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Getting the Measure of Sustainability

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Essay 4

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Abstract

The paper begins with a brief sketch of the environmental disorders, economic, moral and ecological, for which sustainability is perceived to afford a remedy. An understanding of sustainability as the maintaining of human welfare is first briefly sketched and criticised before the more robust notion is introduced, requiring a non-declining capacity, along with its two variants, 'weak' and 'strong', the latter requiring a non-declining level of natural capital. It is argued that even if sustainability requires some minimum or 'critical' level of natural capital, reasons given for maintaining existing levels are unconv7incing. It is further argued that even if there were reasons for maintaining some minimum or 'critical' level, it is unclear how we should measure this level or what would count as its being 'maintained'. In particular it is argued that changes in the level of natural capital need bear little relation to what is ordinarily thought of as environmental degradation, which is one of the problems which sustainability was introduced to address. Finally, it is suggested that in view of the problems outlined, we might do worse than abandon the attempt to track natural capital, whether this is understood in a purely economic sense or in terms of a broader notion of environmental capacity7, and resort instead to measuring changes in the natural environment by means of an ecological inventory. It is recognised, however, that this approach too is not without its problems.

Keywords: sustainability; natural capital; weak; strong; critical

Introduction

The focus of this essay is the difficulty of formulating the goal of sustainability so that it makes the difference to policy which it is supposed to make. For the emergence of such a goal arose out of the sense that we needed to put a brake on development. Hence, a favoured way of characterising sustainability is to see it as a form of constraint upon the operation of 'business as usual'. Among the particular concerns which pointed to the need for such constraint were the following:

(i) First, there was the belief that the headlong pursuit of development was beginning not to pay economically. Hidden 'costs' were beginning to emerge and to haunt us, in the form of extensive pollution, exhausted resources and untoward impacts upon climate, life-forms and life-sustaining systems generally. It appeared that sheer economic *efficiency* required that these previously hidden environmental costs should be taken into account, which in turn suggested that all development proposals should be subjected to a 'sustainability' test.

(ii) Second, there was a growing belief that unrestrained development was indefensible morally.[1] In a world in which natural resources were supposed to be unlimited, this dimension of concern did not arise. But as soon as the idea took hold that there are biological and ecological limits, and that the expansion of the human niche could not be continued indefinitely, then the question arose of how we should discharge our responsibilities to future generations. Sustainability, understood according to the classic Brundtland formulation, as the requirement that e should leave future generations the wherewithal to meet their needs, has been thought to supply the answer.

(iii) Finally, there was the belief that the costs of unrestrained development were unacceptable ecologically.[2] This sense of loss first stirred, albeit only in particular cultural settings, during the eighteenth and nineteenth centuries both as a strand in the 'romantic movement' and, more practically, in the formation of societies devoted to protecting features of he natural environment. It has culminated most recently in current concerns over the loss of biodiversity, and the particular concern that rates of extinction are overtaking rates of speciation. Once again, people have looked to sustainability, understood now to incorporate an ecological dimension, as the goal towards which social and economic policy should be directed.

Which of these several concerns has in practice been uppermost in fuelling the call for constraints is hard to say. Certainly there is no doubting the elegant theoretical appeal of a concept – sustainability – which promises to address all three concerns at a stroke. But at the same time it is as well to be aware of the different sources of concern which it attempts to address, inasmuch as each is likely to put its own particular slant on the requirements of sustainability, and may well issue, therefore, in different ideas about how to make that concept operational. Furthermore, the existence of these different sources of concern poses the question of how far it is reasonable to expect a single concept to supply the looked for solutions.

The critical analysis which follows is offered on the premise that pursuit of sustainability in practice is at least supposed to 'make a difference' – to constitute a departure from 'business as usual', and out of a concern that certain ways of approaching the concept which are intended to achieve this aim may not in fact do so. As it happens, not everyone believes that we can do any better than operate a system of 'business as usual'. Others believe that we can do better, but that sustainability is not in fact a way of doing things better. Neither of these two groups of opinion need be perturbed or even surprised by the analysis which is offered.

Sustainability as non-declining welfare

It is likely to be some combination of the economic and moral concerns referred to above which produces a version of the doctrine of sustainability expressed in terms of human welfare. Specifically, it says that we should aim to replace current practices and institutions with ones which promise to maintain a certain level of human welfare indefinitely.

