3

Theoretical background to the vicious circle principle

The principle of population

The principle of population was put forward by Thomas Malthus in 1798. In the first edition of his *Essay on the Principle of Population* he characterises it as "The perpetual tendency in the race of man to increase beyond the means of subsistence," which he considers to be "one of the general laws of animated nature which we have no reason to expect will change."[346]

Though in discussions regarding the principle it has only been taken in its application to humans, as suggested by Malthus in the above quote, as well as more explicitly in his *Summary View of the Principle of Population*[347] published in 1830, it is clear that it should apply to any animal or plant species, in keeping with the energy-gathering (counter-entropic) nature of the populations of all organisms.

Thus the principle of population is a *biological* principle, and may in fact be seen as a corollary to the principle of evolution. It clearly had a profound influence on Darwin:

> In October 1838, that is, fifteen months after I had begun my systematic enquiry, I happened to read for amusement Malthus on *Population*, and being well prepared to appreciate the struggle for existence which everywhere goes on from long-continued observation of the habits of animals and plants, it at once struck me that under these circumstances favourable variations would tend to be preserved and unfavourable ones to be destroyed. The result of this would be the formation of new species. Here, then, I had at last got a theory by which to work.[348]

> Hence, as more individuals are produced than can possibly survive, there must in every case be a struggle for existence, either one individual with another of the same species, or with the individuals of distinct species, or with the physical conditions of life. It is the doctrine of Malthus applied with manifold force to the whole animal and vegetable kingdoms.
>
> The early progenitors of man must also have tended, like all other animals, to have increased beyond their means of subsistence; they must, therefore, occasionally [*sic*] have been exposed to a struggle for existence, and consequently to the rigid law of natural selection.[349]
>
> Natural selection follows from the struggle for existence; and this from a rapid rate of increase. It is impossible not to regret bitterly, but whether wisely is another question, the rate at which man tends to increase; for this leads in barbarous tribes to infanticide and many other evils, and in civilised nations to abject poverty, celibacy and to the late marriages of the prudent. But as man suffers from the same physical evils as the lower animals, he has no right to expect an immunity from the evils consequent on the struggle for existence.

My guess is that in the last quotation Darwin, in saying, "but whether wisely is another question," means that the inclination to increase, in promoting a greater number and thus variety of candidates for being the fittest, may thereby support the survival of the species. Note too Darwin's recognition of the existence of internal population checks, at least in the case of humans.

Malthus had a similar effect on Alfred Russel Wallace, the 'co-founder' of the theory of natural selection. In his autobiography from 1905, Wallace says that:

> Perhaps the most important book I read was Malthus' *Principle of Population*. … It was the first work I had yet read treating of any of the problems of philosophical biology, and its main principles remained with me as a permanent possession, and twenty years later gave me the long-sought clue to the effective agent in the evolution of organic species.[350]

In other words, the principle of population is necessary to the principle of evolution, for if populations of organisms didn't tend to increase in size, and compete over a common resource in so doing, there would be no survival of the fittest or natural selection resulting in species evolution. From a systems point of view, competition is implied by the attempt on the part not only of each species but of each organism and each group to counteract entropy in a world of limited energy resources.[351]

The principle of population however is not as straightforward as it might first appear. It can be given different formulations, not all of which are equivalent. Here I shall present four:

X. The principle of population

> *1. There is a tendency for the human population (and that of any species) to grow until stopped by external checks.*

I shall call this the first formulation of the principle. A *second* possible formulation is:

> *2. Populations (human and other) tend to produce more offspring than can reproduce themselves.*

A *third* formulation of the principle might be:

> *3. If there were no internal or external checks to population size, that of the human (or any) population would tend to increase indefinitely.*

And a potential *fourth* formulation could be:

> *4. There is a tendency for the human species, and all other species, to have as many members as possible.*

Note that the principle of population, in any of its formulations, is to apply at all times, and not only at some, perhaps future, time. Malthus says:

> [T]he pressure arising from the difficulty of procuring subsistence is not to be considered as a remote one, which will be felt only when the earth refuses to produce any more, but as one which not only actually exists at present over the greatest part of the globe, but, with few exceptions, has been almost [*sic*] constantly acting upon all the countries of which we have any account.[352]

The misunderstanding of the principle in this regard has recurred ever since the time of Malthus.

The *first* formulation of the principle is similar to Malthus' formulation cited above, and suffers from not taking into account the internal homeostatic nature of the population regulation of many species, including humans. In particular, it takes no account of internal checks to population growth (taking account of such checks constitutes a step towards *neo*-Malthusianism).[353] (This, in fact, was Darwin's interpretation of Malthus as he applied it in the theory of natural selection. Though, e.g. in his *Descent of Man* – as quoted above, and

elsewhere[354] – Darwin does mention internal checks such as war, prolonged suckling, licentiousness, infanticide and the requirement of marriage, he does not present them as serving a function in the preservation of the species.) Nor does the *second* formulation take account of internal checks. However, that it is fundamentally correct is supported by the fact that there exist food chains. If the populations of each species did not over-reproduce, then food chains would be impossible, since predation would lead to the constant diminution and eventual extinction of what was preyed upon, and the predatory species itself would in turn starve.[355] Nevertheless, taking account of the potential or real role played by internal checks to growth would improve both the first and second formulations. The *third* formulation takes account of such checks, and is more in keeping with Malthus' thinking in the second and later editions of his *Principle of Population*.

The *fourth* formulation may at first glance appear to ignore checks. But here reference to the human *species* is crucial. For the species to have as many members as possible suggests that the size of its total population at any one time not be at a maximum, but at an *optimum*, in the sense expressed earlier. At such a level the species would not, for example, over-exploit its resource base, which would place its own existence in jeopardy. Employing systems-thinking, another way of expressing this could be: *the total amount of solar energy acquired by any species tends to be as great as is physically possible*. And, as in the case of the third formulation, this may be accomplished partly by the use of karyotypically determined internal checks, at least in the case of humans and other vertebrates. For species that have only external checks, the situation with regard to the fourth formulation of the population principle is straightforward: populations of a species grow as much as possible until they cannot grow any longer due to external factors.

In the case of species with internal checks the situation is more complicated. For example, should one or more of these checks be put out of play and not replaced by another, the species' population could grow beyond what its environment can support, and thereby undermine its own existence.

Different kinds of population check

All four of the formulations of the principle of population presented above imply that the human population has a tendency to increase in size, and is constrained from doing so by the operation of checks. Differences between kinds of internal check – somatic, behavioural and so on – for various species were discussed in Chapter 1. Here we might consider two further distinctions particularly relevant to humans.

Positive vs. preventive checks

Malthus distinguishes between positive and preventive checks to population growth. Positive checks are related to mortality and preventive checks to fertility. We can say that, rather generally, for human populations positive checks concern mortality among potential child producers and rearers, and preventive checks are related to various sorts of birth control (or, more naturally, conception control, thereby making abortion a positive check). As regards positive checks it may be noted that they can function even after male or female menopause. As mentioned, senescence – a constant somatic check – functions in this way by setting limits not only on 'fertility time,' but also on 'babysitting time.'

Internal vs. external checks

A second distinction between different kinds of check is that between what I have called internal and external checks, internal checks being those emanating from within a population/species, and external emanating from without. Almost all external checks are positive, and include e.g. famine, disease, predation and so on. Internal checks, on the other hand, can be positive or preventive. Positive internal checks in the case of humans include the checks of abortion and infanticide mentioned by Carr-Saunders, as well as murder, suicide and executions, while preventive checks include monogamy, contraception, delayed marriage, Carr-Saunders' check of sexual abstinence, and possibly long lactation. War, to the extent that it involves the killing of enemies and the death of individuals for other reasons, is a check that is external to a particular population while being internal to the total population and thereby the species.

Other things being equal, if for some reason a particular form of internal behavioural check were rendered inoperative, then it might be expected that the karyotypic basis of the check would see to it that some other form of check came to play a greater role. But shifting from one form of check to another takes time, and population pressure is bound to arise in the interim. Further, it is to be noted that humans' social checks are based on the weakest kind of instinct, and are thus most susceptible to being overridden by more basic kinds. In order to function, they presuppose a stable social setting. The employment of internal checks places *demands* on individuals, and it requires their *acceptance* of those demands. Cultural legitimation is given to such moral demands through *traditions*. Thus the society, through its *culture*, must exert a strong influence on the population in order for internal checks to be effective, and changes in culture will most likely be to the detriment of the checks in question.

Viewing *internal* checks from the point of view of systems, we could say that some of the free energy from the sun accumulated in the system (population) can function homeostatically, in a negative feedback loop, so as to counteract the system's tendency to expand, as the continued expression of this tendency would create dynamic disequilibrium and potentially lead to the demise of the system.

In biological terms, we should say that it is through the phenotypic manifestations of species' karyotypes in the form of internal population checks, such as that of territoriality, that the populations of vertebrates and various other species see to it that they do not grow to the point that their existence is placed in jeopardy by overpopulation. And, as intimated earlier, natural selection has of course weeded out relevant species that did not include this internal check in their karyotypes, by leading to their extinction.

It should be pointed out that Malthus, already in the first edition of his *Essay*, recognised the existence of internal preventive checks and the role they can play in reducing population pressure. The checks he considered were people's deciding not to marry due to the difficulty to be had in maintaining a family, and prostitution.[356] (Of course, to function as a check to population growth, prostitution must in some way reduce the number of infants who reach reproducing age.) Further, in the second and later editions of his book Malthus placed greater emphasis on the preventive check of delayed marriage.[357] And in the last edition, of 1830, he spoke of the "bad structure of society" and "unfavourable distribution of wealth" as checks to population growth,[358] both of which are internal.

Though Malthus' position, in our terms, was that the ultimate checks to population growth are external (viz. "the laws of nature"),[359] he still believed that humans, employing what we are calling internal checks, have "a great and most extensive influence on [the external checks'] character and mode of operation." At the same time, however, he never realised how powerful internal checks, both positive and preventive, can be and have been. Nor did he realise that human society need not be hierarchically ordered such that those on the bottom suffer from overwork or malnutrition, both of which insights he might have obtained from a study of other animal species or modern hunter-gatherers, the latter of whom he believed to suffer from population pressure.[360] Nor, it may be mentioned, did Malthus give any consideration to the relation between population size and ecological equilibrium.

In keeping with his view that all checks are ultimately external and thus positive, Malthus throughout maintained the attitude he expressed in the first edition of his work where, speaking of the check on population as "the

difficulty of subsistence," he says: "This difficulty must fall somewhere and must necessarily be severely felt by a large portion of mankind."[361] He never envisaged a society which, through implementing internal checks, could avoid having to live "on a level with the means of subsistence." The reason that such societies are possible, as we shall see in the development of the vicious circle principle, is that need is related to *social stratification*, and that such stratification as results e.g. in the malnutrition of part of the population is not a necessary aspect of human society.

In these terms then, we are here suggesting not only that it should in principle be possible for a population to avoid 'severely feeling the difficulty of subsistence' in the event that it exercise checks which are both internal and preventive (this is similar to the position taken by neo-Malthusians), but that this appears to have been so in the case of modern hunter-gatherers. On the other hand, however, we must admit with Malthus that neither positive nor preventive internal checks, nor a combination of the two, have as yet managed to perform this function for humankind as a whole.

Population growth pushes technology

If we look for causal relations in an attempt to explain the development of the new views in archaeology, anthropology and economics, as we shall do more comprehensively in what follows, we see an interesting aspect of the discussion in a suggestion made by Ester Boserup. Boserup's line can be easily assimilated to the new views in these subjects, as we shall see.

Boserup's influential contribution to demographic theory is her drawing attention to the fact, previously noted by Jacques Ellul, that population growth can stimulate technological innovation, rather than merely result from it. (In Ellul's terms, "the growth of population entails a growth of needs which cannot be satisfied except by technical development.")[362] Boserup argues that in the case of agriculture – to which she limits her considerations – technological development is largely a function of population density, and that the various technologies employed by agriculturists constitute a series of responses (cf. the reaction principle) to growing population. Necessity is the mother of invention, or at least of use. In some cases such changing technology may be no more than briefer and briefer fallowing of cultivated plots, eventually leading to annual cultivation.

Boserup takes her own view to run counter to what she terms the neo-Malthusian view – though she names no neo-Malthusians – according to which population size is to be directly related to the availability of food. (Note that Boserup's notion of neo-Malthusianism is not the generally accepted one.) Here however she is

apparently unaware that the idea that necessity is the mother of invention has already been expressed by numerous authors, including Malthus ("Necessity has been with great truth called the mother of invention").[363] Nevertheless, Boserup's emphasis on this notion brings out an important way in which the principle of population should apply differently to humans than to other species. For humans, external population checks can be pushed back (but never removed) through cultural change in the form of technological development.

Thus in situations where a population is experiencing food scarcity at the same time as its members are aware of technological means to alleviate that scarcity, on Boserup's view it is natural that they should use those means. But this suggests that populations that do *not* employ subsistence technologies of which they are aware ought not be experiencing scarcity. So in cases where human population growth is slow or non-existent, despite the knowledge and availability of technology that can increase food production and thus the size of the population, this low or absent population growth must be the result of something other than scarcity. Thus, the slow population growth in pre-industrial societies until recently cannot be explained by saying that it is the result of insufficient access to food due to overpopulation, and we must consider other factors in our attempt to explain population development.[364] Boserup gives no hint however as to what these other factors might be. But on the basis of our previous considerations regarding the principle of population, a prime candidate is the existence of *internal* population checks.

A related aspect of Boserup's view that is particularly relevant to the new views in archaeology, anthropology and economics is her recognition that technological development does not imply the ability to produce more with the same amount of human effort, or to produce the same with less effort, but on the contrary often if not always brings with it a decrease in productivity per working hour:

> The cultivators who subsist by the system of forest fallow are much more primitive in their whole way of life than cultivators who apply intensive methods of production. Moreover, there is no land preparation before sowing and no other agricultural tools than axes and digging sticks. It is tempting, therefore, to conclude that output per man-hour must be particularly low under this system of cultivation. But it is not so in actual fact.

A central aspect of the above interpretation of Boserup's account is the idea that new technology, even if available, is not employed until needed. As Wilkinson says:

> Development is needed when a society outgrows its resource base and productive system. As the established economic system is proved inadequate and subsistence problems become more severe, societies are driven to change their methods. Development comes out of poverty, not out of plenty as many economic theories would lead one to suppose. Poverty stimulates the search for additional sources of income and makes people willing to do things they may previously have avoided. When for instance population growth and the division of land holdings makes units too small for subsistence, people are forced into towns to sell their labour, or else they take up rural crafts to eke out a living. It is the population's increasingly exploitable situation which provides the basis for the growth of capitalist institutions.[365]

Here we note reference once again to the idea that people *resist* the adoption of more intensive means of obtaining a living due to their involving more work.

Thus, though Boserup's view was developed presupposing a context involving primitive agriculture, it can be broadened to cover the whole of humankind's development. What it leads to is the idea treated above, that there have actually existed societies that have *not* been pushed to the limits of subsistence, namely those which did not feel the need to increase food production, though they knew how to do so. In terms of our previous considerations we should say Boserup's line suggests, not that Malthus' principle of population in any of its formulations does not apply, but that, for certain societies, some of the Malthusian checks by which population has been limited have been internal. This is in keeping with the third formulation of the principle and, ironically, with the neo-Malthusian view Boserup claims to be criticising. This being the case for particular populations would explain why their means of subsistence, even if intrinsically quite intensifiable, remain in an extensive state unless the internal checks are put out of play.

Ecological equilibrium, technological/economic development and economic growth

In Wilkinson's theory of economic development, touched on in the previous chapter, a distinction is first drawn between societies capable of limiting their own size and societies that have lost this ability. The former:

> are societies which have stabilized well within the means of subsistence available to them and so have avoided the problems

> which lead to development. Almost all living species have a choice between developing methods of population limitation or facing continuous starvation as their numbers are limited by the food supply. Natural selection seems to have led a great many species to adopt the former strategy, and human societies, with the help of social controls, have often done likewise. Many primitive societies, particularly before contact with Europeans disrupted their cultural systems, prevented population growth [by infanticide, abortion, etc.] and managed to live in equilibrium with their resources without threat of hunger.[366]

When a human population has lost the ability to limit its size, its growth leads to greater demands on the environment. Thus: "Within a stable society in ecological equilibrium, population growth is the most dangerous threat to continued stability." The growth of a population beyond what its environment can support is an indication that the society is out of equilibrium. And, as in Boserup's view, where population growth creates population pressure, necessity can well become the mother of invention, with new technologies being developed that allow increased environmental exploitation, thereby making it possible to meet the current needs of the population while at the same time giving rise to such phenomena as economic growth. In Wilkinson's words:

> Once one has the concept of a society existing in ecological equilibrium there is no difficulty in accepting that the development of need is the real cause of economic development. … Development is primarily a matter of increasing the rate of environmental exploitation to support a growing population. … Instead of regarding development as a matter of 'progress' towards a 'better life' motivated by an incurable dissatisfaction with our present lot, we see that it is a process of solving a succession of problems which from time to time threaten the productive system and the sufficiency of our subsistence. In effect, human societies out of ecological equilibrium have to run to keep up; their development does not necessarily imply any long-term improvement in the quality of human life.[367]

Wilkinson realises that the whole issue of human survival as a species revolves around our maintaining equilibrium with our surroundings – as is in fact implied by the principles of population and evolution.

