

## How to think responsibly about the climate crisis, via precautionary

### reasoning:

#### A case-study in overcoming scientism, after Wittgenstein

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(Summary)

I argue that a properly ‘precautionary’ approach to serious and scalable<sup>i</sup> threats -- that is, to threats whose downside could be indefinitely bad -- escapes the criticisms normally made of it.

Such an approach, in the case of such threats, is frequently (1) *necessary*, rather than being a second-best to the attainment of ‘full scientific confidence’. I lean on Wittgenstein’s *On Certainty* (henceforth OC), to help show this.

Moreover, even in cases where one might in principle be disappointed not to have attained scientific confidence, then, perhaps surprisingly, and certainly crucially, a properly precautionous approach makes strong action to pre-empt such threats (2) *more urgent and important* than in cases where such certainty *has* been attained (Because, in cases where full scientific confidence has been attained, then risk can be calculated, but cases of incalculable risks are always potentially at least as harmful if not more harmful; for, ex hypothesi, one then doesn’t know just how bad the harm will get.<sup>ii</sup>).

I defend my argument — again drawing on Wittgenstein’s *On Certainty*, and also on Nassim Taleb’s important work on risk and uncertainty — from the possible objection against it that the Precautionary Principle would immobilise one, through having to consider any (‘logically’) ‘possible’ threat, however crazy. In fact, I show how a properly precautionary approach (3) *does not expose one to mad threats*.<sup>iii</sup>

Finally, the Precautionary Principle, by calling upon us to act so as to reduce manufactured, avoidable uncertainty, can be in part powerfully expressed as a genuinely<sup>iv</sup> ‘second-order’ or ‘meta’ Precautionary Principle: (4) *We ought to act so as to (aim to) reduce our future exposure to (situations of dangerous) uncertainty*, i.e. To reduce our exposure to situations in which we are forced to invoke and apply the Precautionary Principle to uncertain severe harms. I point here to the need to reduce our *vulnerabilities* to future potentially-catastrophic uncertainties – this implies *accepting* the inevitable presence of some uncertainties/ignorances<sup>v</sup> (and accepting their presence implies allowing ourselves to be vulnerable in some ways to them) and building this into our models of socio-economic organisation such that we can cope and indeed even thrive when things go wrong, and reducing the (e.g. ecological) stakes, in terms of what kinds of things can go wrong and how wrong they can go. Thus the Principle, properly applied, will in the long-term, as one might put it, to some extent benignly ‘self-deconstruct’, or gradually ‘wither away’. For the more it is applied aright, the less avoidable exposure to uncertainty (of the kind bringing in its train serious and non-calculable threats) we will collectively face.

Thus, overall, my argument is that precaution is an alternative to scientism, in particular to the crude and now extremely widespread scientism embodied in the fetish now made of ‘evidence-based’ approaches that ignore precautionary and ethical considerations. It is in this key sense an eminently Wittgensteinian enterprise.

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(0: Introduction)

Scientism is perhaps the dominant ideology of our time.<sup>vi</sup> It is so dominant, at least in most intellectual circles, that it is hard to see it at all. It is rather the sea we swim in. It is so hegemonic that it fails even to register as a belief, as an ideology, as having live-option alternatives.

The dominance of this ideology registers in the extent to which scientism's greatest foe, Wittgenstein, is marginalised in our culture in general and in philosophy in particular. It registers also in the extent to which it appears self-evident to most people in our culture that being 'evidence-based' is an unalloyed good. Of course, being 'evidence-based' is indeed good, if the alternative is engaging in wishful thinking, medicine or government by anecdote, or superstition. But it is not necessarily good as opposed to being grounded in ethics. Or in precaution. (Can we imagine precaution without evidence for precaution? In some cases, yes: we simply practice a *via negativa*. We avoid or prevent engendering new forms of potential pollution, for instance, without requiring any evidence at all that such pollution is actually harmful. I return to this point in section (4), below.)

Moreover, much of what is called 'evidence' simply isn't. For it is not statistically significant, relevant to the long timescales in which 'black swan' events may occur...and when they occur they are not untypically 'dominant': they matter more than everything else combined, both because of their sheer magnitude, and because they are far more likely to be irrevocable / to create new and potentially devastating path-dependencies. Thus it is too easy for being 'evidence-based' to

amount to a very narrow and short-termist view, ignoring the rare, ignoring the dominant catastrophic occurrence; ignoring (in short) our ignorance.

*This is the possibility that I explore in the current essay...* That a precautionary ethic is a possible and indeed a necessary alternative to the dogmas of contemporary scientism. That it steps outside the harmful confines of the mantra of being ‘evidence-based’ that is merely the latest cloak for a dangerous scientism. And that it can find a kind of philosophical support in the work of Wittgenstein and in his profound opposition to scientism.

Of course, there is absolutely nothing wrong with science as such. I am a (Wittgensteinian, Kuhnian) philosopher of science, and like virtually everyone in our culture I praise and admire its special achievements. The problem is when science is taken to be the only game in town. And/or when it is supposed to be unchallengeable. And/or when its *products* (e.g. technologies) are supposed to inherit its epistemic strengths and its ‘neutral’ status.

Picking up the last point there: Tacitly (or sometimes even explicitly), the legion advocates of scientism today suppose that there ought to be a default assumption not just in favour of (genuine) science but also in favour of the adoption of any new technology (or in favour of following up “curiosity” about anything that has been cultivated in any context; or of seeking a technologically “sweet” solution of any kind to any problem...). This is a presumption that I find hubristic and dangerous. This default assumption has been exposed by Heidegger,<sup>vii</sup> as well as by Wittgenstein.<sup>viii</sup> Our society operates on the basis of a problematic default assumption in favour of (technological) ‘progress’.<sup>ix</sup>

Overcoming this myth of progress involves overcoming the extreme ‘Prometheanism’ and the lack of precaution<sup>x</sup> endemic to our current technocracy. We

are held captive <sup>xi</sup> by a myth of progress, so long as we do not step outside the assumption that there ought to be a default assumption in favour of the adoption of new forms of engineering.

In what follows, I expound the precautionary alternative to such reckless scientism.

(1)

Here is perhaps the most-widely-accepted public-policy-relevant version of the precautionary principle, from the 1990 ‘Bergen Declaration’, made by Ministers at the UN Economic Commission for Europe:

“In order to achieve sustainable development, policies must be based on the precautionary principle. Environmental measures must anticipate, prevent and attack the causes of environmental degradation. Where there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.” <sup>xii</sup>

Thus the Principle applies pre-eminently to situations in which cost-benefit analysis (CBA) is inadequate because there can be no strictly probabilistic calculation of risks, because there is not scientific ‘certainty’ (and in fact, even where such ‘certainty’ exists, there will still always be contradictions with CBA, as Larry Lohmann’s work teaches us).<sup>xiii</sup> The relevant situations furthermore are situations where the potential ‘downside’ is severe.

The Precautionary Principle has been exposed to sustained attack by philosophers and others, <sup>xiv</sup> as well as by political opponents of cautious action in diverse fields (most notably, so-called ‘climate-sceptics’). I mean in this paper to defend (a

defensible version of) it. I start doing so by means of a discussion of the subtleties of the invocation of “lack of full scientific certainty”, in the (above-quoted formulation of the) Principle.

The lack of “full scientific certainty” in such situations as are alluded to in the famous quotation above sounds as if it is something to be regretted. There is already something awry in this would-be regret, in that it neglects the extent to which science, if it *is* live science (with a research-frontier) by definition lacks certainty in *some* respects.<sup>xv</sup> ...But, even bracketing that point, there is something deeper awry with the wish always to rely on science if possible.

