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Lucretius 5.1011-27: the origins of justice and the Prisoner's Dilemma

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ABSTRACT: This paper considers two problems in Lucretius' account of the origin of justice: its assumption of an apparently un-Epicurean absolute notion of fairness, and its unexplained assertion that the earliest humans were at risk of catastrophic extinction. It is argued that modern evolutionary theory and game-theoretic models help to solve these problems.

This paper looks at the Epicurean theory of justice from an evolutionary perspective, with a focus on the origins of justice as outlined by Lucretius in 5.1011-27. There has been a previous study of ancient theories of justice from the perspective of the Darwinian game known as the Prisoner's Dilemma by Nicholas Denyer in 1983,[1] but since then great advances have been made in Prisoner's Dilemma and other so-called Darwinian game theories, especially since the mid-eighties and Robert Axelrod's computer models.[2] These advances have allowed a radically different view of the place of cooperation and altruism in evolution, and inevitably will affect our view of ancient theories and their relationship to Darwinian thinking.

I begin with the passage of Lucretius (5.1011-27):[3]

[1] N. Denyer, 'The origins of justice', in *Suzetesis: studi sull' epicureismo greco e romano*, *offerti a Marcello Gigante* (Napoli 1983) 133-52. See also G. Herman, 'Reciprocity, altruism, and the Prisoner's Dilemma: the special case of classical Athens', in C. Gill, N. Postlethwaite, and R. Seaford (eds), *Reciprocity in Ancient Greece* (Oxford 1998) 199-225. An earlier version of the present paper was given at the Leeds International Latin Seminar, 5 May 2000.

[2] See pp.5-7 below. R. Axelrod, *The Evolution of Cooperation* (New York 1984). See also the University of Michigan's Centre for the Study of Complex Systems, online at http://www.pscs.umich.edu/CSCS/research/carReports.html; R. Axelrod, 'On six advances in cooperation theory', *Analyse und Kritik*, 22 (July 2000) 130-151, available online at http://www.pscs.umich.edu/pub/papers/OnSixAdvancesinCoopTheory.pdf.

[3] For this passage in general see E. Asmis, 'Lucretius on the growth of ideas', in G. Giannantoni and M. Gigante (eds), *Epicureismo greco e romano* (Naples 1996) 763-78; K. Algra, 'Lucretius and the Epicurean other', in K.A. Algra, M.H. Koenen and P.H. Schrijvers (eds), *Lucretius and his Intellectual Background* (Amsterdam/Oxford 1997) 141-50, and G. Campbell, *Lucretius on Creation and Evolution* (Oxford, forthcoming) *ad loc*. Studies of Lucretius' prehistory include E. Bertoli, *Tempora rerum: modalità del progresso umano in Lucrezio* (Verona 1980); D.R. Blickman, 'Lucretius, Epicurus and prehistory', *Harvard Studies in Classical Philology* 92 (1989) 157-91; P. Boyancé, *Lucrèce et l'épicurisme* (Paris 1963) 236-61, D.J. Furley, 'Lucretius the Epicurean on the history of man', in *Fondation Hardt Entretiens* 24 (Geneva 1978) 1-27; E.J. Kenney, 'The historical imagination of Lucretius', *Greece and Rome*, 19 (1972) 12-24; B. Manuwald, *Der Aufbau der Lukrezischen Kulturentstehungslehre* (Mainz 1980); L. Perelli, 'La Storia dell'Umanità nel 5 libro di Lucrezio', *Atti della Academia delle Scienze di Torino* 101 (1967) 117-285; A. Schiesaro, *Simulacrum et imago* (Pisa 1990) 91-168; P.H. Schrijvers, *Lucrèce et les sciences de la vie* (*Mnemosyne* Suppl. 186, Leiden 1999) 1-118. The main Epicurean sources

inde casas postquam ac pellis ignemque pararunt,
et mulier coniuncta viro concessit in unum
conubium,[4] prolemque ex se videre creatam,
tum genus humanum primum mollescere coepit.
ignis enim curavit ut alsia corpora frigus
non ita iam possent caeli sub tegmine ferre,
et Venus imminuit viris puerique parentum
blanditiis facile ingenium fregere superbum.
tunc et amicitiem coeperunt iungere aventes
finitimi inter se nec laedere nec violari,
et pueros commendarunt muliebreque saeclum,
vocibus et gestu cum balbe significarent
imbecillorum esse aequum misererier omnis.
nec tamen omnimodis poterat concordia gigni,
sed bona magnaque pars servabat foedera caste;
aut genus humanum iam tum foret omne peremptum
nec potuisset adhuc perducere saecla propago.