In the next chapter I shall present the vicious circle principle, in which the development of humankind is placed in one comprehensive picture.

4

The vicious circle principle of the development of humankind

Presentation of the vicious circle principle

As regards the views of Malthus, Boserup and Wilkinson, we should say that each is right in the main. And taken together they can provide a coherent view of certain important aspects of the human condition. But even considering a synthesised version of their views something is missing, and it is the idea that, in the case where population is growing and ecological equilibrium is lacking, *the increased exploitation afforded by technology typically provides a surplus, which allows renewed population growth*. Once a new line of technological development has been opened it tends to be pursued, and once a resource has been tapped it tends to be exploited. In today's society, the profits made by entrepreneurial capitalists come from this surplus, and are obtained by receiving payment for providing the population with increased material benefits, benefits that may well overshoot the population's vital requirements. In this way technological innovation can have the effect of increasing the potential for a particular area of land to support human habitation beyond the needs of its contemporary population, thereby constituting a major factor in that population's losing its incentive to control its own numbers. This loss of incentive may be manifest e.g. in a cultural shift condoning earlier marriages, or in increasing the convenience of having larger families. And, given the surplus, which weakens internal checks, there is nothing to stop the population from once again becoming too large relative to what it is able to extract from its resource base, until external checks come into play. The way that this eventuality has in some cases been mitigated or avoided has been through the introduction of yet more efficient technology, allowing even more to be extracted from the resource base. In this way a *vicious circle* is created, in which increased consumption is

made possible only by further technological development which in turn further degrades the environment (increases its entropy) while promoting the growth of the population.

All of the principles presented in Chapter 1, as well as the principle of population, apply just as well to other species as to humans. Is there a particular principle applying only to humans – a principle of *human* ecology? The vicious circle principle, which presupposes at least the third and fourth formulations of the principle of population, as well as the principle of evolution and all of the other principles, is a candidate.[368]

XI. The vicious circle principle

> *Humankind's development consists in an accelerating movement from situations of scarcity, to technological innovation, to increased resource availability, to increased consumption, to population growth, to resource depletion, to scarcity once again, and so on.*

The vicious circle principle (VCP) is both easy to understand and in keeping not only with modern science but also with common sense. Briefly put, it says that in the case of humans *the experience of need, resulting e.g. from changed environmental conditions, sometimes leads to technological innovation, which becomes widely employed, allowing more to be taken from the environment, thereby promoting population growth, which leads back to a situation of need*. Or, seeing as it is a matter of a *circle*, it could for example be expressed as: *increasing population size leads to technological innovation, which allows more to be taken from the environment, thereby promoting further population growth*; or as: *technological innovation allows more to be taken from the environment, the increase promoting population growth, which in turn creates a demand for further technological innovation*.

Note that the vicious circle principle is not a truism – for example it is not obvious that technological innovation need lead to more being taken from the environment, or that increasing population size need lead to technological innovation. Once understood however, the principle may appear to be self-evident, as any principle should.[369]

To better understand the vicious circle phenomenon we might compare the operation of the VCP, which only pertains to humans, with what is the case for other species. (Note that the present chapter constitutes primarily a *presentation* of the VCP; the bulk of its support comes in the next chapter.) Any species, including the human, can become extinct due to a change in its environment; but in those conditions where a species is not imminently endangered, it is represented by some optimum range of numbers of individuals, as suggested earlier. If there are too few the species may be subject e.g. to problems related

to interbreeding; and if there are too many its source of sustenance may be eliminated, resulting in either case in disequilibrium and the possible extinction of the species. This is very much in keeping with, if it does not directly follow from, the various formulations of the principle of population.

But what distinguishes humans from other life forms in this regard is our development and use of *technology*. Unlike other species, humans have invented and employed such devices as the hand-axe, fire, clothing, the bowl, spears, boats, the bow and arrow, the hoe, the plough, irrigation, watermills and windmills, sailboats, various engines, and electricity generators operated by nuclear power. And this technology, paradigmatically, has had the effect of pushing back the limits to population size, a phenomenon we do not see in other species.

Humans' development of technology has been *exponential*, and has led to a corresponding exponential increase in our total resource consumption as well as in the size of our population – right from when we first came into existence as a species. Most notable in this regard are our harnessing of fire some 1.5 million years ago, the horticultural revolution of 10,000 years ago, the beginning of the mining of metals 6000 years ago, and the industrial revolution of 250 years ago. But this is a process that is going on all the time (like the operation of the principle of population), with such apparently minor technological innovations as that of the stirrup or horseshoe, or ball-bearing or adjustable wrench, each contributing to the end result of increasing the number of humans that can occupy a given area of land.

Here is the expression of a sophisticated form of the vicious circle principle, or of the form the principle might take in being applied to a relatively complex situation:

> A situation of *scarcity* leads to the experience of *need*
> which creates a demand for *new* or *previously unused technology*
> which in certain cases is *developed* and then *widely employed*
> making the population *genetically dependent* on developing technology
> and giving rise to other unintended *side-effects*
> but which allows the exploitation of previously *inaccessible resources* – renewable, non-renewable or both
> an exploitation which presupposes the *existence* of those resources
> and sometimes makes it possible for human populations to *expand* to areas where the new technology is necessary for their existence
> the taking of resources *reducing the quantity* remaining

and producing *increasing quantities of polluting waste*
as well as leading to the *extinctions* of various species of plants and animals
while at the same time creating *new needs*
technological development itself becoming *self-perpetuating*
while typically producing a *surplus* of consumables
which allows an *increase in resource consumption*
the consumables however normally or often being of *lower quality* than those they are replacing
while at the same time the availability of the surplus weakens *internal population checks*
allowing *population growth*
which gives rise to *population pressure*
and underlies *migration for economic reasons*, first to areas where the new technology is being used to produce the surplus, resulting in *centralisation* and *urbanisation*, then, when possible, to areas where it is *not*, taking it along
the new technology most often being *more complex* than the old
and requiring *specialisation* for its use
which gives rise to a *division of labour* and an *increase* in the *complexity of society* as a whole
thereby promoting *social stratification*
and an *unequal distribution* of the surplus
which promotes an increase in the *property* and thereby *power* of the upper strata
while the lower strata experience an *increase in work* and *illness*, and a general worsening of their *quality of life*
such social discrepancy being maintained by *laws*
a reaction to which, and to the power of the upper strata more generally, may be conflict between the weak and the powerful in the form of *revolt*, *terrorism* and/or *revolution*
while the surplus in the hands of the upper strata leads to conflict in the form of *war* amongst themselves
which gives rise to *migration due to conflict*
the surplus at the same time allowing the *consumption of luxury goods* amongst the upper strata, which can be produced thanks to technological development
as well as providing them with *leisure*
some of which is devoted to *cultural development*: the arts, architecture, philosophy, science and medicine

while the presence of the surplus also leads to *increased trade* amongst the upper strata
which contributes to reducing the *self-sufficiency* and thereby the *security* of society
while the population grows so as to *overshoot* the surplus, i.e. to *overexploit its resources*, such that the surplus begins to dwindle and can no longer maintain the population's quality of life at the same level
the excess population combined with the reduction in available resources meaning *diminishing returns* to the use of the current technology
the results of the employment of the technology thereby *undermining its own usefulness*, and, since people have become genetically dependent on it, potentially *undermining their existence* as well
which leads to *economic decline*
eventuating once again in *scarcity* and *need*; and possible *population reduction*.

Looking over these factors, we see that some of them play more of a causal role while others are more *results* of the operation of the principle. These latter should include e.g. the creation of new needs, increasing pollution, species extinctions, the weakening of internal population checks, increasing complexity, social stratification, cultural development and economic growth.

In terms of systems, the vicious circle principle represents an instance of a positive feedback loop of the increasing kind. If the elements in such a circle are not physical, the circle need not be vicious – for example inflation and increasing nominal wages, or the production of fractals using a computer program, could in principle continue indefinitely. But if the circle produces elements that are physical, its continued turning will lead to disequilibrium in the system of which it is a part, either internal and/or in relation to the other systems with which it interacts. The size or immediacy of the threat to the system will depend on the extent to which vital elements in it are involved in the circle. In the case of the vicious circle principle of the development of humankind, this threat couldn't be greater, as it involves the very biological core of the human species.

Explication of the vicious circle principle

Here follows a rather detailed depiction of the various elements that can go into the manifestation of the VCP, as given above. It is to be kept in mind

that various of these elements can and do work in concert, and that as a consequence the order in which they are presented here is to some extent arbitrary.

Needs and scarcity

Vital vs. non-vital needs

In considering needs in biological contexts one must take into account the sort of biological entity being considered. In the present case we should thus distinguish (at least) between the needs of individual organisms and the needs of the species to which they belong; and we should further distinguish between those needs which must be met for the organism or species to survive, and those which must be met for it to function in an adequate way according to some criteria or other.

Needs in order to survive I shall call *vital* – though they might perhaps just as well be called *basic*, or *absolute*, or *subsistence* – and in the case of virtually all animal organisms they include oxygen, water, food, shelter, etc. The vital needs of animal *species* include the organisms' vital needs (though of course not all organisms of the species must have their vital needs met in order for the species to have *its* vital needs met) as well as the need to procreate, which includes the need for breeding sites. The breeding sites of individuals will be in their or their mates' territories, as will, in the case of many species, their and their families' source of food. In the event that the vital needs of a population go from being met for the whole population to not being met for at least part of it, it may be expected that there will be a reduction in the size of the population. As regards humans, we have essentially the same vital needs as do other large mammals.

But it is only humans that have *non*-vital needs, i.e. needs individuals and/or the species have, the lacking of which will cause disruption (static disequilibrium) but not the demise of the individual or species. In the case of individuals, such needs are often needs in order to accomplish some end, the attaining of which will or may improve the person's situation in some way or other. Such needs might include the felt need for a holiday, what a woman experiences as the need for a particular kind of cosmetic, or an academic's need for e-mail facilities.

Real, imagined and experienced needs

Vital needs are also *real* needs, while non-vital needs may or may not be real. As is understandable, in many cases it may be difficult to determine whether a particular non-vital need is real or not. If a need is not real, it may be termed *imagined*.

When a need is difficult or impossible to meet, I shall call it an *experienced* need. Thus experienced needs may be real or imagined; and they may be vital

or non-vital. In all cases, however, experienced needs result from a scarcity of whatever it is that is needed. So, for example, it may be the case that vegetable foods have become relatively scarce, such that the human population as a whole has an experienced need for more food – an experienced real need which is also a vital need. Or, due to the general scarcity of money, a capitalist will have an experienced need for more of it – a need which is non-vital and may well be only imagined.

In the case of other species, as taken up in Chapter 1, an experienced vital need is typically brought on by changes the populations of the species have not themselves influenced, such as a change in the climate. Experienced need can also be induced in humans in this way. But in our case we typically bring about such changes ourselves, through the operation of the VCP. For example, over the past century the human population has itself had a profound effect upon the earth's climate, a consequence of which will quite likely be an increase in the experienced vital needs we have in the future.

Furthermore, for other species experienced vital need is something that simply must be lived through, and, if prolonged, normally leads to a demographic transition in which the size of the population is reduced. This, however, need not be the case for humans, for reasons mentioned above and which will be considered more thoroughly below.

The needs of the powerful vs. the needs of the weak

Experienced vital need was the only sort of need that contributed to the turning of the vicious circle before the advent of horticulture. The vicious circle of humankind's development has taken us, however, from this situation to one in which the number and variety of humans' experienced needs are greater, both as regards vital and non-vital needs, and both for the powerful and for the weak. But for the weak, experienced needs are still of the vital sort, while for the powerful they are non-vital, and often only imagined (the powerful and the weak might even be distinguished in terms of whether their experienced needs are vital or non-vital): no matter how much some wealthy persons have, they still experience the need for more, either to maintain their position, or to improve it.

Two dominant forms taken by the non-vital needs of the powerful are political rulers' experienced (though perhaps only imagined) need to expand their territory (through military action) and capitalists' experienced (though perhaps only imagined) need to increase their wealth (through economic action).

But where, through the operation of the VCP, the more than sufficient meeting of both vital and non-vital needs leads to such phenomena as increasing

resource depletion and production of waste, it is the more than sufficient meeting of vital rather than non-vital needs that tends to lead to population increase – e.g. a surplus of food and housing among the poor will tend to give rise to an increase in population, while a 'surplus' of mobile phones and pleasure boats among the rich need not. It is the meeting of vital needs and not non-vital needs that provides the preconditions for the survival and procreation of the species, and for the turning of the vicious circle.

Technological innovation

In periods of widespread experience of vital needs, the size of the human population tends to diminish (as does that of other species) as a result of the operation of internal or external checks or a combination of the two. But in this regard – and this is a key aspect of the VCP – the human species is ecologically unique in being able to meet some instances of experienced vital need not by reducing the size of its population but by taking more resources from the environment, though there may be population diminution even in such cases. Thus it may be said that where other species are genetically modified by their environments while they themselves exert only minor influence on those environments, humans modify their environment, and their genetic change is a result of their so doing.

As suggested by Malthus and Boserup, as noted earlier, as well as by Schumacher, and as implied by Wilkinson, in situations of scarcity necessity can become the mother of invention.[370] In the case of humans, scarcity leading to experienced need (whether it be vital or non-vital) may be overcome via *technological innovation*. (Such innovation need not imply a change in technological devices; but if the devices remain the same, then technological change implies using them in a different way or on a different scale.) This does not mean that every instance of experienced need will lead to innovation or the use of previously unused technology – all that is required for the vicious circle to operate is that *every now and then* a technological solution be found to a problem of scarcity. Thus technological change is here seen as *paradigmatically* being a defensive move on the part of humans in reaction to a worsening life-situation resulting from an increase in the number of people living on a particular area of land. Here we have a broad application of the reaction principle.

Though the discovery of new technological solutions may be rare, once made they are remembered, and their use spreads to other cultures. Technological solutions are easily transmitted largely because of their objective nature;[371] and knowledge of how to employ innovations is eventually transmitted to all areas of the world where they can be of use.

Technology only used where it reduces experienced need

The application of a new technology is like the birth of a new species: once its viability has been established its use spreads. The dissemination of technology is often via trade routes, and extends to all areas in which it can reduce experienced need.[372] With the turning of the vicious circle, the role played by commerce in the dissemination of new technology has constantly increased.

Our species' internal homeostatic mechanism regulating the size of our population weakened successively as larger and larger domains were opened up by new technology. But when the homeostatic element was still relatively strong, new technology was not employed until its use could relieve *vital* experienced needs, the reason being that it involved more *work*. (Cf. Boserup.) Thus what may be noted here, particularly against the background of the idea that necessity is the mother of invention, is that, as argued by Wilkinson[373] and as is supported by the VCP, after an innovation has been made, necessity has more been the mother of the *employment* of invention.

Here we have a manifestation of the pioneering principle in a context particular to humans. The new technology can lead to population growth by, for example, opening up new geographical areas containing food and breeding sites. The difference however is that the growth is also affected by the fact that the new technology is not employed unless need is experienced. Note that the pioneering principle may lead to the *development* of technology, as when it leads people to find a way over a body of water. Need may in fact be evident in both cases, as may the necessity to do more work.

Tools, weapons

When we modern humans came into existence with the particular karyotype we have that gave the basic direction to our behaviour, that behaviour, compared with later, involved relatively little use of tools. Concerning the niche into which our species evolved, but which we long ago left, our relentless use of new technology was not part of the picture (though its basis was already being laid by earlier pre-human and human species). And it may be asked to what extent we can or could develop technology and remain viable as a species.

The first form of human technological development resulted in the production of *tools*, which could almost be defined as any means of obtaining *more* from the environment. In keeping with the view of Mumford,[374] we can see tools as being of essentially two types: containers and piercers, paralleling the woman/man, defence/offence and yin/yang dichotomies.

Military technology

It may be noted that new technology may also be employed to increase available resources for one population of humans by taking them from another.