What I have just said might sound strange. For philosophers today, along with Western culture more generally, often think of science as the always-desirable first port of call, as the preferred mode of knowledge or inquiry,<sup>xvi</sup> compared to which other modes are always at best a regrettable default. But, as already implied in (0) above, this is wrong, for multiple reasons, two of which I dwell on and explicate here:

- i) *There are forms of inquiry and knowledge-generation that are not even in principle amenable to scientisation:* for instance, I would argue (and have argued), virtually all of economics and ‘social science’ more generally.<sup>xvii</sup> For to treat the objects of such inquiries *as objects* is to fail to appreciate their capacity to ‘answer back’: It is to fail to appreciate for instance that making an economic forecast (let alone acting on it) can end up being self-fulfilling, *or* self-defeating (And one cannot know for sure which (or neither) of these two possibilities will eventuate, in advance); or that e.g. a monetary policy that relies on the best-extant theory of money can be deliberately bypassed by some societal members/forces seizing on something else to use *as* money. It is to fail to appreciate that the human

future cannot in principle be predicted by a human ‘observer’ (the scare-quotes here are essential, which tells us a great deal), as any such prediction would/does alter the very future it aims to predict. It is to fail to reckon with human creativity (it is conceptually impossible to predict the results of future creativity, because to do so would be already to have achieved that creativity). It is to fail to understand what Winch (following Wittgenstein) has taught us: that there is no understanding of human affairs without an understanding of the human beings who make those affairs happen *as subjects* who themselves understand themselves as acting in particular ways. And it is to fail to understand the ubiquity of ‘Black Swan’<sup>xviii</sup> events in largely determining human affairs.

The types of ‘uncertainty’ being described and alluded to here are radically different from the uncertainty found in stochastic physical systems, (or) famously in quantum physics. They are *sui generis*, and utterly resistant to a programmatic scientisation -- as economists, sociologists, futurologists etc. have found out again and again, to their cost.

Thus point (i) here places an insuperable limit on any programme of social or human science. And suggests instead the need for humility, for humanistic (including sometimes historical) understanding, for cultural immersion, etc., if we want to understand how people and societies may put themselves collectively at catastrophic risk, or counter such potential risks.

ii) *There are forms of knowledge<sup>xix</sup> that are too basic to be scientific.*

I shall very briefly argue for this point using some of Wittgenstein’s *On Certainty* (OC).

*On Certainty*, the writings of Wittgenstein's final years, has not previously been applied to thinking about the Precautionary Principle (henceforth, 'the PP'). But it is easy to do so. Let us consider this remark, penned by Wittgenstein just days before death took him:

"If someone believes that he has flown from America to England in the last few days, then, I believe, he cannot be making a *mistake*. // And just the same if someone says that he is at this moment sitting at a table and writing." <sup>xx</sup>

For it would be as it were too 'big' to be a *mistake*. If such a person turned out, apparently, to be speaking in contravention to the facts of the matter, and if they sincerely believed what they themselves were saying, then we might speak instead, of (say) a "mental disturbance". <sup>xxi</sup>

In *On Certainty*, Wittgenstein investigates the fundamental structure of our knowledge, the relationship we actually have to propositions such as "I have two hands", or "The Earth has existed for more than fifty years". He argues that it is a complete misunderstanding of this kind of basic knowledge (if it is to be called "knowledge" at all), to think of it as being itself provable, or establishable, in any way. In particular, the idea that we could scientifically validate such knowledge is quite simply absurd. For any effort that we made to verify or indeed to disprove such knowledge would itself take exactly such knowledge for granted, in the process. <sup>xxii</sup>

Such 'basic knowledge' <sup>xxiii</sup> cannot be meaningfully contravened. But neither can it be meaningfully undergirded or confirmed. (We might even consider the PP *itself* as an instance of such a fundamental mode of our knowing. I return to this possibility later, in section (4).)



‘The climate system’ in terms of our *understanding* of it as an actual system is partly constituted by type (i) knowledge, above. For example, there are limits to our knowledge about the prospects for our planetary climate because that climate is partly determined by human action that is subject to the ‘constraint’ on knowledge described under (i), above.<sup>xxiv</sup>

Meanwhile, as I shall show in section (3), below, type (ii) knowledge as explicated by Wittgenstein can be invoked to undermine the argument (frequently used against the Precautionary Principle) that that Principle founders on an alleged need to consider all threats, however outlandish, and approach them all equally precautionarily. On the contrary: there are many things that necessarily have to be (and thus are) taken for granted in order for there to be any science, and (more broadly) any knowledge or inquiry (including for instance Precautionary inquiry), at all.

Thus what I have established here in section (1) is that there is a swathe of crucial cases where taking a precautionary approach is not just a second-best to some hoped-for scientific certainty, but is rather a constitutively *necessary* alternative to a ‘*scientistic*’ approach, an approach that argues that the so-called ‘scientific method’ has to be applied to every problem.<sup>xxv</sup> Everywhere, in fact, outside the extremely rare cases of human practice where calculability is possible (e.g. the odds in a casino), and outside the kinds of cases where physical scientific knowledge is feasibly more or less completeable (on which, see section (2), below), we are in a realm where, strictly speaking, there are no strict (objective) probabilities, and so where a precautionary approach may be called for. Now: Where we are exposed to serious scalable threats in such a realm, it *is* called for. And so we can add that there is / would often be a very

strong *ethical* case for the PP even were there to be strict probabilities where Cost Benefit Analysis (CBA) is technically feasible, in such cases – because it’s just not okay to gamble with some kinds of harms. It’s just not OK to put others or all of us at risk of serious enough harms.

(2)

In the public sphere, a lack of knowledge/certainty about the climate system is almost invariably taken to enjoin inaction. ‘More research is needed’, we are told, until we know enough to be ‘entitled’ to act strongly. But this is exactly wrong. *Even if* the climate system were a system that in principle we could hope eventually to attain a precise deterministic physical knowledge of <sup>xxvi</sup> and we were thus regretful of not already having such knowledge of it, the lack of such knowledge would not be a good reason for inaction. Firstly, for the simple and powerful reason, familiar to us from the PP, that we often cannot afford in such cases to wait for such knowledge to be attained, because the threat is too pressing. But also, for the following deeper reason: The presence of fat tails, of which we lack any precise knowledge, should make us *more* inclined to strong precautionary action. Slightly more specifically: Lacking deterministic knowledge of climate tipping points, of ‘1 in 1000 year’ floods, let alone of ‘1 in 1000000 year’ floods, (and of how what used to be a 1 in a 100 year flood may now be more like a 1 in 10 year flood) and so on, makes a precautionary approach essential.

