of science, forged by its creators in the seventeenth century, depends on knowledge and power constantly advancing, banishing ignorance and impotence. For science to come to terms with ignorance, as well as with the global sustainability problem, it will require a new philosophical revolution. The traditional discourse of science has got us into this impasse; some other discourse will be needed to get us out of it.

The scientific faith we have inherited

No philosophical revolution comes easily. Science is central to our civilisation, and indeed defines it in many ways. It is not only a form of knowledge and the basis for our means of production, but it is also an ideal of knowing and doing, standing in explicit opposition to other ways of knowing and doing. To imagine the task of creating a comprehensive and coherent alternative discourse, we might consider what happened in the Reformation. Then the ideological dominance of the Roman Catholic Church was challenged, successfully in many places; but each challenger solved his own problem, and unity among the schismatics was never achieved. On the one hand the various theological issues were bound together in tight and complex ways; on the other, no agreement could be reached on an alternative discourse on the essence of Christianity, then or now. Many people will look back on that historical episode as a positive move for humanity, both in political freedom and in the quality of religion itself. But the immediate price was high: more than a century of civil wars, and the discrediting of religious discourse and its progressive displacement from the centre of culture.

To take the analogy seriously, I believe that the core of the universal modern scientific faith can be found in the classic pronouncement of Galileo:

"If this point of which we dispute were some point of law, or other part of the studies called the humanities, wherein there is neither truth nor falsehood, we might give sufficient credit to the acuteness of wit, readiness of answers, or greater accomplishment of writers, and hope that he who is most proficient in these will make his reason more probable and plausible. But the conclusions of natural science are true and necessary, and '*l'arbitrio humano*' has nothing to do with them." (J.R. Ravetz 1971: 18)

I have kept the Italian for that crucial phrase, since it conveys both judgement ('arbitrate') and will ('arbitrary'). Thus, uncertainty and value-commitments are both foreign to the achievements of the scientific enterprise. In the past many commentators (following Galileo himself) contrasted this perfection of science with the failings of all other spheres of activity and knowledge. Scientists have become a special priesthood, performing the daily miracle of discovering Truth. Having gone through years of indoctrination in which all problems have one and only one solution, they naturally expected to have infallibility. As they were protected from the temptations of ordinary careers, their integrity was guaranteed, and they could do no evil. In the terms of this secular religion of Progress through Science, the task of 'society' was to enable the scientists to make their discoveries unhindered, and then for society to drink from 'the fountain of facts' which they generously provided for our benefit.

When does such a total system of ideas and institutions become vulnerable to change? We are familiar with the corruptions (mainly involving sexual behaviour) within the contemporary Roman Catholic Church, that have brought it to a state of crisis. We should remember that Luther's Reformation was triggered by the discovery of corruptions of a sort appropriate to those times, the sale of 'indulgences' whereby the purchaser paid in advance at a daily rate for a reduction in his time of being purged of his sins. This is a reminder that the weakness of a dominating institution is more on the moral than the practical plane. It seems that hypocrisy is the vice that more than any other that causes revulsion, rejection and collapse.

The errors of the atomic scientists of the Pugwash generation were not the stuff of corruption. The great danger to humanity posed by Hitler meant that only a pacifist conscience could justify refusal to work on the atomic bomb. The extension of that work to the Hydrogen bomb became morally complex, but the supposed danger from the Communist world could still plausibly justify it. But as 'big science' got underway, the combination of technological

and environmental disasters, together with a perceived arrogance of the scientific community, led to an erosion of public admiration and trust. Three Mile Island and Chernobyl became icons of the failures of science and of scientists. But now that 'mega science' is drawn ever more closely into the morally dubious worlds of profit, power and privilege, the new scandals begin to cut into the heart of the scientific enterprise: its integrity.