Thus advances in military technology giving one group an advantage over another are of this sort. Here a distinction along the lines of that between piercers and containers can be made between military (political) and economic power: military power depends on *pointed* weapons, while economic power depends on *accumulated* capital. And we see that it is precisely the development of *weapons* that has always been at the forefront of technological development – first in the form of weapons for hunting; later, weapons for war.

Language

Though the development of tools was the first manifestation of technological development incumbent on the turning of the vicious circle, many other innovations have resulted as well, such as that in the form of language.

Rather than merely being a tool, language can be seen as itself constituting a technology; and it has played an important part in the turning of the vicious circle. For one thing, it has been an aid to other technological innovation through allowing the exchange of ideas regarding how to solve particular problems of scarcity. Language has also aided the dissemination of new technology through putting the concepts required for its manufacture or realisation into a form that can easily be used by others. And language's making possible the giving of orders or commands, and the following of chains of command, has subsequently meant that the implementation of technology on a massive scale can originate with a single person. The most important development in the use of language has been *writing*, which has reinforced such uses as those mentioned above.

Domestication of plants and animals

After the use of fire, which includes today's burning of fossil fuels, the domestication of plants and animals for human purposes constitutes humankind's greatest harnessing of solar energy.[375] This domestication was a 'one time event' like the invention of any tool or machine, one which, however, unlike the invention of artefacts (which become obsolete), constitutes a development on which we have become increasingly dependent.

The process of domestication is of interest not only with respect to how wild organisms have been tamed, but also with regard to how they have been genetically modified. In this regard domestication could in fact be defined as the genetic adaptation of various species to technology,[376] which, when that technology is used to support them, leads to their becoming genetically *dependent* on the relevant technology.

Domestication of the weak

Of the animals domesticated by humans, one can count humans themselves. Just as the ancestors of domesticated animals roamed freely in the wild,

while their domesticated descendants have to remain stationary and close to a shelter, the same may be said of humans, particularly after we became sedentary. And just as species of domesticated animals experienced genetic changes as a result, so did we.

Since the weak constitute the vast majority of the total population, and it is primarily they who have been required to adapt to the operation of technology, the effect has been the domestication of the species as a whole, which has manifest itself in various ways. One of these may be its having led to a general increase in human intelligence (ability to innovate, and to operate sophisticated machines). Another has been pointed out by Darwin: "Civilized races can certainly resist changes of all kinds far better than savages; and in this respect they resemble domesticated animals."[377] And just as domestic animals would perish if the support of technology were removed, we could expect the same of modern humans. We are both karyotypically and genetically adapted to a situation of increasing technological dependence.

Unintended side-effects

Generally we see that the employment of virtually any technology gives rise to unwanted – and often unforeseen – side-effects. As expressed by Aldous Huxley, the advantages accruing from recent technological advances are generally accompanied by corresponding disadvantages; gains in one direction entail losses in other directions; and we never get something except for something.[378] As suggested by Commoner, our most celebrated technological achievements – the car, the jet aircraft, the power plant, industry in general, and indeed the modern city itself – are ecological failures.[379] But where Huxley and Commoner limit their claims to *recent* technological development, on the VCP what they say applies to *all* technological development.

Technology, by its very nature, is employed as a means to accomplish a certain end. But, as emphasised by Garrett Hardin, its effects are always more wide-ranging than the accomplishment of the particular end it is intended to achieve.[380] The very solution of problems by technological means gives rise to new problems.[381] And as further suggested by Ellul, history shows that every technical application gives rise to unforeseeable side-effects which are much more disastrous than what would have been the case if the situation had just been left alone.[382] And we see that this must be so, since the more we counter entropy by bringing technological order to particular parts of the physical world, the more entropy we create elsewhere, such that there is an increase in the entropy of the system as a whole. As Commoner emphasises, the new problems are not the consequences of incidental failure but of technological success.[383]

Here humans are like other animals in that we follow the reaction principle and focus on accomplishing things in the here and now, and tend to ignore what does not impinge on us in a striking fashion. This is an orientation that has served well in the evolution of all species; but in a species with a developing technology that gives rise to unwanted side-effects, it is bound to lead to problems. In a way, the vicious aspect of the vicious circle consists precisely in these unwanted side-effects: population growth, resource depletion, increasing pollution, social stratification and so on.

Further, as pointed out by Jay Forrester, a series of actions all aimed at short-term improvement can eventually burden a system with long-term depressants so severe that even heroic short-run measures no longer suffice. The perceived short-term needs are more visible and more compelling, and speak loudly for immediate attention. (As Boulding wryly notes, "It seems to be very hard to organize a long-run crisis.")[384] Policies which produce long-term improvement on the other hand may initially depress the behaviour of the system in which they are implemented before the improvement is manifest.[385]

Economic development

Economics is the means by which we humans maintain ourselves as individuals, as groups, and as a species. Economic *development* is essentially the same thing as applied technological development, consisting as it does in the new use of technology to meet needs. It is not to be confused with economic *growth* (to be treated later), which implies an increase in available consumables, and which may be said to be the *aim* of economic development. And these two should be distinguished from economic *efficiency*, which concerns the amount of energy required to obtain a product.

As suggested by Wilkinson, a society's being out of ecological equilibrium due to overpopulation necessitates economic development, which, if successful, will increase the extent to which the environment can be exploited. "As the level of environmental exploitation increases, more and more of the production and processing of raw materials is dependent on the work of man [and his machines] rather than on purely natural processes."[386] On the whole this results in declining economic efficiency. Whenever the constraints which maintain a society in ecological equilibrium break down, the society will try to find ways of developing its technology to increase the yield from the environment.

As Wilkinson also says, the appearance of subsistence problems makes people willing to accept changes which previously seemed to require too much work, or which suffered from other prohibitive disadvantages. Most of the changes are accepted because they represent improvements in the supply of subsistence materials, not because they represent increases in efficiency for societies

that already have an adequate living. Economic development is primarily the result of attempts to increase the output from the environment rather than produce a given output more efficiently, its main features including changes in the resource base, the division of labour, the development of trade and industry, increasingly intensive agricultural methods and many other aspects of a society's changing productive activity, all of which are responses to the growth of need.[387]

Increase in available resources

Before considering the nature of resource availability and depletion it is important to distinguish between *resources*, *reserves* and *stocks*. With the implementation of a new technology, both reserves and stocks may be increased, and it is the quantity of these, not resources, that affects the immediate economic value of such substances. So the implementation of a new oil-drilling technology, for example, may increase oil reserves and lower the price of oil, while the quantity of oil as a resource is constantly decreasing.

The use to which new technology is put typically involves increasing the amount taken from the environment by making available resources that were previously inaccessible, the paradigmatic such resource being food. Though the employment of new technology will mean an increase in the available resources at the time of its employment, nothing says in advance that the overall quantity of available resources will be greater than that made available by the older technology. (For example, in Palaeolithic times the employment of the bow and arrow produced less meat than did the spear.) Thus we cannot be sure exactly what our future reserves will be, since there may exist unknown resources that future technological innovations will succeed in making available. Uranium, always a resource, was not appreciated as such – not turned into a reserve – until the advent of nuclear technology. It has in fact often been the case that some substance not known to be a resource or that cannot be treated as a resource at one point in time can later be so treated thanks to technological development, such as in the case of uranium, or e.g. the seeds of wild grasses that could not be digested before the invention of cooking, or coal and petroleum that could not be extracted or refined before the requisite technology was in place. On the other hand, it may also turn out that something assumed to be a resource is not, as is the case with uranium for example, the energy obtained from it undoubtedly being less than the energy required to acquire and use it and properly get rid of the waste.

Prerequisite of the existence of resources

That we use non-renewable resources is to the detriment of the species, first because such resources are *finite* and there's a great risk that we become

dependent on them, and second because after they have been used they become harmful *waste*. It has only been possible for us to get caught up in the vicious circle, as we have been since we first came into existence, because the increasing quantities of resources it requires – renewable and non-renewable – have been there to be exploited. However, that such resources have existed at all, or whether other resources will exist in the future to replace them when they disappear, is a matter of chance. And the more resources we use up, the smaller that chance becomes. As regards non-renewable resources, though technological innovation has in many cases made them available, it has not created them. To take but one important example, all technology employed in the extraction and use of fossil fuels would not have produced a surplus of anything if fossil fuels had not existed.

However, up until the present, nature has provided us not only with the materials necessary to produce such complex technology as is involved e.g. in the use of nuclear reactors, but the energy sources required to operate them, both of these conditions having to be met for such complex technology to be able to fill a need. In the case of specialisation, human development parallels the evolution of species, for the survival of new species depends precisely on the increased specialisation necessary to find an unoccupied niche or oust some other species from its niche. Typically, each new species, when it first comes into existence, should occupy the same niche as, or a very slightly different one from, the species from which it evolved. But in the human case, thanks to the turning of the vicious circle, we have constantly been adopting ever larger niches.

Each use of a non-renewable resource diminishes the total quantity remaining, and moves us closer to the point at which the only resources that may be left apart from water and air are plants, animals and stones. Thus, if not for some other reason, sooner or later the vicious circle will stop turning due to the lack of resources to fuel it. From the point of view of our species' survival, the role played in the vicious circle by non-renewable resources and the unsustainable use of resources is therefore particularly noteworthy, for it implies a dependence of the species on a state of affairs which, by the very nature of the case, cannot continue.

Increased energy use

The implementation of a new technology will quite generally mean an increase in a society's use of *energy*. Historically, the first non-human source of such energy was wood used in fires, and later domesticated animals such as the ox and the horse, and then water and wind, and since the industrial revolution mainly fossil fuels. While usable energy is itself a non-renewable resource, its *source* may be renewable.

All use of technology demands energy; when the technology is used in production it is generally the case that the more sophisticated it is, the more energy it requires per unit produced, unless or until benefits of scale appear. At the same time, the energy required to obtain non-renewable resources constantly increases as they become less accessible. Similarly with trade, the greater the distance between trading partners, the greater the energy required to trade a particular entity. From the other end, increase in the availability of energy promotes economic expansion, thanks to both the increasing number of products technological development makes available and the ease of transportation it makes possible. And this economic expansion implies an increase in the extent to which we counteract entropy within society while increasing it without.

Geographic expansion made possible by technological change

Throughout the existence of humans, technological development has meant the ability of the human population to spread to new areas. Originally this meant expansion to areas unoccupied by humans (as in the spread of *Homo erectus* and to some extent *Homo sapiens*), and then later the spread to areas occupied by karyotypically more primitive humans (e.g. the occupation of Europe by modern humans despite the presence of Neanderthals), and lastly the occupation by more technologically developed humans of areas occupied by those who are less developed (e.g. the occupation of the New World by Europeans). In each case we have a manifestation of the pioneering principle.

Resource depletion

As regards the ecological equilibrium of the human species when it comes to resource use, what is of primary importance for the turning of the vicious circle is not our use of non-renewable resources *per se*, but our use of resources *in an unsustainable way*. Thus some resources, such as particular types of stone, may be non-renewable but nevertheless exist in such quantities that we could never use them up, in which case their use would be sustainable. And other resources, which are renewable, may be used in such a way that they cannot renew themselves.

The differences between such states as the vicious circle's turning normally, slowly, quickly or with greater momentum, and its accelerating or stopping, are directly related to the rate at which resources are being used. The *normal* turning of the vicious circle requires constantly *accelerating* quantities of resources, and it will continue as long as they are provided. The turning of the vicious circle, like the growth of population on the population principle, has no internal limiting mechanism, and under ideal conditions grows physically at an exponential rate.

Our increasing unsustainable use of resources is itself a precondition for the turning of the vicious circle. If all potentially renewable resources were renewed or allowed to renew themselves, as in the case of other species, and if at the same time we hadn't become dependent on the use of non-renewables, then it would have been possible to avoid getting caught up in the vicious circle, as many modern hunter-gatherer communities had not before the intrusion of other cultures. But, as noted by Wilkinson, as population increases, the aggregate subsistence demand for the particular resources on which the cultural system is based come to exceed the supply the environment can provide, and the system loses its (quasi-)equilibrium. The scarcity of vital resources encountered at this point forces the society to alter the way it gains its living from the environment, and, through technological change, it ends up occupying a different ecological niche.[388] Our unsustainable use of resources has led to a situation in which technological innovation, and with it the turning of the vicious circle, becomes a *must* (cf. technology perpetuating itself, above) in order to extract a replacement when the acquisition of a particular resource becomes uneconomical.

From one point of view, our non-sustainable use of resources is, on the VCP, primarily due to our inability to foresee, and/or disinclination to consider, the consequences of the application of technology; that is, it is a manifestation of the reaction principle. Here again we act as other animals would: given that a particular resource is available, we use it, without considering the long-term effects of so doing. That we share this predilection/disposition with other animals suggests that it is *instinctual* – that it stems from our karyotype and not simply from our genes. Here we have an instance of a karyotypical aspect of our natures that is not pre-adapted to our using and developing technology – an aspect deeply rooted in our nature as a species.

Waste and pollution

Any use of resources will result in waste; even the mere consumption of food involves at least body waste. Wastes resulting from the sustainable use of resources are biodegradable, and if properly dealt with need not be of concern to humans. On the other hand, the production of wastes from the use of organic and inorganic minerals (increasing entropy outside the social system) constitutes a negative and unintended side-effect of technological development. Such wastes can not only lead to a worsening of humans' life-situation, but can undermine the conditions for the functioning of technology itself. Rivers may become so mired that their water can no longer be used either for drinking or as engine coolants; waste deposited at sea can kill fish and thereby undermine the fishing industry; non-biodegradable garbage can swamp agricultural land

making it useless. Such wastes as can have this effect may be termed *pollution*. (We might define pollution as any substance deposited in an ecosystem that tends to disrupt its equilibrium.) Thus we see that technological development, and with it the vicious circle of the development of humankind, can come to a standstill not only through the unsustainable use of resources, but also from the effects of the pollution that their use gives rise to.

Increasing extinctions

Thanks to the turning of the vicious circle, *Homo sapiens* is the only species to exterminate other species *systematically*, a process which began with the extinctions of large mammals during the Pleistocene. In that case the species directly affected were the targets of human predation, their elimination being made possible by technological development, while at the same time many of the non-human predators of such prey also became extinct for lack of food. To this may be added the effects of foreign organisms imported by humans, such as rats and the micro-organisms they carry, as we spread over the world and increased in numbers.

Apart from eradication through hunting, the extinctions of various plant and animal species can be seen to result from the operation of the VCP in the form of the constantly accelerating growth of the human population, together with its increasing per capita use of technology, and the greater pollution to which this use gives rise. Humans' constantly increasing exploitation of the physical and biological environment has eradicated the habitats of the relevant populations, and thereby the preconditions for the continuing existence of their species. Not only has the turning of the vicious circle led to the extinctions of various species, but with its constantly increasing momentum it has also led to an *acceleration* in their extinction, such that more species are becoming extinct per unit time at present than ever before in the past 65 million years.

New needs

Once a technological innovation meeting a vital need has been adopted, the pioneering principle, as noted above, has the effect that the population tends to expand to the size that the resources made available by the new technology allow. And as also intimated earlier, once this happens the population becomes dependent on these resources, and, moreover, on the technology required to obtain them. In other words, these resources and technology become *new needs* for the population.

Typically, other new needs also arise with the adoption of new technology, such as the needs to service the technology and provide adequate conditions for its use. Thus, just as we might say that necessity is the mother of invention, we

might also say that invention can be the mother of necessity, necessity which in turn requires further invention. Once a new invention has been adopted in a particular society, it tends to create pressures within the society to make other innovative changes. In this way we humans are the only species that has come to create new needs for itself.

The application of new technology creates not only the needs associated with its own maintenance, but also those associated with its dissemination. Once telephones come into use, telephone cable technology and switchboard technology have to be developed, and the results manufactured and put to use. The development of the car not only made roads and service stations necessary for the first cars, but for all of an increasing number of cars as they filled the experienced non-vital needs of an increasing number of people.

Such needs are not removed until or unless the technology in question is usurped by a newer technology; and the newer technology will, of course, bring with it yet newer needs related to *its* maintenance and application. And new needs, created by the impact of the employment of new technology on people's lifestyles, provide the stimulus to higher levels of consumption. Also, technological development leads to the need of a broadened resource base (larger niche) – more different kinds of metals, for example. This is related to the new technology's only providing *part* of what the old technology provided, and to constantly increasing complexity/division of labour in society. In effect, as suggested by Wilkinson, the real cost of living is increased by technological development. And in the modern era this growth of need makes new activities profitable to capitalists.[389]

Technological development self-perpetuating

In terms of systems, technological development, unlike the development of individual organisms and certain species, but like the development of the biosphere as a whole, has no internal homeostatic mechanisms or checks to its own growth. It is the key part of the turning of the vicious circle, which itself has no internal check. As expressed by Schumacher: "Technology recognises no self-limiting principle – in terms, for instance, of size, speed or violence. It therefore does not possess the virtues of being self-balancing, self-adjusting, and self-cleansing."[390]

Though technological development could in principle be limited by human intervention, this has so far not occurred on any significant scale; and if it involves the non-sustainable use of resources, it will prevent humans from coming into equilibrium with their surroundings. Left to itself technology will continue to develop, and grow in physical size, until the resources on which its development or growth depend have become exhausted – unless the wastes it

produces prevent it from continuing before that. And, as Schumacher says, "In the subtle system of nature, technology, and in particular the super-technology of the modern world, acts like a foreign body, and there are now numerous signs of rejection." Thus technology and technological development tend to undermine their own existence, as well as that of any species dependent on or otherwise affected by them. And when technological development comes to a standstill, the vicious circle of the development of humankind will stop turning as well.