Then, after they had got huts and skins and fire for themselves, and woman joined to man had retired into a single marriage, and they saw children created from them, then it was that the human race first began to soften. For fire saw to it that their now tender bodies were unable to bear the cold under the open sky as they had before, and Venus lessened their violence, and children with their winning ways easily broke the arrogant nature of their parents. And then eager neighbours began to form friendship pacts with one another neither to harm nor be harmed, and they entrusted children and the female race to each other's care, signing with cries and halting gestures that it is right for all to pity the weak. It was not possible however for complete concord to arise, but a great part kept the pacts with integrity, or already at that time the human race would have been completely destroyed, nor would their offspring have been able to prolong the race to this day.

From 5.925 to 1010 Lucretius has described the lives of the first humans after they had sprung fully formed from the earth. They live a wandering 'beast-like life'[5] with no arts, technologies, laws, society or marriage, chasing wild animals with clubs and living in caves and forests. Their bodies are tough and hairy, and neither physically nor behaviourally are they clearly differentiated from the other animals. Their behaviour towards each other is described at 5.958-61:

nec commune bonum poterant spectare neque ullis
moribus inter se scibant nec legibus uti.

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on the origins of society are conveniently collected in A.A. Long and D.N. Sedley, *The Hellenistic Philosophers* (Cambridge 1987) ch. 22.

[4] *Post* 1012 *lacunam indicavit Marullus*, 1013 conubium *Lachmann*: cognita sunt *OQ*

[5] Cf. Eurip. *Supp*. 195-218, *Orest*. 1646; Critias *Sisyphus TrGF* 1.43 fr. 19; Hipp. *De Vet. Med*. 3.26; Isocrates *Or*. 3.6, 4.28, 4.39; Dicearchus fr. 49 Wehrli; Moschion *TrGF* 1.97 fr. 6; Polyb. 6.5.4; Diod. Sic. 1.8.1, 1.90.1; Cicero *De Inv*. 1.2, *Rep.* 1.25.40; Vitruvius *De Arch*. 2.1; Vergil *A*. 8.314; Horace *Ars* 391, *Sat*. 1.3.99; Tibull. 2.1.37; Ovid *Am*. 3.10.7, *Ars*. *Am*. 2.621, 2.289, 3.113; Manilius *Astron*. 1.66; Pliny *NH* 16.1; Plutarch *Adv. Colotem* 30, *De Is*. *et Os*. 13; Tacitus *Ann*. 3.26; Apuleius *Apol*. 23.

> quod cuique obtulerat praedae fortuna, ferebat
> sponte sua sibi quisque valere et vivere doctus.
>
> Nor were they able to look to the common good, nor to use any customs or laws among themselves. What booty fortune had obtained for each person, each carried off at will for themselves, taught to live for himself and so to be strong.

Then the brief passage 1011-27 describes three things: the clear differentiation of humans from animals by a process of softening, domestication and socialisation; the formation of the first societies; and the origins of justice. All three are closely inter-linked: the first humans soften physically and psychologically by an evolutionary process in response to their new-found culture and environment of fire, clothes, houses, marriage, sex and child-care. This evolution into modern humans[6] enables them to perceive the societal value of cooperation, so to form friendship pacts on the Epicurean model, and so to enable the formation of the first village societies. I shall not here go into all the details of the evolutionary process, or rehearse all the arguments around the Epicurean theory of justice as presented by Lucretius, but I shall look at two problems Lucretius' account presents.[7]

First, in line 1023 we hear the first villagers explaining to each other that it is right for all to pity the weak. This, as Phillip Mitsis has said,[8] assumes a pre-existing absolute notion of fairness or rightness that, given Epicurus' insistence that there never was an absolute justice,[9] would seem to render it not truly Epicurean.