The image of scientific integrity has been increasingly compromised by the involvement of science with power and its mixed consequences, as well as by the discredited hype for civil nuclear power and by the recent scandals of science-based consumer industries (BSE, cover-up of harmful pharmaceuticals, junk-food with sugar, salt, fat). As an example of the new image, John le Carré's *The Constant Gardener* (2001) is no more an exposé of corrupt drugs trials by science-based multinationals than *The Sopranos* is an exposé of the folkways of New Jersey gangsters. In both cases the evil is an uncontroversial plausible background element of the plot. 'Trust me, I'm a scientist' has become an ironic motto in the U.K.

What sorts of consequences could there be, of a general discrediting of the integrity of scientists in the policy process? Up to now there has been the naïve belief of many campaigners, that 'my' scientists are all true and honest, producing the damning facts, while 'theirs' are corrupt and dishonest, providing the cover-ups for their immoral acts. This could easily slide into the cynical assumption that all scientists in a debate, mine as well as theirs, are just hired guns; if they don't deliver to order, we get rid of them and easily find others. Should this view become common-sense, then we will come to the irrelevance of all expertise; any person can decide for themselves whether they are being polluted or otherwise oppressed. Such anarchy soon gives way to tyranny, where in the absence of any attempt at a civilised debate, naked power rules unhindered, and the only struggles are between rival mobs. In terms of science related to policy, this would be a situation where a pseudo-debate goes on, like elections in a banana-republic, but where the immediate demands of

profit, power and privilege rule without challenge.

Since such processes of degeneration have occurrred, and are indeed still occurring now in many civil societies, we should not dismiss such scenarios are unrealistic doom-mongering. The theme of creating alternative forms of scientific practice and their associated discourses, is among the most important tasks for the preservation of civilisation in the troubled times to come. Alternative voices within science have, up to now, been totally marginal. Where can we look for examples of a reasoned critique, not merely of this or that abusive practice, but of the whole enterprise?

Post-Normal Science

There have been many calls for a different sort of science. I have noted 'critical science', 'citizens' science', 'civic science', 'community research', 'action research', 'open science' and 'see-through science', as well as 'environmental', 'ecological' and 'sustainability' science. Each in its own way challenges some aspect of the current dominating discourse in science. This was, after all, the aim that Silvio Funtowicz and I had when we launched 'post-normal science'. For we could see that the illusions of certainty and objectivity, fostered for centuries by philosophers, teachers and publicists, have been making science ever more vulnerable to domination by the interests of profit, power and privilege, and ever more dangerous to our survival.

In our analysis we used the device of a quadrant-rainbow, with three zones. The first is 'applied science', corresponding to the uncritical, indeed anti-critical 'puzzle-solving' normal science identified by Thomas Kuhn in his book *The Structure of Scientific Revolutions* (1962). Then there is an intermediate zone, where either or both 'systems uncertainties' and 'decision stakes' are moderate. This is the world of the professional, say the surgeon or senior engineer, using science but needing to cope with uncertainties and emergencies. Then the outer zone, post-normal science, is where 'facts are uncertain, values

in dispute, stakes high, and decisions urgent'. Inquiry in this area requires a new discourse, one of 'dialogue' instead of 'demonstration'. It also needs a new methodology including (and here we go political) an 'extended peer community' of participants who bring their own knowledges and their own commitments to the table.

(Insert PNS diagram here)

Post-Normal Science enables us to recognise and then to move on from the assumption that The Expert Knows Best, that his discourse is the only legitimate one. He might be the researcher or the professional, or even the technician. He has the training, and he can spout scientific technicalities that leave the layperson totally bemused. In the conventional model of the process, the expert person starts with the science, and then deduces what should be done in practice. This model assumes that the world of practice is sufficiently like the world of science, so that his deduction is accurate. For 'applied science', it works routinely; for 'professional consultancy', it needs some skill and judgement in interpretation. In those traditional cases, those without expert training would seem to have little to contribute to the process of inquiry or decision.

