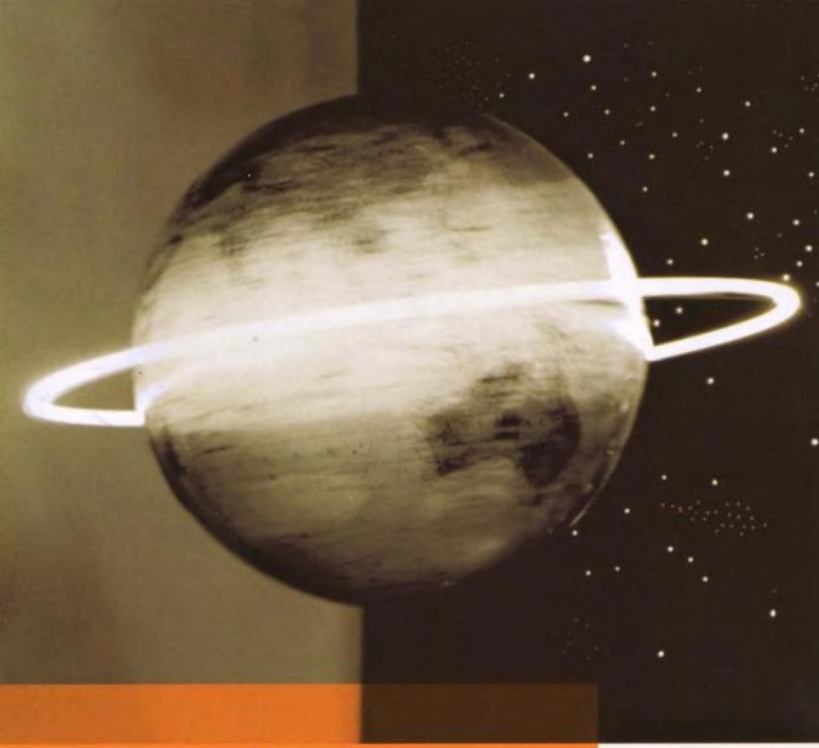

E. F. Schumacher

small is beautiful

a study of economics as if people mattered

VINTAGE

E. F. Schumacher

SMALL IS BEAUTIFUL

A Study of Economics as if People Mattered

VINTAGE BOOKS
London

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INTRODUCTION BY JONATHON PORRITT

SMALL IS BEAUTIFUL is 20 years old. When it was first published, there was no instant fanfare, no rave reviews. To begin with, sales were very modest, but increased steadily every quarter until both the book and its enormously popular title were suddenly everywhere.

And they still are 20 years on. Countless people in dozens of different countries have been deeply inspired by this little book, impressed by the clarity of its key ideas, and moved to do more in their own homes or work places as a direct consequence of it.

The achievement is all the more astonishing in that *Small is Beautiful* is essentially a collection of essays and speeches written and given over a number of years, more or less cobbled together as a series of overlapping snapshots. But even the repetitions seem to work, re-presenting the same issues from quite different perspectives depending on the target audience or literary outlet.

Overall, Fritz Schumacher was a great synthesizer, bringing many disparate concerns within the same frame of reference. He was the first of the 'holistic thinkers' of the modern Green Movement.

Re-reading *Small is Beautiful*, one has a very strong sense of the rich tradition from which Schumacher himself gained so much. He is the natural inheritor of the insights of William Morris on the crucial significance of giving people access to good work, of Lady Eve Balfour and Henry Doubleday on organic farming and the importance of maintaining soil

fertility, of Lewis Mumford on technology and the Industrial Revolution, of Gandhi, Kropotkin, Tawney and Galbraith. All these and many more were stirred into Schumacher's pot to produce a work of wonderful vitality and originality. As the subtitle implies ('*A study of economics as if people mattered*'), it is to the problems of economics he returns time after time. Everything he wrote 20 years ago is just as relevant today, and the refusal of contemporary economists and politicians to take it on board remains all but inexplicable. As he argues so passionately, the cardinal error of our whole industrial way of life is the way in which we continue to treat irreplaceable natural capital as income.

> 'Fossil fuels are merely a part of the "natural capital" which we steadfastly insist on treating as expendable, as if it were income, and by no means the most important part. If we squander our fossil fuels, we threaten civilisation; but if we squander the capital represented by living nature around us, we threaten life itself.'

Hence the continuing absurdity of human societies pinning all their hopes on achieving exponential economic growth, of measuring success solely in terms of increased GNP, and of ignoring the social and environmental 'externalities' of contemporary consumerism. It's not that economists are ignorant about these things – they've been written about at great length over many decades. But they continue to treat them as minor problems, as irritating aberrations in a system that has otherwise proved itself to be both durable and flexible.

