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Post-Normal Science and the complexity of transitions towards sustainability☆

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ABSTRACT

The theory of Post-Normal Science is now approaching obsolescence; it needs to be renewed and enriched. In historical perspective, PNS evolved from a criticism of Probabilistic Risk Analysis, and put the essentially political idea of Extended Peer Community at its core. Establishing the legitimacy of the EPC requires a review of the methodology of science in the policy process. The time is not ripe for a modification of PNS, and so the best move forward is to raise the issue of Sustainability. For that I sketch a theory of complex systems, with special attention to pathologies and failures. That provides the foundation for a use of 'contradiction' as a problem incapable of resolution in its own terms, and also of 'characteristic contradiction' that drives a system to a crisis. With those materials it is possible to state the characteristic contradiction of our modern industrial civilisation, and provide a diagram with heuristic power.

1. Introduction

The roots of our problem can be traced to a philosopher who wrote these lines while a resident in the city of Utrecht:

> "...it is possible to reach a kind of knowledge which will be of the utmost use to men, and that in place of that speculative philosophy which is taught in the Schools, we can achieve a practical one by means of which, by ascertaining the forces and action of fire, water, the air, the heavenly bodies, and the skies, of all the physical things that surround us, as distinctly as we know the various trades of our artisans, we can apply them in the same way to all the uses for which they are fit, and thereby make ourselves the lords and possessors of nature (Descartes, 1638)".

Descartes' dream was to realise the power of the magicians and alchemists, but to exercise it over a disenchanted nature that is tame and safe. In this vision there is no longer need for awe of the world and its supposed Maker, nor a need for awareness of our ignorance. Such hubris was certain to bring about its nemesis. Our awareness of this historic drama of our civilisation started with the Bomb, and it now continues to grow through the environmental crises of this century.

With that perspective, we must ask, to what degree is our inherited science part of the problem, and how must it be modified if it is to become part of the solution, understood here as the transitions to sustainability.

In this essay I will deal with a natural sequence of themes. The first is Post-Normal Science (Funtowicz and Ravetz, 1992, 1993, 1994a; Ravetz, 1999a, 1999b, 2001, 2005). I will review recent developments in the theory, which serve to improve its scope and effectiveness. But I must recognise that the theory is approaching obsolescence, and I face the problem of how to manage a transition to a new basic insight. This will be based on my qualitative version of complex systems theory, which (exceptionally for that field) focuses on imperfection and

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failure. Within systems theory we can understand a special version of the concept of 'contradiction'. I extend that to speak of the 'characteristic contradiction' of a system. With those conceptual tools, I can analyse the problematique we face, with the twofold contradiction of affluence (expropriation of the poor and of the environment), now challenged by the desire of the poor to have 'development' and thereby make their own contribution to the ecological crisis. I produce a diagram which describes this compounded characteristic contradiction; and in conclusion I have a diagram describing the parallel technical fixes, among the rich and the poor. Finally, I ask whether there are other approaches, following the spirit of Gandhi, that might be effective.

2. New understandings of Post-Normal Science

In the quarter-century since PNS was first conceived by Silvio Funtowicz and myself, the politics of uncertainty has been transformed. Since PNS has always had strong political aspects, we should consider whether and in what ways its content should now also be modified.

The principal policy context of the original insight of PNS was probabilistic risk assessment. This scientific field, created mainly in the service of civil nuclear power, attempted to apply standard mathematical methods to problems where the uncertainties were actually overwhelming. The 'probabilistic risk assessments' enjoyed an initial plausibility because they were presented as Science, that is objective and certain, free from bias and doubt. The policy agenda was clear: a risk of one-in-a-million is acceptable, hence an installation with such a risk is scientifically proved to be safe. In many of the national debates, those who criticised those exercises were branded as subversives or sectarians, motivated by political or even psychological agendas in their opposition to the authoritative judgements of the established scientific communities. Only with the Three Mile Island disaster, when a reactor with a one-in-a-million chance of a serious accident exploded within a few months of start-up, did the façade of scientific complacency and arrogance begin to crack. The risk analysts had to admit a category of 'zero-infinity' risks, strictly speaking with negligible probability but unacceptable harm. The product is indeterminate, and so quantitative risk analysis found its limits.