The *less* deterministic knowledge we have, the *more* scope there is for the worst case scenario to be devastating. Thus my argument here is that (for example) even if ‘climate-sceptics’ are right that our climate models are unreliable, they ought

(more strongly!) to cleave to the PP, to prevent climate-disaster. For model-unreliability *cuts both ways*: it means that things may be much less bad *or worse* than we suppose.<sup>xxvii</sup>

I strongly applaud the climate-modelers, including my world-renowned colleagues at the Tyndall Centre (at UEA), who are seeking to show us all what may happen to our planet's atmosphere/ecosystem if greenhouse gas emissions are unabated. I think it especially valuable, in order to concentrate the mind, to have vivid scenarios (and here novelists, film-makers etc. may well be as vital as scientists) sketching what a climate-chaotic future, likely to be consequent on a business-as-usual greenhouse-gas-emissions scenario, might look like.<sup>xxviii</sup> But one of my fundamental points in this essay is this: In situations of relatively small upside and *open-endedly large downside*, detailed modelling is not *needed*. It is desirable, but not non-negotiably essential. The decision of what to do (or otherwise) in terms of potentially disturbing our climatic system by pumping more and more greenhouse gases into it comes out right simply as a 'decision-theoretic' one without benefit of the 'knowledge' that comes from modelling-scenarios. This is really the deep lesson of the Precautionary Principle, the way in which it 'translates' into real-world action in a way that undermines crude assumptions about the alleged need for scientific knowledge. *You don't need to know about the future at a level of detail, in terms of what models tell us 'will' happen, to know what to do (and, just as important, what not to do).*<sup>xxix</sup> Models (in the sense of scientific theory about how the climate system works) can obviously help show us *that* the potential downside is large. But if the science indicates that there is a real (not merely a 'logical') possibility of a very large downside, and if the science itself cannot specify it or tell us how large, then the correct thing to do is to invoke the

Precautionary Principle and act, rather than to spend millions and millions on building ever more complicated computer models that will in any case NEVER BE ABLE TO PREDICT THE FUTURE, even if we spent every penny we have on them.<sup>xxx</sup>

The reason why climate-modelling has taken up such a prominent place in the struggles to save our common future from climatic-devastation is simple to sum up, in one word: scientism. It is the belief that without evidence, and without modelling, one has nothing. Whereas my argument is that precaution alone is enough to justify strong action to prevent the loading up of our atmosphere with unnatural and unprecedented levels of (greenhouse) gases. As already stated above, I have of course nothing against climate-modelling; it is valuable. Modelling and precaution complement each other: but even without reliance on modelling, precautionary reasoning alone would do the trick. And it has the advantage of being anti-fragile to ‘climate-scepticism’ and climate-denialism: the *more uncertain* the future, the *stronger* the precautionary argument becomes.<sup>xxxi</sup>

To sum up this section: that a threat cannot be non-stochastically computed makes action to pre-empt it *more* urgent and important than if it could be. Because, in cases where scientific certainty has been attained, then risk can/could be calculated, but cases of non-calculable risks are always potentially more-harmful. Thus the widespread notion of regret at (e.g.) our lack of ‘complete’ knowledge of the climate, and the inference from this that this gives us an excuse for inaction in relation to mitigating manmade climate change, is the *inverse* of the rational and morally responsible attitude that should be taken.

(3)

The Precautionary Principle is often criticised as being itself a recipe for inaction, when it is ‘thought through’ to its ‘logical conclusion’<sup>xxxii</sup> (Some even call it ‘the Paralyzing Principle’). For example, it is said that any action at all might carry dire risk: thus perhaps it is cautious to stay at home forever, and not take the risk of getting knocked down crossing the road outside one’s house. It can easily be seen that this is wrong, because of course such a course of action would itself be unprecautious: it would expose one to new dire risks (from lack of exercise, from the build-up of multiple fragilities in one’s system, etc.). We have to think of precaution *in the round*: we have to think of what is *on balance* cautious, of what does the *opposite* of ‘fragilizing’ us further.

Does this mention of ‘on balance’ re-introduce a strictly probabilistic balance of risks? Does it re-introduce a space for Cost-Benefit Analysis with regard to big decisions, rather than for Precaution? Yes-and-no, and no. ‘Yes’, inasmuch as, very very roughly, *the risks in such cases as mentioned above are partially* calculable. Actuarial tables may tell you something about the risk you set yourself up for each time you cross the road -- and the risk that you set yourself up for by not exercising!<sup>xxxiii</sup> But ‘no’ too, and (I think) in a deeper sense. It is absurd to think that one can make all or even most of one’s decisions in life through calculation (and here we return close to the territory of section (1), above, again): These decisions have to be made, largely, on the basis of what Wittgenstein called “imponderable evidence”,<sup>xxxiv</sup> on the basis of heuristics, on the basis of values/ethics, and on the basis of a rationality that is not comprehensible in the way that Rational Choice Theorists<sup>xxxv</sup> or first-generations Cognitive Scientists such as (famously) Kahnemann and

Tversky<sup>xxxvi</sup> seem to like to think of rationality. (Crucially: when thinking of rationality, they typically fail to think seriously of meta-probabilities.)

And ‘no’ further, also, in that — crucially — while the argument that one should not expose oneself to unnecessary danger by leaving one’s house is desperately bad, the argument that we should not collectively expose ourselves to unnecessary danger by tampering in a top-down manner in open-systems with fundamental biology by means of genetic-engineering technology, or with fundamental atmospheric physics by means of geo-engineering technology, for instance, is in my view relatively strong.<sup>xxxvii</sup> Precaution itself militates *against* the former argument, but, on balance, in favour of the latter argument.

What about the argument that one should stay at home permanently because one will then be less liable to be constantly surveilled by police et al watching one constantly on CCTV cameras – or by the CIA – or by invisible little men from Mars – on the streets outside? In other words: what about the oft-quoted<sup>xxxviii</sup> worry that the Precautionary Principle requires one to guard against a series of more or less paranoid or (more generally) mad threats. . .

The Precautionary Principle is for situations that we may actually encounter. It is required for real but non-calculable possibilities of serious harm (and, as mentioned earlier, it is relevant for plenty of cases even if and where harms can be calculated but should not be gambled with, too). The PP is not required or relevant for situations so outlandish or mad that we literally needn’t worry about them at all. Mad threats – the threat for instance of the Giant Pumpkin wreaking a terrible revengeful havoc on the Earth, for some unknown slight – need not detain us. (For those as yet uncertain of this, we will turn to Wittgenstein momentarily, to undergird the thought.)

Nor need the alleged concern that there is no criterion to separate mad threats from realistic threats detain us. There is no *algorithmic* criterion, it's true; it is a matter rather of art/judgement. The distinction between mad threats and credible threats is too *basic/fundamental* for there to be any algorithmic criterion. It should itself be seen as an instance of the kind of 'basic knowledge' that, following Wittgenstein, we outlined in section (1), above. (Thus David Runciman's popular rendition of the argument against the Principle, a rendition based on the notion that the PP cannot discriminate between mad and non-mad threats, fails.<sup>xxxix</sup>)

Again, Wittgenstein's *On Certainty* can help us to understand the main philosophical point that we have been making here in this section. A fundamental principle established in that work is this: that doubts not only come to an end somewhere,<sup>xi</sup> but that they *require grounds*, in the first place.<sup>xli</sup> And Wittgenstein goes further: compare the following important remarks from *On Certainty*:

"115. If you tried to doubt everything you would not get as far as doubting anything. The game of doubting itself presupposes certainty."

"450. A doubt that doubted everything would not [even] be a doubt."

If we seek to imagine the Precautionary Principle as applying to every conceivable contingency, however outlandish, then we are imagining just such hyperbolic doubt. We would then be engaging in a quasi-Cartesian enterprise. Such an enterprise does not need engaging in, nor answering. It can simply be ruled out, as not just unnecessary, not even just self-defeating, but in fact as merely chronically ill-defined. Lacking a determinate sense.

Again then: The distinction between mad doubts/threats and credible/doubts threats is, following Wittgenstein, too *basic* for there to be any algorithmic criterion for it.

Human beings are inclined dangerously to under-prepare for (i.e. we inadequately mitigate ahead of time against) dangerous contingencies that can be prepared for and mitigated against *by a series of precautionary policies and decisions that simplify and antifragilise the systems we construct* and are part of (We will expand upon this point shortly, in section (4)). Together, we can build down our exposure to risk and uncertainty by building down our level of fragility. ...But we believe this, of course, only for real contingencies. Philosophy, after Wittgenstein (and Popper, and Taleb),<sup>xliii</sup> encourages us to prepare as we can against the (catastrophic) ‘black swan’ – not against the Giant Pumpkin.