Indeed, at one level a lot has been going on. The OECD first called for the 'internalisation of environmental costs' more than 15 years ago. Governments have been burbling on about the 'Polluter Pays Principle' for almost as long. The United Nations has had a working party on alternatives to GNP that has produced endless verbose reports. A few pioneering countries have developed parallel systems for drawing up their national accounts, and a few pioneering economists have pushed hard to get environmental economics into the mainstream of courses in colleges, universities and business schools.

But nothing ever changes. Even interested economists seem entirely incapable of organising themselves into any kind of

pro-active campaigning body to put some really expert pressure on the politicians. And here in the UK at least, there is no one of Fritz Schumacher's stature to make them squirm at the manifest inadequacies of contemporary economic orthodoxy.

For instance, would that just one Minister at the Department of Employment, let alone one Opposition Spokesperson on Employment, could read and absorb the chapter entitled 'Buddhist Economics'. As they struggle forlornly to return to the kind of economic circumstances in which full employment could be delivered, they continue to disregard the very simple fact that work means so much more to people than the relatively straight-forward business of getting paid for selling one's labour. In an industrial society, psychological benefits such as security, fulfilment, status, solidarity and conviviality are all delivered primarily through the jobs that people have or the work that they do.

The distinction between jobs and work remains a fundamental one. 'Full employment', invested as it is with the power of contemporary politicians' most popular panacea, still means full time jobs for all but an unreachable minority. It still is not used to mean the desirability of giving access to good work for all who are capable of it.

On this and many other matters. Fritz Schumacher blazed a trail that still provides the *only* alternative to the anachronistic advocacy of full employment in an age of robotisation and 'mobile capital' pursuing ever cheaper labour costs.

On some other issues, however, his views have not weathered quite so well. Like every other environmentalist writing in the early Seventies, Schumacher was convinced of the imminence of serious oil shortages and deeply fearful of the economic and social dislocation that these would cause. Twenty years on, the emphasis now is not on oil running out (current reserves will almost certainly last at least until the middle of the next century), but rather on the environmental damage that will be done if they continue to be used up at current rates.

Equally, it comes as something of a surprise to revisit Schumacher's cogent defene of the UK's nationalised

industries! It is timely to remember that in those days there was still a lively debate going on about the most appropriate means of ownership. The so-called 'free-market' was not then deemed to be the sole arbiter of all social and economic benefits, nor had its defenders assumed the kind of intellectual supremacy that society accords them today.

But even that orthodoxy is now being challenged. Markets today are neither free nor are they always efficient; they exacerbate wealth differentials and accelerate environmental degradation. As the pendulum swings back to the idea of regulated, planned and properly controlled markets, the ideas of Schumacher in this area may well assume a new authority.

And when the notion of 'subsidiarity' is on the lips of every citizen of the European Community, we can rest assured that *Small is Beautiful* will certainly remain an ever-popular catch phrase! Whether it's used properly or not is another matter. It is intriguing to remember that Schumacher himself drew some of his ideas on appropriate scale from the Catholic Church's doctrine of subsidiarity ('It is an injustice and at the same time a grave evil and disturbance of right order to assign to a greater and higher association what lesser and subordinate organisations can do'), and that small wasn't *always* beautiful in his eyes.

> 'What I wish to emphasise is the duality of the human requirement when it comes to the question of size: there is no single answer. For his different purposes man needs many different structures, both small ones and large ones, some exclusive and some comprehensive. For constructive work, the principle task is always the restoration of some kind of balance. Today, we suffer from an almost universal idolatry of giantism. It is therefore necessary to insist on the virtues of smallness – where this applies.'

But as Schumacher's publisher was very well aware, 'Small is Sometimes Beautiful' would undoubtedly not have had such an impact as a title as 'Small is Beautiful'! That deceptively simple notion still resonates very powerfully throughout the Green Movement today, reminding us all of the wonderfully inspirational life and work of one of the great figures of the modern age.

'Few can contemplate without a sense of exhilaration the splendid achievements of practical energy and technical skill, which, from the latter part of the seventeenth century, were transforming the face of material civilisation, and of which England was the daring, if not too scrupulous, pioneer. If, however, economic ambitions are good servants, they are bad masters.

'The most obvious facts are most easily forgotten. Both the existing economic order and too many of the projects advanced for reconstructing it break down through their neglect of the truism that, since even quite common men have souls, no increase in material wealth will compensate them for arrangements which insult their self-respect and impair their freedom. A reasonable estimate of economic organisation must allow for the fact that, unless industry is to be paralysed by recurrent revolts on the part of outraged human nature, it must satisfy criteria which are not purely economic.'

R. H. Tawney
Religion and the Rise of Capitalism

'By and large, our present problem is one of attitudes and implements. We are remodelling the Alhambra with a steam-shovel, and are proud of our yardage. We shall hardly relinquish the shovel, which after all has many good points, but we are in need of gentler and more objective criteria for its successful use.'