Secondly, in 1025-7 we are told that had the first people not formed friendship pacts and kept them, the human race would have died out there and then. There is no obvious explanation for such a dramatic catastrophic extinction, given the only moderate level of violence between humans in the previous wild wandering phase of existence, and we are not given an explanation such as that of Plato's Protagoras, who says that because the first people lacked the divine gift of political science the first gatherings exacerbated the level of violence between them.[10]

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[6] Lucretius regards the first people as human (cf. 5.925: *genus humanum illud*), but as a more bestial sub-species. His scheme of evolution in 1011-27, then, does not cross species boundaries (cf. his insistence on the fixity of species at 5.878-924). The problem of defining the origins of the genus *Homo* still remains in the present day, see B. Wood and M. Collard, 'Is *Homo* defined by culture?', in J. Coles *et al*. (eds), *World Prehistory: Studies in Memory of Graham Clark* (Oxford 1999) 11-24.

[7] For a more detailed analysis see G. Campbell (n.3) *ad loc*, and *id.* 'Zoogony and evolution in *Timaeus*, the Presocratics, Lucretius and Darwin', in M.R. Wright (ed.), *Reason and Necessity: Essays on Plato's* Timaeus (London/Swansea 2000) 145-80.

[8] P. Mitsis, *Epicurus' Ethical Theory: The Pleasures of Invulnerability* (Cornell 1988) 106 n.15c.

[9] Cf. ΚΔ (*Principal Sayings*) 33.

[10] *Protagoras* 320c-323a. Lucretius describes a similar descent of the first cities into violence and bloodshed (5.1105-60), but its cause, unlike in *Protagoras*, is not ignorance of political science but competition driven by the fear of death and the fear of the gods. Cf. *DRN* 3.59-93.

Some light may be thrown on these problems by viewing this passage of Lucretius from a modern evolutionary point of view. Since the publication of the anarchist Prince Peter Kropotkin's *Mutual Aid: A Factor in Evolution* in 1902, classical Darwinian thinking has struggled to account for the origins of cooperative behaviour, altruism and justice.[11] Kropotkin pointed out that nature and human society are characterised as much by cooperation as by competition, and that there is at least as much cooperation and altruism in nature as competition. Darwin himself had relied upon competition as the driving force of evolution in his theory of Natural Selection, but his followers, Huxley in particular, laid even heavier stress on competition than Darwin had. Darwin need not be held entirely responsible for the subsequent history of the idea of 'survival of the fittest in the struggle for existence'[12] as a positive evolutionary force, and its use to justify some of the most brutal economic and social policies of the last century, but the idea is at the heart of his thinking, and is still very strong in political and economic thinking and tends to colour our view of even ancient theories of the origins of justice.[13]

Various attempts have been made over the last century to explain the origins of altruism within the Darwinian framework of Natural Selection, all of them more or less unsuccessful, or at least only partly successful. The main difficulty faced by Darwinists has very often been expressed in terms of the Prisoner's Dilemma. In this scenario two prisoners are charged with the same offence, and in order to extract a confession from them the police chief offers them both a deal: if they both keep silent (cooperate) they will both be convicted of a lesser offence, and each receive a year in jail; if, however, one confesses and gives evidence against the other (defects) he will be let off free, while the other gets ten years in jail. They are put in separate cells to think it over. Each one reasons thus:

> If I stay silent I will only get a year in jail, which is not too bad, but it is worth my while to confess and so get out free. In any case, I am not sure I trust my colleague to keep quiet for my sake, and so I had better confess before he does.

And so the one who cooperates and stays silent gets ten years in jail, the least desirable outcome, and the one who confesses (defects) gets out of jail free, the most desirable outcome. There are many ways in which the problem may be stated, but they all share one thing: that a rational approach to the problem leads to defection and to the best result for the defecting player. Accordingly, cooperation would seem to have negative value in evolutionary terms: Natural Selection would seem to favour defection, and so cooperation seems not to be an adaptive strategy, and thus cooperation in Nature is left unexplained.

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[11] For a general overview of the arguments see M. Ridley, *The Origins of Virtue* (London 1996).

[12] The phrase 'survival of the fittest' was coined by Herbert Spencer. It was urged on Darwin by Alfred Russel Wallace in preference to Darwin's own 'Natural Selection' since the latter seems to imply some intelligent agency in the process. Darwin conceded: 'I must be a very bad explainer. I suppose "natural selection" was a bad term' (quoted from Daniel Dennett, *Darwin's Dangerous Idea* (London 1995) 73).

[13] See Ridley (n.11) 247-65.