To sum up this section: Endorsing the Precautionary Principle does *not* force one to have to take action against mad threats. Only an absurd scientific notion of being able to *compute* all potential threats, and an absurd scientific notion of our not being able to judge the difference between sane and insane concerns, would lead one to think that it did.

With mad threats sidelined, we can focus our attention where sanity demands it be focussed. Turning once more to the implications for the case of existential risk upon which we have been focussing here, the risks consequent upon messing with our climate: We ought to be deeply worried by the unquantifiable risk of ecological systems-breakdowns consequent upon unrestrained economic growth terminally wrecking our climate system. Weighed in the balance against the comparatively lesser



/ trivial harms allegedly caused by loss of economic growth, such uncertainties about a possible end to civilisation are overwhelming.<sup>xliii</sup>

(4)

The logic of my work,<sup>xliv</sup> allied closely in this regard with that of Taleb, is then that, in response to real, un-mad, very serious, *incalculable* threats, we should adopt a ‘via negativa’ approach (Because any other approach risks creating new ‘Black Swan’ threats). We should aim to tamper less and less with (e.g.) the climate system. *We should build down the level of uncertainty that humans have introduced into that system.* We should reduce the ignorance manufactured by some of the efforts thus far undertaken to (allegedly) stabilise the system.<sup>xlv</sup> Thus, we should reduce the potentially dire threats we have collectively subjected ourselves to by our tampering with the climate, and (thus) reduce the likelihood of negative ‘Black Swan’ events. (These “should”s are all simultaneously moral and rational. They express the responsibility at this time especially of rational, caring beings.)

And this leads us to my final substantive point. The Precautionary Principle is generally expressed as a substantive principle, as in the version quoted in section (1), above. But philosophers in particular might helpfully think of it in the following -- second-order <sup>xlvi</sup>-- form (I am here adapting directly the language of the famous quotation with which I began the main body of this paper (in section (1)); the reader may wish to look back at that quotation, to compare):

In order to achieve a maximal feasible level of antifragility, policies must be based on the meta precautionary principle. Environmental measures must anticipate, prevent and attack the causes of situations necessitating us to consider invoking the precautionary principle. Where there are threats of serious or irreversible damage,

lack of full scientific confidence should not be used as a reason for postponing measures to prevent the creation of new situations of threats of serious or irreversible damage, and of lack of full scientific confidence.

To be clear: the PP does not imply trying to reduce exposure to *all* kinds of uncertainties — for example, the uncertainties inherent in romantic love are not in the least frowned upon by it — but only to uncertainties *with a potentially catastrophic downside*. In the very long run, these are the uncertainties/ignorances/risks that really matter; the rest is recoverable from, and may even be beneficial. Much as Taleb thinks of it: we love and need uncertainties of other kinds. Depriving anti-fragile systems of volatility, randomness and stressors misses a trick, and will tend to *harm* them. In matters of livelihood a peasant- or indigenous- type “safety-first” conservatism (venerating Pachamama etc.; minimizing exposure to unlikely or unforeseeable events whose consequences could or would be massive and bad) is an example the kind of thing that fits well with this meta version of the PP; *so long as* we see too that this kind of conservatism consorts well with a lively and welcoming attitude toward exposure to a vast range of *other* oddball events.

To sum up this section: the Precautionary Principle, by calling upon us to act so as to reduce manufactured, avoidable uncertainty, can then itself be powerfully recast as a ‘second-order Precautionary Principle’: *We ought to act so as to reduce our future exposure to uncertainty*, i.e. To reduce our exposure *to situations in which we are forced to invoke and apply the Precautionary Principle*. The Principle, properly applied, will be in the long-term gradually bring itself more and more into abeyance. For the more it is applied aright, the less uncertainty bringing in its train serious and incalculable threats we will be exposed to. It will probably always be to some extent required, because it is actually, in a way, a kind of common-sense, a kind of basic (quasi-)knowledge perhaps of the very kind Wittgenstein drew our attention to, in *On*

*Certainty*. But we might think of it as approaching a limit asymptotically: if we manage to become wiser and wiser, and live on a more and more human scale, we will be less and less in need of actually applying the (first-order) Precautionary Principle to *stop* something.

The very radical implications of this include a serious slowing of technological ‘progress’. Subjecting such progress to the test of whether it is compatible with the greatest confidence of very-long-term safety for human beings and the ecosystems on which they (we) utterly depend. This implies that, rather than being hoodwinked by promises (*even if they (are very likely to) turn out true, reliable*) of benefits, of sunny uplands, we ought to engage in very long term rigorous closed testing of potentially dangerous potentially-‘epidemic’ technologies (e.g. GM) and in very slow initially-small-scale-only introduction of ‘non-epidemic’ technologies that nevertheless at scale may be very harmful (e.g. new fridge-coolants). We could have ended civilisation, had we used bromine rather than CFCs as our fridge-coolant; bromine would have blasted the ozone hole way before we had the chance to save ourselves.<sup>xlvii</sup> But only because we allow new technologies substances to be used at scale relatively rapidly. A true precautionary approach would not do this. It would thus place a constraint on technology (and on capitalism) more significant than any we have yet use. If we don’t take this step, then we are gambling with our future: risking the whole human future on (e.g.) the desire to be able to spread fridges more quickly than we ought (if we were playing safe) to do.

(Conclusions)

If I have been successful here, then how should one understand what I have achieved in the present paper? In this paper, I have sought to show how, far from being some *recherché* piece of philosophy exposed to damning objections, the Precautionary Principle should actually be seen as entirely defensible, in part because it is a kind of codification of (as we might risk putting it) *moral common sense* at its best. It says that, in the case of serious enough potential threats that are real, that have grounds, then one shouldn't run catastrophic risks. One should search for a way of avoiding such risks/threats, without generating others as grave.

I have, as one might even risk putting it, sought to *naturalise* the PP. To show how it simply falls out of a more general rational and moral attitude, of 'antifragility', which is enjoined independently of particular perhaps-controversial scientific modellings.

As is, I hope, obvious, one reason for engaging in this exercise is to address the extraordinarily widespread mind-set that seeks complete scientific unanimity prior to costly action. Speaking for myself, I have a good and increasing degree of confidence in the models that show how the danger of greenhouse gas build-ups escalate from 2 degrees of over-heating upward, and that how what kind of concentrations of GHGs are likely to lead to such over-heat effects. But *the reader need not share that confidence*, in order to be convinced of the same conclusion as I have drawn in the present paper: that strong precautionary action, to build down the climatic sword of Damocles hanging over us all (and especially, over our children), is mandated. That broadening of the appeal of the PP is a key conclusion of the present paper. We can and should all act on the climate threat, *even if* there isn't even general agreement on the science that models our likely climate future(s). For we ought to think of dangerous climate change as like a volcano that might well erupt and yet

whose eruption we could make less likely by preventing the discharge of a certain pollutant. Even if we did not have a clear picture of how likely the eruption was and how bad it would be, it would be desperately irresponsible not to warn clearly of the possibility of eruption and of the possible extremely harmful effects of the eruption, and, more crucially still, not to desist from destabilising the volcano further by continuing to pump out the pollutant that we knew to be altering the state more or less of balance currently in place in the geophysical system.

“We need more science” is thus, in the context of the climate threat and threats alike to it, a dangerous prevaricating move. One might most usefully see the *real* problems surrounding issues of precautionary action and our failure to undertake it as questions of will, deep questions of the political will and the ethical integrity to face our actual situation and do what is necessary, even if that involves painful changes and the giving-up of various things that we have grown used to.<sup>xlviii</sup> They bring to mind Wittgenstein’s desperately-important thought that philosophical problems are, in the end, more problems of the will than of the intellect.