Aldo Leopold
A Sand County Almanac

PART ONE

THE MODERN WORLD

I

THE PROBLEM OF PRODUCTION

ONE OF THE most fateful errors of our age is the belief that 'the problem of production' has been solved. Not only is this belief firmly held by people remote from production and therefore professionally unacquainted with the facts – it is held by virtually all the experts, the captains of industry, the economic managers in the governments of the world, the academic and not-so-academic economists, not to mention the economic journalists. They may disagree on many things but they all agree that the problem of production has been solved; that mankind has at last come of age. For the rich countries, they say, the most important task now is 'education for leisure' and, for the poor countries, the 'transfer of technology'.

That things are not going as well as they ought to be going must be due to human wickedness. We must therefore construct a political system so perfect that human wickedness disappears and everybody behaves well, no matter how much wickedness there may be in him or her. In fact, it is widely held that everybody is born good; if one turns into a criminal or an exploiter, this is the fault of 'the system'. No doubt 'the system' is in many ways bad and must be changed. One of the main reasons why it is bad and why it can still survive in spite of its badness, is this erroneous view that the 'problem of production' has been solved. As this error pervades all present-day systems there is at present not much to choose between them.

The arising of this error, so egregious and so firmly rooted, is closely connected with the philosophical, not to say religious, changes during the last three or four centuries in man's attitude

to nature. I should perhaps say: *western* man's attitude to nature, but since the whole world is now in a process of westernisation, the more generalised statement appears to be justified. Modern man does not experience himself as a part of nature but as an outside force destined to dominate and conquer it. He even talks of a battle with nature, forgetting that, if he won the battle, he would find himself on the losing side. Until quite recently, the battle seemed to go well enough to give him the illusion of unlimited powers, but not so well as to bring the possibility of total victory into view. This has now come into view, and many people, albeit only a minority, are beginning to realise what this means for the continued existence of humanity.

The illusion of unlimited powers, nourished by astonishing scientific and technological achievements, has produced the concurrent illusion of having solved the problem of production. The latter illusion is based on the failure to distinguish between income and capital where this distinction matters most. Every economist and businessman is familiar with the distinction, and applies it conscientiously and with considerable subtlety to all economic affairs – except where it really matters: namely, the irreplaceable capital which man has not made, but simply found, and without which he can do nothing.

A businessman would not consider a firm to have solved its problems of production and to have achieved viability if he saw that it was rapidly consuming its capital. How, then, could we overlook this vital fact when it comes to that very big firm, the economy of Spaceship Earth and, in particular, the economies of its rich passengers?

One reason for overlooking this vital fact is that we are estranged from reality and inclined to treat as valueless everything that we have not made ourselves. Even the great Dr Marx fell into this devastating error when he formulated the so-called 'labour theory of value'. Now, we have indeed laboured to make some of the capital which today helps us to produce – a large fund of scientific, technological, and other knowledge; an elaborate physical infrastructure; innumerable types of sophisticated capital equipment, etc. – but all this is but a small part of the total capital we are using. Far larger is

the capital provided by nature and not by man – and we do not even recognise it as such. This larger part is now being used up at an alarming rate, and that is why it is an absurb and suicidal error to believe, and act on the belief, that the problem of production has been solved.

Let us take a closer look at this 'natural capital'. First of all, and most obviously, there are the fossil fuels. No-one, I am sure, will deny that we are treating them as income items although they are undeniably capital items. If we treated them as capital items, we should be concerned with conservation; we should do everything in our power to try and minimise their current rate of use; we might be saying, for instance, that the money obtained from the realisation of these assets – these irreplaceable assets – must be placed into a special fund to be devoted exclusively to the evolution of production methods and patterns of living which do *not* depend on fossil fuels at all or depend on them only to a very slight extent. These and many other things we should be doing if we treated fossil fuels as capital and not as income. And we do not do any of them, but the exact contrary of every one of them: we are not in the least concerned with conservation; we are maximising, instead of minimising, the current rates of use; and, far from being interested in studying the possibilities of alternative methods of production and patterns of living – so as to get off the collision course on which we are moving with ever-increasing speed – we happily talk of unlimited progress along the beaten track, of 'education for leisure' in the rich countries, and of 'the transfer of technology' to the poor countries.

The liquidation of these captial assets is proceeding so rapidly that even in the allegedly richest country in the world, the United States of America, there are many worried men, right up to the White House, calling for the massive conversion of coal into oil and gas, demanding ever more gigantic efforts to search for and exploit the remaining treasures of the earth. Look at the figures that are being put forward under the heading 'World Fuel Requirements in the Year 2000'. If we are now using something like 7,000 million tons of coal equivalent, the need in twenty-eight years' time will be three times as large – around 20,000 million tons! What are twenty-eight

years? Looking backwards, they take us roughly to the end of World War II, and, of course, since then fuel consumption has trebled; but the trebling involved an increase of less than 5,000 million tons of coal equivalent. Now we are calmly talking about an increase three times as large.