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[1] For ease of exposition I am adopting, but not endorsing, a narrowly anthropocentric notion of 'morality'.

[2] For anyone with a non-anthropocentric perspective, this is also of course a moral concern.

There are at least two initial problems with this approach. One is that the economic and the moral considerations in question might pull in different directions. For example, within a given economy it is in principle possible that gross national product, however measured, could be maximised by the introduction of a system of slavery, which would (or could) be morally unacceptable. If we transpose this idea to the inter-temporal dimension, the analogue would be that of several generations undergoing extreme hardship for the sake of the people who come after. This, after all, is not so unlike the ideology which informed the Stalinist regime in Russia (Deutscher 1966, 296). Conversely, the people who come after might be the ones who undergo the hardship, being born at the fag end of a process which nevertheless delivers a higher level of welfare overall than any alternative. The second problem is that even if we focus on the moral dimension only, not everyone's moral sensitivities would lead them to advocate a policy designed to achieve a constant level of welfare over time. Wilfred Beckerman, for example, sees nothing morally commendable about the even distribution of welfare over time, if some other pattern of distribution would in fact achieve greater overall welfare (Beckerman 1994).

Even if these two problems are set on one side, there are severe and probably insuperable practical difficulties surrounding any attempt to provide for a certain level of welfare throughout a given population. Chiefly, the point is that actual welfare, or happiness, is a function of a number of circumstances which cannot realistically be anticipated or provided for - such as: individual psychological disposition; cultural circumstances, including perceptions of relative levels of welfare; and unforeseeable events. These difficulties are serious enough when it is the welfare of current people which is under consideration; they are compounded when the attempt is being made to provide for the welfare of future people.

One response to this difficulty is to distinguish between a more, and a less, ambitious aim. The more ambitious aim would be to bring about equality of welfare over time in the most inclusive sense- that is to say, taking account not only of material welfare but also moral and 'spiritual' welfare and the satisfaction of people's ideals and aspirations, all of which contribute to their sense of whether they are living a 'worthwhile life'. The less ambitious aim would be to bring about the evenhanded satisfaction of needs. It might be conceded that the former aim is unrealistic; but it might be claimed that the latter aim, at any rate, is no more unrealisable than is normal in human affairs.

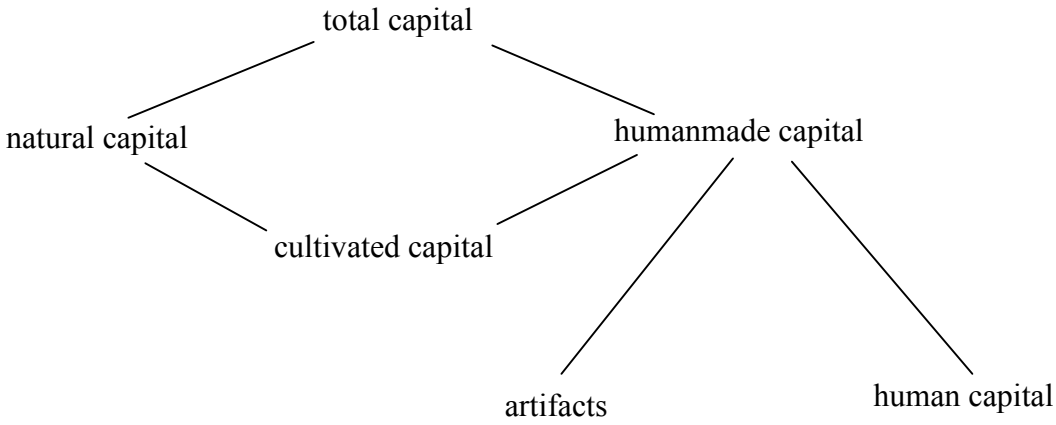
Certainly this response would serve to mitigate the difficulty; but it is arguable that it still underestimates the extent to which even the satisfaction of needs is conditional upon the economic, social and political conditions which obtain. The result is that any arrangement put in place which is designed to provide for the more equitable satisfaction of needs is still conditional, and in particular is hostage to the institutions prevailing at the time.