In this paper, I have been *clearing the ground* for facing up to these things. I have, in that sense, been creating the conditions for a more honest and more moral conversation about climate, risk, uncertainty, precaution, etc. .

The Precautionary Principle, as I have shown, applies to all harmful eventualities that can come from action (or, similarly, from inaction<sup>xlix</sup>). It refuses, that is, to allow that one *must* choose between (say) GM crops and ‘conventional’ large-scale use of pesticides,<sup>1</sup> or between dangerous climate change and uncontrolled world economic collapse. It insists that one search for solutions that genuinely minimise risk and uncertainty, solutions that are genuinely precautionary. It requires one to forsake courses of action that carry grave avoidable risks of dire consequences, in

favour of long-term safer alternatives, even if these are less easy / more awkward, etc. . So, for example, world starvation need not follow from the scaling back of pesticide use *and* the scaling back of the massive uncontrolled experiment that is GM crops: if older and organic/permacultural/agroforestry/agroecological etc. alternatives are put in place. Or if world population is built down in an agreed and non-tyrannical manner (a manner that would not itself be likely to spawn violent reactionary revolution / more 'Black Swans').

We are not *forced* to accept the taking of unacceptable risks of one kind or another, provided we are willing to think and act outside of the terms of the 'dilemmas' which are standardly set up for us. Truly precautionary principled thinking involves looking to build down the *level* of uncertainty that we are exposed to, by searching for genuinely safe(r) alternatives. It looks to reduce the *general* level of risk, uncertainty and ignorance that our extremely fast, unnecessarily complicated, and increasingly *non-natural* (i.e. involving much that is synthetic, artificial, linear, and high-entropy) modern mode of living has created. It questions the dogmatic, still-hegemonic ideology of 'progress' that Wittgenstein, famously, questioned.

In this paper, I have tended to focus on the case of dangerous climate change, because it is perhaps the most consequential of all species of threat currently facing our species. The same or similar logics apply to other similar cases (of which there are quite many), as I have at times mentioned above: such as to outdoor growing of GM crops, the manmade ozone hole, the fragile banking system, or the energy (in particular, the nuclear; plus of course the fossil fuels) industry. (Moreover, additional ethical considerations can be argued for, on the basis of such logic(s): I will come to these in a moment.<sup>li)</sup>

Of the number of potential truly global/ecocidal threats that emerge from the largely man-made vista of uncertainty and ignorance that I have sketched in this section, I'm less bothered than some<sup>lii</sup> are by the 'robot apocalypse' scenario, of strong AI taking over and eliminating humanity. This article has concentrated on the climate threat and its drivers partly purely for purposes of illustration, but also because *I believe this to be probably the gravest threat of all that we currently face.* (Though I'm enough of an advocate of the PP not to gamble too much on that!) In part, because I think it *subsumes* a number of other threats that I haven't dwelt on here, including that of 'robot apocalypse'. Precautious action against a potential threat is supererogatory if that threat is only feasible in the event of the mobilisation of a similarly grave more immediate threat. I think it very likely that we will reach 'Peak Robot'<sup>liii</sup> before any plausible risk of robot apocalypse.<sup>liv</sup> Either through building down our impacts as recommended in section (4) above (a building-down which would necessarily build down the potential for the existence of very powerful AI entities, let alone of channels for them to affect negatively the whole of civilisation) — or through civilisational collapse. Civilisational collapse due to climate chaos etc. is the likely outcome of a business-as-usual (non-precautionary) way of living in the 21st century. It would obviously take out robots and AI with it. The key drivers of anthropogenic dangerous climate change *include* the key drivers of any potential robot-apocalypse, and of many other imaginative scenarios which creative thinkers have come up with for human self-destruction.

So I think that some high-tech existential risks need not occupy too much of our time as philosophers — because the ultra high-tech, high-energy, high-throughput, high-entropy future they depend upon would in any case drive a reasonably rapid climate-apocalypse, to which we may become committed in less

now than a generation. (In Hollywood terms: I think we should be more worried about *The Road*, or at best *The Hunger Games*, as a vision of our future, than about the *Terminator* series...).

(Coda)

I hope that my thinking in the present essay has not been too bold. Those in authority (political or epistemic) who make unprecautious arguments or ‘forecasts’ should, arguably, have ‘skin in the game’;<sup>lv</sup> they should stand to lose something, in the event that they have not taken enough care of those who will listen to them.

For people RELY on ‘forecasts’. One can only be absolved if one makes nuanced and reasonable (not hyperbolic, nor non-existent) assertions of imperfection, in respect of one’s claims or concerns (or lack of concerns!) about the future...

I will end then by hazarding a remark about the recent controversy about the Italian seismologists convicted/imprisoned because they were found (so it has been said) to have failed to forecast an earthquake.<sup>lvi</sup> Many voices in the academic world were raised vociferously against this court decision, which was largely overturned on appeal (Only one of the seven had his conviction upheld, and his jail term was reduced).

I am not altogether convinced by the scientists' reaction in this case, and by the way that the academic world has virtually without exception rushed indignantly to their defence,<sup>lvii</sup> and has expressed delight at the overturning of the convictions (of six of the seven). I am not in a position to judge the details of the case; I haven’t studied it closely enough and am no legal expert. I have no reason, for instance, to



doubt that the appeal court's decision was just. But, whatever the exact rights and wrongs of the case, and though it might sound harsh to say so, it seems to me that this turn of events in Italy — the fact that this trial happened and that one scientist is even in jail because of it — might (even) be salutary. I am no fan of jailing people, and one cannot but sympathise with anyone caught harshly in the public eye, and with scientists/academics/professionals/officials with difficult jobs trying to do those jobs well. But if this Italian case encourages a more genuinely *precautionary* attitude among scientists <sup>-lviii</sup> e.g. climate scientists - rather than them continuing to rely on 'models', and simultaneously continuing in most cases not to raise the alarm about the way that we may be placing our living world at present very drastically in harm's way, then the cloud that has hung over these seismologists may have a silver lining for humanity.

For the Italian court's decision, as I understand it, was *not* at all that the seismologists were imprisoned for failing to predict, to forecast the earthquake. It is that they were imprisoned for failing sufficiently to hedge their prediction that there was unlikely to be an earthquake (i.e. for overly bold modelling and prediction claims), thus (as it turned out) putting citizens at risk, and perhaps also for failing to point up the drastic consequences of what would happen if their prediction was wrong (i.e. for understating the *exposure* to harm from such an event, no matter how unlikely they deemed it to be).

Now: Probably these seismologists were urged *not* to hedge, just as climate scientists are constantly enticed by policymakers to translate uncertainties into probabilities. The scientists can and should be blamed for collaborating in their own 'corruption', in such cases; but the problem clearly does not lie only with them. It lies at *least* as much with policy-makers, with the press, and with an entire culture that has

not given enough careful thought to how to live with and minimise potentially-disastrous uncertainties.

*The present paper is designed to help shift that culture in a different and healthier - safer - direction.* A Precautionary approach in such cases would be to give a full sense of the parameters of uncertainty (Even a small risk of a fatal seismic event is of course enough to justify reasonable precautions, such as stepping outside for a while). And, of course, also, to act so as to reduce the likelihood of future catastrophe. (If L'Aquila is to be rebuilt at all, it has to be rebuilt in a radically different way, using for instance the kinds of methods that have been tested in broadly-similar circumstances in Japan.)

We need a culture that is not hooked on the artificial creation of certainties. We need to learn better how to live in a world that we will never understand as much as scientism fools us into thinking we will.