People ask: can it be done? And the answer comes back: it must be done and therefore it shall be done. One might say (with apologies to John Kenneth Galbraith) that it is a case of the bland leading the blind. But why cast aspersions? The question itself is wrong-headed, because it carries the implicit assumption that we are dealing with income and not with capital. What is so special about the year 2000? What about the year 2028, when little children running about today will be planning for their retirement? Another trebling by then? All these questions and answers are seen to be absurd the moment we realise that we are dealing with capital and not with income: fossil fuels are not made by men; they cannot be recycled. Once they are gone they are gone for ever.

But what – it will be asked – about the income fuels? Yes, indeed, what about them? Currently, they contribute (reckoned in calories) less than four per cent to the world total. In the foreseeable future they will have to contribute seventy, eighty, ninety per cent. To do something on a small scale is one thing: to do it on a gigantic scale is quite another, and to make an impact on the world fuel problem, contributions have to be truly gigantic. Who will say that the problem of production has been solved when it comes to income fuels required on a truly gigantic scale?

Fossil fuels are merely a part of the 'natural capital' which we steadfastly insist on treating as expendable, as if it were income, and by no means the most important part. If we squander our fossil fuels, we threaten civilisation; but if we squander the capital represented by living nature around us, we threaten life itself. People are waking up to this threat, and they demand that pollution must stop. They think of pollution as a rather nasty habit indulged in by careless or greedy people who, as it were, throw their rubbish over the fence into the neighbour's garden. A more civilised behaviour, they realise, would incur some extra cost, and therefore we need a faster

rate of economic growth to be able to pay for it. From now on, they say, we should use at least some of the fruits of our ever-increasing productivity to improve 'the quality of life' and not merely to increase the quantity of consumption. All this is fair enough, but it touches only the outer fringe of the problem.

To get to the crux of the matter, we do well to ask why it is that all these terms – pollution, environment, ecology, etc. – have *so suddenly* come into prominence. After all, we have had an industrial system for quite some time, yet only five or ten years ago these words were virtually unknown. Is this a sudden fad, a silly fashion, or perhaps a sudden failure of nerve?

The explanation is not difficult to find. As with fossil fuels, we have indeed been living on the capital of living nature for some time, but at a fairly modest rate. It is only since the end of World War II that we have suceeded in increasing this rate to alarming proportions. In comparison with what is going on now and what has been going on, progressively, during the last quarter of a century, all the industrial activities of mankind up to, and including, World War II are as nothing. The next four or five years are likely to see more industrial production, taking the world as a whole, than all of mankind accomplished up to 1945. In other words, quite recently – so recently that most of us have hardly yet become conscious of it – there has been a unique quantitative jump in industrial production.

Partly as a cause and also as an effect, there has also been a unique qualitative jump. Our scientists and technologists have learned to compound substances unknown to nature. Against many of them, nature is virtually defenceless. There are no natural agents to attack and break them down. It is as if aborigines were suddenly attacked with machine-gun fire: their own bows and arrows are of no avail. These substances, unknown to nature, owe their almost magical effectiveness precisely to nature's defencelessness – and that accounts also for their dangerous ecological impact. It is only in the last twenty years or so that they have made their appearance in *bulk*. Because they have no natural enemies, they tend to accumulate, and the long-term consequences of this accumulation are in many cases known to be extremely dangerous, and in other cases totally unpredictable.

In other words, the changes of the last twenty-five years, both in the quantity and in the quality of man's industrial processes, have produced an entirely new situation – a situation resulting not from our failures but from what we thought were our greatest successes. And this has come so suddenly that we hardly noticed the fact that we were very rapidly using up a certain kind of irreplaceable capital asset, namely the *tolerance margins* which benign nature always provides.

Now let me return to the question of 'income fuels' with which I had previously dealt in a somewhat cavalier manner. No-one is suggesting that the world-wide industrial system which is being envisaged to operate in the year 2000, a generation ahead, would be sustained primarily by water or wind power. No, we are told that we are moving rapidly into the nuclear age. Of course, this has been the story for quite some time, for over twenty years, and yet, the contribution of nuclear energy to man's total fuel and energy requirements is still minute. In 1970, it amounted to 2·7 per cent in Britain; 0·6 per cent in the European Community; and 0·3 per cent in the United States, to mention only the countries that have gone the furthest. Perhaps we can assume that nature's tolerance margins will be able to cope with such small impositions, although there are many people even today who are deeply worried, and Dr Edward D. David, President Nixon's Science Adviser, talking about the storage of radioactive wastes, says that 'one has a queasy feeling about something that has to stay underground and be pretty well sealed off for 25,000 years before it is harmless'.