When we come to the situations where Post-Normal Science is appropriate, where uncertainties and value-loadings cannot be denied, we see that old model of scientific demonstration is inappropriate. Instead we need a discourse that embraces dialogue. In this situation, everyone has something to learn from everyone else. Of course the experts will have a special command of the more technical issues. But others might know better how well, or how badly, the scientific categories fit in with the reality that they experience. Many policy debates hinge on 'safe limits'. It doesn't need a Ph.D. to be able to ask intelligent questions about safety tests, and to inquire whether they are truly realistic in relation to practice. For example, we might need to know whether

the sample populations in a pollution study included children and pregnant women, or animals that breathe air close to the soil. Or we might need to know whether the specifications for safe use of equipment are likely to be respected in real industrial or agricultural situations (in Third World locations, it is prudent to assume that they are not). All such observations and criticisms can be put by people who have independence and common-sense. People with local or practical knowledge can spot these sorts of flaws more effectively than experts who are trained up in a standard doctrine and who need to interpret reality within its confines.

This new perspective on science has benefits for the scientists themselves. They can be liberated from the confusion and self-doubt resulting from their discovery that some scientific problems cannot be solved by 'normal' methods. The failure to produce conclusive information about pollution or climate change is not the fault of the science or the scientists themselves. It is because we live in a new age of policy where science is necessary but not sufficient for solutions. For their part, the extended peer community are no longer relegated to second-class status, and their special knowledge is no longer dismissed as inferior or bogus. They are full partners in the dialogue, who have much to teach as well as to learn. That is the way forward, as expressed in the title 'post-normal'.

The growing success of the idea of post-normal science indicates to us that it has helped to open the way to a genuinely alternative discourse. The arrogant expertise of the policy scientists, of the sort that once so firmly assured us that nuclear power would be so cheap that we could throw away the meters, is now challenged routinely by other legitimate voices from NGO's. But the politically effective criticisms and protests have been focused on special issues, of safety, health and the environment. Even though it is also well known that some branches of science have been suborned by commercial interests (notably pharmacology and its related disciplines), there has been no systematic critique of science. This critique would need to extend to the exclusive discourse of

science that embodies crucial assumptions about the the world and our interaction with it.

Background: varieties of scientific thought and endeavour.

One of the most powerful means of encouraging an alternative discourse is to show that the work has, in many ways, already been done. All the different sorts of propaganda for modern science have focused on the vision of Galileo and his fellow prophets, as if there were nothing worthy of the name of real science before them. This vision included a very special metaphysics, of Nature reduced to mathematical quantities, and also an implicit social practice, of isolated experts discovering isolated bits of truth. Even as a matter of historical record, this picture is quite misleading. Other founders of modern science, as William Gilbert (who disovered the earth's magnetism), William Harvey (who discovered the circulation of the blood) and Johannes Kepler (who discovered the basic laws of planetary motion) all inhabited a world where life and meaning were present and let their science be guided by their cosmology.

A study of history, or of science enriched with an historical perspective, would remind us that civilisations come and go. For some centuries Western Europe north of the Pyrenees was backward and barbarian, while the Mediterranean lands of the Islamic civilisation flourished. Our debt to their science and technology is enshrined in words like 'muslin', 'alcohol', 'chemistry' ,'algebra' and even 'cheque' (U.S. 'check'). As we have now come to understand it, classical Islamic science had its own intellectual and ethical framework, derived from the moral injunctions of the Koran. Further east, in their own ways the Indian and Chinese civilisations produced great and progressive science, which we have only recently come to appreciate through therapies like yoga and acupuncture.

Typical of the debt to the East, and of Europe's failure to recognise it, is

the list of the 'Three Great Inventions' with which Francis Bacon explained the rise of European power during the Renaissance. Little did he know that printing, gunpowder and the magnetic compass all derived from the East, with transmission and perfection under Islam. One of the great issues of world history is how these three imported inventions became the tools of the European conquest of the world.