Strong precautions action is needed to save our species from the all-too-possible threat of climate catastrophe. Making this clear is quite simply the most profound responsibility facing today's intellectuals. The form of this needful action should largely be a 'via negativa':<sup>lix</sup> not the setting-up of new knowledges<sup>lx</sup> and plans<sup>lxi</sup> (that only make future 'Black Swans' more likely), but the building-down / elimination of our tamperings with existing systems (most obviously: the climate system itself) that can *work*, if only we as a species will let them. In other words: we should 'build down' the climate threat, desist as swiftly as feasible from the actions generating it (principally: the production of GHG emissions, but there are of course many other such actions which we need to end, such as (crucially) widespread deforestation).

The philosophical upshot is an alternative to epistemic hubris, and thus the Precautionary Principle is vindicated by the antifragile thinking implicit at least in germ in the work of the likes of Popper and Wittgenstein. Thinking that is clear about the constitutive limits of scientific thinking,<sup>lxii</sup> clear about the need for precaution rather than relying on modelling and on the ‘confirmation’ of models, clear that we need only be precautionary with regard to what we actually have some ground or reason to believe is possible in our world, and clear that our ultimate objective – seemingly-paradoxically, but actually quite-properly -- is to reduce the need for the kind of thinking that is here recommended.

When the ground is cleared of scientism, then and only then will precaution be able to take its rightful place at the very foundation of sane thinking about our common future, about technology, and so forth. This shows the stakes of establishing the cultural meaning of Wittgenstein’s philosophy, and of allowing that philosophy to be received. If Wittgenstein’s philosophy were to be received, inherited, and the tide of scientism to turn, if it became possible to *see* the latter, and for it no longer to be merely transparent to us, then at last we would stand a real chance as a species of making precaution rather than recklessness into our common sense.<sup>lxiii</sup>



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<sup>i</sup> i.e. Where there is no ‘lid on it. No known (or even knowable) upper bound to it.

<sup>ii</sup> On which, cf. Henry Shue’s recent talk, representing his forthcoming work in this area: <https://www.youtube.com/watch?v=JHctUFWrqlc>

<sup>iii</sup> And after all, realistically, in policy-making humans cannot work without there being a margin of uncertainty. This has not however, paralysed decision making in most areas of policy making. So why must it seemingly impair decision making in environmental policy? (Thanks to Vera van Gool for this point.)

<sup>iv</sup> In contrast to Daniel Steel’s so-called ‘meta-precautionary-principle’, which is really just the Principle itself as a rule about decisions. See p.17f. of his (otherwise-excellent) book, Philosophy and the precautionary principle (Cambridge: CUP, 2015).

<sup>v</sup> On the latter, see Harremoës et al., Late Lessons from Early Warnings: The Precautionary Principle 1896-2000, London: Earthscan, 2002. pp.169-70.

<sup>vi</sup> Rival candidates for this ‘title’ include liberalism, individualism, managerialism. In fact, all these are natural bedfellows for scientism. As outlined in my work elsewhere, especially Wittgenstein among the sciences (Farnham: Ashgate, 2012). The Precautionary Principle itself might be viewed as a kind of translation of certain ‘commons’ norms into the quasi-scientistic “planning” language of industrial capitalism – like all translations, this has certain consequences that have to be carefully explored. The instinctive attraction that the Principle has for a lot of we ecologically-minded people is, I suspect, at bottom an allegiance to a broadly commonsian understanding, and is also rooted in an appreciation of the dialectic between commons and capital. This is another way of saying that the deeper issues that the present essay throws up might ultimately be better pursued not (just) through a defence or parsing and re-parsing of the Principle, but through movement-building based more explicitly and firmly in the commons politics that underlies our attraction to it. I.e., a more historical, anthropological and political as well as philosophical approach, informed by understanding the struggles of peasant and indigenous societies but also by struggles in industrial societies over the creation of new commons, etc. . A place to start in this connection is: to democratise the Precautionary Principle. To ensure that it is a matter of and a resource for citizen debate and understanding, not merely for elites. That is why I think the thinking of Andy Stirling, Brian Wynne etc. on how to find and place Precaution in the agora important.

<sup>vii</sup> E.g. in his ‘The question concerning technology’

[http://homes.lmc.gatech.edu/~xinwei/classes/readings/Heidegger/heidegger\\_techquestion2.pdf](http://homes.lmc.gatech.edu/~xinwei/classes/readings/Heidegger/heidegger_techquestion2.pdf) .

<sup>viii</sup> See e.g. my <https://www.youtube.com/watch?v=hEPcO6sIOTY> .

<sup>ix</sup> I challenge the ideology of progress in my “Wittgenstein and the illusion of progress”, forthcoming in *Philosophy*.

<sup>x</sup> On which, see my joint article with Nassim Taleb et al, here:

<http://www.fooledbyrandomness.com/pp2.pdf> .

<sup>xi</sup> Cf. *Philosophical Investigations* 105.

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<sup>xii</sup> Quoted at p.115 of Cameron's "The precautionary principle in international law", in Tim O'Riordan, James Cameron and Andy Jordan, Re-interpreting the precautionary principle (London: Cameron May, 2001). Now, it might immediately be objected that this and other classic formulations of the Precautionary Principle (PP) don't prevent use of Cost Benefit Analysis (CBA), so long as the potential loss can be in some way computed. But even if this is true, it is very unclear that the loss can really be computed in the case in question: Is it anything less than an exercise in obscenity and absurdity to seek to put a 'price' on the potential end of civilisation, for instance?

<sup>xiii</sup> See e.g. "The Cost-Benefit Analysis Dilemma: Strategies and Alternatives", *Economic and Political Weekly* 36:21 (May 26 - Jun. 1, 2001), pp. 1824-1837. Some (including e.g. Lord Stern) seem to view the PP and CBA as connected – either through thinking of CBA as amendable to be more 'precautionary' or (e.g. in the case of Dupuy and Grinbaum, see: "Living with uncertainty: from the precautionary principle to the methodology of ongoing normative assessment" in *Geoscience* 337 (2005)) through thinking of the PP as usable only through using some version of CBA. My view, which preserves the distinction between the PP and CBA, is close to Stirling's, 2001, "The Precautionary Principle in Science and Technology," in O'Riordan et al (op.cit.).

It might be argued that a Bayesian stance, focussing on 'subjective probabilities', circumvents the problems with 'standard' CBA, in that such a stance is not committed to being able to compute numbers to objectively measure risk. But a Bayesian approach of course moves further from any direct concern with objective probabilities which can output numbers that can then actually represent the real level of a risk. It is the absence of the existence of such numbers which lies at the root of my stress on the ubiquity of uncertainty (and thus the relevance of the PP). Moreover, even in a Bayesian approach there is no progress without numbers, without computing results. But I am suggesting that the use of numbers to measure risk is itself a founding delusion, except where there *are* objective probabilities (e.g. in a non-crooked casino). And that what is needed is a precautionary approach that can work without the need to resort to probabilities, no matter of what kind. (The exception is only when, as in much of Taleb's work, 'probabilities' are represented only as the *logic* of a situation, *not* as something to which numbers can literally be ascribed.)

<sup>xiv</sup> This can be clearly seen in for instance Stephen Gardiner's influential piece, "A core precautionary principle" in *Journal of Political Philosophy* 14 (1): 33–60 (2006). Gardiner means to be defending the Principle against widespread criticisms that other philosophers have made, but, by my lights in the present piece, some of the concessions he makes amount to an attack on the Principle.

<sup>xv</sup> For discussion, see e.g. p.78 of the 3<sup>rd</sup> edition of Kuhn's *Structure of Scientific Revolutions*.