One attempt to get around this problem has been 'Group Selection', and this is one explanation that Darwin himself uses.[14] In this a group of creatures more instinctively cooperative than other groups of the same species in food-gathering, hunting, child care and so on, would inevitably be more successful, and so out-compete others, and thus breed more prolifically and spread their cooperative behaviour genetically. But this model is vulnerable: critics point out that selection does not occur at the group level but at the level of the individual. What mechanism may operate to promote cooperation at the expense of competition between members of the same group is not clear: the Prisoner's Dilemma would still seem to operate against selection for cooperation between members of the group.

The other main strand of thought may be described by Richard Dawkins' 'Selfish Gene' label.[15] Here, cooperative and altruistic behaviour is explained at the genetic level. Put briefly, behaviour that may be directly disadvantageous to the individual organism may well be advantageous to its genes. This may be seen most clearly among social insects such as bees: it is directly disadvantageous to a worker bee to die defending the hive, but in doing so she promotes her genes in the form of the young of the hive, the females of which are at least her half-sisters and some her full sisters. She behaves selflessly, but this result is brought about because her genes behave selfishly. Again, this may be criticised in terms of the level selection works upon. Selection does not take place at the genetic level: genes are simply the carriers of information created by selection at the individual level. Another mechanism must be sought to allow individual and genetic advantage to coincide more neatly.

Both of these mechanisms, Group Selection and Selfish Genes may well play a part in the evolution of cooperation, but they are only a part of the story. One problem with them is that both they and the classic model of the Prisoner's Dilemma presuppose that altruism and self-interest are polar opposites, and that cooperative behaviour is directly disadvantageous to the individual, directly advantageous to the group (or the genes), and only indirectly advantageous to the individual. The work of Robert Axelrod, and many others since, has thrown doubt on the validity of this neat polarisation. Axelrod noticed that when the Prisoner's Dilemma was played more than once between the same players ('iterated') in computer models, something remarkable happened. In a version called the Diner's Dilemma[16] three different types of player, Defector, Sucker and Tit-for-Tat, eat in the same restaurant repeatedly, dining with those adjacent to them. Each player gains points for the number of dinners bought for it, and thrives and reproduces

[14] C. Darwin, *The Descent of Man* (1871), ch. 5, 'On The Development of the Intellectual and Moral Faculties': 'A tribe including many members who ... were always ready to aid one another and to sacrifice themselves for the common good, would be victorious over most other tribes; and this would be natural selection.' See P. Skelton (ed.), *Evolution: A Biological and Palaeontological Approach* (Wokingham 1993) 254-62.

[15] R. Dawkins, *The Selfish Gene* (London 1976).

[16] See C. Badcock, *Psycho-Darwinism* (London 1994) 38-58, and U. Gneezy, E. Haruvy and H. Yafe, 'A laboratory versus field study of the Unscrupulous Diner's Dilemma: are people that nice?', online at http://gsbwww.uchicago.edu/fac/uri.gneezy/vita/Restaurant jpe.pdf.

when successful or dies out if unsuccessful. Defector never buys anyone else dinner, and so is in the position of the confessing prisoner in the static game, and thus could be expected to be the most successful at getting free dinners. At first, as expected, the Defectors do well and the Suckers (who always cooperate) disastrously badly. But as the game progresses a strategy called Tit-for-Tat begins to thrive. Tit-for-Tat simply begins by cooperating (here buying dinner), and then does just what each player did to it last time. So it will always cooperate with Suckers and defect against Defectors. It holds no grudges though, and if a Defector were to change tactics and decided to cooperate, Tit-for-Tat would cooperate with it next time. After a while the Defectors use up most of the available Suckers and are left playing mainly against Tit-for-Tats, against which they can make no headway because Tit-for-Tats will not cooperate with them, or playing against other Defectors, which can bring them no advantage since they never buy dinner for anyone. Tit-for-Tat soon drives the Defectors nearly to extinction, and becomes the dominant player. Perhaps even more remarkably, Sucker, now that the Defectors are weak, begins to thrive by playing with Tit-for-Tat; both of them behave in exactly the same manner towards one another, buying each other dinner in turn. Finally, Sucker and Tit-for-Tat have almost equal numbers, and Defector struggles to survive, on the edges of electronic society. At least in the limited and artificial world of the Prisoner's Dilemma, then, it can be seen that the former judgement was entirely wrong: competitive selfish behaviour does not give an adaptive advantage beyond the very early stages of the game. A modified and contingent cooperative strategy, Tit-for-Tat, is the most effective survival technique both *directly* for the individual organism, and for the group. Startlingly, an entirely unmodified and irrational seeming cooperative strategy, Sucker or always cooperate, is the second best individual survival strategy, thus giving an entirely different gloss to the maxim of W.C. Fields: 'never give a sucker an even break.'

