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DISCUSSIONS

IS THE END OF THE WORLD NIGH?

By John Leslie

I

A frightening argument has been toyed with by cosmologists recently, though I know of no discussion of it in print.[1] While not itself straightforwardly inductive, it appeals to considerations of kinds which carry weight in standard cases of induction. Its conclusion is that we have grounds for thinking that human life will shortly go extinct.

'Nothing new in that', you may sigh. 'Anyone guided by history can see that very destructive weapons will always be used in war recklessly, and those guided by science will tell you that a hydrogen bomb war would be enough to wipe out humanity.' But an alarming thing about the cosmologists' argument is that, as was said just now, it is not straightforwardly inductive. The result is that no re-evaluation of the lessons of history or of the destructiveness of hydrogen bombs would serve to dismiss it, nor, for that matter, would getting rid of the bombs themselves. The argument might even seem to put us in the position of the helpless pawns of the Greek Fates, unable to defend themselves against their destiny no matter how hard they struggle. 'If hydrogen bombs fail to do the job,' the argument can seem to say, 'then the greenhouse effect will, or a monstrous rock from outer space, or something as yet undreamed of.'

The Doomsday Argument runs like this. One might at first expect the human race to survive, no doubt in evolutionarily much modified form, for millions or even billions of years, perhaps just on Earth but, more plausibly, in huge colonies scattered through the galaxy and maybe even through many galaxies. Contemplating the entire history of the race – future as well as past history – I should in that case see myself as *a very unusually early* human. I might well be among the first 0.00001 per cent to live their lives. But what if the race is instead about to die out? I am then a fairly typical human. Recent population growth has been so rapid that, of all human lives lived so far, anything up to about 30 per cent – figures quoted in this area vary according to,

[1] It may first have been suggested by B. Carter's 'The Anthropic Principle and its Implications for Biological Evolution', *Philosophical Transactions of the Royal Society of London*, A 310, (1983), pp. 347–63. Carter's paper illustrates that versions of the anthropic principle – which draws attention to possible selection effects linked to each observer's own existence – can be brought to bear on circumstances in which observers *are likely to* find themselves, just as much as on ones in which they *must* find themselves. And in the Discussion after the paper Carter comments that 'something like a man-made ecological disaster ... might well be discussed with reference to the anthropic principle'.

for example, how far back in evolutionary history we see humans and not just apes – are lives which are being lived at this very moment. Now, *whenever lacking evidence to the contrary one should prefer to think of one's own position as fairly typical rather than highly untypical.* To promote the reasonable aim of making it *quite ordinary* that I exist where I do in human history, let me therefore assume that the human race will rapidly die out.

We must not reason against this as follows: that if the race will have lasted for n generations before dying out, then the chances of any given person's generation having been any particular one – the fiftieth generation, say, or maybe the very last one – will be, *prima facie,* just $1/n$, so that no birth-time can be any more unordinary than any other. We must not reason like that because, for a start, the sizes of the various generations cannot simply be disregarded. (If a hundred groups are called up for military service, one after another, and the first ninety-nine groups each contain ten people only, while the hundredth contains ten million, then *primia facie* I am far more likely to find myself in the last group rather than somewhere among the others.) Again, *being very unusually early* could also be something which we ought not to disregard. This point will be discussed further in a moment.

The Doomsday Argument could interest inductive logicians, in part because it is not straightforwardly inductive, yet claims to tell us something about our race's probable future, and in part because (as will also be discussed in a moment) it really does rely on considerations of kinds which carry weight in straightforwardly inductive reasoning. But its main interest is for applied ethics. If powerful, it shows that end-of-the-world scenarios must not lightly be dismissed. The survival of our race ought not to be taken for granted.

Let us hope that the Argument has a flaw! Yet if it has one, then where?

II

The Argument's underlying principle that *one should, all else being equal, take one's position to be fairly typical rather than very untypical,* surely has much in its favour. Catching what looks like a monkey, you seat the animal before a typewriter. The keys are struck and out rolls a sonnet. You must not dismiss the affair by saying that something or other had to roll out and that if a sonnet would occur sooner or later in a sufficiently gigantic set of monkey-and-typewriter scenes, then why not in the very first scene to meet your eyes? – the sonnet being *no more unlikely* to occur on the first possible occasion than on the fifty-three quadrillionth occasion. You must not dismiss it like that, because typical monkeys would not type things like sonnets first time, or even in the first trillion years of trying, whereas typical comedians dressed as monkeys could well do so. Better, then, to suppose that the apparent monkey is a disguised comedian. Your situation when you see the sonnet could then itself be fairly typical, instead of not typical in the least.[2]

[2] I develop points of much this kind in 'No Inverse Gambler's Fallacy in Cosmology', *Mind* (1988), pp. 269–72, and 'Anthropic Explanations in Cosmology' in A. Fine and P. Machamer (eds), *Proceedings of the Philosophy of Science Association, 1986*, Vol I. (Ann Arbor, 1986), pp. 87–95.