<sup>xvi</sup> Even leaving aside here the valid point, implicit in my *Wittgenstein among the sciences*, that even the idea of natural science as a unitary phenomenon is itself

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questionable. (For the most compelling argument to that conclusion, see “The Disunity of Science”, John Dupré *Mind* New Series, Vol. 92, No. 367 (Jul., 1983), pp. 321-346.)

<sup>xvii</sup> See especially my *There is no such thing as a social science* (co-authored with Phil Hutchinson and Wes Sharrock; Farnham: Ashgate, 2012) and *Wittgenstein among the sciences* (Farnham: Ashgate, 2012). See also Nassim Nicholas Taleb’s *Antifragile* (London: Penguin; 2012), <http://www.fooledbyrandomness.com/pinker.pdf> and *The Black Swan* (New York: Random House, 2<sup>nd</sup> ed: 2010), works which have been a huge influence on the present paper.

<sup>xviii</sup> And ‘Grey Swan’ – see below.

<sup>xix</sup> Though that may turn out not to be the most helpful word in relation to what is under discussion here. As Wittgenstein discusses at some length, the very status and nature of such “knowledge” is itself at issue.

<sup>xx</sup> Wittgenstein, *On Certainty* (Oxford: Blackwell, 1969; henceforth OC) section 675; emphasis in the original. Wittgenstein is of course explicitly contesting here the legacy of Descartes, the founder of modern Western philosophy, who sought to suggest that *everything* could potentially be doubted.

<sup>xxi</sup> See e.g. OC 71.

<sup>xxii</sup> A similar argument in the phenomenological tradition can be found in the early chapters of Michel Henry’s *Barbarism* (London: Continuum, 2012).

<sup>xxiii</sup> Which cannot, however, *contra* Moore and Descartes alike, be used as a *foundation* to build an epistemological edifice on.

<sup>xxiv</sup> It might seem that this is not so. It might seem that the question “What will the climate be like in X years time *if* we emit Y quantity of GHGs” has a definite answer, regardless of human action. But this isn’t the case. For the question can at best be answered on a *ceteris paribus* basis. But *ceteris* never is *paribus*, when human beings are to some extent or another aware of what is happening or reacting to it. For example, the climate, *even at* a given level of GHGs, will be radically different if we geoengineer; or if we cut down the Amazon rainforest; or if we restore it. There is moreover a whole literature discussing the “climate determinism” that is today in some senses furthered and elaborated by GCM methodology; see for instance Mike Hulme’s work.

<sup>xxv</sup> We do not of course mean to imply that there is any *conflict* between science and the PP. Far from it. Indeed, Stirling (op.cit.) claims that the PP is more scientifically *appropriate* than “narrow risk” approaches (by which he means CBA), because it more genuinely reflects the complexities of uncertainty.

<sup>xxvi</sup> One reason why it *isn’t*, is given in section (1)<sub>7</sub> above; another reason, which we shall not press here, is the broadly Mandelbrotian nature of the climate system even considered as a physical system. (Furthermore: even deterministic systems are not necessarily predictable beyond a rudimentary, short-term level.)

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<sup>xxvii</sup> This only fails to follow if the model is total rubbish: e.g. if one has no good reason to believe in the greenhouse effect at all. But few ‘climate-sceptics’ are as bold as to be physics-deniers, thus rendered unable to explain why (for instance) the Earth’s surface is warmer than the Moon’s...

<sup>xxviii</sup> It is perhaps worth noting here the irony that there is a problem inherent in efficaciously using precautionary action: the problem of not being able to show that it has *worked* (even if – or rather, especially if - it in fact has done so). For, when it works, we can’t of course show people the counter-factual. That is to say that, sadly, we can only see just how badly we need to act cautiously by observing what happens in cases where, sadly, we don’t/didn’t.

<sup>xxix</sup> At most, you need to know that the kinds of harms you want to prevent are worse than the kinds of harms you might risk from taking ‘action’/inaction...

<sup>xxx</sup> Add to this the ultimately spurious nature of the techniques used to estimate probabilities of outcomes in such models: spurious, most centrally for the *kinds* of reasons given in (1) (i) above.

<sup>xxxi</sup> See <http://www.blackswanreport.com/blog/2015/05/our-statement-on-climate-models/> & also <http://www.theguardian.com/environment/climate-consensus-97-percent/2014/apr/04/climate-change-uncertainty-stronger-tackling-case> .

<sup>xxxii</sup> For detail and discussion, see Chapter 2, section 3.4 (ii) of Ruth Makoff’s 2011 UEA Ph.D thesis, “*Ethical criteria to guide an international agreement on climate change*”.

<sup>xxxiii</sup> And there are of course many globally ‘non-scalable’ cases where a rough-and-ready ‘balance of probabilities’ approach *can* be fairly harmlessly taken: e.g. The decision, as a woman over 40, of whether or not to have regular mammograms. As explicated by Taleb in the opening pages of Chapter 22 of *Antifragile*, it is by no means clear that such a calculation suggests that the rational thing to do, given the evidence, is to have regular mammograms (I also note however that there are elements of this case too that are in any case not amenable to rational calculation: such as the question of being nagged by doubts in relation to a decision which might have serious consequences for one’s body-image, physical attractiveness, etc). To generalise: Randomised Controlled Trials and the like give one useful evidentiary basis for making decisions in situations which, while not strictly calculable as odds in a casino are, can nevertheless generally be roughly calculated. Such are *not* however ‘fat-tail’ cases; they are not the kinds of cases most commonly encountered in the social/economic sciences (that we explored in section (1), above), and often, similarly, in the environmental sciences.

<sup>xxxiv</sup> See his beautiful discussion at p.228 of section xi of ‘Part II’ of *Philosophical Investigations* (Oxford: Blackwell, 1997 (1953)).

<sup>xxxv</sup> Consider here for example the way in which the *uber*-Rational-Choice-Theorist Jon Elster gradually came to realise that for many decisions it is / would be irrational to make them by means of the canons of Rational Choice Theory.



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<sup>xxxvi</sup> Compare here Lakoff and Johnson’s critique (e.g. in Philosophy in the flesh (New York: Basic, 1999)) of Hahnemann & Tversky et al: Tversky is not (as he thinks he is) showing us that we are all almost constantly more or less irrational; he is only ‘showing’ us that our idea of rationality as calculative, explicit, conscious, etc. is a prejudice that we need to overcome. And that our/his/that narrow idea of rationality does not properly encompass the way in which common-sense reasoning often implicitly includes an intelligent concern with meta-probabilities: that is, with reasons for being concerned about uncertainties present or inherent in calculations of risk. (He is also sometimes ‘showing’ us examples of inadvertently poor experimental design on his part...)

<sup>xxxvii</sup> On this, see especially <http://arxiv.org/abs/1410.5787>

<sup>xxxviii</sup> See e.g. David Runciman’s *London Review of Books* piece: <http://www.lrb.co.uk/v26/n07/david-runciman/the-precautionary-principle> . See also for discussion *Studies in History and Philosophy of Science Part C: Studies in History and Philosophy of Biological and Biomedical Sciences* Volume 34, Issue 2, June 2003, Pages 329–344; “Is the precautionary principle unscientific?”, by David B. Resnik.

<sup>xxxix</sup> See again <http://www.lrb.co.uk/v26/n07/david-runciman/the-precautionary-principle> . Runciman’s approach is I think derived from that of Sunstein. Sunstein’s book and approach is highly problematic, but it does have one positive virtue: it allows some space for an ‘anti-catastrophe principle’, which is thus evidently not a million miles away from my interpretation of the PP. Runciman would have done well to have learnt from *this* moment in Sunstein’s book.

<sup>xl</sup> See OC 110, 130 & 204.