Axelrod was looking for a simple strategy that did not involve complicated thinking or any sentiment or emotion, and he predicted that Tit-for-Tat would be an evolutionarily stable strategy, by which he meant that it would win in any circumstances and conditions.[17] Since the mid-eighties, other more efficient strategies than Tit-for-Tat have been derived, but they all have one thing in common: they are all more forgiving and cooperative than Tit-for-Tat. For example, a strategy called Tit-for-two-Tats outperforms the simple Tit-for-Tat by forgiving the first defection against it, and only responding in kind after a second defection.

Nicholas Denyer's analysis of the status of the Epicurean theory of justice in terms of the old static Prisoner's Dilemma concluded that the Epicurean model of justice, the pragmatic contractarian friendship-pacts model, achieves the second

[17] A strategy that did not depend upon family relationships, considerations of position within a social hierarchy or emotional attachments: Tit-for-Tat needs only to remember what each player did to it last time, which, in a small group at least, is not too difficult. Ridley (n. 11) 62-3 describes the process in colonies of vampire bats. For evolutionarily stable strategies see Dennett (n.12) 251-66.

best result for the individual, but the best result for the group: a wise person will forego a direct individual advantage for the mutual benefit of the group, from which she will also, in turn benefit. This was a fair analysis at the time, but now we may view it differently. Using Axelrod's reiterated Prisoner's Dilemma to analyze the Epicurean theory, the model would achieve the best result *both* for the individual *and* for the group: the individual gives up no direct advantage by sticking to the friendship / non-aggression / mutual aid pacts of the Epicurean theory, but receives a direct personal advantage by doing so.

This may go some way in explaining the seemingly un-Epicurean absolute moral statement Lucretius has the first villagers make in 5.1024: 'it is right that all pity the weak.' In terms of the Prisoner's Dilemma we could put it as: 'it is right that all refrain from defecting against Suckers', characterising the weak here as Suckers because, due to their position of weakness, they are unable to defect in the face of defection and so must always cooperate. This would be entirely correct from the point of view of Tit-for-Tat. Tit-for-Tat behaves from no sentimental motives, and does only what is advantageous to it. It refrains from taking advantage of the weak (defecting against Suckers), because it derives a direct personal benefit from cooperating with them. Tit-for-Tat does not simply protect Suckers from Defectors, it behaves exactly as a Sucker when dealing with Suckers, and thus gains as many points from them as it does in dealing with other Tit-for-Tats. So if Tit-for-Tat defected against Suckers, it would lose a large part of its livelihood.

I said earlier that the statement 'it is right that all pity the weak', because it involves an appeal to a pre-existing notion of fairness, cannot be properly Epicurean if the Epicureans are absolute moral relativists and utilitarians. But if I now rephrase the statement from the point of view of Tit-for-Tat, it becomes: 'it is a powerful individual and group survival strategy that all refrain from taking advantage of the weak.' This gives us our pre-existing notion of fairness, but in a different form. It is not now an appeal to an absolute notion of fairness that exists somehow metaphysically independent of physical reality, but simply a statement of the true position, that this sort of behaviour will always outperform all others in producing beneficial results for all individuals involved: it is in fact an evolutionarily stable strategy. To put it another way, it is a prediction, based on empirical observation rather than abstract theorising, of the likely outcome of pitying the weak, and so the notion of fairness appealed to is established as a reference point upon which future decisions may be made. It does not exist independently of human action, but it may be said to pre-exist actions themselves because cooperative behaviour is an evolutionarily stable survival technique. The prehistoric and evolutionary setting of the Epicurean theory of justice parallels this temporal looseness: pragmatic cooperation saved the human race in the beginning, and so may reasonably be used as a model for future survival and success.