Sustainability as non-declining capacity

It is perhaps in recognition of the sorts of difficulties just outlined that one more commonly finds the goal of sustainability explained as the attempt to maintain 'capital' - by which is meant the attempt to maintain for people over time the wherewithal, or the means, to provide for their own welfare. So, we find Kerry Turner and David Pearce claiming that the conditions for achieving sustainability involve "leaving the next generation with a stock of capital assets that provide them with the *capability* to generate at least as much development as is achieved by this generation". Hence sustainability comes to be elucidated as the attempt to maintain a non-declining level of capital.

The aggregate of the different kinds of capital is usually referred to as 'total capital' - namely the sum total of resources capable of contributing to human welfare. Included in this 'genus'

are several 'species' or 'varieties'. The two main 'species' of capital usually distinguished are 'natural capital' and 'humanmade capital' (Pearce 1989,34-37). A representative view of natural capital is provided by Tony Clayton: "The phrase 'natural capital' is used to refer to those aspects of nature - minerals, biological yield potential, pollution absorption capacity etc., that are utilised or are potentially utilisable in human social and economic systems" (Clayton 1991,14). Humanmade capital comprises both artifacts, such as factories, buildings and machinery, and also human capital - the knowledge, skills and habits needed to realise the value of both natural and other humanmade capital. An important kind of capital straddling these two is 'cultivated capital' - roughly, the total of cultivated plants and domesticated animals, together with their very considerable effects – rasslands, for example. For the purpose of this discussion, we shall assume the following 'taxonomy':



Two versions of this approach to sustainability have emerged in recent discussions - so-called 'weak sustainability' and 'strong sustainability'. Proponents of weak sustainability are said to advocate policies devoted to securing a non-declining level of total capital. Proponents of strong sustainability are said to advocate policies devoted to securing a non-declining level of natural capital in particular. However, it is far from clear that there are two positions here to be distinguished. For, as long as the value yielded by the capital in question is understood in an anthropocentric way, as tends to be true under 'neo-classical' assumptions, the impression given that 'strong' and 'weak' positions somehow differ in principle and, further, that strong sustainability has a specific commitment to sustaining environmental, or 'natural', capital, is in fact quite misleading. For the real difference between the two positions turns out to be no more than a difference about what seems to be a question of fact. Specifically, proponents of weak sustainability are supposed to believe that natural and humanmade capital are indefinitely substitutable; proponents of strong sustainability believe that they are not. Thus, on the one hand, proponents of strong and weak sustainability both advocate the maintaining of a non-declining level of welfare; on this point of principle there is no difference between them. On the other hand, proponents of strong sustainability happen to believe, in addition, that maintaining a non-declining level of natural capital is a necessary condition for achieving this, because they happen to believe that humanmade capital cannot substitute for natural capital. Their attachment to natural capital is therefore entirely contingent upon their belief that its protection is required in order to secure non- declining levels of welfare.

It has been argued elsewhere that the doctrine of substitutability is radically ambiguous and is also by no means the straightforward empirical claim it might seem to be (Holland 1996). But

suppose, for the sake of argument, that there is some straightforward sense in which it is false. What is less often observed (but see Daly 1995) is that the relation can go both ways. For, suppose that there are indeed natural features for which there are no humanmade substitutes. What is no doubt equally true is that there are also humanmade features for which there are no natural substitutes, and probably some for which there are no other humanmade substitutes either. Moreover, there are humanmade substitutes for at least some natural features. For these reasons, given that the overall goal is to maintain the capacity to secure future human welfare, the denial of the doctrine of substitutability does not support the protection of all natural capital nor does it support the protection of only natural capital, because it does not support the protection of natural capital insofar as it is natural, but only insofar as it is 'critical' – by which is meant, again under neo-classical assumptions, 'critical for securing future levels of human welfare'. For, some natural capital is not necessarily critical in this sense; and even a great deal of non-substitutable natural capital is not necessarily critical, because although being substitutable means not being essential, it does not follow, conversely, that not being substitutable means being essential. Furthermore, because of the interdependence of natural and human made capital, it is undoubtedly true that much natural capital is no more critical than much humanmade capital. It has been observed, for example, that with one or two notable exceptions nature never got round to evolving wheels (S.J.Gould 1984[3]), which happen to be critical to many a human enterprise. In fact, you would need to go back to before the time when the human race started to use tools to find a period when at least some humanmade capital was not 'critical'.