Due to the need acquired for a particular technology, the use of that technology becomes – perhaps genetically – ensconced in the population or society, and cannot be given up but only replaced. As in the case of specialisation, this replacement parallels evolution in that just as new species tend to be more complex than their predecessors, so do new forms of technology. Following the innovation–speciation analogy further, we should say that each group of people consisting of all specialists of a particular sort is comparable to a species.

New techniques tend to be applied to a smaller range of resources than those they are replacing.[391] Thus each technique that is replaced is often replaced by a *number* of new techniques to cover all of the necessary resources. Due to technology's tending to eliminate its own resource base, it is normally only a matter of time before its replacement itself becomes a necessity. In this way a positive feedback loop of the increasing kind is created in which technological development is a driving force behind further technological development.[392] And the population becomes dependent not only on technology, but on the *development* of technology. This is part of the expression of the VCP, and constitutes a vicious circle in itself.

Creation of a surplus and increased consumption

Technological change originally employed to counteract need has often *overshot the mark*, giving rise to a surplus, i.e. to more resources, reserves and/or stocks than is necessary to meet the needs of the current population. The acquisition of such a surplus is a precondition for the turning of the vicious circle. It is to be noted however that the existence of a stored surplus itself implies a relative scarcity of what is stored.[393]

Here we might distinguish between cache, store and surplus. Both a *cache* and a *store* are paradigmatically ways of preserving food, and it may be suggested that where a cache is typically of hunter-gatherers' dried meat, a store is typically of agrarians' grain. More generally, caches and stores may consist of resources, reserves and/or stocks, as well as entities that have only exchange value. Money, for example, is stored in a bank. A *surplus*, on the other hand, is

essentially that portion of a physical cache or store that exceeds the vital needs of the extant population.

Note that a surplus is essentially of *vital* resources, i.e. of resources, reserves and/or stocks meeting vital needs. This is necessary for population growth and the turning of the vicious circle. In a situation where such a surplus is lacking, all needs are vital needs. Given such a surplus, however, *non-vital* needs may develop. These needs may be met by non-vital resources, of which there may or may not be a surplus. Thus we can speak of surpluses of both vital and/or non-vital resources, the existence of a surplus of non-vital resources presupposing that of vital.

It is the constant presence of surpluses of vital resources that has allowed the vicious circle to turn. Most importantly in this regard, it has allowed an increase in the meeting of vital needs, including through the production of an excess of food as well as the construction of a greater number of shelters or homes in which families can be raised (an increase in perceived territory for the masses). As dictated by Liebig's law, an increase in both food and breeding sites is necessary for population growth, and in the case of humans, for the vicious circle to turn. What this implies, among other things, is that a surplus of available resources, i.e. of *reserves*, must further be converted into *stocks* if it is to be used. For example, reserves of oil must be *refined*; land amenable to agriculture must produce *food*; and so on.

A surplus of a resource (or resources) can take a variety of forms; and it may be of a resource different from but nevertheless able to meet the same needs as the resource that became scarce. What is typically the case is that the scarce resource is at least partly *replaced* by another resource that meets the same need(s). At the same time, however, it may be the case that a newly acquired resource have an application that is *broader* than that of the resource it is replacing, though this is not the norm. The presence of more resources meeting vital needs will mean an increase in the consumption of these resources (taking both breeding sites and food into account), in keeping with the pioneering principle.

Inferior substitutes

The implementation of new technology may result in the acquiring of products that are superior to those they are replacing. However, this is not always the case, and, as has been implied by Wilkinson,[394] more often has *not* been the case. On the other hand, however, replacements have generally been greater in *quantity* than what they are replacing. When it comes to food, for example, the quantity of food available to the whole of humankind over the ages has constantly been increasing, while at the same time its quality has on

the whole been worsening over the past 25,000 years. A modern example of inferior substitutes given by Wilkinson is plastics as compared with leather in shoes and handbags.[395]

As regards resources more generally, the trend towards substitutes of lower quality is the same. We must recognise however that the inferiority of replacements is not a priori, unless such a view is taken as that given our evolutionary nature, those resources that are nearest to hand are those of the highest quality, i.e. best supportive of the continued existence of our species.

The idea that substitutes will tend to be inferior receives support from looking at ourselves as rational agents: given the choice we will first take what is best. The more difficult a resource is to acquire, the lower its use value for that very reason. As expressed by Daly, we do not satisfy ends in any arbitrary sequence but seek rationally to satisfy our most pressing needs first. Likewise, we do not use resources in any order but first exploit the most accessible ones known to us. The former fact gives rise to the law of diminishing marginal benefits, the latter to the law of increasing marginal costs.[396]

Population checks

The survival of the human species is to be ensured by the replication of its karyotype by fit organisms successfully reproducing neither too many nor too few reproducing offspring. As treated in Chapter 1, if too many are produced, other things being equal, homeostatic mechanisms checking growth should come into play, so as to keep the species in equilibrium with its surroundings. It might here be kept in mind that the modern human ideal of no mortality until old age suggests that through artificial means the human species should differ from all others in eliminating infant mortality. (Cf. the second formulation of the principle of population.) The implications of this ideal for potential population growth are clear.

Positive vs. preventive checks

As regards checks to growth then, we should perhaps begin by noting Malthus' *positive* and *preventive* checks. As remarked earlier in discussing the principle of population, positive checks are causes of premature death (i.e. death prior to the loss of the capacity to produce or rear children); and preventive checks are checks on birth rate (or rate of conception). Note that population control, when positive, means higher mortality and lower life expectancy.

Internal vs. external checks

The distinction between internal and external checks has also been dealt with earlier. Where the positive checks to human population growth are

typically external (e.g. predation, disease, starvation), preventive checks – to the extent they have been operative – are normally internal.

In keeping with what was suggested earlier, the weakening of *internal* checks – both positive and preventive – may be seen on the VCP to be the result of technology continually providing humans with a surplus of vital resources, including both food and the materials requisite for the building of dwellings. Had we only been provided with surpluses of food, but not an increase in breeding sites, or vice versa, then external checks would alone have been able to limit the size of the population, in keeping with Liebig's law. We have reacted to these continual increases in the quantity of food and breeding sites as virtually all species of animal would, and as accords with the pioneering and reaction principles – by increasing our population.

Constant vs. transitory (stress-provoked) checks

All transitory internal checks are stimulated by crowding. Such internal checks may appear only in case of stress; or they may exist independently of stress and be intensified by it.

Modern human population density, in order not to lead to stress, should be about the same as (or at most slightly greater than) that of the species humans are directly descended from. Thus due to constant human population growth, stress is de facto endemic to virtually all human populations, though it of course increases and decreases with increasing and decreasing population pressure.

Territoriality

The more complex the species, the more its basic instincts are supervened upon by its less basic, and the greater its behavioural adaptability. Complex species are more dependent on instinctually less-basic behaviour, the highest form of which is *intelligent* behaviour. In the present context this is manifest in humans' greater reliance on learned (cultural) behavioural checks. In our case, all behavioural checks are variable manifestations of territoriality, taking the form they do as the result of the mediation of other factors, particularly culture on the macro level and genes on the micro.

Territoriality tends to keep the population size in check *before* there is a scarcity of food. Here it is important to note how the territory in question is perceived. Though there may in fact be sufficient territory to support population growth, if it is not *perceived* as sufficient no such growth will occur (cf. Wynne-Edwards' smallholder cocks). Similarly, when the territory available for potentially mating pairs is perceived as being too small, even if there should exist sufficient food, action will normally be taken to reduce the size of the reproducing group (as in the guppies example). It is this flexibility that makes it possible for territoriality (stemming from the sexual instincts) rather than

food availability (the survival instincts) to function as an *internal* population check.

As taken up in Chapter 1, in virtually all species this excluding of others from an individual's or group's territory involves aggression, which, particularly in the case of mammals, may or may not result in death(s). At least since we first became sedentary, the fit man's aggressive dominance over nearby men has ensured him his territory; and it is the similar dominance of one group over another that assures the group its territory.

For non-human species when sedentary, as well as for Neolithic humans, the size of any particular male's territory is limited by his ability to roam and defend it. And the same can be said of groups. We might also expect that in the absence of other fit males in the vicinity, both individuals' and groups' territories would tend to be larger than otherwise (the pioneering principle). Increasingly for humans this 'territory' of the average person is not patrolled by the individual owning or ruling over it, but consists rather of those areas where the person and his family live, plus those areas where the food and other resources they consume are produced or obtained.

In many sophisticated species other males must be allowed to mate in group territory ruled over by a leader. And, like the leader, other males may have a number of mates – in the case of humans, as in that of many other mammals, polygyny being evident in the marked differences in males' and females' body size and strength. This was so with our primate ancestors and it is so with us. (Among other things, this suggests that human monogamy is a *cultural* population check.)

It may also be kept in mind that, as noted earlier, while territoriality promotes aggression between males, once individual territories are decided on it brings about peace, and in fact group territoriality leads to social cohesion amongst those occupying each of the individual territories in question. As in the case of other social animals, a ranking system is developed with the leader (fittest individual) on top. And, also as in the case of other animals, the peace continues until the next occasion for conflict arises with the challenging of the leader's position. While the positions of the members of the hierarchy are only temporary, the form of the hierarchy itself is permanent, stemming directly from the species' karyotype.

Thus the coherent unit constituting a tribe, with its leader, fights other tribes occupying other territories, it being *morally obligatory*[397] – and in fact unquestioned – for fit males to do so: cf. the Murngin above and Darwin's bees, below. In this way territoriality can account for both divisive (individual territoriality) and cohesive (group territoriality) forces in society. And when societies become more complex and kin/tribal relations are obliterated, the social

instincts operate so as to form similar relations in groups that are more artificial, such as nations, religious communities, platoons of soldiers, ethnic groups and social classes.

Thus in the case of humans, dominant males have been able to become the leaders of huge populations and/or populations occupying huge territories. By being able to gain control over a significant proportion of the population's *weapons*, the leader can see to it that the territory he rules over is protected for him by others. Being the leader of his nation, his ruling over the group's territory through his controlling its members gives him his status and social position. But the *motor* behind this development, viz. the dominating behaviour of males, is present in all territorial species; it's just that in the case of humans many of the normal checks to particular individuals' increasing the size of their territory have been removed.

In the case of kings, each must be able, using his *army*, to defend his (group's) territory from peoples led by other kings, and in the best of cases increase its size by taking territory from other peoples and kings. (That he have an army at his disposal is largely thanks to the social instinct of all fit males in the territory he rules over to fight for their group.) It is thus to the leader's advantage that he have large numbers of followers when it comes to conflict with other groups.

As expressed by Charles Galton Darwin, any nation that should limit the size of its population would be forced off its land (territory) by some other nation or nations that had not done likewise.[398] But having large numbers is also to the advantage of the group as a whole, in that in the case of war it increases the likelihood not only of personal survival but a sharing of spoils. While on the one hand infanticide and killing in war, both resulting from social instincts supporting group territoriality, tend to reduce the size of the population, the social instinct for males to defend and enlarge group territory, which supports population growth, is the stronger influence, since it is reinforced by the survival of those groups that evince it. So we see that *where individual territoriality tends to limit population size, group territoriality tends to increase it*. This tendency is counteracted by inter-group killing (among other things), a population check that does not exist in non-social species, the result being that there is a balance between group territoriality's promoting population growth and inter-band killing's repressing it. Because of the population-increasing effect of group territoriality, infanticide is only employed when increasing the size of the population is of detriment to the group; and then it is mainly the females that are killed, who cannot be employed in defending or expanding the group's territory. In other species the expansive influence of group territoriality is sufficiently countered by inter-group competition, resulting in an inter-group homeostasis and

relatively constant population sizes. In the case of humans, on the other hand, the influence of group territoriality in increasing the population has *not* (to date) been sufficiently countered for population sizes to level off.

To ensure that his army be as powerful as possible, the king supports the inclination of the group to grow, so that the number of males in his group's territory able to bear arms be as large as possible (which also provides him with more income from taxes). Despite this, however, even in the case of post-horticultural people, the actual fight over group territory tends to function as a population check. This is due both to soldiers' and civilians' succumbing directly to enemy weapons, and even more to war's leading to starvation and the spread of disease; it is only that this check is overridden by the experienced need of the powerful male to have as many followers as possible, together with the presence of a surplus and the natural tendency of the social group to increase its population so as to be able to defend its territory. Regarding the surplus, as Grahame Clark observed, war is "directly limited by the basis of subsistence, since the conduct of any sustained conflict presupposes a surplus of goods and manpower."

Thus not only the presence of a surplus, but also that of males constantly driven to acquire more territory in the form of land or capital, supports a relaxing of population checks in society. And human leaders' desire to have large populations, given the constantly recurring surpluses in our past, can explain why they have consistently turned their backs on problems of overpopulation.

The adaptability of members of the human species – to a large extent manifest in our intelligence – may be important not only with regard to our innovative ability, which has increased the actual number of humans who can be raised, but also with regard to our perception of territory. Though the members of many non-human K-selected species are resistant to a certain amount of crowding, none appear to be so to the extent that humans are – though still with increased violence as a result.

Looking over the whole of the development of our species, we see that the average space available to each pair for breeding, i.e. the male's territory, has constantly been shrinking due to population growth, at the same time as the space *needed* for successful breeding has also been shrinking, thanks to the results of technological innovation (the building of many-storied dwellings, etc.). That smaller breeding sites are perceived as sufficient and will in fact suffice does not eliminate however the karyotypically based *psychological* effect of reduced space – the effects of *crowding* – from expressing itself in various forms of violence of man against man. We note however that, as in the case of other animals, conflicts amongst humans become less intense after social adjustments to crowding have been made.[399]

In any case, given crowding, at some point territorial animals can be expected instinctively to begin positively or preventively reducing their own numbers. We humans, on the other hand, though our territoriality is also instinctual, thanks to our intelligence can nevertheless adapt to such situations, as long as our vital needs are met. And a higher density can be more easily tolerated if boundaries of ownership are clearly marked, a house for example having clearer boundaries than a flat.[400] Human adaptability to crowding is a necessary aspect of the weakening of our initial population checks.

Somatic vs. behavioural checks

Somatic checks of particular interest are those, such as reduced ovulation, which are variable and can come into operation through stress due to crowding.

Behavioural checks, also induced by crowding, are notably either *preventive*, such as coitus interruptus or failure to mate; or *positive*: negligent maternal behaviour, infanticide, abortion, initiation rites. They can vary from species to species, and in humans from culture to culture and/or individual to individual.

Cultural (learned) vs. instinctual checks

In the case of humans internal checks take various forms, and it is as regards *behavioural* checks, all of which are internal, that humans evince great variety. This variety may be seen as stemming from greater human intelligence/adaptability/learning ability.

Cultural checks are a more sophisticated form of learned check, cultures themselves existing *only* in human populations, and in *all* of them, and being essentially determined by the population's technology. Such checks are a manifestation of the *social* instincts, as exist in all social animals. Like all learned checks they are *variable* and are *mediated* on the macro level by learning, and on the micro by our genes. Further, they may be either constant or transitory (requiring an external stimulus).

As Divale says, unlike other animals, man adapts primarily through culture.[401] Thus, as Wilkinson says more particularly, the most important (internal, behavioural, social) mechanisms for limiting *human* populations are cultural. As with most aspects of human behaviour, the physiological and other invariable mechanisms for homeostatically controlling reproduction are inadequate on their own: they can serve only as fall-back systems when cultural checks fail. Human populations are only adequately checked and starvation avoided in cultural systems which are sufficiently well adapted to have developed their own homeostatic controls. It is variations in the cultural system, not in man's physiology, which decide whether starvation occurs in human populations[402] – though we

note that in modern humans cultural change both influences and is influenced by genotypic change.