Again, suppose you prepare a new chemical and it explodes almost at once. Better to assume that it is violently unstable rather than that it just happened to undergo a breakdown of a kind you would be unlikely to witness so much as once in a thousand years. Again, if a dog bites you then do not hurry to treat this as very untypical behaviour for this particular dog. That sort of consideration enters into inductive reasoning in a fairly basic way, one could well think.

You might protest that even a race which survived for infinite time (as F. Dyson thinks possible[3]) would include people who could be tempted by our Doomsday Argument. A race which survived for billions of years and spread throughout its galaxy would have had some earliest members who would have been severely misled, had they accepted the Argument. But the reply to this is that probabilistic arguments can be powerful despite being liable to mislead those rare people who are in untypical, improbable situations. If sheer chance has made you catch in swift succession the three longest fish in the lake, you may be *misled* in thinking that very long fish are typical of the lake but your thinking will not be unwarranted, *misguided.* It will be reasonable thinking.

Imagine, though, that each of the 10^{11} galaxies in the visible universe gives birth to a race of intelligent beings, which in almost every case spreads through its galaxy and survives for billions of years. Intelligent beings who existed at early stages would be greatly outnumbered by those existing after the spreading had begun; and yet, we might argue, this unordinariness of theirs would be balanced by the fact that it was very ordinary for intelligent races to survive for billions of years and spread widely. So the statistical unusualness against which the Doomsday Argument tries to guard me would in their case (which would *ex hypothesi* be my case also) be cancelled out or made unimpressive.

No doubt it would; yet this would seem not to ruin the Argument. For the sad truth is that I do not in fact know that the typical galaxy will give birth to an intelligent race which will spread widely and survive for billions af years. Now the Doomsday Argument is deployed against the background of my lack of knowledge. It says only that, *lacking evidence to the contrary,* I had better not think of my position as very extraordinary.

'But what,' you may ask, 'would be specially extraordinary in being *untypically early* in human history?' Early humans would no doubt form a comparatively very small class if the race survived for billions of years, yet absolutely any humans can be made to fall into very small classes if we identify those classes appropriately. Any human must exist at some time or other during human history: for example, when between 56.99999 per cent and 57 per cent of that history has elapsed. Would not humans in that narrow time range *also* be statistically unusual?

It would not be enough for us just to reply that early humans would probably form a class *much smaller* than the humans who existed during equivalently short periods after the race had begun massive growth by expanding through the galaxy; for, quite apart from any doubts about whether expansion through the galaxy could occur, we should simply run into the same old objection that the class into which any given

[3] F. Dyson, 'Time Without End: Physics and Biology in an Open Universe', *Reviews of Modern Physics*, Vol. 51 (1979), pp. 447–60.

human falls can always be made as small as you please by identifying it appropriately. (The objector could point to the class of humans with port-wine birthmarks on their foreheads, then inquiring scathingly whether anything comparable to a Doomsday Argument could be adopted by anyone who found himself in this tiny group.) Instead we need to insist on the fact that the words 'extraordinarily early in human history' can trip smoothly off the tongues of reasonable men, in a way in which 'extraordinarily falling into the 56.99999 per cent to 57 per cent time range' do not.

Why is that a fact, though?

For a start, let us bear in mind that we cannot do much science or get far in everyday life unless willing to treat various affairs as *standing out* against the background of others in ways which should influence our explanations, even when those various affairs are not 'unusual' in any sense which is merely and purely statistical. The person who draws the only red ball in a large urn filled to the brim with green ones and who then does not examine the ball with special care (to see, say, whether it is particularly light-weight so that it might be expected to end up at the top when the urn was shaken) but just comments that this red ball was presumably no more unlikely to be drawn than any other particular ball and that every ball is unique in all sorts of respects – this person, say I, will not get far in life.