But even if sustainability requires that some minimum or 'critical' level of natural capital be maintained, it does not follow from this that existing levels of natural capital should be maintained. It has in fact been argued by Turner and Pearce that there are at least four main reasons why it would not be acceptable to run down environmental assets (i.e. natural capital) in the pursuit of sustainability. They cite: uncertainty; irreversibility; life-support, and loss aversion (Turner & Pearce 1993, 181). However, none of these reasons which they give is entirely convincing.

(i) Uncertainty. The argument is that we do not know the consequences for human well-being of running down natural capital, because we do not know how complex natural ecosystems work. However, uncertainty is a rather frail banner to wave in the face of those who witness human misery now, and think they see ways of alleviating that misery even though it may involve using up natural capital. In other words, we sometimes know that misery will result from not using up natural capital. A second point is that the argument rather assumes that a world in which natural ecosystems were left to their own devices would be more secure. But if the gradual expropriation of natural ecosystems by human made ecosystems really leads to a less secure world, it is unclear why humans have persisted in this project.[4] There is certainly a widespread belief that human life is made more secure thereby; nor is it clear that the belief is unjustified, whether one thinks in terms of the security of the average individual life, or of the human niche as a whole. It is perhaps not sufficiently appreciated how far the fears for human security which underlie the argument from uncertainty stem from the

[3] The two exceptions which Gould records are the bacterium *E. coli* and a single-celled organism that lives in the gut of termites.

[4] It is unclear how far environmentalists can go in explaining such behaviour purely by reference to human 'greed' as distinct from ordinary and understandable attempts to alleviate and ameliorate the human condition.

very same motivations which have led the human race to expropriate so much of the natural world in the first place.[5]

(ii) Irreversibility. It simply is not true that "only natural capital has the attribute of irreversibility" (Turner and Pearce 1993). Nor is it true of all natural capital that its decrease is irreversible. In the first place, it is no more possible to replace a Norman church than to replace an ancient forest. And even if we focus on technological capital, it will often be impossible to reconstruct *its function,* even if the thing itself could be refashioned. In what sense, for example, could the 'capital' represented by a bronze spear in the bronze age be recreated? In the second place, many natural systems have remarkable powers of regeneration. All that can be claimed is that some natural systems are irreplaceable. In fact, the examples of irreversibility which are suggested – species extinction and global warming, seem singularly ill-chosen. For it is far from clear that global temperature could not be lowered by technological means. And while it may be true that species extinction is irreversible, it is not true that the extinction of a species necessarily implies a decrease in natural capital. Natural extinctions, at any rate, have been an integral part of a process - the history of life on earth - in which natural capital may presumably be said to have 'expanded'. And since this is true, it follows that the effects of humanly induced extinctions upon the level of natural capital would each need to be judged on their merits. They do not automatically constitute a decline. The ecological effect of certain species might be to suppress possibilities of speciation which their removal could then release.[6]

(iii) Life-support. It cannot be denied that "some ecological assets serve life support functions". But this is not true of all ecological assets, nor is it even claimed to be true (by Turner and Pearce). So consideration of their Iife-support functions will not constitute a defence of ecological assets (natural capital) as such. As John Lawton succinctly puts it: "The planet can be made to work with rather few rivets" (Lawton 1991,4).

(iv) Loss aversion. It is no doubt true that people "are highly averse to environmental losses". But it can hardly be claimed that this is peculiarly true of *environmental* losses. If it were, why have we already lost so much? Moreover, people are as concerned, sometimes even more so, over the loss of a Norman church or some early cultivated variety of fruit or vegetable, as they are over the loss of many natural features.

To summarise, it turns out that the citation of natural capital in the elucidation of the position referred to as strong sustainability is a red herring. The pursuit of sustainability by no means entails the protection of natural capital as such. Further, although the proponents of this approach claim to capture economic, moral ~ environmental concerns, this also must be

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[5] From this perspective, the pursuit of sustainability understood in this way looks much more like a continuation of 'business as usual' than a departure from it. *By* the same token, hanging on to, or even reintroducing, natural ecosystems, if it is no longer misconstrued as the counsel of 'precaution', can be reconstrued as the more adventurous and risky path and therefore as a departure from the pursuit of security.