Cultural population checks may have been sufficient to keep the populations of many hunter-gatherer societies, in which technological development was non-existent (and into and out of which there was no migration – to be taken up below), from pressing against their environmental limits for thousands of years at a time. But when technological development related to vital needs takes place internal checks can be overridden. This is particularly so at the time of major revolutions in the turning of the vicious circle, with the cultural upheavals they entail. Though it may be expected that after such revolutions internal checks gradually build up again, they should never do so completely so long as there is a surplus, i.e. as long as the vicious circle continues to turn.

Morality

What we term *altruism* in the case of social animals quite generally may be called *morality* in the case of humans, i.e. the *cultural* requirement to act in such a way as potentially or actually reduces one's own genetic fitness (reduces one's fecundity or fertility) while supporting the fitness of one's community and thereby one's species.[403] (If we consider the nature of human values, we could say that they are of essentially two kinds: egotistical – supporting the individual's gene line, and altruistic – supporting the group's gene line. The latter, when they are to the real or potential detriment of the individual's gene line, are morals.) However, morality is of greatest relevance to the species' survival in situations of overpopulation, due to our species' inordinate tendency to grow in numbers, its function in such cases being to check population growth; and the weakening of population checks in the presence of a constant surplus is expressed in moral terms in an increase in moral laxity.

Thus when a mother feels obliged to kill her infant during a period of scarcity, we can speak of a cultural check to population growth. In this regard, Darwin has pointed out that:

> The murder of infants has prevailed on the largest scale throughout the world, and has met with no reproach; but infanticide, especially of females, has been thought to be good for the tribe, or at least not injurious. Suicide during former times was not generally considered as a crime, but rather, from the courage displayed, as an honorable act; and it is still practised by some semi-civilized and savage nations without reproach, for it does not obviously concern others of the tribe.[404]

And he elsewhere suggests that:

> If, for instance, to take an extreme case, men were reared under precisely the same conditions as bees, there can hardly be a doubt that our unmarried females would, like the worker-bees, think it a sacred duty to kill their brothers, and mothers would strive to kill their fertile daughters; and no one would think of interfering.

All species are karyotypically inclined to produce more offspring than can be expected to survive, with the *fittest* of them being those that do survive and themselves have offspring. On the average each individual of any sexually reproducing species can only have *one* reproducing offspring; thus it is not natural for any species, including the human, that all infants live to reproducing age. This means that if we assume the fertility of the average human female to be, say, five children, then three of those children must die before themselves reproducing. The death of half or more of the children born in a human society is the natural state of affairs. And if these children do not die due to external checks, then they must be killed through the internal checks of infanticide, etc.

As suggested by Baschetti, we may say that the selective advantages of animal aggregation explain why many species, including humans and other primates, live in social groups. In ancestral times early communities of apes, to enhance their chances of survival, had to evolve selectively advantageous social behaviours, which constitute precisely the essence of morality.[405]

By means of selective pressures evolution has favoured morality over immorality in human groups, rewarding socially beneficial behaviour by favouring the survival of those groups that evinced it to the appropriate degree. Darwin wrote: "At all times throughout the world tribes have supplanted other tribes; and as morality is one element in their success, the standard of morality and the number of well-endowed men will thus everywhere tend to rise and increase."[406] (But we might add: until the 'well-endowed men' started getting away with pretending that what is best for them is best for society.) And Mayr has said:

> [C]ultural group selection may reward altruism and any other virtues that strengthen the group. … It is easy to imagine how a particular value system within a culture might lead to the prosperity and numerical increase of the group, which might, in turn, lead to genocidal warfare against neighbors, with the victor taking over the territory of the defeated. Any divisive tendencies within a group would weaken it and in due time lead to its extinction. Thus, the ethical system of each social group or tribe would be modified continuously by trial and error, success and failure.

Note that *cooperation*, while based on the social instincts, is not in itself an expression of morality, though morality can foster cooperation.

Religion and myth

Religions are *cultural traditions* the most important function of which is to reinforce instincts benefiting the community as a whole, and this they do by giving higher authority to and making explicit certain rules of behaviour the members of the community are to follow. These instincts are *social*, and benefit from religion's reinforcement particularly due to their being the weakest of the instincts; and the explicit rules authorised are *moral*. Note further that religions more particularly support group territoriality and its pushing of population growth – a point to be returned to in Chapter 5.

As E. J. Mishan suggests, no moral law, no matter how enlightened, will command the allegiance of men if it is known to be founded explicitly on considerations of social expediency. Socially instinctive submission to its precepts is ensured only if they are engraved on stone on the inner layers of the conscience, distinct and inerasable, resistant alike to exemptions and concessions. All past religions have been of divine origin.

Not only the great monotheistic religions, but all the supernatural beliefs that guided and influenced the behaviours of societies large and small, imparted stability and cohesion to those societies. And these beliefs include not only the sacred myths but also the secular ones – those sustaining beliefs held by a tribe, a folk, a race, a nation, about its heroes, and about its heroic origins and its heroic achievements.[407]

Conscious vs. cultural checks

Another distinction may be made between kinds of check, namely between cultural and conscious checks. Thus, for example, some people may use contraceptives in societies where their use is not condoned. But even conscious checks, which depend, say, on reason, have a karyotypic basis, just as reason itself has such a basis. Here it may be noted, however, as has been pointed out by C. G. Darwin, that purely voluntary population control selects for its own failure.[408] The gene lines of those families that have few children will become fewer, while those who have many will increase.[409] Thus we see, for example, the impracticability of the (neo-Malthusian) suggestion of Russell and Russell,[410] that the regulation of human populations by voluntary birth-control would be the most important first step towards eliminating human violence.

Population growth

As suggested by Allen W. Johnson and Timothy Earle, there can be no population growth beyond a certain limit without technological changes

permitting more food to be provided per given unit of land. Population and technology have a feedback relationship: population growth provides the push, technological change the pull. But it is fundamentally population growth (or its concomitant population pressure) that propels the evolution of the economy.[411]

Humans must *eat* to survive, so an increase in the size of the population will mean an increase in its food requirement. Due to the presence of a surplus of food and breeding sites thanks to technological development, we humans, as would other animals in a similar situation, and as is suggested by the pioneering principle and the second formulation of the principle of population, tend to have more than a replacement number of offspring. And as suggested by the reaction principle, the inclination of the members of *any* species is naturally to react to their immediate situation. Though our *reason* may tell us that an alternative mode of action is appropriate, in the main we follow our instincts, including our social instincts. And, again thanks to technological innovation and the surplus it provides, since at least some of the extra children we produce are not eliminated by internal or external checks, the result is the constant growth of the human population.

While the populations of modern hunter-gatherers have apparently not had a tendency to grow, according to Cohen, as intimated earlier, this phenomenon is anomalous. Thus "the concept of carrying capacity as a fixed ceiling to which population responds, although applicable to specific populations under particular conditions, has little general validity for human history."[412]

As has been emphasised by Virginia Abernethy, throughout human history periods of surplus have as a matter of fact been followed by periods of population growth. As noted at the beginning of this chapter, such seemingly minor innovations as the adjustable wrench can have the ultimate effect of providing or increasing a surplus. The increase in the amount of resources that can be extracted from the environment is then taken as permanent, and what Abernethy terms a 'euphoria effect' (or what we might term a 'pioneering effect') takes hold, leading people to have larger families.[413] Without such a surplus, population growth would be impossible. Thus human adaptability, both with regard to our ability to find technological solutions in situations of need, and to reproduce in situations of crowding, together with the surplus that technology has provided, leads to population growth. All of these factors are necessary to the normal turning of the vicious circle.

In terms of systems, technological development undermines the homeostasis of the human species; where there is no technological development, and resources are being used sustainably, homeostasis tends to assert or reassert itself. In terms of our thermostat analogy, the constant presence of a surplus of

food and the diminution in the area necessary to raise a family lead to higher settings at which the thermostat controlling population growth clicks in.

According to the VCP, technology's role in the growth of the human population is central, such that one may say that without technological development its size would be minuscule as compared to what it is today. And technological development itself, together with the existence of resources to which it can be applied, constitutes the most important aspect of the vicious circle.

Closed vs. open populations

In *closed* populations of K-selected species, i.e. populations in which there is no immigration or emigration (such as those of modern hunter-gatherers and virtually all non-human social mammals), population homeostasis is maintained by internal checks. A population may or may not be closed for a number of reasons, including geographical location, social mores and politics.

The operation of population checks in *open* populations (such as those of Palaeolithic hunter-gatherers and today's various human populations) is more difficult, however. In human groups that allow immigration and emigration, it is harder to establish the social cohesion necessary for the maintenance of cultural traditions checking population growth. The situation is similar to that of Wynne-Edwards' red grouse in unstable or transitory environments, where their internal population-controlling mechanism is destabilised, resulting in overpopulation. In such populations, it is also possible for people to acquire knowledge about innovations made elsewhere, as well as to emigrate in the case of overpopulation. An open population also makes *trade* possible, without which the resources for technological development are more limited.

The fact that in a closed population excess members have nowhere to emigrate means that if there were to be such an excess, those in it must die prematurely – but this being the case inclines the society not to produce too many people in the first place, so that ecological disequilibrium due to overpopulation is avoided. Thus the likelihood of closed societies' attaining or maintaining equilibrium is greater than that of open societies – the smaller the society, the greater the likelihood. In such a society technological development may come to a standstill, and the population tend to remain at a sustainable size – as happened in the case of various tribes of modern hunter-gatherers.[414]

Population pressure and crowding

Population pressure occurs when the size of a population is too great relative to the carrying capacity of its habitat. According to the VCP, increasing population pressure is endemic to *Homo sapiens'* development.

In some cases population pressure, while it exists, may not be *experienced*, due e.g. to the presence of a surplus of non-renewables. When experienced, population pressure is manifest in *stress* – which may be psychological and/or somatic – due to a diminution in consumables and/or land (territory). Stress due to a diminution in the amount of land is *crowding*; and due to a diminution in consumables takes the form e.g. of malnutrition. Consumables can be considered in terms of whether they are reserves or resources, *experienced* population pressure existing only in regard to reserves. Non-experienced population pressure is related to *resources* – and of course both sorts of pressure can be manifest at the same time. All non-experienced population pressure eventually becomes experienced, unless a renewable alternative is found in the meantime. The use of non-renewable resources to relieve experienced population pressure exacerbates the problem humanity faces as regards non-experienced population pressure and our total resources. Both sorts of population pressure result from per capita resource diminution due to population growth and/or total resource diminution.

When it comes to population pressure and violence, one is inclined to say that if a certain level and form of mortality is well ensconced in the culture of the society – i.e. if the size of the population has been regulated through self-imposed mortality over a long period of time (cf. Darwin's bees), then population pressure has been avoided. In this case continual warfare, rather than being a sign of population pressure, could be seen as a means of eliminating or lessening it – though it could be both. If, on the other hand, there is a sudden *increase* in mortality through e.g. infanticide or war, or external checks such as starvation or disease, we should say that this is a sign of population pressure.

Migration and centralisation

Migration occurs in the populations of virtually all species of plants and animals. As suggested by the principle of population, and more particularly by the pioneering principle, if new territory becomes available adjacent to that already occupied, plants will tend to move into it through the spreading of their seeds or roots, and animals will do the same by themselves moving, in both cases increasing the likelihood of the population's having reproducing offspring. This also applies to humans.

Population pressure functions so as to strengthen the pioneering phenomenon. This was the case both when fire was first controlled and people began moving into colder environments, and when the land bridge opened to America and people crossed it in pursuit of prey. And population pressure can also play a role in the migration of animals other than humans.

In the case of humans in particular, the reasons for migrating become more complex due to the operation of the VCP. Thus human migration can be to

places where changed employment of technology has led to an increase in available resources such that e.g. more people can be fed there than before. In this way we are the only species that has expressed the pioneering principle geographically *inwards*. When reserves or stocks are stored, the places where they are stored will function as magnets to those who want to partake of them, particularly if paying jobs dealing with them can be found. The result is a *centralisation* not only of stocks but of people, with urbanisation being the result if the population is sufficiently large. Thus, as expressed by Ellul in this context: "The idea of effecting decentralization while maintaining technical progress is purely utopian."[415] This may be seen as being partly due to the fact that the cost of distributing the stored consumables – a cost borne by the consumer – increases with distance. (It may be noted that the centralisation of people works against the natural inclination of humans to associate only with their, from birth, 'significant others,' as in crowded urban settings they have mainly to deal with strangers.) Quite generally, any amassing of social power at one point will tend to attract people, either competitors, beggars or something in between. The greater the store a group can obtain, the greater will be the centralisation of power and institutions dependent upon power (as all are) in that group.

The operation of the VCP can also lead to migration to or expansion into places where a particular form of technology has not yet been implemented, with the migrants intending to implement it upon arrival, as in the case of colonisation. Another form of migration incumbent upon the turning of the vicious circle is migration due to weaponed conflict, most notably when those not engaged in the conflict flee the area where it is taking place.

Increasing complexity

Of technology

As mentioned earlier, it is natural in the case of biological evolution that more complex organisms evolve from simpler, such that organisms as complex as humans might result, and that the biosphere itself constantly become more complex until some biophysical limit is reached at which increased complexity no longer provides survival benefits. In keeping with Darwin as cited in Chapter 1, this increase in complexity results from more-complex species being able to occupy niches 'between' those of already existing species, or to usurp the niches of those species, which suggests their being able, or better able, to acquire the relevant resources. Following Wilkinson, we can say that substituting one resource base for another implies changing from one niche to another.[416] Such a resource base includes the species' vital resources – both food and breeding sites.

There is also increased energy use in the case of evolution, generally the more complex the species, the higher it is on the food chain, i.e. the more solar energy it requires relative to body weight. In systems terms, as expressed by Boulding, evolution moves the world towards less probable and more complicated arrangements in both society and the biological world. Order is created within each of them at the cost of creating a greater quantity of disorder without.[417] Each more complex species (higher on the food chain) that is introduced into the biosphere means an increase in the conversion of usable solar energy per unit biomass into unusable energy such as heat.

As regards social evolution or development, the more-complex technologies can, like successful new species, acquire resources unavailable to simpler technologies. Also, social change may be seen as resulting from the 'mutation' of earlier technology, just as new species come into existence through the mutation of earlier species. The simplest technology capable of acquiring particular resources is usually developed first, as it is normally easiest (most natural) both to create and to use. More complex technology – or more complex *tools* – may be employed before simpler however (e.g. the bow and arrow was widely used before the hoe), if their use provides at least the same quantity of consumables while requiring less work or energy.

However, just as there is a limit to the complexity of the biosphere, there is also a limit to the complexity of technology. In the case of technology, its limit depends, among other things, on the nature of physical reality and its potential for 'moulding.' In this regard the quantity of non-renewable resources amenable to technological development is constantly dwindling and will eventually disappear. Our renewable resources are also constantly dwindling through use. Even if they were not, however, in that they themselves are limited there must be a limit to what technology, no matter how sophisticated, can obtain from them (particularly given that increased sophistication suggests increased energy use).

So, like the biosphere, the technosphere has a tendency to develop towards greater complexity as long as there exist resources that can be employed in this development, and resources to which it can be applied, plus a sink to receive waste. The force behind this process is the human drive to meet experienced needs, needs which are constantly present largely due, in particular, to the growth of the human population that technological development has itself made possible, and due more generally to the turning of the vicious circle.

Of society: specialisation, or the division of labour

The human population as a whole, like the populations of other species and as is suggested by the reaction principle, is karyotypically adapted to

the immediate exploitation of its available resources which, given its size and the nature of human intelligence, has resulted in specialisation and order. This order increases with increases in energy use, population size, and the specialisation required for handling the new technology.

Specialisation and the division of labour are the same phenomenon seen from different points of view. Division of labour occurs *in a group* through the specialisation of *individuals*. (According to John Ruskin, the division of labour was misnamed. It was not the labour that was divided but the men, "into mere segments of men – broken into small fragments and crumbs of life." Men were now condemned to forms of labour that made them 'less than men' in their own eyes.)[418]

Specialisation and increased societal complexity were originally the result of the increasing effort required for a society to obtain the resources requisite for survival; and it may be that people with particular skills which most other people lack come to concentrate on employing those skills. Note that while this phenomenon implies an increase in the complexity of society, it need not mean an increase in the complexity of the tasks performed by individuals, but quite the reverse. Thus the division of labour between the making of weapons and using them to hunt, while it increases the complexity of society, makes individuals' tasks in the food quest simpler. In fact specialisation, or the division of labour, resultant upon the turning of the vicious circle has meant an increase in the simplicity, and thus monotony, of the lives of most individuals.

Specialisation in human society is necessary not only for the design of new technology, but also for the acquisition of the resources needed to construct and fuel it. Unlike in the case of specialisation through biological evolution however, this specialisation is not directly the result of karyotypic change, nor even of genetic change – though there may well be interaction between human specialisation and either of them. What it involves rather is *cultural* change, i.e. learning and the acquisition of skills. In this regard, like culture itself, it is uniquely human.