To develop that kind of point in detail would involve difficulties too great to be discussed here.[4] Tackling them properly would require a long book analysing such concepts as Simplicity and their importance to common sense and to science. Yet even without such a book one might suspect that willingness to treat *being very early* as 'standing out' against the background of such other things as *being in the 56.99999 per cent to 57 per cent time range* could be, like treating a single red ball as standing out against the background of a hundred green, the sort of thing that is central to induction. The Doomsday Argument, let me say again, is not itself straightforwardly inductive, yet it could seem to rely on reasoning of a general type on which users of induction also rely. Could not even *being very near one end of a line* be viewed as 'standing out' against the background of such other affairs as *being just about exactly fifty-seven hundredths of the distance along it*?[5]

Perhaps so; yet if this were all that could be said then the Doomsday Argument would not make me lose much sleep. But unfortunately we can tell two other urn stories which move us much closer to the Argument.

In the first you draw several balls, in each case replacing them and shaking well before redrawing. Every single time, the same ball is drawn. Is this remarkable and in *prima facie* need of some such special explanation as that trickery is at work or that the

[4] I discuss them further in 'Cosmology, Probability and the Need to Explain Life', in N.Rescher (ed.), *Scientific Explanation and Understanding*, (Lanham and London, 1983), pp. 53–62; and in ch.5 of *Universes* (London and New York, 1989).

[5] In *Foundations of Inductive Logic* (London, 1956), R.F. Harrod suggests that being near a line's termination could be interestingly 'special'. A short-sighted ant walking the line should assume its place to be typical and not special, therefore expecting the line to continue beyond its field of vision. Sadly, this could not be made a basis for expecting human life to continue *very* long – particularly since a one-dimensional line is very different from a human population which suddenly undergoes the kind of growth which has made you and me fairly ordinary in our temporal location (at least for the moment) despite our being (at least for the moment) very late in human history.

drawn ball is specially light-weight? Suppose the balls are numbered 1 to 20. A mathematician makes the comment that the actual sequence of draws – fifteen successive 5's, let us say – is no more improbable than any other possible sequence such as 4,7,20,18,13,14,12,5,3,3,11,20,1,16,8. (Like all other possible sequences, fifteen 5's constitutes *exactly one* of the possibilities.) Should you be impressed by such a comment? No; for both trickery and light weight would have understandably favoured the sequence of 5's above other possible sequences, *thereby much increasing the likelihood of your seeing what you did see*: compare the monkey-and-typewriter case. The upshot is that you have *inductive warrant* – not conclusive yet impressive – for expecting the 5's to continue.

In the second story, you know that just one ball in an urn is marked with your name. Balls are drawn one after another – and behold, the seventh is 'yours'. Which theory should you prefer: (A) that the urn had just twenty balls, or (B) that it had a thousand? Well, you now have quite strong grounds for preferring (A), as its correctness *would have given a far greater chance of your ball being drawn fairly early*: typically, a ball would have been drawn by the eleventh draw. Such preference for theories whose correctness *would have much increased one's likelihood of seeing what one did see* is (as was noted in the case of the previous story) altogether respectable.

Does this last story describe anything sufficiently close to our own situation when we consider our birth-times? True, we were never immaterial spirits waiting to be put into new-born human bodies, our birth-times being allocated through the drawing of balls from an urn; yet the story does strike me as helpful. Maybe this is partly because I seem able to make sense of the idea that *I myself* might well have been born much later, if the human race is due to continue for another billion years; yet I think that the Doomsday Argument need not rely on that philosophically controversial idea. What is crucial to the Argument is just an eagerness, met with in induction also, *to see one's situation as fairly typical rather than highly untypical.* (If the balls in the urn are only twenty, not a thousand, then a ball drawn on the seventh draw has not been drawn at all markedly early but is instead a very typical ball; and likewise, if the human race is soon to die out then with respect to my birth-time I am a very typical human, since maybe getting on for 30 per cent of all humans will have been born at roughly that time; but if, in contrast, the race is going to survive for many million further years then surely I am a human whose life is very, very untypically early. The sole way of escape from such a conclusion would be via the assumption that the race will continue for millions of years *at a greatly reduced size* – say, of only a thousand people in each generation. But who would swallow so bizarre an assumption?)

III

I conclude that the Doomsday Argument is forceful. It must take its place beside those optimistic arguments which predict a long future for humanity.

