

MAN AND HIS FUTURE - A SCIENTIST'S VIEW

by

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When one looks at the world to-day it is hard to avoid the feeling that society is in a period of crisis - a period in which man, after about two centuries of quite unparalleled material progress seems suddenly to have become unsure of himself. Why should this be so? I believe that the answer is to be found in the fantastically rapid growth of science-based technology. Although seemingly paradoxical it is also my belief that only through science and science-based technology can the crisis be resolved and man's future be assured.

It is common to-day to talk of our "technological society", but, of course, such a description could equally be applied to human society at every stage of its development. Technology which is simply the application of discovery or invention to practical use has been the basis of all human progress (and let it be clear from the outset that technology per se need not involve science and, indeed, rarely if ever did so until about the middle of last century). Technological innovation was there when man fashioned his first tools and weapons and when he began to plant crops and move from a hunting to an agrarian society. Man differs from all other animals in that he can consciously alter and, in some measure, control his environment through technology and it would seem probable that selection for mating on the grounds of technological skill played a significant part in the evolution of Homo sapiens. Otherwise it is difficult to explain the enormous disparity in brain size of man and the chimpanzee, although both species derived from a common primate ancestor just a few million years ago.

Perhaps the greatest single factor in the development of human society as we know it to-day was the introduction of agriculture. Without it the development of large social units would have been impossible and man would have got little further than the small nomadic tribal society found among the Australian aborigines or the Eskimos. With it settled agrarian communities of increasing size and complexity developed - from the tribe to the city and thence on to the nation and empire. So powerful has been the influence of agriculture that modern civilisation still shows clear signs of its agrarian origin. The development of society through all these stages took a very long time. Each step forward was associated with some technological innovation in the military, agricultural, industrial or organisational activities of the society in which it occurred. Because discovery and invention occurred purely by chance and because means of communication were poor over all but the shortest distances, progress varied widely in different parts of the world and there were some differences in the pattern of the developing societies which emerged, but the general trend was the same everywhere; only the speed of advance varied. Not all innovations are successful or good and there is an element of risk in every advance. There must have been many failures and setbacks, but clearly successes on the whole must have outweighed the failures and society gradually became more complex. The speed of technological advance also increased if only in proportion to the growth in population which occurred as society advanced and so offered more food and security to its members.

Man, like all other animal species, is essentially conservative. He seeks above all for stability within his own lifetime and so it is not surprising that the societies he built up laboriously over thousands of years had a built-in resistance to change or at least a resistance to sudden changes which might disrupt the normal pattern of life. This manifested itself in the maintenance of an elaborate ritualistic hierarchy supported and strengthened by religion and by the handing on from one generation to the next of a not altogether unbiassed history of the origin and development of the state hierarchy and the benefits to be expected from its preservation. Until very recently this was all fairly successful; the pace of change, although it increased, did so almost imperceptibly and although social upheavals did occur they were on the whole rare and, in general, man's desire for stability within the span of one lifetime was met. The pattern was steady and apprenticeship was the standard form of education. The child learned from its father or other master craftsman a set of skills sufficient to equip it with little or no change for the whole of its working life. Empires rose and fell, but the pattern of life for the individual in an apparently heaven-ordained social order remained much the same. And yet this state of affairs was precarious and depended on three things. Rapid and revolutionary developments were unlikely as long as man remained short of mechanical power and had to rely on muscle power, either of himself or of animals, eked out by rather static forms like wind- and water-power. Secondly, lack of rapid and effective means of communication meant that the spread of innovation was extremely slow, and, thirdly, as long as technological progress rested

on chance discovery and invention advances were likely to be sporadic.