People's having to perform ever more specialised tasks of course means a general movement away from individual self-sufficiency and flexibility as regards the filling of needs, and towards greater dependence on society. And as regards society as a whole, it means a constantly increasing dependence on both technology and its development. Included in this is the necessity for individuals to devote years of their lives to learning a trade, during which time they have to be housed and fed by others.

Territory, property and commerce

Where individual or family territory and its contents are *owned* by individual persons, group territory may be *ruled over* by individuals, but may be

considered to be owned – i.e. be the property of – the group. As Daly recognises, both individual and collective property-holding are manifestations amongst humans as well as in the animal kingdom of the territorial instinct.[419] The nature of the ownership becomes more attenuated moving from individual to family to group. In the event that the property can also be *traded* it constitutes *capital*.

It has earlier been suggested that access to food and territory constitute the most fundamental population checks for all territorial species. Food is required for the survival of the individual; territory for the survival of offspring. Following this distinction further, we can say that what consists solely of food for the lower vertebrates, in the case of humans consists not only of food but more generally of *consumables*. (Stocks, reserves and resources are all consumables – and potentially capital – in various states of refinement.) In other words, where other animals consume only food, as noted in discussing the food chain, we 'consume' many other things as well, such as manufactured products; that is, we convert the low entropy in many other things than just food into high entropy. Consumables have a *use value*; if they have an *exchange value* as well, they are also *commodities*. *Debt*, including in the form of *money*, has *only* an exchange value. (Note the general transition from use value to exchange value as the vicious circle turns.) Consumables and commodities may be the *property* of *individuals*, which suggests that their ownership is primarily an expression of the acquisitive aspect of the survival instinct.

The behavioural manifestation of ownership of places and objects is very highly developed in humans, but this predilection is not peculiar to modern man. It is almost universally present in terrestrial vertebrates, on either a permanent or seasonal basis.[420] Thus, as pointed out by Darwin, a dog's bone, a monkey's stone or a bird's nest might also be considered their property.[421] And *trading* has its basis in the fact that consumables can be *stored*, the trading of consumables, i.e. making commodities of them, constituting an *economic system*.

Now, for humans, and potentially for other animals as well, social power consists in an individual's ability to control others, and may be manifest among other ways in his owning or ruling over territory. Power over other people can take the form of either owning them or of otherwise controlling them, both of which imply a controlling of their access to vital resources, as will be returned to in Chapter 5. As implied in Chapter 1, economic power lies in being able to control other people through owning individual territory or what it produces, while political power lies in being able to control other people through military strength.

Social stratification and class societies: the powerful vs. the weak

Social stratification is a manifestation of Darwinian *intraspecies* survival of the fittest, and exists in the populations of virtually all social animals, which

includes most of those that are medium to large size. The basis of social stratification lies in inter-organismic relations of two types, both stemming from the sexual instincts: the power of the male over the female, and the power of the male who rules over territory (or owns property) over the one who does not.

As regards social stratification generally, it would appear that the territorial dominance of males over other males plays a greater role than does the dominance of males over females; and this form of dominance behaviour increases with the complexity of the species. In the case of modern humans, it increases with the complexity of *society*. Thus society becomes stratified such that the application of new technology can be directed by the powerful and the work performed by the weak, while the status of the female generally rises or falls with that of her mate.

In terms of our division among the survival, sexual and social instincts, class societies develop on the basis of social instincts, strongly influenced by the sexual instincts. They concern the *group*. Furthermore they are more particularly *cultural* (variable, learned) rather than invariable.

The larger and more complex the society, the greater the number of levels in the hierarchy and the more complicated their interrelations. Moreover, since the time of the horticultural revolution it has virtually always been the case that there has not been sufficient breeding space for the weakest of the weak. Recognising this, we obtain three classes of people: the small class of the powerful, the large class of the weak who can breed, and the variable class of the weak who cannot.

Further classes can also exist in various societies, some of which are hereditary, such as in the case of caste systems favouring the powerful. As regards classes, we note in particular the existence of the *middle class* in Western societies – stronger (richer) than the weak, and weaker (poorer) than the powerful.

Unequal distribution of the surplus

The existence of class societies is also particular to humans, and is made possible by technological development and the redistribution of resources that it gives rise to; that is, it is dependent on the turning of the vicious circle. While the amount of resources going to the weak is normally only sufficient to allow them to raise children, that which remains – including virtually the whole of the surplus – goes to the powerful, a small portion of this going to the middle class, if such a class exists. The higher one is in the hierarchy, the greater the amount of resources at one's disposal.

Note that the mere increase in a surplus, even if evenly distributed, does not in itself guarantee an improvement in standard of living. It must be possible to *use* that surplus in a way that such an improvement results.

Property and power

Political and economic power, the possession of the one reinforcing that of the other, each consists in being able to control the behaviour of other people. Both sorts of power are thus forms of *social control*. Thanks to such control, the politically powerful individual *rules over* group territory, i.e. he *sets the rules* for those living in the territory. Ruling over territory does not mean owning it – for example the ruler cannot sell it. One result of the foregoing is that, given our social instincts, political power can be used to have others defend or increase the territory one rules over. As is in keeping with the nature of group territoriality amongst primates and early humans (*social* animals), a person's political power does not rest in his personal ownership of land (territory). It rests rather in his being the leader of a *group* (nation) that occupies land (a state), and which he thereby controls due to his position as leader (access to soldiers and arms). (Of course if the form of leadership is tyrannical, the leader as much as owns the group's land – if not the people themselves – in which case it is his property.) Political power can in this way be seen as ultimately stemming from the necessity for social species to ensure the existence of food and breeding sites through their groups' possessing territories.

Where political power concerns group territory, *economic* power concerns individual territory, and consists in individuals' *ownership* of property in the context of an economic system, i.e. consists in their ownership of *capital*. It is through the ownership of capital in the form of vital resources, reserves and/or stocks that the economically powerful are able to control others. The seeking of economic power stems ultimately from the necessity of the individuals of all species to acquire energy in the form of food in order to counteract entropy.

As regards the drive to attain political power, it is natural in all social species for males to be inclined to attempt to lead their group and take prime responsibility for the group's territory. This drive can be seen to be based on our social instincts as evolved from our sexual (fighting) instincts. The drive to obtain economic power, on the other hand, is a more recent development, and rather than be based on our sexual and social instincts, is based on our survival and sexual instincts. Here the survival instincts play a greater role, for what economics basically concerns is not territory *per se*, but the products of the territory: originally food; later capital. It concerns what is needed in order to survive, not reproduce. Nevertheless it is part of the male hominid's role to provide food (meat) and living space for his family, and so the sexual instincts are also involved. In any case, the drive to obtain economic power hasn't to do with group territory, but with individual territory. Individual human territoriality is further removed from the territoriality of other animal species in that, with the turning of the vicious circle, it has constantly become more abstract,

the most important development in this regard being capital's increasingly taking over the role of individual territory from land.

Here we must turn to a human trait, touched upon earlier, which was genetically strengthened through the turning of the vicious circle, namely a latent tendency to *hoard*. Though hunter-gatherers began to cache dried meat towards the end of the Palaeolithic, actual hoarding on the part of individuals began with sedentism, when it was no longer necessary to be able to carry all one's belongings. And once hoarding became possible it also became a potential route to power, i.e. a means of controlling other people,[422] as intimated above.

We can say that the fact that there exist people with economic and/or political power is a result of the turning of the vicious circle. In both cases the circle's technological innovation of language has been necessary to the having of such power, since without language commands cannot be given; and in the case of political (military) power, the development of weapons-technology incumbent on the turning of the circle has made possible the existence of power of enormous physical magnitude. In the case of economic power it is rather the vicious circle's provision of a surplus of consumables that has been key, though here too the hugeness of that surplus to date has given tremendous power to capitalists in relation to society's weak.

Both political and economic power provide *social status*, though social status can also be derived e.g. from fame. Politicians and businessmen have power and status; movie stars *qua* movie stars have only status. The middle class phenomenon of 'keeping up with the Joneses'[423] – already taken up by Mill as quoted in Chapter 2 – has to do with social status, but not power. Thus ordinary people's ownership of property beyond what is required for comfortable survival is not acquired for the sake of having the property (e.g. in horticultural times a man and his family could only eat so much of the grain they owned), but for the sake of maintaining or improving their status.

Social position is determined by political power, economic power and/or social status. Both social status and social position are partly determined by the way an individual is *perceived*; social *power*, on the other hand, is determined by what the individual can actually *do*.

Kings with vast territories will war with other kings in order to increase the importance of their nations and thereby improve their own social position, the ultimate reward being to rule the world – even if it's a world of destroyed cities and starving people. And virtually any means available will be used to do this. Where, for example, a capitalist will never take on more workers than he has to, a general will never spare his soldiers' lives if doing so would interfere with his winning a battle. Capitalists and generals have the power they do *because* they behave in this way. If they did not, they would be ousted by others who did.

Given the nature of both political and economic power, the more power a person has, the more he can get. When it comes to competition over power, it's an advantage to be more powerful. In this regard, as noted by Ellul, "Competition is thus an incitement to such technical progress as will bring victory over the competitor. This means that competition tends to destroy liberalism."[424] Quite generally, an individual's or group's having power, in whatever form, is part of a positive feedback loop of the increasing kind which generates more power for the individual or group.

Social stratification as a population check

The function of ranking (resulting from the operation of the sexual instincts) as a population check among higher animals in general is described by Wynne-Edwards:

> The hierarchy [ranking] … produces the same kind of result as a territorial system in that it admits a limited quota of individuals to share the food resources and excludes the extras. [I]t can operate in exactly the same way with respect to reproduction.[425]

In the case of humans, however, where the stratification is *social*, it works in quite the opposite direction, supporting population growth due to the needs of leaders for large populations.

Social Darwinism

Note that the above discussion does not support Social Darwinism, taking Social Darwinism to be the idea that the dominance of the powerful over the weak is to the advantage of the species. The reason that Social Darwinism is not supported is again due to the operation of the VCP. It is the activities of the socially 'more fit' (the powerful) to a greater extent than those who are socially 'less fit' (the weak) that are paramount in turning the vicious circle and thereby undermining the preconditions for the survival of the species.

Furthermore, given their constant desire to acquire more property, and the subordination of a large population being an aid to doing so in times of surplus, throughout history the powerful have tended to support the reproduction of the weak to a greater extent than reproduction amongst themselves. This means that their gene lines are not as strongly represented in later populations, which distinguishes them from the socially powerful in hunter-gatherer societies. As expressed by Lorenz: "It is fortunate that the accumulation of riches and power does not necessarily lead to large families – rather the opposite – or else the future of mankind would look even darker than it does."[426] On the other hand, however, were the 'more fit' suddenly to be eliminated, it may be expected that the 'less fit,' since they are driven by the same instincts and operate in the same milieu, would soon come to act in the same

or a similar way, à la Orwell's *Animal Farm*. (We might term this the *Animal Farm* syndrome.)

Lower quality of life for the weak

According to the VCP, the nature of human males' territoriality, given a sufficiently large population together with the appropriate means, should lead to a disproportionate part of that population living lives only slightly above the level of survival. Meanwhile the small minority with power reap the benefits of the surplus that the turning of the vicious circle has provided, as is the case in the world today.

Increased work

As Wilkinson points out, under the impact of ecological problems the productive workload tends to grow throughout society.[427] The need to employ new technology to acquire a particular resource typically means that more energy is required to obtain the resource, which in turn means more work for the weak. And during periods when there is no surplus, it is the weak who suffer first and most, often with massive death.[428] Furthermore, the population growth in the labour force promoted by the powerful widens the gulf between the powerful and the weak through, among other things, its reducing the value of a person's labour.[429]

Labour, as a concept, may be compared to the broader concept of *work*. To labour is to do physical work for someone of a higher economic class, the products of one's labour belonging to the person one is working for; thus we should say that the middle and upper classes don't perform labour. Work, on the other hand, may be simply defined as the creation or use of technology, or the provision of the preconditions for its use.

Poorer diet

That the weak have less leisure and do more work means a lowering in the quality of their lives, particularly for those drawn into the extraction of resources or the production of the goods or services (consumables) resulting from the implementation of the new technology. The extra labour on the part of the weak, together with their much poorer diet, is manifest in increased mortality. Generally, however, as the use of the new technology becomes an integral part of society, this effect tends to lessen – until a peak is reached and returns begin to decline.[430]

Disease and other causes of mortality

Even more important than heavy workloads and poor diets, however, though abetted by both, is the influence of disease. It is an effect of the principle of population that the populations of all species tend to grow to be as

large as possible while not over-exploiting their habitats. This also applies to micro-organisms.

Unlike in the case of other animals, throughout history humans' infectious diseases have accounted for the vast majority of mortalities prior to male and female menopause. As regards other animals, in the case of wild birds, for example, it seems unlikely that disease is an important factor in regulating their numbers; and in the case of North American deer, the influence of disease seems to be of secondary importance.[431] Of course all populations of all wild animals are generally healthy thanks to natural selection.

As Wilkinson says, disease in general tends to act as a homeostatic population regulator, taking a higher toll from human populations living in bad conditions, particularly if people are crowded or their resistance is weakened by malnutrition.[432] That this scourge of humankind is the result of the turning of the vicious circle can be seen from the fact that the vast majority of the infectious diseases from which humans suffer have arisen from the technological innovation of animal domestication, and their spread has been incumbent upon the constantly increasing size of the human population made possible by technological development.

Stress, aggression and conflict

As treated in Chapter 1, intraspecific territorial conflict amongst animals was seen to have two main effects: the survival and reproduction of the fittest organisms, and, by allowing only a portion of the population to reproduce, the checking of its size such that it doesn't tend to outgrow its resource base. These 'functions' of conflict, existing in virtually all animal species, also constitute the basis of conflict amongst humans (men). Note that this means that human extra-familial conflict is related to the relative scarcity of females and/or breeding sites, and thus to the procreation of the species, and not to a relative scarcity of food, i.e. the survival of the individual – though food, as a form of property, can nevertheless play a role in inciting conflict.

According to Russell and Russell, violence in human societies is not the result of an innate propensity towards aggression irrespective of conditions, but a response to *stress*. In an overly dense population cooperation and parental behaviour are replaced by competition, dominance and violence, violence being part of a complex of responses evolved to achieve a drastic reduction in the size of a population that is in danger of outgrowing its resources. Recurrent population crises produce what Russell and Russell call a *stress culture*, consisting of behavioural aberrations transmitted through the generations,[433] which include increased violence and greater emphasis on maintaining or improving one's place in the pecking order rather than sharing; in other words, a stress culture leads to the social

instincts coming increasingly to be usurped by the survival and sexual instincts, and morality thereby coming to be replaced by immorality.

The difference is to be noted between aggressive behaviour in a population that is in equilibrium with its surroundings, and aggressive behaviour in situations of crowding. Aggressive behaviour functions in virtually all animal species as an instinctual population check; but it can vary in intensity, becoming more strongly manifest in situations of crowding. Thus aggressive behaviour is favoured by natural selection, since its manifestation as a population check enhances the likelihood of the survival of the species in question.[434]

There are essentially three kinds of conflict amongst humans: conflict between the weak and the powerful, conflict amongst the powerful, and conflict amongst the weak. The two classic types are first the powerful against the powerful, which can take the form of commercial competition, but which, when weapons are employed, can become *war*; and second, the weak with breeding sites against the powerful, which can be manifest economically e.g. in trade unionism or, when weapons are involved, in *social revolt*. Conflict between the weak and the powerful can also involve *terrorism* on the part of the weak. Conflict amongst the weak, on the other hand, consists in competition with one's neighbours over jobs and property, or fighting strangers in war.

The greater the power gap between the strong and the weak, and the greater the population pressure, the greater the likelihood of all three kinds of conflict. Population pressure clearly increases conflict between the weak and the powerful, and is easily understood to play a role in conflict amongst the weak in the event that the property allowed them by the powerful is too small for healthy procreation, or is perceived as such. In the case of conflict amongst the powerful, the greater a man's power, the greater the likelihood that he will attack somebody else to further increase it, since already being powerful he may believe his chances of winning are good. But the experience of population pressure in his own nation will give him an added incentive to act. Also, having an advantage in weaponry almost always leads those seeking military power to attack weaker parties.

The population pressure that exacerbates conflict may be caused e.g. by a diminishing surplus, as may be manifest in economic decline. In the case of war, even if the potentially warring group lacks a surplus, the powerful can often still scrape together what is required to outfit and feed an army by taking (more) resources from the weak, e.g. by increasing taxes – of course in such a case the army would not be as large or strong. Decreasing per capita property in a population leads individuals to attempt to avoid losing their own property and/or to obtain property from others, the result being conflict – a conflict in which the powerful will have an advantage over the weak. More generally, however, all

increases in mortal conflict amongst humans may be seen as being the result of population pressure combined with the availability of weapons, and will tend to check population size – whether effectively or not. Decreases in mortal conflict, on the other hand, may be seen as resulting from the greater order required for political leaders to have soldiers, and capitalists to have cheap labour.