In the first, wandering stage of humanity, people had learned that aggressive competition was the only survival technique, but now that the human race has evolved, they are able to make the conceptual leap from their previous conviction

learned in the 'University of life' and the 'school of hard knocks' that 'every man for himself' is the best way to survive and thrive, to 'it is right that all pity the weak'. Both are seeming absolutes, but both are really predictions of outcome,[18] or perhaps rules of thumb rather than carefully worked out rational strategies.[19]

The Diner's Dilemma is of course very narrow and limited: the diners have no choice of which restaurant to go to, or of whom to dine with. In reality, if we find that someone is scrounging too many free dinners or drinks from us without reciprocating, we simply avoid dining with them, or go to a different restaurant or bar where we may meet more cooperative people. This is certainly what the Epicureans do in practice: withdrawing into the Garden to ensure they may interact only with other cooperative people, and so if they do play Tit-for-Tat in the Prisoner's Dilemma they seem to bend the rules. But this would also be a method of defecting against Defectors, and cooperating with cooperators. Epicurus in ΚΔ (*Principal Sayings*) 39 puts it:

> He who best knew how to meet external threats made into one family all the creatures he could; and those he could not, he at any rate did not treat as aliens; and where he found even this impossible, he avoided all dealings, and, so far as was advantageous, excluded them from his life. (Trans. Long and Sedley).

So the Epicurean will attempt to cooperate repeatedly even with Defectors, and to make friendship pacts with them. Only when she has satisfied herself that someone is incapable of changing their ways will she defect against them, and keep them at arm's length. This could be perhaps described as 'Tit-for-two-or-three-Tats': she begins by cooperating, continues cooperating in the face of defection, and finally defects only when the Defector proves incapable of cooperating. In ΚΔ 32 Epicurus talks about an ability to make non-aggression pacts:

> Nothing is either just or unjust in relation to those creatures which were unable to make contracts over not harming one another and not being harmed; so too with all peoples which were unable or unwilling to make contracts over not harming and not being harmed. (Trans. Long and Sedley).

Hermarchus seems to take a tougher view, at least with respect to animals (fr. 34 Longo-Auricchio = Porphyry *De Abstinentia* 1.12):

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[18] In Epicurean terms a *prolepsis* (preconception). It may be objected that, while clearly the first humans were born with a *prolepsis* of the meaning of words (*DRN* 1028-90), they cannot have originally had a *prolepsis* of the value of cooperation. This may be answered by appealing to the doctrine of the inheritance of acquired characters (see below n.26): the early humans acquired a preconception of the value of cooperation and then passed this preconception on to their descendants, who were then born with such a preconception. Cf. Long and Sedley (n.3) 64.

[19] Cf. Axelrod (n. 2, 2000) 134: 'The rationality assumption of traditional game theory has been widely challenged ... Herbert Simon ... has emphasised that people have a limited knowledge of their situations, limited ability to process information, and limited time to make choices. People are therefore likely to use rules of thumb rather than detailed calculation, more likely to experiment than to determine an optimal response, and more likely to imitate someone who is doing well rather than rely completely on their own experience.'

> If then it were possible to make a kind of contract with the other animals, as with men, over their not killing us or being killed by us indiscriminately, it would have been good to push justice up to this point; for it would have extended our security. But since it was impossible to associate creatures that lack reason with law, it was not possible to use such an instrument as the means of providing for utility in our security from other living beings any more than from lifeless things. All that can assure our security is the option, that we now have, of killing them. (Trans. Long and Sedley).

So the Epicurean will defect permanently from some creatures and some people who are incapable or unwilling to make contracts, and actually consider them outside justice. This seems harsher than the simple Tit-for-Tat, which never entirely gives up on a Defector. It keeps playing with any Defector in the hope that one day it may reform. This goes some way to explaining the closeting of the Epicurean school in the Garden. The Epicureans may seem, by withdrawing from the cut and thrust of normal society, to distrust the power of the friendship pacts to produce a just society, but their seclusion is actually part of their tactics in the game.[20]