Of course, things were not wholly static and communications, especially by sea, steadily improved so that by the mid-eighteenth century not only had all the continents been discovered, but sailors, explorers and merchants from the western world had brought it into contact with other and different forms of society in Asia and elsewhere - forms in which the ideas of religion and state hierarchy, although serving the same ends, were nevertheless rather different from those hitherto accepted in Europe and the Near East. This contact undoubtedly had a disturbing effect and the facade of the western social order began to show a few serious cracks. Now, however, chance took a hand, and the fortuitous appearance of several major inventions towards the end of the eighteenth century ushered in the so-called Industrial Revolution in Western Europe - a revolution which was to transform our civilisation. The Industrial Revolution was, in principle, no different from the technological advances of the past; it occurred through the fortuitous appearance of several inventions at nearly the same time, and the equally fortuitous appearance of a group of outstandingly able inventor-entrepreneurs to exploit them. But among these inventions was one - that of the steam engine - which far exceeded the others in its importance because it put almost unlimited mechanical power for the first time into the hands of man.

There are some who attribute the Industrial Revolution to the growth of science

during the previous century, but I think this is mistaken. Science, it is true, had thrown off the shackles of dogma and mysticism at the time ^{of} the so-called Scientific Revolution which began in the mid-seventeenth century and had been growing steadily, but unobtrusively, largely in the hands of amateurs. But it had as yet little influence on everyday life and, although science played a part in its later modification, the invention of the steam engine had nothing to do with science as such. As we shall see, the association of science with technology came later. We are, of course, all familiar with what happened. Plentifully supplied with power, industry burgeoned in Europe. Communications, as a result, rapidly improved and new markets for expanding industry were sought all over the world. Population increased rapidly and to meet its needs and those of expanding industry, colonial expansion speeded up and many of the older less aggressive societies of the Orient fell prey to military and commercial exploitation by the Western industrial powers. The effect of the rapidly increasing wealth of the industrialised nations - and Britain was well in the forefront - coupled with the opening up of new territories as sources of food was bound to cause a great increase in population. This response to better conditions and more food is common to every animal species and many examples could be quoted of countries where the benefits of a technological advance have been swallowed up by a rise in population. It would seem that population always increases to the point where it permits of the lowest acceptable standard of living; this at any rate has been the case in the past and it was certainly so

with the Industrial Revolution. Whether conditions in the appalling industrial slums which developed in the nineteenth century were worse than those of earlier times is arguable, but at least the scale was larger. The emergence of a large industrial proletariat was a feature of the nineteenth century in Europe and it set up serious strains in society. Social trouble was indeed inevitable, since the new industrial society emerged within a single lifetime and continued to change. The old patterns clearly held no longer and one of the symptoms was a decline in traditional religious beliefs. This was not surprising since religion had always been used to help legitimise the state and the social order within it. But without religion in one form or another the fabric of society cannot hold together and so, as the classical religions declined, new ones began to spring up, some in the guise of political theories such as Marxism and others in a great array of curious sects embodying fragments taken from a variety of the old religions of both East and West.

Although the rate of technological advance was greater than that of social adjustment before eighteen fifty it is possible that if the former had continued to be dependent on chance discovery society might well have contained it. But, although one cannot put an exact date to such changes it was just about that time that men first began to apply science, or rather the methods of scientific research, to the solution of practical problems of agricultural, medical, industrial and military importance. Science is a branch of culture like music and the arts and as such as no direct effect

on material civilisation; it seeks to expand the frontiers of knowledge by observation and experiment. It is, however, clearly possible to apply it to solve practical problems and thereby to develop a science-based technology. This is precisely what happened round about the middle of last century and it was this which ushered in what I call the Second Industrial Revolution which is still in progress and which in the course of little more than a century has transformed our whole existence. I shall not seek to recount all the results of that revolution, but it has taken us in the twentieth century to the harnessing of nuclear energy, to the exploration of outer space and to an understanding of the basis of heredity of living organisms. These are tremendous achievements and the pace of technological advance shows no sign of slackening; it is the pace of change rather than its nature that has imposed the real strain on society. I have already mentioned the built-in resistance of our traditional society to rapid change and how it developed under which change, although it occurred, was in general so slow as to be barely noticed by the individual. Our social patterns were already badly affected by the speeding up of change last century, but that speeding up is as nothing compared with what has happened since. The fact is that society has been unable to adjust itself to such rapid change and it is this which is responsible for the unrest and strife which we find throughout the civilized world to-day. Problems which once were only of local significance are now global in character and unrestricted growth in population, coupled with the requirement that each individual should enjoy the full

benefit of every technological advance, has brought to the fore problems of pollution and deterioration of the environment which unchecked could threaten our very existence. We should remember that evolution is not yet finished and that only through the exercise of his superior intelligence is there any good reason to believe that man will escape the fate of other animal species which in the distant past have dominated the earth.