According to Abernethy, though the underlying cause of much domestic and international conflict is rapid population growth, violent upheavals are often reported as class, ethnic and religious conflicts because regions and societies fracture along these lines, while reports of political and social stresses and associated individual pathology often omit mention of the causal role of rapid population growth.[435] To this it may be added that these different conflicting groups stem from what were originally different tribes.

Note however that, as is implied above, population growth, economic decline and so on, while increasing the likelihood or extent of human conflict, are not *necessary* to it; such conflict should be expected even in the case of a population in equilibrium with its surroundings, it being an expression of our territorial instinct, which, other things being equal, should check the size of the population *before* overpopulation develops.

Laws; crime

According to Jean-Jacques Rousseau, whose view here is partly in keeping with the VCP, once men begin to claim possessions, the inequality of their talents and skills leads to an inequality of fortunes (the rich get richer, and the poor …). Wealth enables some men to enslave others; and the very idea of possession excites men's passions and provokes conflict. This, according to Rousseau, leads in turn to a demand for a system of *law* to impose order and tranquillity (countering entropy). The rich (note: not primarily the militarily powerful, who have *weapons* to defend their property) especially voice this demand, for while the state of violence threatens everyone's life, it is worse for the rich because it threatens their possessions as well. Hence, in keeping with Hobbes, the agreement among men to live under a political system.

> Such was, or may have been, the origin of civil society and laws, which gave new fetters to the poor, and new powers to the rich; which destroyed natural liberty for ever, fixed for all time the law of property and inequality, transformed shrewd usurpation into settled right, and, to benefit a few ambitious persons, subjected the whole of the human race thenceforth to labour, servitude and wretchedness.[436]

Further according to Rousseau, the effect of the establishment of political societies is to both institutionalise and increase inequalities; and the

establishment of such things as property rights and titles of nobility sets the seal of law on inequality.[437]

Note here the relation between laws and the individual/group territory distinction. Laws are maintained *within* the group's territory – they are *intra*tribal or *domestic* – and are fundamentally an economic and not a political concern. (There are no laws against waging war.) They pertain to the property of *individuals*, and serve to strengthen the hierarchy within the community.

A view similar to Rousseau's was expressed already in ancient Greece, e.g. by Plato, where he has Thrasymachus say: "I affirm that the just is nothing other than the advantage of the stronger,"[438] a position Socrates tries to undermine. And in Hesiod's *Theogony* Zeus overcomes his elders and rivals by sheer force, which Hesiod for his part clearly considers to be quite acceptable.

While we here accept these views as adequate characterisations of the nature of social organisation, I suggest that in a complex society laws might very well be to the advantage of the weak as well, at least in the short term. Since it is to the benefit of the powerful that there exist numerous weak to labour and fight for them, laws protecting the position of the powerful will also see to it that the position of the weak, including their ability to raise offspring, is also protected. Thus there are two sides to the coin when it comes to the role of laws in society. (Cf. *Pax Romana*.)

Also when it comes to social organisation, in a small society of the hunter-gatherer-type moral action, i.e. action benefiting the group at the expense of the individual and/or his or her family, can be directly reinforced, due to everyone's being intimately acquainted with everyone else. But in larger societies, where the members do not know most of their fellows, the shame, guilt and pride felt vis-à-vis others becomes greatly lessened. The feelings one has for the other members of society who are strangers moves in the direction of the feelings one has towards strangers in hunter-gatherer societies, where they belong to other tribes, which places them immediately under suspicion. And this feeling is strengthened in the event that the stranger can be *seen* to be of another culture. Thus laws enforced by paid police provide the function in society of maintaining peace where there otherwise would be a return to tribal groupings and armed fighting among them. Society would still be organised, but into smaller states with or without an overordinate political power. It is to be noted that *economics* requires the existence of such a power (cf. Hobbes).

Nevertheless, the basic function of the laws is to maintain the status quo, and most particularly the positions of the powerful. Thus in a broader perspective it may well be the case that the laws themselves are unjust. As Jeffrey Reiman says, a criminal justice system is a means to protect the social order, and it can be no more just than the order it protects. A law against theft may be

enforced with an even and just hand. But if it protects an unjust distribution of property, the result is *injustice evenly enforced*.[439]

Revolt, terrorism and revolution

Given humans' territorial instincts, it is natural that there be conflict not only between classes, but within them. As regards conflict between classes, the almost total lack of power on the part of the weakest of the weak means that their access to significant weapons will be minimal, as will therefore the military threat they pose to the higher class or classes.

The basis of the conflict between the poor and the rich is the rich's taking more from the poor than the poor can tolerate, i.e. the creation of a situation amongst them in which a scarcity of vital resources is the norm ("Let them eat cake"). And this, as noted above, is more likely to occur in times of economic recession. In such a situation, as emphasised by Joseph Tainter, the marginal returns to energy expended will be constantly decreasing, and population pressure will be more severely felt. Thus, when the marginal cost of participating in a complex society becomes too high, productive units across the economic spectrum passively or actively increase their resistance to the demands of the hierarchy, or overtly attempt to break away.[440]

Through the weak's experience of increasing desperation, what was originally a relatively benign form of conflict can thus escalate into one of rebellion. As regards social revolt, as long as the weak experience their lives as worth living, in that they have food, shelter, and can raise a family, they are not likely to rebel. When families of the weak are threatened, however, as in the case of famine, their dissatisfaction with their lot increases. The size of the threat this constitutes to the powerful minority is not dependent so much on the numbers of the weak as on their access to meaningful weapons, which also plays a role in whether they actually go so far as to rebel. When the weapons at the disposal of the rebels are less effective, then of course their number and the number of people who bear them become more relevant. In keeping with what has been noted by Tainter, the willingness of strong groups other than the one being threatened to provide the weak with arms is often vital in this context. Such weapons will not be provided by other strong parties for humanitarian or egalitarian reasons, however, but only if it is thought that their use will improve their own political position – or that their sale will provide a profit.

Terrorism can be seen as an extension of the above. Since in modern times the weapons available to the weak are not such that they could win an all-out military conflict with the powerful – with or without the support of other powerful groups – they can still inflict notable or even grievous harm by making isolated attacks on particular places. The likelihood of this sort of revolt increases as the vicious circle turns, its development being largely due to improvements in

military technology. It has meant that highly lethal weapons can be operated by but a few, unlike in the days of the Bastille. Note, however, that each terrorist group has a leader who, in having control of the group, is himself powerful. Thus in some cases terrorism may be seen more as a conflict amongst the powerful, the leader of the terrorists being a sort of Robin Hood.

Another reason terrorism becomes more likely as the vicious circle turns is that, as intimated above, constant technological development leads to a centralisation of services, such as defence, business and energy transformation. This makes the society as a whole, and the powerful who own these services, more vulnerable to attack, since one well-placed blow could paralyse them; and terrorists could take advantage of this fact. Also, at the same time as the wealth-gap between the rich and the poor constantly increases, the population of the poor grows both in absolute terms and relative to that of the rich, which means a constant reduction in the relative size of the territory available to them.

Revolt or rebellion is an attempt on the part of the weak to wrest property (territory) from the powerful, with the use of whatever military technology they can get their hands on. If the weapons employed by the weak are on the whole superior to those of the powerful, the revolt may end in a *revolution*. While revolution may lead to a more equitable distribution of power and wealth, the effect will only be temporary, since the sexual territorial instinct increasing the distance between the powerful and the weak is always operative. Thus some of the weak who benefit from the revolution eventually become as powerful as those the revolution deposed, while the power of others does not increase at all – the *Animal Farm* syndrome – and thus we have the 'necessity' of continual revolution.

As suggested by Georgescu-Roegen,[441] Marx and Engels admitted that all social movements up until the time of their writing (1848) had been accomplished by minorities for the benefit of minorities. They, of course, believed and preached that the Communist revolution would be an exception to this rule. By now, we know that it is not: a new privileged class crystallises under every communist regime. As Milovan Djilas says regarding the Communist system: "The new class may be said to be made up of those who have special privileges and economic preference because of the administrative monopoly they hold."[442] Georgescu-Roegen adds:

> For a few glaring examples from some countries leaning heavily toward socialism: in Indonesia scores of luxurious villas have been built in the most attractive spots for the use of the *president*, who cannot visit them all during one year; in Bombay, scarce though the medical resources are all over India, the best-equipped clinic has been earmarked by … law for the *exclusive* use of the families of the members of the local government and legislature.[443]

> [T]here is absolutely nothing in the constitution of the average man that could make him not wish to be the king. And the question is why he should be a rickshaw man and not the king.
>
> [I]n the future as in the past, human society will pass from the control of one elite to another and … each elite will have to influence not the genotypes of people, but their beliefs, with the aid of a seemingly different, yet basically homologous, mythology.

And he continues, that only in the late twilight of the human species, when human society will very likely disintegrate into small packs of people, will the social factors which produce the circulation of elites fade away too. Class conflict, therefore, will not be choked forever if one of its phases – say, that where the captains of industry, commerce and banking claim their income in the name of private property – is dissolved. Nor is there any reason to justify the belief that social and political evolution will come to an end with the next system, whatever that system may be.

War

War, like virtually any form of male–male violence in human society, stems from the instinctual basis of human territoriality.[444] To this it may be added however that war is in particular a manifestation of *group* territoriality, i.e. stems from the *social* instincts. As succinctly put by Keeley, war is a method, derived directly from hunting, for getting from one group what another group lacks and cannot peacefully obtain.[445] That the basis of war lies in group territoriality means that it is fostered not only by the powerful few – the group leaders – but also by the fit weak, whose social instincts include protecting their group. As a result of these social instincts, as described by Diamond, humans have always practised a dual standard of behaviour: strong inhibitions about killing one of 'us,' and a green light to killing one of 'them.'[446] Note too how war itself reinforces group solidarity, as evinced by the big cheer that often goes up on the part of the populace when its nation goes to war.

That war has a karyotypic basis means that the impulses that give rise to it may be modified, but not eradicated.[447] But this leaves open the question as to the *extent* they may be modified. If we follow Russell and Russell in seeing human violence as directly related to crowding-induced stress incumbent on overpopulation (or population pressure; note that the idea that overpopulation leads to war is at least as old as Plato),[448] we could imagine that territorial instinct that gives rise to war might manifest itself in a non-lethal form of conflict, such as when nations compete at sporting events. Such thoughts are highly speculative, however, for the general trend in our species' development has always been towards increasing population pressure; and as regards

our past we have little to go on apart from our knowledge of modern hunter-gatherers and the skeletal remains of Palaeolithic peoples (which tell us, among other things, that a lot more killing went on amongst them).

Distinct from social revolt, not only does war involve conflict between different *states* or *nations* (cf. Rousseau: "War, then, is not a relation between men, but between states; in war individuals are enemies wholly by chance, not as men, not even as citizens, but only as soldiers; not as members of their country, but only as its defenders. In a word, a state can have as an enemy only another state, not men."),[449] but it also typically involves conflict amongst the *powerful*, rather than between the powerful and the weak, or the weak and the weak. (Cf. Quincy Wright: War implies a struggle between equals.)[450] According to Schumacher, the wealth of the rich in the modern world depends on making inordinately large demands on limited world resources, and thus puts them on an unavoidable collision course – not primarily with the poor (who are weak and defenceless) but with others who are rich.[451]

Part of what makes a rebellion a rebellion, and a revolution a revolution, is that the weak occupy the same geographical territory as do the powerful against whom they are rebelling. War, on the other hand, typically takes place in situations where one powerful individual (or individuals) rules over a group territory different from that ruled over by another individual, and at the same time believes himself to possess a military strength superior to that of the other. The winning of a war, then, will decrease the territory and thus power of the loser, and increase that of the winner, including his wealth, if the war hasn't been too costly.

The attacks of the Mongols and Turkic peoples against sedentary peoples, while constituting war in being between different states (or nations and states) as well as between powerful men, are nevertheless similar to revolts in being uprisings on the part of the poor against the rich.

Further by way of distinguishing war and revolt or rebellion, it may be said that war involves *armies* in a situation in which the leaders are powerful and the soldiers weak, and in which there must be *provisions* for *campaigns*. Thus the waging of war, as noted earlier, is dependent on the existence of a surplus, to feed, clothe and arm the non-productive soldiers.

Apart from having a larger army, as mentioned earlier, a second factor that will improve a ruler's odds when it comes to winning a war is his army's having weapons superior to those of his opponent's army. We thus see that the territoriality of rulers also spurs innovation in weapon technology. A smaller army can defeat a larger one if it has superior weapons. More important than its particular weapons, however, is their potential total effect, which would normally depend on their number and the existence of soldiers to wield them. But as weapon technology advances and weapons become more destructive, it may be expected that the need for large armies will decline, just as, with the development of

machinery, the need for a large labour force in industry should decline. This development however will be to a disadvantage in the case of guerrilla warfare.

Feuding and protowar

Major conflicts between groups of humans that involve killing but not armies may be termed *protowars*, and may be considered to involve *skirmishes* between armed *warriors* of different *tribes* in *protoarmies* the leaders of which are *chiefs*, rather than *battles* between armed *soldiers* of different *nations/states* in *armies* the leaders of which are *generals*. Protowars are typically related to the relieving of *vital* rather than non-vital needs. Where many warriors of a particular tribe are closely genetically related or have known each other all their lives, thereby constituting something like an 'army of lovers,'[452] soldiers are almost always (to begin with) strangers to their fellows. And it may be noted that already in the case of protowar, success is supported by population growth in the community, as is, due to population pressure, the extent to which the group engages in such conflict.

We should also here make explicit the distinction between protowar and *feuding*, i.e. prolonged *intra*societal conflict between families, bands or clans. Feuding, protowar and war all have their phylogenetic basis in the sexual instincts and the fight over females and/or individual territory, the connection being strongest in the case of feuding and weakest in the case of war. Feuding occurs mainly in primitive groups and involves blood-revenge; and, as intimated in Chapter 2, the fighting that sets it off is often over women (adultery, rape, wife-stealing), which may be seen as being at least partly a result of their relative scarcity due to female infanticide.[453]

Armed conflict as a population check

Stanislav Andreski depicts civil disturbance and war as 'alternative releases of population pressure, as they are alternative methods of organising emigration to the hereafter.' Russell and Russell concur, suggesting that war is a response to experienced population pressure in each of the contending countries. According to them, the reason violence exists both at the level of the individual and the whole society is ultimately as a means for reducing the size of the population when confronted with population crises. (And they also agree with Andreski that the limiting of population growth, and a determined attempt to bring the majority of the population of the world out of its present condition of misery, offer the best hope of abolishing war.)[454]

Other things being equal, the use of weapons by humans should reinforce intraspecific conflict as a form of population check, particularly in a situation of experienced population pressure.[455] But other things are not equal. The need of the powerful to have large armies – and in the case of business, a large labour

market – together with the continual presence of a surplus, has meant that the human population has to date continued to grow despite armed conflict.

As regards different sorts of conflict functioning as population checks, *armed revolution* constitutes a check which is internal to a society; *terrorism* may or may not do so, but generally takes relatively few lives; and *war*, which is *between* societies, tends to check the sizes of the populations of both. All three, particularly indirectly through their effect on female fertility, are cultural checks to the growth of the total human population.

In Chapter 2 *warfare* was considered as a possible check to the growth of human populations, not only through the direct killing of men on the battlefield, but also through the female infanticide that can be practised by warring societies. (The population-curbing effect of female infanticide is greater than the death of men in battle, since, as taken up earlier, any number of females can be impregnated by the same male.) And a further population check associated with war is the aforementioned starvation and disease that usually accompany it. Normally, the crowded and unsanitary conditions of warfare breed infectious diseases which kill many more people, civilians as well as soldiers, than does actual fighting.[456] And the almost invariable period of starvation in the state that has just lost the conflict further increases mortality amongst women as well as men. According to Moran, warfare is the cultural price that must be paid to keep these mechanisms of population control operative.[457]

Not only does political leaders' drive to acquire power lead to population growth, but that growth itself becomes an excuse for acquiring more power. As expressed by Harold Cox:

> As soon as a population grows big, its leaders say: 'Our people are so numerous we must fight for more space.' As soon as war has taken place, the leaders invert this appeal, and say: 'We must breed more people in preparation for the next war.'