However that may be, the point I am making is a very simple one: the proposition to replace thousands of millions of tons of fossil fuels, every year, by nuclear energy means to 'solve' the fuel problem by creating an environment and ecological problem of such a monstrous magnitude that Dr David will not be the only one to have 'a queasy feeling'. It means solving one problem by shifting it to another sphere – there to create an infinitely bigger problem.

Having said this, I am sure that I shall be confronted with another, even more daring proposition: namely, that future

scientists and technologists will be able to devise safety rules and precautions of such perfection that the using, transporting, processing and storing of radioactive materials in ever-increasing quantities will be made entirely safe; also that it will be the task of politicians and social scientists to create a world society in which wars or civil disturbances can never happen. Again, it is a proposition to solve one problem simply by shifting it to another sphere, the sphere of everyday human behaviour. And this takes us to the third category of 'natural capital' which we are recklessly squandering because we treat it as if it were income: as if it were something we had made ourselves and could easily replace out of our much-vaunted and rapidly rising productivity.

Is it not evident that our current methods of production are already eating into the very substance of industrial man? To many people this is not at all evident. Now that we have solved the problem of production, they say, have we ever had it so good? Are we not better fed, better clothed, and better housed than ever before – and better educated? Of course we are: most, but by no means all, of us: in the rich countries. But this is not what I mean by 'substance'. The substance of man cannot be measured by Gross National Product. Perhaps it cannot be measured at all, except for certain symptoms of loss. However, this is not the place to go into the statistics of these symptoms, such as crime, drug addiction, vandalism, mental breakdown, rebellion, and so forth. Statistics never prove anything.

I started by saying that one of the most fateful errors of our age is the belief that the problem of production has been solved. This illusion, I suggested, is mainly due to our inability to recognise that the modern industrial system, with all its intellectual sophistication, consumes the very basis on which it has been erected. To use the language of the economist, it lives on irreplaceable capital which it cheerfully treats as income. I specified three categories of such capital: fossil fuels, the tolerance margins of nature, and the human substance. Even if some readers should refuse to accept all three parts of my argument, I suggest that any one of them suffices to make my case.

And what is my case? Simply that our most important task is to get off our present collision course. And who is there to tackle such a task? I think every one of us, whether old or young, powerful or powerless, rich or poor, influential or uninfluential. To talk about the future is useful only if it leads to action *now*. And what can we do *now*, while we are still in the position of 'never having had it so good'? To say the least – which is already very much – we must thoroughly understand the problem and begin to see the possibility of evolving a new life-style, with new methods of production and new patterns of consumption: a life-style designed for permanence. To give only three preliminary examples: in agriculture and horticulture, we can interest ourselves in the perfection of production methods which are biologically sound, build up soil fertility, and produce health, beauty and permanence. Productivity will then look after itself. In industry, we can interest ourselves in the evolution of small-scale technology, relatively non-violent technology, 'technology with a human face', so that people have a chance to enjoy themselves while they are working, instead of working solely for their pay packet and hoping, usually forlornly, for enjoyment solely during their leisure time. In industry, again – and, surely, industry is the pace-setter of modern life – we can interest ourselves in new forms of partnership between management and men, even forms of common ownership.

We often hear it said that we are entering the era of 'the Learning Society'. Let us hope this is true. We still have to learn how to live peacefully, not only with our fellow men but also with nature and, above all, with those Higher Powers which have made nature and have made us; for, assuredly, we have not come about by accident and certainly have not made ourselves.

The themes which have been merely touched upon in this chapter will have to be further elaborated as we go along. Few people will be easily convinced that the challenge to man's future cannot be met by making marginal adjustments here or there, or, possibly, by changing the political system.

The following chapter is an attempt to look at the whole situation again, from the angle of peace and permanence. Now

that man has acquired the physical means of self-obliteration, the question of peace obviously looms larger than ever before in human history. And how could peace be built without some assurance of permanence with regard to our economic life?

little; but where is the rich society that says: 'Halt! We have enough'? There is none.

Perhaps we can forget about 'enough' and content ourselves with exploring the growth of demand upon the world's resources which arises when everybody simply strives hard to have 'more'. As we cannot study all resources, I propose to focus attention on one type of resource which is in a somewhat central position – fuel. More prosperity means a greater use of fuel – there can be no doubt about that. At present, the prosperity gap between the poor of this world and the rich is very wide indeed, and this is clearly shown in their respective fuel consumption. Let us define as 'rich' all populations in countries with an average fuel consumption – in1966 – of more than one metric ton of coal equivalent (abbreviated: c.e.) per head, and as 'poor' all those below this level. On these definitions we can draw up the following table (using United Nations figures throughout):

TABLE I (1966)

Rich	(%)	*Poor*	(%)	*World*	(%)
POPULATION (millions)					
1,060	(31)	2,284	(69)	3,384	(100)
FUEL CONSUMPTION (million tons c.e.)					
4,788	(87)	721	(13)	5,509	(100)
FUEL CONSUMPTION PER HEAD (tons c.e.)					
4·52		0·32		1·65	

The average fuel consumption per head of the 'poor' is only 0·32 tons – roughly one-fourteenth of that of the 'rich', and there are very many 'poor' people in the world – on these definitions nearly seven-tenths of the world population. If the 'poor' suddenly used as much fuel as the 'rich', world fuel consumption would treble right away.