If we go further afield, we discover that our present conception of the real world as a mathematical model is perhaps not so all-powerful. The Sanskrit writings of ancient India show a refined awareness of consciousness and its varieties, that far exceeds ours. The cultures of Egypt and Tibet had a deeper understanding of the psychology (and hence the meaning) of dying, than we can even hope to imagine. If we go back further in time, we discover cultures in which art, science and religion were indistinguishable; thus the marvellous cave paintings from twenty-thousand years ago, where rituals of the hunt left their traces on the walls. It is a mark of our modern scientific arrogance that the professional archaeologists at first dismissed those paintings as forgeries, since 'primitive man' could not have been capable of such great aesthetic productions.

An example of innovation.

Since science works so well (up to now) on the less complex systems in the world, we need to go to the social sciences to see arrogance defining whole fields. A prime example is mainstream economics. We are all familiar with the jargon-laden discourse of mainstream economists, living within their closed world of pseudo-quantification and vacuous mathematisation, all in the service of corporate interests who would destroy a genuine competitive market as soon as they saw one (Mirowski 1989).Perhaps therein lies the vulnerability of conomics; its pretensions to be the physics of society (on a thoroughly Victorian conception of physics) have become just too blatantly fantasised and corrupt.

Now a coherent and increasingly important critical voice is developing within Economics. Some five years ago a group of French students launched 'post-autistic economics'; on the basis of its success, there is now a broader movement of 'heterodox economics'. In this alternative discourse, it is permissible to criticise the abstract mathematical models of the mainstream tendency, and also (heretically) to include institutions, politics and the environment in fundamental theories of economic behaviour. Both these movements are aware of the danger of imposing new orthodoxies for old, and so they are fully committed to openness and debate, letting all the perspectives and tendencies learn from each other. (Their materials can easily be found on the Internet).

Could such a movement occur within natural science? There is one obvious difficulty: in economics, much of the syllabus is obvious nonsense, and any student could, given half a chance, see this. But in science the contents are, with all their limitations, correct. It is hard for someone raised inside the system to imagine an 'alternative science' syllabus. At the risk of shocking my readers, I must say that this correctness is an illusion. I am not 'deconstructing' science as a whole, claiming that it is a mere expression of power, or male prejudice or whatever. I am focused on teaching. What is taught at any given level in science is exposed at the next higher level as a caricature, simplified and vulgarised for the sake of immature minds. And then again at the next higher level, and so on. We can get away from the idea that the materials of science as taught deserve some special reverence. We do best to think of them as tools, perhaps analogous to software, which certainly have their utility and the reality-testing, but nothing like being 'true and necessary' along the lines of Galileo's faith. In this way, the taught materials of science embody uncertainty, in that they cannot correspond even to what the research scientists know. They also embody values, in that whatever is present in a syllabus is there because by processes that are in part political, rival materials have been excluded. The debates on syllabuses are never on which content is more 'true', but rather on which is more valuable. Hence even the most elementary materials provided to science students are, to some significant extent, post-normal.

In my new book *A No-Nonsense Guide to Science* (2006), I go through other myths about the scientific enterprise, hopefully providing the elements of materials for a critical movement within science analogous to heterodox economics. But that is only the first part of the task. Once the scales have fallen from one's eyes, it is easy enough to demolish an incoherent intellectual structure. It takes more dedicated effort to reconstruct, so that the outcome is not cynicism and chaos. Can we think of an organising idea whereby the criticism of science can be enlisted in a positive cause? I have already given a list of candidates, but none of them have caught my imagination. Even 'post-normal science' is backward looking in all sorts of ways. What could be the leading idea for an alternative discourse for science?

A suggestion: non-violent science.

Let me offer a suggestion for our consideration. What about 'non-violent science'? Although the term is negative in its form, it describes one of the most positive developments in human civilisation in the past century. It encapsulates the vision of science developed by Ervin Laszlo in his book *The Chaos Point* (2006), where the paradigm based on 'conquest, colonialisation and consumption' (the historic context of European science) is replaced by 'connection, communication and consciousness' (the properties of any science of sustainability). Suppose that mainstream science had heroes like Martin Luther King and Nelson Mandela; would not that raise commitment and morale among the best of our young people? We must ask why it has not. After all, even Joseph Rotblat had to choose between research and political endeavour; and although his choice was certainly correct, he did stop being a 'scientist' in the narrow sense that is assumed in the communities of researchers.