This leads on to the second problem; the extinction of the human race had they not fortuitously hit upon the Epicurean theory of justice, and so survived. Clearly, Lucretius presents an outline of the Epicurean theory of justice: his *nec laedere nec violari* (5.1020) is a translation of Epicurus' μὴ βλάπτειν μηδὲ βλάπτεσθαι, the basis for the friendship pacts that underlie the Epicurean conception of justice.[21] But the setting of it in prehistory gives it a much less theoretical feel than it otherwise might have.[22] Lucretius is saying that far from being an ideal of justice, the Epicurean model is actually justice in its naturally occurring state: it is how justice came about before the rise of civilisation, and so before the imposition of restrictive legislation to curb human wrongdoing and to produce the limited amount of cooperative behaviour that now enables a civil society to exist. In Lucretius' account at 5.1105-60 legislation is a late invention and arises only in a third stage of civilisation. First, powerful technocrats become kings and begin to found cities out of entirely selfish motives, then competition for power, wealth and position leads to revolution and the assassination of the kings, and a state of anarchy follows. Only then, tired of constant strife do people listen to certain individuals and accept the restrictions imposed on them by legislation for the common good. Legislation is presented as the salvation of civilisation, but it is not claimed that the human race would have become extinct had legislation not been invented. In Lucretius' prehistory, the first humans are depicted behaving selfishly towards one another; they are unable to form any notion of the common good, but there is little explicit violence between them. They simply seem to wander alone with as little interaction as possible. When they see some food they snatch it for themselves rather than sharing it, but we do

[20] Axelrod (n.2, 2000) 158 discusses a similar strategy in the Prisoner's Dilemma called 'Exit' in which a player may refuse to play with uncooperative players.

[21] Cf. ΚΔ 31, 32, 33, and 35.

[22] From Epicurus' use of the imperfect in ΚΔ 39 and 40 it seems likely that he too discussed the nature of justice in terms of its prehistoric origins.

not see them fighting over it, although we may imagine such things happening. All the explicit violence is between humans and animals, and we may, if we are looking for enough violence to cause the extinction of the human race, see the reference in 5.1025-7 as being towards the survival of the human race through collaboration in the face of wild animal depredations (much as in *Protagoras* 320c-323a, Diodorus Siculus 1.8, Cicero *Republic* 1.25.40, and in Porphyry's report of the Epicurean Hermarchus). But the tone in 5.1011-27 is quite different. Lucretius speaks of the formation of human relations in terms of the ending of strife between humans and the beginnings of the protection of humans from other humans, of the weak by the strong. It may not be too fanciful to say that it was simply the inefficiency of their former survival strategy that would have led to the extinction of the human race. In terms of Darwinian game theory the selfish competitive behaviour exhibited by Lucretius' first humans before the formation of the first societies is the least efficient survival technique, and in less theoretical evolutionary thinking the development of an ability to cooperate, especially in hunting large game and in the sharing of the meat surpluses this brought with it, is often thought to have been one of the evolutionary advantages that enabled modern humans to out-compete archaic humans and so drive them to extinction.[23] I suggest Lucretius thinks in similar terms, for the following reasons.

In 5.780-836 we are given a description of the origins of animals and humans. Humans arise by the same process as the other animals and at the same time. They are in fact one animal species, as we should expect in an anti-teleological account.[24] In 855-78 we are told that all other animals had special characteristics that enabled them to survive: lions *virtus*, deer *fuga*, and foxes *dolus*. Without these, they would simply have become extinct. In addition, certain animals survived because of their *utilitas* to humans. Dogs, sheep, and oxen entered into a friendship pact with humans, and so they survived. This is clearly an anachronistic retrojection of the beginnings of animal domestication into Lucretius' scheme of the origins of species, but the force is clear: all the animals that survived had special characteristics without which they would have died out. For some it was their ability to compete as individuals, and for others it was their cooperative ability that saved them. Dogs, sheep and oxen were saved by cooperating, but in the Epicurean theory the benefits of such cooperation are mutual. Since they cooperated with other animals, humans also received a direct benefit, and so the same mechanism also helped preserve the human race from extinction. We may compare Epicurus ΚΔ 32 where a similar picture is given, also associating the formation of the first societies with cooperative human / animal relationships.[25] Clearly, animal domestication and herding cannot take place before the formation

[23] Ridley (n.11) 105-24.

[24] The standard Presocratic, Atomist and Rationalist view: cf. Anaximander DK12 A30; Empedocles DK31 B71; Xenophanes DK21 B27, B29, B33; Archelaus DK60 A4; Anaxagoras DK59 A1; Pythagoras DK 58 C6; Democritus DK68 A139; Epicurus fr. 333 Us. (Censorinus *De die nat*. 4.9); Diodorus Siculus 1.7. See S. Blundell, *The Origins of Civilization in Greek and Roman Thought* (London 1986) 79.