Still, those arguments could be forceful too. They suggest, for example, that good will and determination could end tne nuclear arms race. The Doomsday Argument, I said, might seem to make us like the helplessly struggling pawns of the Greek Fates. But the truth of the matter, I think, is only that our *prima facie* need to see our

temporal position as ordinary will remain just as strong no matter how much we struggle. Yet this is not to say that arguments pointing to the happy results to be expected from summoning up good-willed determination would be equally weak, whether or not we summoned it up! The presence of good will and determination could help supply the sort of *evidence to the contrary* which ought to make us doubt our ordinariness.

That, though, does not mean that the Doomsday Argument can safely be disregarded. Strictly speaking, it is true, the argument is only for *a shift* in any estimate of the risk of our race's imminent extinction. If we started by believing that this risk was as low as one in a million, say, then the shift might only increase our estimate of it to one in ten thousand; and a risk, which seemed that small, we might continue to disregard. Yet a mere one in a million is surely too low as an initial estimate. Something much higher seems appropriate in view of how we humans are behaving. We desperately need to change our ways, therefore. We must try to make the initially estimated risk – the risk as judged after considering all such things as nuclear warfare – as low as possible, so that even after the Doomsday Argument has been considered as well, the risk can *still* appear low. We thus need to look very seriously at disaster scenarios before calling them too far-fetched to concern us.

The risk of huge rocks arriving from outer space (unless we deflect them) can I think be disregarded, as our ancestors have survived it for millions of years. Might one protest that, had they not survived it, then we should not be discussing the affair, so that their survival of it is irrelevant? Surely not. Suppose the fifty sharp-shooters of a firing squad all miss you. Your reaction cannot reasonably be, 'If they hadn't all missed, then I'd not be here to consider the matter, so I've no new reason to believe myself popular with them.'

Nuclear war, in contrast, has not threatened us for very long, yet I think it unlikely that absolutely all of us will die from it. A runaway greenhouse effect could well be a more severe danger. Yet the doomsday scenario which may be most frightening concerns very high energy experiments.[6]

Even 'empty' space is a ferment of quantum fluctuations, particles bursting into being and then vanishing. Its energy density is considerable. Now, the Inflation story of A. H. Guth and A. D. Linde[7] tells us that this energy density was far greater early in the Big Bang, leading to very fast expansion. Taking advantage of how gravitational binding energy is *negative energy*, Inflation created the entire visible universe from something starting with very little mass indeed. Well, what are the dangers of taking tiny volumes ever closer to early Big Bang conditions, as physicists do when their accelerator beams collide? First, some tiny volume may reach so high an energy density that a new Big Bang will begin. And second, Space, as we know it, may be only *metastable* like a vase balancing upright; the push of a very violent particle collision

[6] I here come to scientific points considered in much more detail in my 'Risking the World's End', *Bulletin of the Canadian Nuclear Society*, 10 (1989) no. 3. (This also presents the Doomsday Argument as a case of Bayesian reasoning for a shift in estimated risk.)

[7] A fine introduction is A.D. Linde, 'The Universe: Inflation out of Chaos', *New Scientist*, Vol. 105 (1985), pp. 14–18; repr. in J. Leslie (ed.), *Physical Cosmology and Philosophy* (New York, 1989).

might then produce a bubble of Space with a still lower energy density. It would expand at virtually the speed of light, destroying all life.[8]

Before panicking one should consider various things:

(a) Experimental physics is still a long way from Big Bang energies.

(b) P. Hut and M. J. Rees calculate that cosmic rays have been colliding in the visible universe (i.e., inside our past light-cone, the boundary to all events which could have had a chance of affecting us) at energies well above those of present-day accelerators.[9]

(c) Probably a man-made Big Bang would be just the creation of 'another universe', i.e., of a Space inflating enormously but in a way unaffecting the Space we inhabit. Guth and others have therefore suggested that we might start a new Bang with a hydrogen bomb exploded in such a way that its energy became concentrated at a point, without blowing up Earth.[10]

However, there are the following grounds for caution:

(i) Experimental physicists are ingenious.

(ii) Nobody can be sure even of the correctness of the Hut–Rees calculations, let alone of whether a man-created Bang would expand otherwise than into *our* Space.

(iii) E. Fermi long ago stated a 'Where Are They?' problem. Beings of manlike intelligence could be expected to spread through their galaxies quickly; hence, if such intelligence is common in our galaxy, we should expect to have seen extraterrestrials; so why haven't we? This is of course a problem only if manlike intelligence *is* common. There are two specially strong grounds for doubting that it is. Both should disturb us.