<sup>xli</sup> See OC 4, 516, 122.

<sup>xlii</sup> Here I am thinking especially, as is I trust obvious, of Taleb’s important broadly Popperian work of contemporary public philosophy, The Black Swan.

<sup>xliii</sup> For amplification, see Larry Lohmann’s impressive arguments against cost-benefit analysis (CBA) and for precaution, at [thecornerhouse.org.uk](http://thecornerhouse.org.uk) ; and compare Cranor’s paper (Carl Cranor, “Toward understanding aspects of the precautionary principle” (*Journal of Medicine and Philosophy* 29:3 (2004), pp.259-279)), which (at pp.267-272) rebuts the alleged advantage of CBA over precaution that the former is supposedly more normatively ‘neutral’.

<sup>xliv</sup> For broader background to and other exemplifications of this logic, see e.g. Taleb’s (*op.cit.*); see also my [www.greenhousethinktank.org/files/greenhouse/home/Guardians\\_inside\\_final.pdf](http://www.greenhousethinktank.org/files/greenhouse/home/Guardians_inside_final.pdf) and my “On future people”, in *THINK!*: Volume 10 / Issue 29; September 2011, pp 43 - 47. ~~GIVE REF.~~ Cf. also Larry Lohman’s work

<sup>xlv</sup> I have in mind here especially Lohman’s superb ‘epistemological’ critique of the Kyoto Protocol, e.g. here: [www.thecornerhouse.org.uk/sites/thecornerhouse.org.uk/files/IgnoranceFinal.pdf](http://www.thecornerhouse.org.uk/sites/thecornerhouse.org.uk/files/IgnoranceFinal.pdf)

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<sup>xlvi</sup> Perhaps it shouldn't surprise one that the Precautionary Principle, when understood aright, takes on a 'second-order form': I.e. that it requires acting so as to avoid future needs to invoke the precautionary principle. For the PP clearly requires and is an instance of "second-order" learning: learning about learning. Roughly: It concerns and offers a wiser way of applying our learning from -- and acting appropriately in light of -- our ignorance.

<sup>xlvii</sup> See the closing paragraphs of <https://newrepublic.com/article/74544/planet-doom> for reference to this little-known fact, which James Hansen, the great NASA climate scientist, laid out.

<sup>xlviii</sup> These problems of course extend then to the problems of asymmetric effects (the 'sacrifices' needed to prevent the likelihood of runaway climate change come mainly now, the benefits come mainly much later), of the tragedy of open-access (the 'sacrifices' needed benefit the sacrificer themselves only very marginally, in material terms, thus leading to a potent 'free-rider' problem), of despair at what to do in light of dysfunctional political systems and systems of international governance, etc. . In relation to the last point: there is little basis for cautious action if one has no confidence that the threat facing us is one we *can* possibly succeed in fighting. If the Earth were to be faced with the possible sudden coming of an asteroid storm that, if it came, would be so vast as to be clearly beyond human powers to resist, then the PP would not apply. But of course to think that manmade climate change is like that is surely itself to slip into the mode of thinking I opposed in (1) (i), above: it is to slip into a fatalism that is inappropriate, with regard to human action, where, as philosophers from Pascal to James have brought us to understand, the great danger of a belief that we cannot succeed in addressing a grave threat is not that the belief is *true*, but that the belief is *self-fulfilling*.

<sup>xlix</sup> Though it tends to recommend, as we might put it, a more generalised inaction, in the sense that it cautions in general against actions that introduce new fragilities – see section (4), above.

<sup>l</sup> For both of these are dangerously monocultural, fragile, potentially leading to long-term disaster.

<sup>li</sup> See e.g. Book VII of Taleb's *Antifragile*, "The ethics of fragility and antifragility".

<sup>lii</sup> Notably, Nick Bostrom and the Future of Humanity Institute at Oxford.

<sup>liii</sup> See my article thereon, here:

[http://www.greenhousethinktank.org/uploads/4/8/3/2/48324387/response\\_to\\_pearmain.pdf](http://www.greenhousethinktank.org/uploads/4/8/3/2/48324387/response_to_pearmain.pdf) .

<sup>liv</sup> One reason I think this is that I think, for Wittgensteinian (and phenomenological) reasons, that it is going to turn out to be far more difficult than is generally currently supposed to create any strong AI. I suspect that strong AI — actual intelligence, rather than focussed, powerful simulacra thereof) — will not be feasible without creating robots (creatures with bodies, not just very powerful computers) that actually 'live' and learn in an open-ended way, over long periods - very roughly as infants do. I think that Wittgenstein, Lakoff and Johnston, and Merleau-Ponty have suggested

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good reasons for doubting that a being without motor functions, and without sociality, would actually be... a being. Thus I think that strong AI (let alone a strong AI that would be anti-fragile to human efforts to damage it) is probably still a very long way off. For such beings will not only require a long time to 'grow', but remain different from what in most cases is the focus of AI 'research' and development. (To take this discussion further would require a further paper, so I must leave it there.)

<sup>lv</sup> For explication and argument, see again Book VII of Taleb's *Antifragile*. In future work, I hope to develop thinking further on what would be some of the institutional, cultural implications and innovations of and in a society that really took this point on board.

<sup>lvi</sup> See e.g. <http://www.thestar.com/news/world/article/1275309--earthquake-experts-get-six-years-in-jail-for-failing-to-warn-people-in-italian-town> & <http://news.sciencemag.org/earth/2014/11/updated-appeals-court-overturns-manslaughter-convictions-six-earthquake-scientists> .

<sup>lvii</sup> There's a reasonably nuanced account of the situation here, in *Nature*: <http://www.nature.com/news/2011/110914/full/477264a.html> .

<sup>lviii</sup> There is a danger, of course, that it will simply encourage litigiousness, and (on the part of scientists) fear and reluctance to speak out at all. (Cf. [http://www.nature.com/news/2011/110914/full/477251a.html?WT.ec\\_id=NATURE-2011095](http://www.nature.com/news/2011/110914/full/477251a.html?WT.ec_id=NATURE-2011095) .) But there is a balance to be sought here. A balance to be sought, *between* that unhappy outcome on the one hand, and a complete lack of 'skin in the game' among scientists on the other. My point is this: that, when/where the pronouncements of scientists are connected to *exposure* to risk among the public, then it is vital that a properly precautionary attitude be taken. If it requires the risk of the odd person being taken to court to encourage the taking up of that attitude, then so be it.

<sup>lix</sup> See <http://www.blackswanreport.com/blog/2015/05/our-statement-on-climate-models/> for explication in exactly the present context.

<sup>lx</sup> See again Lohman's arguments, *op.cit.*

<sup>lxi</sup> Compare here John Gray's (also Karl Polanyi's) sense of *laissez-faire* as itself being a plan, programmatic, rather than the absence of one that it pretends to be in the hands of (say) Hayek. See the Introduction to Gray's *Beyond the new Right* (London: Routledge, 1993) (and Polanyi's *The Great Transformation* (London: Beacon, 2002 (1944)) (*passim*)).

<sup>lxii</sup> While *of course* acknowledging that science is itself *necessary* for helping to reveal to us the limits of scientific thinking, of what it is that scientists as scientists can enable us to know. For the limits of such thinking are to a large extent found 'from the inside'. Only: I would emphasise nevertheless that science is not *sufficient* for revealing all of those limits, and that it is ethically irresponsible (and politically naive) to place on scientists the sole burden of establishing the attitude that ought to be taken to the kinds of threats with which this article has been concerned. For that burden, the burden of not *gambling* with our common future, falls on us all, and requires a mobilisation of values that far exceed the role of the scientist *qua* scientist.

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