The task for the philosophical critic then was to show that not all problems with a scientific appearance are capable of solution in orthodox scientific terms. The way had already been opened by Alvin Weinberg, with his concept of 'trans-science' (Weinberg, 1972). For him the distinction was one of degree rather than kind; and he was pleased when a crucial trans-scientific problem could, through advances in technique, be tamed. We had to show that the difference is of kind; that there exist some problems which are in principle not reducible to 'puzzle-solving' normal science in Kuhn's term (Kuhn, 1962). Further, we wanted to use this philosophical argument to justify the extension of participation in scientific debate beyond the closed circle of accredited expertise. For this we had a few examples in mind, all relating to risks. One was of Dan Ford of the Union of Concerned Scientists, a lawyer who mastered enough of the relevant nuclear physics to demolish an industry spokesman before a Congressional committee. Even more significant was that of Sheldon Krimsky, who showed that ordinary citizens of Cambridge, Massachusetts were quite as competent as anyone else in assessing the safety standards of a proposed lab for recombinant DNA research at Harvard. And there was Phil Brown, whose story of Woburn, Massachusetts showed how entrenched experts could react when citizens tried to do something about their own health and safety issues (Brown, 1990). Between them, they provided the initial empirical foundation for the what we called the 'extended peer community'.

Our solution to the philosophical problem is by now well-known; we achieved the necessary distinction by means of a standard gambit, that of demonstrating an undeniable intermediate case. For us it was 'professional consultancy' (a label that took some time to achieve). Here we have a very distinct occupational role, actually one that typically has more prestige and remuneration than mere research. It uses science; but its problems, and hence its solutions and its methods, are radically different. The key difference is that both 'systems uncertainties' and 'decision stakes' are significantly higher. The professional must cope with greater challenges of uncertainty, and more is dependent on his success or failure; hence s/he justifiably gets greater rewards than the researcher. In the UK, professionals are organised in 'Institutions', while scientific specialties only have 'Institutes'. With that intermediate case firmly established, we could argue that Post-Normal Science is qualitatively different practice from 'normal' or 'applied' science (Fig. 1).

Now, 25 years on, 'uncertainty' has become respectable. We even find 'unknown unknowns' in popular discourse, with the most surprising pedigree. An awareness of the new state of science, stressing mission-orientated problem-solving, has been articulated under the name of 'mode 2' (Gibbons et al., 1994). On the PNS scheme, this would approximate to our 'professional consultancy', but as enlisted on industrial projects rather than serving individual clients as in the past. That study was (I believe) intended to protect the research

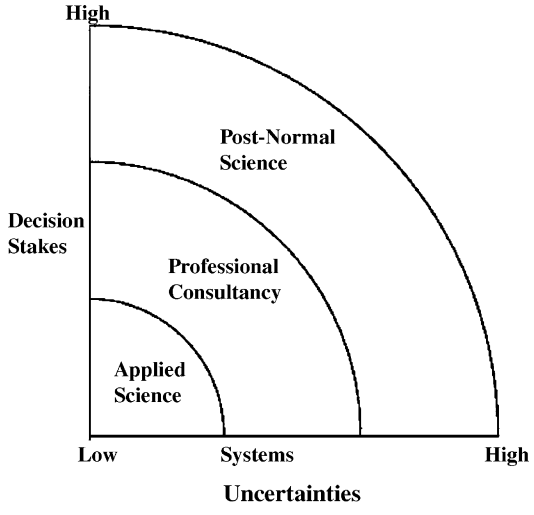

Fig. 1 – The Post-Normal Science diagram.