[6] There is an additional, conceptual, point which might be worth making here, which is that reversibility is itself – a matter of which end you get hold of a process by. Species extinction is said to be irreversible. But looked at another way, it is simply the manifestation of the reversibility of the process of speciation.

called into question.

The relation between natural capital and welfare

We have seen reason to doubt whether proponents of strong sustainability really do have grounds for maintaining the (existing) level of natural capital as such, even if there may be reason to maintain some level of natural capital. But let us assume, for whatever reasons, that this is thought an important component of any sustainability programme, and let us turn now to problems having to do with measuring the level of natural capital. Since the nature of these problems varies, depending in part upon the way in which natural capital contributes to human welfare, we need first to undertake a brief analysis of the ways in which natural capital may be said to be 'used' or 'utilisable' to provide for human needs and welfare.

Natural capital may be said to deliver welfare in two ways: (a) directly; (b) by being transformed.

a) Natural capital delivers its value directly in a number of different ways, which can be itemised under three headings. First, it can be of value by virtue of its characteristics: for example, it can be beautiful, interesting or symbolic. Second, it can be of value as constituting a special sphere or place of operation: for example by being a 'playground', a 'museum', a 'cathedral' or 'storehouse'. (Notice that the idea of nature as 'storehouse' is every bit as metaphorical as the idea of nature as a 'playground', although this fact tends to escape economists who treat the idea of nature as 'storehouse' as if it were a 'given'.) Finally, it can be of value by virtue of its function: for example by being a 'sink', and by sustaining the conditions under which life is possible, with appropriate mixes of temperature, humidity, atmosphere and suchlike.

b) Natural capital which yields its value by being transformed does so in two ways: one is by providing material for production - so-called 'raw materials'; the other is by providing material for consumption - for food, clothing and shelter.

These two ways in which natural capital may be said to deliver welfare are not necessarily exclusive. For example, a garden results from the modification or transformation of nature, but may then be valued directly – say, for its beauty. On the other hand, these two sources of welfare can often be in competition with each other, so that the realisation of the one kind of value is incompatible with the realisation of the other. For example, maintaining a forest for its yield of timber may well mean sacrificing some of the interest and beauty it would otherwise have. Clearly, this fact is the source of a great many of the environmental conflicts which occur around the world.

Although the distinction is somewhat rough and ready, it nevertheless has important implications for the question of how we go about measuring the 'level' of natural capital; for it points to an important difference in what counts as the *maintaining* of a given level of natural capital. Maintaining natural capital insofar as it is a direct source of welfare is largely a matter of spoiling it. On the other hand, maintaining natural capital insofar as it delivers value by being transformed is largely a matter of not using it in a way that involves using it up.

Some problems of measurement

How, then, are we supposed to measure whether or not the level of natural capital is being maintained? The idea seems to be abroad that we can simply equip natural scientists with

tape measures and ask them to get on with it. Let me attempt to dispel this idea. The measuring of natural capital in particular presents many 'challenges to evaluation'.

(i) First there is the problem that a great deal of the value of natural capital - construed as its value to the human community - is very clearly culturally specific. Consider first some of the kinds of value which natural capital delivers directly, such as beauty, for example. The area of the Yorkshire Dales known as the Three Peaks is today designated an area of outstanding natural beauty; whereas in 1724 Daniel Defoe found it to be a place of "inhospitable terror" (Defoe 1927). Or again, take a simple example of natural capital transformed for consumption. Certain varieties of snails, considered culinary delicacies by the French, are of no value at all in English cuisine. Parsnips, on the other hand, which are something of a delicacy in some English kitchens, are not given house room by the French chef. Such homespun examples may seem a little peripheral, but they point to a general problem for environmental valuation, which is how it is to deal with what philosophers know as 'Cambridge change'. A 'Cambridge change' is a change which something undergoes without changing 'in itself'. For example, if I am fully grown and my younger brother should grow to be taller than I, then I shall have undergone a 'Cambridge change', being first taller than he and then shorter. This is a kind of 'change' to which the value of natural capital, as we are currently understanding this term, must be constantly susceptible, and which presents formidable problems of measurement. What is at least clear is that measuring the level of natural capital, on this way of understanding the term, is not a simple matter of stocktaking to be conducted by natural scientists, but must take into account all sorts of social and cultural factors.