But this cannot happen as everything takes time. And in time both the 'rich' and the 'poor' are growing in desires and in numbers. So let us make an exploratory calculation. If the 'rich' populations grow at the rate of 1¼ per cent and the 'poor' at the rate of 2½ per cent a year, world population will grow to

about 6,900 million by 2000 AD – a figure not very different from the most authoritative current forecasts. If at the same time the fuel consumption *per head* of the 'rich' population grows by 2¼ per cent per year, the following figures will emerge for the year 2000 AD:

TABLE II (2000 AD)

Rich	(%)	*Poor*	(%)	*World*	(%)
POPULATION (millions)					
1,617	(23)	5,292	(77)	6,909	(100)
FUEL CONSUMPTION (million tons c.e.)					
15,588	(67)	7,568	(33)	23,156	(100)
FUEL CONSUMPTION PER HEAD (tons c.e.)					
9·64		1·43		3·35	

The total result on world fuel consumption would be a growth from 5·5 milliard tons c.e. in 1966 to 23·2 milliard in the year 2000 – an increase by a factor of more than four, half of which would be attributable to population increase and half to increased consumption per head.

This half-and-half split is interesting enough. But the split between the 'rich' and the 'poor' is even more interesting. Of the total increase in world fuel consumption from 5·5 milliard to 23·2 milliard tons c.e. an increase by 17·7 milliard tons, the 'rich' would account for nearly two-thirds and the 'poor' for only a little over one-third. Over the whole thirty-four-year period, the world would use 425 milliard tons of coal equivalent, with the 'rich' using 321 milliards or seventy-five per cent, and the 'poor', 104 milliards.

Now, does this not put a very interesting light on the total situation? These figures are not, of course, predictions: they are what might be called 'exploratory calculations'. I have assumed a very modest population growth on the part of the 'rich'; and a population growth rate twice as high on the part of the 'poor'; yet it is the 'rich' and not the 'poor' who do by far the greatest part of the damage – if 'damage' it may be called. Even if the populations classified as 'poor' grew only at the rate assumed for the 'rich', the effect on total world fuel require-

ments would be hardly significant – a reduction of just over ten per cent. But if the 'rich' decided – and I am not saying that this is likely – that their present *per capita* fuel consumption was really high enough and that they should not allow it to grow any further, considering that it is already fourteen times as high as that of the 'poor' – now, that *would* make a difference: in spite of the assumed rise in the 'rich' populations, it would cut total world fuel requirements in the year 2000 by over one-third.

The most important comment, however, is a question: Is it plausible to assume that world fuel consumption *could* grow to anything like 23,000 million tons c.e. a year by the year 2000, using 425,000 million tons c.e. during the thirty-four years in question? In the light of our present knowledge of fossil fuel reserves this is an implausible figure, even if we assume that one-quarter or one-third of the world total would come from nuclear fission.

It is clear that the 'rich' are in the process of stripping the world of its once-for-all endowment of relatively cheap and simple fuels. It is their continuing economic growth which produces ever more exorbitant demands, with the result that the world's cheap and simple fuels could easily become dear and scarce long before the poor countries had acquired the wealth, education, industrial sophistication, and the power of capital accumulation needed for the application of alternative fuels on any significant scale.

Exploratory calculations, of couse, do not *prove* anything. A *proof* about the future is in any case impossible, and it has been sagely remarked that all predictions are unreliable, particularly those about the future. What is required is judgment, and exploratory calculations can at least help to inform our judgment. In any case, our calculations in a most important respect *understate* the magnitude of the problem. It is not realistic to treat the world as a unit. Fuel resources are very unevenly distributed, and any shortage of supplies, no matter how slight, would immediately divide the world into 'haves' and 'have-nots' along entirely novel lines. The specially favoured areas, such as the Middle East and North Africa, would attract envious attention on a scale scarcely imaginable

today, while some high consumption areas, such as Western Europe and Japan, would move into the unenviable position of residual legatees. Here is a source of conflict if ever there was one.