First, a universe which had undergone Inflation could easily contain trillions of regions each extending as far as telescopes could probe. Richly complex events leading to the evolution of intelligent beings, even if very unlikely to occur in any region picked at random, might still be expected in some regions or other – and it would then, of course, be such very improbably rich regions which those beings observed. (This is an application of a 'superweak anthropic principle'.[11]) Thus we may well be the only intelligent beings in the entire visible universe. So we cannot exclaim, 'It's safe to do experiments taking us close to Big Bang energies. Among the 10^{22} stars visible to us, many must surely be warming planets whose inhabitants have done such experiments, and clearly no new Big Bang or similar disaster has ensued.'

[8] M.S. Turner and F. Wilczek, 'Is Our Vacuum Metastable?', *Nature*, Vol. 298 (1982), pp. 633–4.

[9] P. Hut and M.J. Rees, 'How Stable is Our Vacuum?', *Nature*, Vol. 302 (1983), pp. 508–9.

[10] E. Farhi and A.H. Guth, 'An Obstacle to Creating a Universe in the Laboratory', *Physics Letters B*, Vol. 183 (1987), pp. 149–55. The requisite high-energy state 'is obtained by compressing a modest amount of energy'. The 'obstacle' – it could seem that no amount of compression would serve – might well be illusory, the authors stress. And while they claim that a child universe would expand 'at no cost to the parent' so that 'we would not be destroyed', their paper is full of such words as 'seems' and 'we have not excluded'. (See also another very speculatiye paper by A.H. Guth, S.K. Blau and E.I. Guendelman in *Physical Review D*, Vol. 35 (1987). It gives about 20 kilograms as the mass-energy which would have to be achieved in highly compressed form – and yet the equally expert Linde writes that our universe inflated from 'less than a hundred thousandth of a gram'.)

[11] I discuss the principle on pages 112–13 of 'The Scientific Weight of Anthropic and Teleological Principles', N. Rescher (ed.), *Current Issues in Teleology* (Lanham and London, 1986) pp. 111–19.

Second, let us suppose that the universe contains hugely many regions each stretching as far as telescopes could probe, life of some degree of intelligence evolving in most of them. In most, the beings who win the race to evolve manlike intelligence start a new Big Bang or something like it. No beings could have long for contemplating the fact that other beings in their regions had started new Big Bangs: they would die almost as soon as they learned of it. Once more, therefore, the peaceful starry heavens give no evidence that very high energies are undisastrous.

IV

Induction is no doubt the only game in town when one wants to predict the fine details of the future. But this does not mean that we can safely conclude such things as that the sun would still be shining a few years from now even if we introduced very high energies as new factors in the game. Moreover, regardless of what you may think of the risks of those energies, the Doomsday Argument is deeply disturbing. It is disturbing for precisely the reason which (I have found) causes people to shrug it off instead of actually examining it: namely, that it is not itself truly inductive. It makes no appeal to disputable facts about the dangers of high energy experiments, nuclear warfare, greenhouse effect, loss of ozone layer, and so forth. It gives no fine details of the future. It just suggests that we need to be very careful, else we shall be hit by Something-it-knows-not-what.

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ON THE PROBLEM OF EVIL'S STILL NOT BEING WHAT IT SEEMS

By David O'Connor

The points I shall make in reply to P. J. McGrath's criticisms[1] of my 'On The Problem Of Evil's Not Being What It Seems'[2] fall into three groups. First I will show that he seriously misrepresents my position and that, accordingly, his attacks upon it fail. Second, I will point out significant defects in the solution that he goes on to propose to the problem of evil. And third, I will sketch out an argument for my conclusion about God and all evil that was not in my original paper.

I

McGrath reads me as arguing, without qualification, that there is no such thing as the problem of God and all evil, the so-called quantified problem. But that is a

[1] P.J. McGrath, 'Is There A Problem Of Evil?', *The Philosophical Quarterly*, 39 (1989), no. 154, pp. 91–4. I shall incorporate page references to this in my text using the device (M., p. 00).

[2] D. O'Connor, 'On The Problem of Evil's Not Being What it Seems', *The Philosophical Quarterly*, 37 (1987), no. 149, pp. 441–7. I shall incorporate references to this in my text using the device (O., p. 00).