Nor is the problem merely one of prediction. For, in the first place, the fact is that the decisions we take today actually help to shape the tastes, values and even the needs of future generations, thus changing the value that any given environmental item may have. And in the second place, we could actually decide to set about deliberately changing the tastes, values and needs of future generations, and affect the amount of capital available to them in this way. To anyone who professes to find this kind of speculation unreal, I can only suggest that they have not been paying attention to the enormous potential opened up by recent advances in biotechnology, and in particular, genetic engineering. At the very least I am suggesting that if we employ the concept of natural capital as a policy instrument, we need a concept that will serve us in the future and will take account of the likely momentous impact of biotechnology.

ii) The first problem turned on the fact that the value of natural capital, on this 'economic' interpretation, could fluctuate, whilst the natural items themselves underwent little change. Hence, providing the wherewithal to ensure the constancy of such value is much more problematic than it would at first appear to be, and would certainly not be guaranteed by trying to ensure that natural items underwent little change. The problem mainly affects the value which natural capital generates directly. The second problem turns on the fact that the value of natural capital could undergo little change, whilst the natural items themselves were seriously depleted. The reason for this lies in the fact that the value which natural capital can generate by being transformed, whether for production or for consumption, is heavily dependent upon available technology and institutions- in other words, upon manmade and human capital. Thus, this is a problem which affects the second kind of value identified above, the value which natural capital generates by being transformed. Now it is important to see that the issue here is not simply that capital value could apparently be sustained despite what would normally be considered as environmental degradation, or the 'running down' of natural capital, because this would be compensated for by the build-up of manmade capital. The point is that the situation *would not be identified as a 'running down' of natural capital at*

all. On the view under consideration, natural capital does not consist of the actual physical items themselves, the 'physical stock', but the realised or realisable value of that stock. And if more value is realised or realisable from less physical stock, due to technological innovation, then the level of *natural* capital might be held to *remain no lower than it was before.* What this means is that, so long as the character of the manmade capital available serves to make efficient enough use of the physical stock to compensate for environmental depletion, the distinction between weak and strong sustainability will turn out to be a sham. So long as total capital remains the same, then natural capital will be held to have remained the same also. Indeed, given that the GNP of the world economy stands higher than it has ever done before, it is hard to see how an economist can believe there is such a thing as an environmental crisis at all; and some, of course, do not.

Turner and Pearce partly acknowledge these points, but decline to "dwell" on them, pointing out that the increasing capital which might result from more advanced technology will be needed to offset population growth, and that in any case not all technology is benign. However, reliance on contingent empirical claims, together with human incompetence, seems hardly sufficient to justify discounting their effect.

Herman Daly might seem to have an answer to this criticism when he points out that the relation between natural and manmade capital is such that they are complementary *to* each other, not *substitutes for* each other. In outline, his argument is that in former times natural capital was plentiful, whereas manmade capital was in short supply. It therefore made economic sense to use, and even to use up, natural capital in order to build up manmade capital. Nowadays, on the other hand, whereas manmade capital is plentiful, natural capital is in short supply; it no longer makes sense to run it down. Before, there was plenty of fish, but not enough boats; now, there are plenty of boats, but not enough fish. In short, there are now sound *economic* reasons to protect natural capital.

But according to the argument rehearsed previously, this involves a conflation of two different accounts of natural capital. There may be economic reasons to protect the fish, but the fish themselves only count as natural capital on the 'physical stock' view. On the 'economic' view, if modem boats are more efficient at catching the fish, it cannot be said that natural capital is (yet) in short supply. But against this it may be replied (a) that whatever the fish are called, there are economic reasons to protect them which, contrary to the sense of the critique so far, would be welcomed on environmental grounds also; and (b) that natural capital in the economic sense embraces future as well as current utility and that insofar as anticipated yields are lower, there can indeed be said to have been a decline of natural capital in the economic sense. Hence, environmental concerns, and the economic conception of natural capital, are interlinked and can, after all, be held together.