As nothing can be *proved* about the future – not even about the relatively short-term future of the next thirty years – it is always possible to dismiss even the most threatening problems with the suggestion that something will turn up. There could be simply enormous and altogether unheard-of discoveries of new reserves of oil, natural gas, or even coal. And why should nuclear energy be confined to supplying one-quarter or one-third of total requirements? The problem can thus be shifted to another plane, but it refuses to go away. For the consumption of fuel on the indicated scale – assuming no insurmountable difficulties of fuel supply – would produce environmental hazards of an unprecedented kind.

Take nuclear energy. Some people say that the world's resources of relatively concentrated uranium are insufficient to sustain a really large nuclear programme – large enough to have a significant impact on the world fuel situation, where we have to reckon with thousands of millions, not simply with millions, of tons of coal equivalent. But assume that these people are wrong. Enough uranium will be found; it will be gathered together from the remotest corners of the earth, brought into the main centres of populations, and made highly radioactive. It is hard to imagine a greater biological threat, not to mention the political danger that someone might use a tiny bit of this terrible substance for purposes not altogether peaceful.

On the other hand, if fantastic new discoveries of fossil fuels should make it unnecessary to force the pace of nuclear energy, there would be a problem of thermal pollution on quite a different scale from anything encountered hitherto.

Whatever the fuel, increases in fuel consumption by a factor of four and then five and then six . . . there is no plausible answer to the problem of pollution.

I have taken fuel merely as an example to illustrate a very simple thesis: that economic growth, which viewed from the point of view of economics, physics, chemistry and tech-

nology, has no discernible limit, must necessarily run into decisive bottlenecks when viewed from the point of view of the environmental sciences. An attitude to life which seeks fulfilment in the single-minded pursuit of wealth – in short, materialism – does not fit into this world, because it contains within itself no limiting principle, while the environment in which it is placed is strictly limited. Already, the environment is trying to tell us that certain stresses are becoming excessive. As one problem is being 'solved', ten new problems arise as a result of the first 'solution'. As Professor Barry Commoner emphasises, the new problems are not the consequences of incidental failure but of technological success.

Here again, however, many people will insist on discussing these matters solely in terms of optimism and pessimism, taking pride in their own optimism that 'science will find a way out'. They could be right only, I suggest, if there is a conscious and fundamental change in the *direction* of scientific effort. The developments of science and technology over the last hundred years have been such that the dangers have grown even faster than the opportunities. About this, I shall have more to say later.

Already, there is overwhelming evidence that the great self-balancing system of nature is becoming increasingly unbalanced in particular respects and at specific points. It would take us too far if I attempted to assemble the evidence here. The condition of Lake Erie, to which Professor Barry Commoner, among others, has drawn attention, should serve as a sufficient warning. Another decade or two, and all the inland water systems of the United States may be in a similiar condition. In other words, the condition of unbalance may then no longer apply to specific points but have become generalised. The further this process is allowed to go, the more difficult it will be to reverse it, if indeed the point of no return has not been passed already.

We find, therefore, that the idea of unlimited economic growth, more and more until everybody is saturated with wealth, needs to be seriously questioned on at least two counts: the availability of basic resources and, alternatively or additionally, the capacity of the environment to cope with the

questions, we could establish peace on earth, is an unrealistic, unscientific, and irrational hope. The exclusion of wisdom from economics, science, and technology was something which we could perhaps get away with for a little while, as long as we were relatively unsuccessful; but now that we have become very successful, the problem of spiritual and moral truth moves into the central position.

From an economic point of view, the central concept of wisdom is permanence. We must study the economics of permanence. Nothing makes economic sense unless its continuance for a long time can be projected without running into absurdities. There can be 'growth' towards a limited objective, but there cannot be unlimited, generalised growth. It is more than likely, as Gandhi said, that 'Earth provides enough to satisfy every man's need, but not for every man's greed'. Permanence is incompatible with a predatory attitude which rejoices in the fact that 'what were luxuries for our fathers have become necessities for us'.

The cultivation and expansion of needs is the antithesis of wisdom. It is also the antithesis of freedom and peace. Every increase of needs tends to increase one's dependence on outside forces over which one cannot have control, and therefore increases existential fear. Only by a reduction of needs can one promote a genuine reduction in those tensions which are the ultimate causes of strife and war.

The economics of permanence implies a profound reorientation of science and technology, which have to open their doors to wisdom and, in fact, have to incorporate wisdom into their very structure. Scientific or technological 'solutions' which poison the environment or degrade the social structure and man himself are of no benefit, no matter how brilliantly conceived or how great their superficial attraction. Ever bigger machines, entailing ever bigger concentrations of economic power and exerting ever greater violence against the environment, do not represent progress: they are a denial of wisdom. Wisdom demands a new orientation of science and technology towards the organic, the gentle, the non-violent, the elegant and beautiful. Peace, as has often been said, is indivisible – how then could peace be built on a foundation of reckless

science and violent technology? We must look for a revolution in technology to give us inventions and machines which reverse the destruction trends now threatening us all.