Of course, the the situation is not completely polarised. Some scientists find work on environmental and social issues, and others do educate the public

and use their influence to spread the message of enlightenment. Among the latter, Martin Rees, one of the UK's most distinguised scientists (now Master of Trinity College Cambridge, President of the Royal Society, and Astronomer Royal) has written a popular book (2003) where he faces the big question of whether we will survive this century. He is not alone, but scientists with such vision and courage are still in the minority. The organisation Scientists for Global Responsibility, which includes Martin Rees as a prominent member, has made a start on this transformation of consciousness among scientists, and opened the way to alternative discourses of science in which ethical issues are recognised rather then being ignored or suppressed.

Out of our answer to the question of why science has not had great heroes of non-violence, we can approach a picture of what non-violent science would be like. That would empower a discourse that is alternative to those of the myopic puzzle-solving research that is reinforced on scientists, by pressures from their subject-specialties, from industry and from the state. And it would need to engage with the fact that violence has been deep in scientific practice from its earliest days. The first time that a scientist suffered professionally from engagement with war was when Joseph Haber was condemned for developing poison gas for its first use by the Germans in World War I. Only with the atomic bomb, and the generation of Joseph Rotblat, did leading scientists seriously consider the evils of the violence to which they were contributing.

The very conception of non-violence in science is therefore very new. I am at the very beginning, and I can think of a few themes. First, I would like us to think seriously about what non-violence would mean in science. There is the age-old concept of 'ahimsa', the core of the still vital Jain religion, which animates a totally positive life. Gandhi adapted that idea to one directed more at the self: 'satyagraha', a struggle for truth to oneself, implying the same virtues of humility and forgiveness. Clearly, the Buddhist virtue of compassion, the wisdom of the later Hebrew prophets, Christ's teachings in the Sermon on the Mount, and Mohammad's teaching of Surrender (Islam), are all

saying the same thing in different ways. In the present period, Gandhi's message has (so far) been less diluted than some of the others. Let us make a list of the attributes of a science based on satyagraha, focused on ourselves. These include awareness: of one's own ignorance and propensity to error; of the readiness to learn from anyone, be they a student or a citizen; of responsibility for the unanticipated consequences of one's discovery or invention; of the possibility of doing evil in the name of good; and of the contradictions that afflict anyone who faces the corrupting pressures of power or responsibility.

The details given above are to some extent arbitrary, based on my own preliminary vision of things at this moment. The first element is learned by competent scientists as they see the fate of their own limited efforts in the onward sweep of scientific progress. As to the others, the experience of working scientists is quite restricted or even nonexistent. Only in the Vietnam years did some American scientists confront such issues. That is a measure of how far we are from a discourse of nonviolence in science, and indeed why my own ideas are so rudimentary. Could there be a programme of education, and a fellowship of scientists, based on such principles, so that an alternative discourse of science could be created? Perhaps. There are already some materials at hand. In India, Vandana Shiva has built nonviolence into her total philosophy of Gandhian activistm (2005). In the West, David Waltner-Toews (2004) has an holistic approach to ecosystem health that embodies nonviolence in practice. In addition to Scientists for Global Responsibility, there are university programmes for the study of ethics in science, and the journal *Science and Engineering Ethics*. Some guidance also can be obtained from the writings of scholars, such as Karl Popper with his emphasis on the fallibility of science (1963) and Robert K. Merton with his 'four norms' of ethical scientific practice (1973). In this list the last word could be with Galileo's contemporary Descartes, who said that he could not bring himself to work on projects that could do good for some only by doing harm to others (1638: part 6, end).

Above all, there must be dedication, of the sort that scientists of old had

in their search for truth. Through a discourse of non-violent science, that dedication could find both a new goal of service for science and an enhanced self-consciousness in its practice. In that way, science could find a worthy new mission. If the Pugwash movement were to intiate a dialogue on the meaning, and realisation, of a non-violent discourse in science, that would be a worthy memorial to Joseph Rotblat.