And as Cox further says, human beings would never hesitate to kill one another when, as a result of population pressure, they find that war is the only alternative to starvation.[458]

As regards the function of armed conflict in its capacity to counter the VCP, it should be pointed out that in the broader perspective it actually speeds up its operation. Not only does war, more than anything else, promote technological innovation, but the destruction it wreaks requires taking more from the environment to replace what has been destroyed. As Russell and Russell say regarding human violence generally, it can no longer serve the fundamental function for which it was evolved in animals – the conservation of the natural resources of a species. On the contrary, it does the exact opposite, destroying resources on which the species must depend in the future. This means too that selection

for power favours those who exploit nature and discards those who revere it. In keeping with C. G. Darwin's conception, a society that exploits its resources quickly accrues more power than a similarly based society that husbands its resources and protects its environment. The resource-exploitative society may then overpower the more nature-protective society and seize its resources for additional quick exploitation.[459]

Cultural development

As expressed by Torsten Malmberg, human beings can become adapted to almost anything – polluted air, treeless avenues, starless skies, the rat race of overly competitive societies, even life in concentration camps.[460] This adaptation is accompanied by genetic change. The fundamental determinants of human behaviour, on the other hand, have their biological basis in the human karyotype, not in individual genes. Thus human adaptability, whether it be on the part of groups or individuals, takes place within the limits set by our instincts.[461] In fact, since the human tendency to quick adaptation has its basis in our karyotype, it may itself be considered instinctual. It is to be kept in mind that since we modern humans came into existence some 200,000 years ago, our karyotype has remained the same, while our individual genotypes and cultures have changed.

The adaptability of human *groups* – not as pronounced as that of individuals but having a greater influence on the species – is manifest in changes in their *social organisation* (changes of social *system*), particular populations adopting particular cultures ultimately because those cultures in some way tend to support the continuing short-term existence of the population.[462] As expressed by Lorenz, natural selection determines the evolution of cultures in the same manner as it does that of species.[463] Though our species' karyotype remains constant, it allows for genetic change capable of producing a wide spectrum of behaviour. Note that this is not the same as simply allowing a great deal of genetic change; dogs, for example, are capable of more genetic change than we are – and might therefore be more adaptable as a species in the long term. But we are more intelligent, i.e. adaptable in the short term. In having culture humans have *exosomatic* means of adaptation, means which are being called upon to a constantly greater extent as our impact on our surroundings increases.[464]

The most important of cultural changes are those related to the economy, for it is only with a functioning economy that individuals can survive and reproduce and the species thereby continue to exist. As expressed by Wilkinson: "If the demands which basic production imposes on society change, then the rest of the cultural system will have to change to meet them." And, as he continues: "Most fundamental within the adaptive context is a society's technology." Thus in the case of humans we have a situation where the survival of the

species is dependent on the adaptability of human culture, where cultural and genetic change are dynamically related.[465] And where on the micro level the *continuity* of human group behaviour stems from the constancy of the human karyotype and the transmission of gene types, on the macro level it stems from human culture, or, more particularly, from the maintenance of *traditions*. As expressed by Georgescu-Roegen, it is the role of tradition to transmit knowledge as well as propensities from one generation to another.[466]

As Wilkinson points out, our capacity to produce culture provides us with a means – much greater than that available to other animals – of exploiting different ecological niches, suggesting that in biological terms cultural change is nothing other than the adoption of a new niche. When people change the source of food and raw materials they depend on, when they find ways of increasing their resistance to diseases and parasites, or develop forms of protection against inclement climatic and geographic conditions, then they may be said to have changed their ecological niche. The adaptive function of culture is its *raison d'être*.[467] Just as living creatures have evolved over time to fill particular environmental niches, so have human societies.

While it is true that culture is a particularly efficient adaptive mechanism, it is nevertheless too slow to react to the changes in the environment it itself produced the previous time it made an adaptive move. Each cultural (economic) adaptation has repercussions necessitating a new adaptation, and this at an accelerating rate. Cultural change generally, like technological development specifically, is an adaptive mechanism that undermines the preconditions for its own functioning.

Luxury goods and leisure; art and architecture; philosophy and science

The increasing complexity of society means that the needs of the powerful also increase in complexity, and come to include not just vital needs but non-vital ones as well. Such needs may be filled by converting vital resources into non-vital, or there may be a 'mining' of non-vital resources directly. Thus given a sufficient surplus of vital resources there may arise the production of *luxury* goods – meeting non-vital and often only imagined needs – over and above the goods necessary for the survival of the population. Such goods may themselves be of a technical nature, as are e.g. the aforementioned mobile phones and pleasure boats, and thereby constitute instances of non-typical technological change, i.e. technological change that does not support the maintenance or growth of the population.

Leisure too, or the potential for leisure, will also be greater the greater one's power. Where in hunter-gatherer societies everyone had ample leisure, with the turning of the vicious circle and the more marked stratification of society, leisure becomes available only to those of the upper strata. This leisure had by the powerful, in combination with the human tendency to innovate, has given

rise to the arts and philosophy. And, in combination with constantly increasing technological know-how, it has allowed for their expression and development e.g. in the form of monumental architecture and science. Thus, on the VCP, with its strong biological-ecological orientation, the arts and sciences are an 'emergent property' of the basic dynamics of our species' development – they could be seen as a side-effect.[468] The existence of both is dependent on the existence of a surplus. In the case of modern science, however, as expected already by Francis Bacon, some of the results of the search for knowledge and understanding of the physical world have been channelled back into the productive effort – particularly that of the military – thereby speeding up the course of the vicious circle. (Cf. Ellul: "Science is becoming more and more subordinate to the search for technical application.")

Medicine

From the point of view of the VCP, medicine is a typical technological development which has the potential to improve the life-situation of the existing generation while worsening that of posterity – for example by making it possible for biologically less fit individuals to procreate, thereby weakening the human strain and making humans dependent on medical technology for their existence. (Cf. the state of health of the !Kung and the Hadza.) It is only in recent years however that the development of medicine has meant an increase in what is taken from the environment, through the building of hospitals and the development of complex diagnostic and treatment apparatus. And where originally medicine was available to everyone, as the vicious circle turns and medicine becomes more sophisticated it increasingly becomes available only to the powerful.

Economic growth

The surplus of consumables resulting from the new use of technology may be, and in modern times virtually always is, put on a market, thereby giving rise to trade, or, in the case of ongoing trade, giving rise to an increase in trade, i.e. exchange of capital. The notion of economic growth is often thought to apply to such an increase, but we shall adopt another common line which has been assumed earlier and is here more to the point, namely that of seeing economic growth as consisting in *an increase in the quantity of consumables*. Thus, for example, the invention of the bow and arrow resulted in economic growth in this sense, for its use originally led to an increase in the quantity of meat obtained – meat being a consumable but not a *commodity* in the non-trading economies of hunter-gatherers.

Note that economic growth in the context of trading is dependent on the existence of a surplus that can be traded,[469] and furthermore that economic growth speeds up the diminution of that surplus, the greater the rate of growth,

the more quickly the surplus is used up. If the surplus is sufficiently great, and of the right sort, economic growth will not only involve an increase in the production of goods, but an increase in other activities as well, such as those related to distributing the goods. The *social* phenomenon of *economic growth* is, thanks to the principle of the conservation of matter, nothing other than the *physical* phenomenon of *increasing resource depletion*. And here, rather than in our prehistory, do we have the expression of the entrepreneurial spirit: to obtain, by means of business, as much of the present surplus as possible. This spirit will lead to such enterprises as the improvement or building of roads and other transportation systems, and the building of dwellings, all of these things constituting consumables/commodities, and all of them providing capitalists with a profit.

As Schumacher points out, though economic growth as seen in the context of economics, physics, chemistry and technology has no discernible limit, it must run into bottlenecks when viewed from the point of view of the environmental sciences,[470] and thus must do so in reality. Economic growth, like technological development and the turning of the vicious circle more generally, will stop when the surplus on which it is dependent no longer exists, or the waste it produces can no longer be disposed of. Seen as a system, it lacks internal checks to its own expansion. In this way it is similar not only to technology but to the biosphere. But unlike the biosphere, which simply stops growing, at the end of a period of economic growth there tends to be a period of economic collapse, due to the over-exploitation of resources supporting the growth.

The orientation to economics which suggests a positive value in economic growth (but which does not take account of its requiring a surplus) goes back at least to Hobbes' social contract theory. Hobbes' basic orientation involved the application of Greek atomistic thinking and its notion of perpetual motion to social phenomena.[471] Having constructed a system which would purportedly explain humans' motions relative to one another, his aim was then to deduce what kind of government they would have to have to enable them to *maximise* that motion.[472]

And Adam Smith, for his part, suggests in a similar vein that:

> It is in the progressive state, while the society is advancing to the further acquisition, rather than when it has acquired its full complement of riches, that the condition of the labouring poor, of the great body of people, seems to be the happiest and the most comfortable. It is hard in the stationary, and miserable in the declining state. The progressive state is in reality the cheerful and the hearty state to all the different orders of the society. The stationary is dull; the declining melancholy.

Of course technological development may mean, and has meant in the past, the creation of a new surplus; but the amount that can be taken from the environment is finite, and growth will end when it can no longer be taken in increasing quantities. Furthermore, the dependence of growth on non-renewables means that its end will be more abrupt than otherwise. For an economic system to be sustainable, it must involve as an integral element only the use of renewable resources that in fact are being renewed. In any case, economic growth cannot continue indefinitely, and, whether or not it involves the use of non-renewables, it directly detracts from a society's becoming sustainable.[473]

Decreased security

Increased centralisation and trade, and the destructive power of weapons, all lead to decreased security. In the case of trade, trade routes are created on which the society becomes dependent, and with economic growth become more numerous and longer, thus opening the society to attack at many points. As pointed out by James Bonar, dependence on other nations for the first necessity of life is a source of political insecurity to the nation so depending; and, though the dependence is mutual, identity of commercial interests seldom prevents interdependent nations from going to war with one another,[474] economic relations in fact *increasing* the chance of war.[475] Security is further decreased both for the individual and for society with the turning of the vicious circle due to increasing specialisation and technological dependence.

Over-exploitation of resources and population overshoot

Not only does population grow when provided with a surplus, but it grows beyond what the surplus – which is itself dwindling faster than otherwise – can support at the same subsistence level.[476] And, as intimated earlier, culture, as an adaptive mechanism, is too slow to react to such changes. Here we see the impact of the overshoot principle, where in a pioneering situation populations expand beyond the carrying capacity of their environment. This overshoot manifests itself, among other ways, as a lowering of the quality of people's lives, and may well result in a population crisis, with an increase in mortality, and depopulation. During such crises large political units may disintegrate into many smaller ones, at the same time as there are massive famines and the society opens itself to foreign invasion, as was the case e.g. on various occasions in China. Resources are wasted, and previous concerns with art, nature and the past all disappear.[477]

The new, larger, population, in order to avoid this eventuality, thus employs technology it would not otherwise have needed, thereby taking the vicious circle further round its path. So while the quality of people's lives thus tends to

decline at this stage in the turning of the circle, an increase in mortality may be reduced or avoided.

Population overshoot may thus be seen to be potentially of two levels of intensity. On the first level there is a decline in the quality of life; on the second, which may or may not be avoided thanks to economic development, there is an increase in mortality. It is also to be noted that, as the notion is being employed here, overshoot, whether it be of population or the provision of resources, is relative to *short-term* carrying capacity (Glossary).

Diminishing returns and the undermining of technology and human existence

The phenomenon of diminishing returns is the expression of a negative feedback loop of the decreasing kind, and is taken up elsewhere in this book with regard to predation, increasing evolutionary complexity, and economics. When resources are being used in an unsustainable way, as suggested by Carr-Saunders, if there is no technological improvement (if new needs are not met), the returns to the same doses of capital and labour will diminish.[478] However, if there *is* technological improvement, returns can increase. As mentioned earlier, however, more energy is normally required for the operation of new technology than was needed for the operation of old, and in the beginning it provides little more by way of output. Its output then increases as it becomes properly operative – during which process energy expenditure per unit produced may well drop and increasing returns *for the new technology* result – reaching a peak at some point in time. After the peak, diminishing returns set in, mainly because of the increasing energy that must be expended both to obtain the resources on which the technology is dependent as well as – from society's point of view – to get rid of them when they become waste. Eventually the returns become so low that a yet newer form of technology may be introduced, and the cycle repeat itself.

This is the notion of diminishing returns as applied to one turn of the vicious circle. But the whole process involving the turning of the vicious circle can be seen on the same pattern. Technology itself, rather than a new instance of technology, moves through a phase of bringing increasing returns, at the end of which it peaks, and after which there are diminishing returns. I would suggest that in the industrialised countries this peak was during the 1950s and 1960s (see Chapter 6). Note that this is prior to the peak in resource use.

The quality of life of the ordinary person follows this process. It drops when the new technology is first introduced, due to the extra energy (work) needed to operate it. Then, once the new technology is functioning, it tends to rise, only to fall again when returns begin diminishing; and then with the introduction of yet newer technology to drop even further. In the long run the size of the

population increases due to the increase in consumables made available by the new application of technology, while at the same time the diminishing returns from technology produce a situation of experienced population pressure.

Note how this process is dependent on the turning of the vicious circle, with its technological development and non-sustainable use of resources. If resources are used sustainably, the employment of technology needn't mean diminishing returns. We can imagine, for example, the technology of fire being used in a sustainable way, such that it doesn't involve the turning of the vicious circle.

The employment of new technology to obtain a needed resource will first be devoted to obtaining that which is the most easily acquired, and as efforts come to be focused on resources that are more difficult to obtain, it will be found that greater energy is required to do so, with an *overall* decline in returns *and* increasing complexity *as results*. But in this way an increase in the complexity of technology itself can be seen as part of technological (economic) development as a whole, in that more complex forms of technology, which require more energy to develop and employ, will be required to obtain the resources that are beyond the reach of the simpler technology. Thus while the constantly increasing energy required to obtain ever less-accessible resources will in itself mean diminishing returns in relation to energy input, the constantly increasing complexity of the process required to obtain them will exacerbate the problem, and shorten the time before the point of decreasing returns is reached for the currently employed technology. From a systems point of view, however, *all* processes leading to decreasing returns involve an increase in energy expended vis-à-vis the result obtained.

Economic decline

Just as the life of the ordinary person normally follows the rise and fall of returns, so does the growth and shrinking of the economy. Imagine a situation where the employment of a particular technological innovation results in the obtaining of a surplus, either by turning previously unusable resources into reserves, or by increasing the quantity of products given extant reserves. Due at least to the growing human population, that surplus is constantly being eroded, however, and at an increasing rate. As resource consumption increases, a point is reached at which the amount of reserves per capita starts to decline, and returns to economic activity start to diminish. The surplus becomes a deficit, and economic decline sets in. In modern society this may be manifest in rising prices. This depression lasts until and unless the use of new technology begins to create a new surplus (to give rise to increasing returns). Note that such depressions need not be worldwide. In fact, they are occurring all the time in every industry, depending on the particular resource(s) used by that industry.

Here we have an example of the turning of the vicious circle on a small scale, giving rise to the idea of there being a hierarchy of vicious circles in encompassing and overlapping relations.

Such depressions are naturally more severely felt by the poor than the rich, their experienced needs being *vital* (though the absolute and even perhaps proportional decrease in wealth may be greater for the rich). This is particularly so when the lost surplus is that of food. Further, in such times of economic decline, the strong take from the weak whatever they perceive themselves as needing.

Scarcity, need and population reduction

There is both a *momentum* and a *time-delay* in social systems – manifestations of the overshoot principle. The momentum consists in the slowly changing mores inclining people to have the same number of children as their parents, even when it is no longer ecologically reasonable to do so; and the time-delay consists in the fact that, due to the increasing consumption and the consequent reduction in resources, the surplus that existed when the children were conceived may no longer exist when they reach adulthood. In any case, the end result, if new technology is not employed earlier, is the return to a situation of *scarcity*, and possible population reduction.

Conclusion

The theory of *Homo sapiens'* development based on the vicious circle principle, which itself presupposes the fundamental principles of modern science, unifies and makes understandable the new views in anthropology, archaeology and economics presented in Chapter 2. It suggests technological development to be essentially a reaction to population pressure, as is in keeping with Cohen's view of the horticultural revolution and Wilkinson's theory of economic development. And on the vicious circle principle population growth can just as well push technological development as be the result of it, the former idea being advocated by Boserup and Wilkinson.

Thus on the present theory the essence of technological change, looked upon as *progressive* on the traditional, Western perspective, is seen as actually being *regressive* when it comes to the long-term existence of the human species, since its employment undermines the preconditions for our survival – as is partly exemplified in the phenomenon of prehistoric overkill.

In the next chapter the correctness of our theory will be demonstrated through its application to the whole of the development of humankind. Given its correctness, this application will also serve to reveal the dependence of that development on the operation of the vicious circle principle.