To assess the strength of this response, we need to face up to the question of the status of 'cultivated' capital. The threat to the fish stocks has driven further technological innovation, specifically the enhancing of fish through genetic manipulation. In the light of these developments, it is not clear we can say that anticipated yields are lower; perhaps we have reason to think they will keep pace, and in this sense to be confident that natural capital is being maintained. Moreover, it is far from clear that environmental concerns are met by the assurance that the seas can be stocked with genetically engineered fish and the lands with artificial forests. At the very least, what becomes clear is that the blanket concept of natural capital is unhelpful. It may be that the overall level of natural capital is being maintained by virtue of the new transforming agency, but this will be at the cost, say, of the inspirational value conferred directly by wild nature. If the environmental interest were correctly represented by the economic conception of natural capital, this ought not to be disturbing; but

it is. An even more disturbing reflection is that the newly transformed capital will actually require *protection from,* and therefore possibly the destruction of, wild nature which competes for the use of the fish stocks or the forests (Sagoff 1988). It seems reasonable to conclude that the adoption of the economic conception of natural capital will lead to a way of measuring sustainability which is very far from satisfying environmental concerns.

iii) A third problem is posed by the question what is to be counted as 'utilisable'. For example, suppose that a use for uranium never had been and never was going to be found, would this substance nevertheless count as contributing to the level of natural capital? Perhaps any natural item is capable of delivering welfare to human kind if we take into account technology which is at present unimaginable. But clearly, if we understand capital in this broadest possible sense, it would not provide us with a very usable criterion. The level of natural capital could be said to be maintained for more or less as long as the principle of the conservation of matter was in operation. In order for there to be a usable measure of the level of natural capital, a judgement needs to be made as to what counts as natural capital which is relative to available knowledge, or at least to predictions about what kinds of knowledge and technology are like to become available. Thus it turns out that, amongst other complications, the concept of natural capital is an epistemological one. In other words, we are faced with a further dimension of 'Cambridge change', a further complication involved in any attempt to measure the level of natural capital, and a not inconsiderable one. Referring back to the example of uranium, this century would seem to reckon it a considerable addition to the store of natural capital. Should the next century judge the nuclear experiment to have been an unmitigated disaster, judgements as to the state of our current natural assets would need to be seriously revised.

iv) A fourth problem is posed by the question whether we consider natural capital as providing the wherewithal to maintain *aggregate* welfare, or the *average* welfare per individual. The first point to notice is that these would generate different judgements over whether or not the level of natural capital was being maintained. The second point is that either option would have somewhat counterintuitive consequences. If we take first the option of supposing that a policy of sustainability should be aimed at maintaining the wherewithal for a non-declining aggregate of welfare, then it would be possible to increase the value which natural capital provides directly by *increasing* the human population - not normally something which environmentalists advocate. If, on the other hand, we suppose that the aim should be to maintain the wherewithal for non- declining welfare per individual, then it would be possible to increase the value produced from the transformation of natural capital by *decreasing* the human population. We could increase the value of natural capital dramatically, for example, by painlessly poisoning half the world's population - much more so if we chose the richest half! What these points again underline is the fragility of the concept of natural capital and the extent to which it is hostage to social forces.

v) Even supposing that we can somehow find ways of measuring these ups and downs in the level of natural capital, a final problem is posed by the question level of natural capital should be aimed for in the first place. Is it enough that we should have the wherewithal to enjoy the level of welfare enjoyed by the ancient Egyptians, or by our Neanderthal ancestors? An obvious response is that the question is an unreasonable one and that we can do no other than start from where we are. But the question is not so unreasonable as it might first appear to be. For the fact is that it costs something to set out on a sustainability path; we have to forego things. But then it is perfectly proper to press the question of why we should forego things, if it should turn out that the present level of welfare is higher than could be sustained over the long term anyway. In that event we might as well sit back and enjoy the windfall. As 'lottery theory' seems to indicate, there is no general perception that justice requires anyone to give

up a windfall.