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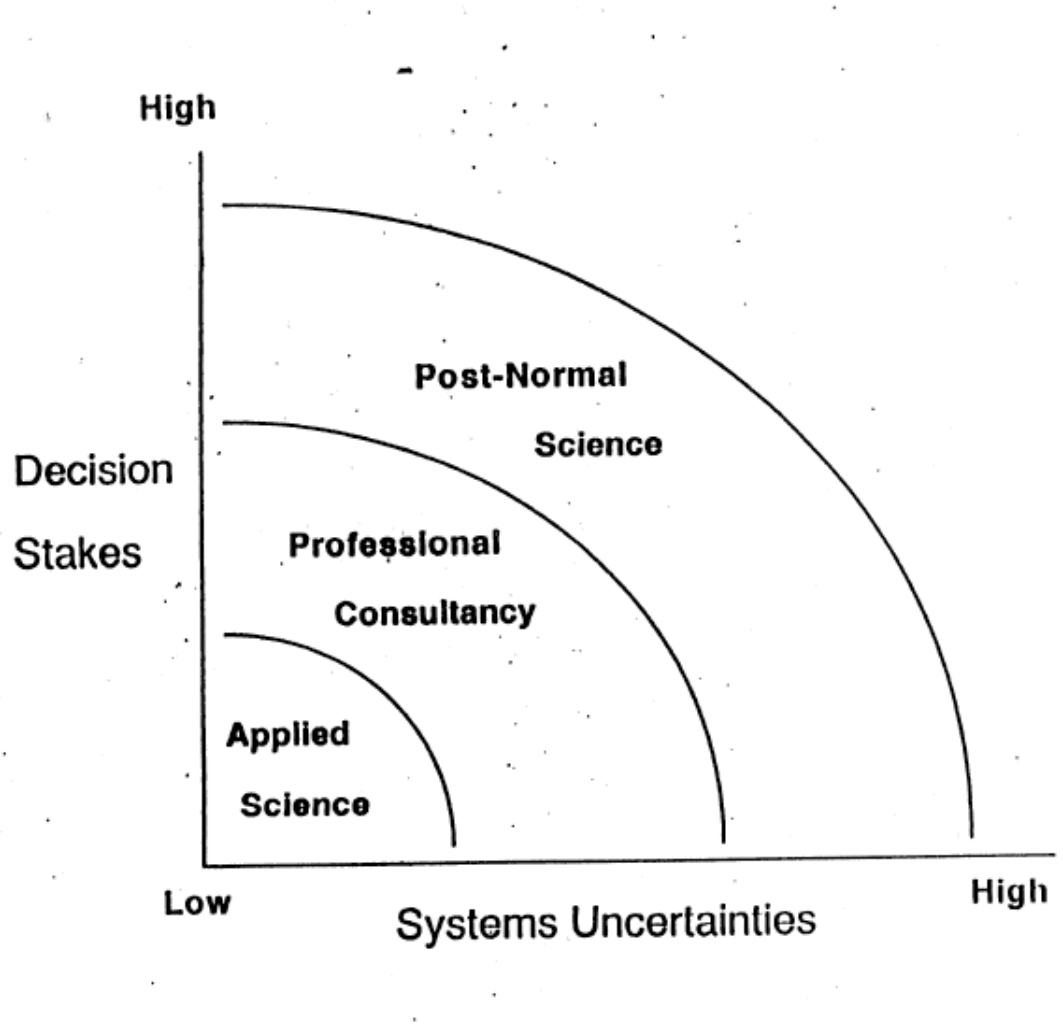

Post-Normal Science Diagram

addendum

Capitals in my text

Nearly every time I have used capitals, it has been deliberate, to convey something special about the term. Thus I have Nature and 'Progress through Science'. I believe that 'Post-Normal Science' is a special title.

I will change 'Professional' ('the world of the Professional) if you wish.

I will also change Economics.