Concern about the growth of human population is hardly new. It has been expressed many times since Aristotle in his "Politics" warned of the need for an effective birth control policy. In particular Malthus looking at the experience of the 18th century stated that population would always rise to the limits made possible by food production so that there must always be hunger and poverty; he gloomily predicted that although numbers could be held in check to some extent by famine, war and pestilence we were moving inexorably and rapidly to a global crisis. Malthus, of course, could not foresee the enormous developments in food production that were to come through science based technology; these seemed to belie his thesis and support the Marxist view that overpopulation was a capitalist-inspired myth. But things are not quite as simple as that.

There is no question but that the world could sustain and feed a vastly greater population than it now has. No doubt in a number of areas in the world, poverty, malnutrition, disease and indeed famine are problems of appalling urgency to-day and are likely to be so to-morrow. But, given peace and sanity, the day after to-morrow, i.e. in about thirty years time we could so expand food production as to cope easily with

the doubling of world population which will have occurred by then. Looking further ahead there is no immediate risk of a Malthusian type of food crisis. Even without bringing more land into cultivation or farming the seas or developing the so-called unorthodox methods of food production based on micro-organisms it has been calculated that if all land now cultivated were managed as it is in Holland it would support some 60 billion people on a typical Dutch diet. Evidently on the grounds of food we could support enormously more people on earth than we now do, and a Malthusian crisis is a very long way off. But Malthus was wrong to some extent in his formulation of the problem; given adequate food an animal population will only increase to the point at which individuals achieve the minimum acceptable standard of living. Now it is probably true to say that for most animals an acceptable living standard means only food and adequate free space. But one of the most striking things about man is that he demands that every technological advance be applied to his personal benefit. So it is that living standards as measured by demands on world resources rise at a fantastic rate in the world of to-day and a ~~living~~ standard that would have been considered generous fifty years ago is now regarded as little above poverty level. It has been estimated that the population of the world will have doubled by about the year 2000 and that if it were to have the current average standard of living of the United States the demand on our natural resources would be about 70 times what it was in 1950; and this makes no allowance for technological advances bringing new kinds of demand. Since many of the resources which we use such as metals and minerals are non-renewable it is clear

that even a 1% per annum increase in world population which would mean a doubling every 70 years would become totally unacceptable in quite a short time. Moreover, unless human beings take steps now to control world population then any idea that the inhabitants of the present underdeveloped countries can aspire to American living standards may be dismissed; what will happen is that standards in the advanced industrial countries will decline. How to control population is perhaps the central problem of our time, for unless we can solve it we have little hope of bringing about the social changes necessary to create stability and order in the face of accelerating technological change.

I am reasonably optimistic that the population problem and the related problems of pollution and deterioration of our natural environment will be solved - the fact that they are now recognised and widely discussed is the basis for that optimism. But whether we can reach solutions quickly and relatively painlessly or whether we will first muddle along and go through the bitter waters of near disaster before we do so depends primarily on the vision and resolve of the young generation - indeed of the graduating classes such as this from whose ranks we must draw the leaders of the future.

And I want you the leaders of the future to look at these problems objectively, and proceed to solve them objectively (for objectivity is sorely lacking in many public pronouncements on them). It is no use simply bleating and wringing one's hands about pollution and the environment; it is equally futile to inveigh against science and technology.

It is not technology that debases the quality of life by polluting the natural environment - it is we ourselves. In this as in most matters the greatest enemy of mankind is man. Now is both a time to think and a time to act. We have available to us through science well-nigh limitless power over our environment if we use it properly. What we sorely need is a parallel development of what are sometimes called the social sciences so that we may understand ourselves. Science-based technology has shown that man can be healthy and wealthy - it is up to the rising generation to show that he can also be wise.

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