The 'physical stock' approach

So far, discussion has focused on natural capital in the sense of the actual and potential economic value residing in natural items. There is, however, another possible approach to the problem of measurement, which is to attempt an inventory of the natural items themselves. An attraction of such an approach is that it might enable us to avoid some of the entanglements which we have shown to surround the attempt to measure economic value, especially those which arise from the fact that economic value is inevitably a function of the relation between the natural world and prevailing cultural and technological institutions.

An initial point to notice is that to adopt such an approach is to do more than adopt a different system of measurement; it is to lay stress on a different kind of value. So far as the measure of economic value is concemed, the transformation of a natural item must be seen as enhancing or even creating the natural capital; for it would have no value if it was not utilised or utilisable. This seems to be borne out in actual markets, where one pays far more for meat or for kindling than for the animal 'on the hoof, or for the tree. (Of course, the transformation might at the same time destroy other kinds of value which it has, but that is a different point.) To focus on the natural items themselves, on the other hand, would seem to involve laying stress on their *potential* value; and this is not an unreasonable thing. Natural items in their original state might be thought of, along the lines of the cells which constitute living things at the very outset of their development, as 'totipotential'. To transform them is, arguably, to limit the possible range of uses to which they may be put, just as differentiation in the case of the cells limits their developmental role.

So far as particular kinds of natural item are concerned, making an inventory seems to present few problems. There are ways of estimating stocks of coal and oil, and ways of judging whether there are fewer or more bullfinches this year. In this way, perhaps, each 'resource' might be itemised and some estimate of the 'amount' of the given item arrived at. The major question which arises, however, is how far an aggregation of natural items is possible or even makes sense. If all else remains the same, and a couple of lesser spotted woodpeckers go missing, then no doubt we can judge that we are slightly down on natural capital. But consider even so simple an example as that provided by the 'twelve days of Christmas'. 'Four colley birds, three French hens, two turtle doves': what is the total capital here? Well, nine birds, perhaps. But suppose there were three colley birds and four French hens. Would the total be the same? Now throw in nine lords-a- leaping. What is the total here? Eighteen animals perhaps? But what if we now add in the five gold rings?[7] Or an ozone layer, perhaps? One begins to see the difficulties.

The difficulties may not be insuperable, however, since there are more sophisticated ways of making an inventory. One way is to look for indicators rather than to count numbers. The decline of a particular species can tell us that all is not as it should be; and plants in particular can function like the canaries which were taken down mines, as harbingers of climatic and other adverse kinds of change which threaten to deplete natural capital. Indeed, it seems that there must be signs of this sort available; otherwise it is hard to see how there can have been the awareness of environmental degradation which fuelled calls for sustainability in the first place. Another way is the use of more comprehensive indicators such as biodiversity, which, because of ecosystemic dependencies, can reveal the state of organic/inorganic compounds

[7] The example is illustrative only; I ignore the fact that humanmade capital has crept in.

such as soil and water, as well as the state of biotic communities. Finally, from a more managerial perspective comes the idea that natural capital might be treated along the lines of the portfolios of investment companies. The particular point here is that a comparison of portfolios may not require the impossible calculation of the total assets of each, but judgement which takes in a range of factors such as stability, range of options and so forth.

Conclusion

What seems to emerge from the foregoing discussion of sustainability is that the 'physical stock' view of natural capital, often discarded as impossible to operate, may be found to have fewer methodological drawbacks than the 'economic' view, usually more favoured because it seems to offer a single criterion by which to measure the total amount of natural capital. What also seems to be true is that the objective of maintaining natural capital when this is understood in the 'physical stock' sense is more likely to do justice to specifically environmental concerns. But this may well be at the cost of both economic and moral considerations and shows up a real disagreement about fundamental values. Natural capital will only be sustained at a certain cost. The question might be and has been raised what possible point there can be making economic sacrifices to secure the continued existence of obscure species of beetles. Even more pressing is the question whether we could be morally justified in diverting resources into environmental projects which might otherwise be used, say, to provide clean drinking water; unless, of course, it could be demonstrated that the one is a means of securing the other. Strong reasons can be given for at least qualifying the 'physical stock' approach by reference to economic value, and for limiting attention to natural capital which is 'used or utilisable'. Thus, economic value may need to be referred to in order to determine which items should count, even if we have found reason to doubt that it provides a satisfactory way of counting them.

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