What is it that we really require from the scientists and technologists? I should answer: We need methods and equipment which are

– cheap enough so that they are accessible to virtually everyone;
– suitable for small-scale application; and
– compatible with man's need for creativity.

Out of these three characteristics is born non-violence and a relationship of man to nature which guarantees permanence. If only one of these three is neglected, things are bound to go wrong. Let us look at them one by one.

Methods and machines cheap enough to be accessible to virtually everyone – why should we assume that our scientists and technologists are unable to develop them? This was a primary concern of Gandhi: 'I want the dumb millions of our land to be healthy and happy, and I want them to grow spiritually . . . If we feel the need of machines, we certainly will have them. Every machine that helps every individual has a place,' he said, 'but there should be no place for machines that concentrate power in a few hands and turn the masses into mere machine minders, if indeed they do not make them unemployed'.

Suppose it becomes the acknowledged purpose of inventors and engineers, observed Aldous Huxley, to provide ordinary people with the means of 'doing profitable and intrinsically significant work, of helping men and women to achieve independence from bosses, so that they may become their own employers, or members of a self-governing, co-operative group working for subsistence and a local market . . . this differently orientated technological progress (would result in) a progressive decentralisation of population, of political and economic power'. Other advantages, said Huxley, would be 'a more humanly satisfying life for more people, a greater measure of genuine self-governing democracy and a blessed

freedom from the silly or pernicious adult education provided by the mass producers of consumer goods through the medium of advertisements'.[1]

If methods and machines are to be cheap enough to be generally accessible, this means that their cost must stand in some definable relationship to the level of incomes in the society in which they are to be used. I have myself come to the conclusion that the upper limit for the average amount of capital investment *per workplace* is probably given by the annual earnings of an able and ambitious industrial worker. That is to say, if such a man can normally earn, say, $5,000 a year, the average cost of establishing his workplace should on no account be in excess of $5,000. If the cost is significantly higher, the society in question is likely to run into serious troubles, such as an undue concentration of wealth and power among the privileged few; an increasing problem of 'drop-outs' who cannot be integrated into society and constitute an ever-growing threat; 'structural' unemployment; maldistribution of the population due to excessive urbanisation; and general frustration and alienation, with soaring crime rates, and so forth.

The second requirement is suitability for small-scale application. On the problem of 'scale', Professor Leopold Kohr has written brillantly and convincingly; its relevance to the economics of permanence is obvious. Small-scale operations, no matter how numerous, are always less likely to be harmful to the natural environment than large-scale ones, simply because their individual force is small in relation to the recuperative forces of nature. There is wisdom in smallness if only on account of the smallness and patchiness of human knowledge, which relies on experiment far more than on understanding. The greatest danger invariably arises from the ruthless application, on a vast scale, of partial knowledge such as we are currently witnessing in the application of nuclear energy, of the new chemistry in agriculture, of transportation technology, and countless other things.

Although even small communities are sometimes guilty of causing serious erosion, generally as a result of ignorance, this is trifling in comparison with the devastations caused by

gigantic groups motivated by greed, envy, and the lust for power. It is moreover obvious that men organised in small units will take better care of *their* bit of land or other natural resources than anonymous companies or megalomanic governments which pretend to themselves that the whole universe is their legitimate quarry.

The third requirement is perhaps the most important of all – that methods and equipment should be such as to leave ample room for human creativity. Over the last hundred years no-one has spoken more insistently and warningly on this subject than have the Roman pontiffs. What becomes of a man if the process of production 'takes away from work any hint of humanity, making of it a merely mechanical activity'? The worker himself is turned into a perversion of a free being.

'And so bodily labour (said Pius XI) which even after original sin was decreed by Providence for the good of man's body and soul, is in many instances changed into an instrument of perversion; for from the factory dead matter goes out improved, whereas men there are corrupted and degraded'.

Again, the subject is so large that I cannot do more than touch upon it. Above anything else there is need for a proper philosophy of work which understands work not as that which it has indeed become, an inhuman chore as soon as possible to be abolished by automation, but as something 'decreed by Providence for the good of man's body and soul'. Next to the family, it is work and the relationships established by work that are the true foundations of society. If the foundations are unsound, how could society be sound? And if society is sick, how could it fail to be a danger to peace?

'War is a judgment,' said Dorothy L. Sayers, 'that overtakes societies when they have been living upon ideas that conflict too violently with the laws governing the universe . . . Never think that wars are irrational catastrophes: they happen when wrong ways of thinking and living bring about intolerable situations.'[2] Economically, our wrong living consists primarily in systematically cultivating greed and envy and thus building up a vast array of totally unwarrantable wants. It is the sin of greed that has delivered us over into the power of the machine. If greed were not the master of modern man – ably assisted by