[25] See Long and Sedley (n.3) 1.135, and D.R. Blickman, 'Lucretius, Epicurus and prehistory', *Harvard Studies in Classical Philology* 92 (1989) 157-91, at 168.

of the first societies in 1011-27, and so there is a temporal shift in Lucretius' account: 855-78 must refer to the period covered by 1011-27. Both passages, then, describe the same mechanism of extinction avoidance through cooperation, but only in the second passage is it stated that *humans* were saved by the process. The first passage refers to human / animal cooperation, and the second to human / human cooperation, but the import is the same in each case. The special characteristic that has enabled humans to survive is their ability to cooperate. Had they carried on mistakenly thinking that aggressive competition is the best strategy, they would have died out. Humans do not have the *virtus* of lions, the *fuga* of deer, or the *dolus* of foxes.

Humans are the only animals described by Lucretius as evolving. All the others—we hear about deer, lions, dogs, foxes, sheep and oxen—seem to appear from the earth complete with their distinctive characteristics. The other creatures which did not have special characteristics have died out, leaving only those we see today. No other species has had to acquire the characteristics that enabled them to survive. This is not to say that the other animals could not evolve and acquire other characteristics in Lucretius' scheme, but for the purposes of his argument, we are the only species that did so.

The evolutionary change comes about by direct response to environment, and presumably involves the inheritance of acquired characteristics—standardly accepted in ancient biology, by the Hippocratics and Empedocles, and closely allied to the pangenetic theory of embryology that Lucretius shares.[26] The physical and psychological softness[27] acquired in response to fire, houses, sex and child-care would be passed on to offspring, and so become the new human nature. Lucretius speaks of a 'breaking' of the *ingenium* of the early humans: it is permanently altered. This mechanism of evolution is closer to that of Lamarck than of Darwin.[28] In Lamarck's system creatures evolve by passing on to their offspring characteristics they have acquired during their lifetimes by responding to environmental change. The giraffe has evolved its long neck by parent giraffes stretching up to eat high leaves, thus lengthening their necks slightly. They then pass on this acquired extra neck length to their offspring, who are born with slightly longer necks than their parents had been. They then repeat the process,

[26] See *DRN* 4.1041-4 with R. Brown, *Lucretius on Love and Sex* (*Columbia Studies in the Classical Tradition*, Leiden, 1987) *ad loc*.; cf. Epicurus fr. 161 Arr. For Empedocles cf. Aristotle *Gen. an*. 722b17-30; Aëtius 5.1.8; for the Hippocratics *Nat. puer*. 17 (7.496.19-20 Littré), *Genit*. 1 (7.470.1-21).

[27] The process would seem also to be one of the feminisation of these early humans, especially given the context of Venus as the principle active in the change. For *mollescere* (5.1014) we may compare Latin etymologies of *mollis*: Isid. *Orig*. 10.179: *mollis, quod vigorem sexus enerviati corpore dedecoret, et quasi mulier emolliatur*; 11.2.18: *mulier vero a mollitie, tamquam mollier, detracta littera vel mutata, apellata est mulier*. Cf. also Velleius Paterculus 2.88.2. I owe this point to Matthew Leigh.

[28] J.B. Lamarck, *Philosophie zoologique* (Paris 1809) and *Histoire naturelle des animaux sans vertèbres* (Paris 1835). See R.W. Burkhardt, *The Spirit of System: Lamarck and Evolutionary Biology* (Cambridge, Mass. 1995).

and so on from generation to generation until we get the very long-necked giraffes of today.[29]

So the differentiation of humans from animals occurs by a Lamarckian evolutionary process at a late stage, and involves the gaining of reason, which leads to the formation of justice. Our cooperative ability is thus the feature that defines our humanity, and enables us to survive. Without it, we would have been simply one of the species preserved only as fossils, like those creatures Lucretius says did become extinct because they lacked special characteristics: the world, after all, does not exist for the sake of humans.[30] As lions are defined by their strength, deer by their speed and foxes by their cunning, we are defined by our cooperative ability. Thus the destruction of the human race had the friendship pacts not been kept is explained. In Lucretius' prehistory, the human race survived only because they evolved into proto-Epicureans.

[29] *Philosophie zoologique* 1.256-7. This is no longer thought to be possible. However, neo-Lamarckism long provided an alternative mechanism to Darwinian natural selection, especially in the Soviet Union under Lysenko, with disastrous results for Soviet agriculture. See P.J. Bowler in E. Fox Keller and E.A Lloyd (eds) *Keywords in Evolutionary Biology* (Cambridge, Mass. 1992) 188-90.

[30] *DRN* 5.156-234.