THE NEXT MILLION YEARS

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PREFACE

WHEN anyone starts to write on a subject, at which he has not hitherto worked professionally, his proper procedure should be to set out on a long course of reading, with careful preparatory annotations of all he has read. Such a course on a tremendous subject like the present one might easily take ten years. At the time when I determined to write this essay I was already over sixty-one, and it is safe to say that it would never have been written, if I had adopted this policy. Since I very much wanted to write it, the only alternative seemed to be to give up the idea of elaborate preparatory reading, and to make use from memory of a very considerable amount of unsystematic reading and thinking on the subject. A book written in this way can of course make no claim to the sort of authority that might be given to one which was based on exhaustive preliminary studies.

I fear that the absence of references will give some inconvenience to my readers. I might be able to quote some of the references, but many of them I could not, and some of these among the most important, so that justice would not be done to the subject by only citing the sources I could recall accurately. In the same way, I have gathered a good many of my ideas from conversations and discussions, in only some of which could I name my informants, so that there again it is juster to name none of them. In view of these doubts about the sources of my knowledge, it would not be proper for me to claim any originality in the views I express; I believe that some of them are original, but even with regard to these I shall not be at all surprised, if it turns out that I have been anticipated.

I have realized to the full the dangers to which I am exposing myself in forgoing the elaborate preliminary studies which the subject demands, but from my experience in other subjects I am encouraged to think that little harm will be done by it. The spirit of criticism is much commoner in the world than the spirit of invention, and progress has often been delayed by authors, who have refused to publish their conclusions until they could feel they had reached a pitch of certainty that was in fact unattainable. Progress in knowledge is more rapidly made by taking the chance of a certain number of errors, since both friends and enemies are only too pleased to exert their critical faculties in pointing out the errors; so they are soon corrected, and little harm is done.

Nevertheless I have taken all possible precautions so as not to make mistakes. I have tried to avoid errors both of principle, and in the examples which I cite, by getting comments from various friends who are well versed in the different branches of the subject, and I have certainly been saved from a good many errors in this way. Lest they should be thought responsible for opinions they may not share, I will preserve their anonymity, but I would take this opportunity to thank them for the great help they have given me.

PREFACE

In composing the essay I have had the difficult task of deciding the degree of knowledge that I might assume in my readers. It has seemed to me wise to err, if anything, on the side of explaining too much rather than too little, and I had therefore better apologize in advance if some readers consider I have wasted their time by explaining in too much detail things with which they were already familiar.

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INTRODUCTION

ANYONE who attempts to predict the history of the next ten years is a rash man, and if he attempts to make his forecast for a century he is very properly regarded as so foolhardy as not to be worth listening to at all. Nevertheless, I am proposing here to do what may appear at first sight a very much wilder thing still. I maintain that with our present knowledge of the world and of the things in it, though we cannot at all see the detail, we can foresee the general course its history is almost certain to take over a long period. It is certainly not possible to predict anything like a detailed history of the world, but nevertheless it is now possible to foresee a good deal of what I may call its average history. I do not know whether the true historian will admit that this has any claim to the title of history; certainly it could make no claim whatever to be a narrative of events. Its aim is far more modest; it is to describe roughly the kind of things that will be going on most of the time in most places.

In one respect it might appear that the prophet of the next million years had a very easy task. With the great differences of conditions over the different regions of the earth, it is almost inevitable that there must be a great deal of variety in modes of life. In the vast period of a million years, and over the great expanse of the earth, there must be an enormous variety in the happenings, and it may well be so great that, no matter what the prophet foretells, his prophecy will be verified at some place and time. To succeed in prediction in this sort of way would not content me; it would be no better than the prophecies of the fortune-teller, who makes a long list of mutually contradictory statements in the confidence that some at least of them are bound to be verified. My aim on the other hand is to form an estimate of the normal and not the exceptional course of the life of mankind on earth; to describe what will be happening most of the time. It is definitely concerned with the less exciting parts of history, the parts over which the historian's narrative often passes most lightly, because these parts include none of the stirring events which make up the great crises of history.

I need not say that I recognize that this is an exceedingly ambitious programme; probably most readers will start by regarding it as so over-ambitious that it is doomed to failure. My justification for attempting it is that it does appear to me that in the course of the past century, and in particular of quite recent years, there have been such enormous accretions to almost every branch of knowledge, that now as never before an essay like this has become possible. There have been very great historians in past eras, perhaps greater than any we have now, but they simply did not possess the material to accomplish anything of the kind. I have of course no claim whatever to pose as a historian, and it is through my other studies that I have been drawn to this attempt at a synthesis of the various branches of accumulating knowledge in the form of a forecast of future history. I have always had a great interest in history and in the biological sciences, but the final stimulus came from my studies in the physical sciences. It is these that provide the real reason for expecting that something like the present essay may be worth attempting. It may well be that some of my deductions will be corrected by those who have a deeper knowledge of the various subjects than any I can claim. I shall naturally be disappointed if my conclusions have to be corrected or amended in whole or in part, but even if it should be so, I hope I shall have persuaded some readers that the method itself is right; that is to say that it is possible now, with existing knowledge, to make a good forecast of tbe future fate of tbe human race.

To justify the principle that we can know what I have called the average history of humanity, I must make a short incursion into physical science. Perhaps I had better begin by reassuring the reader that I shall only need to explain a few generalities, and that no one need fear that there will be much further reference to the subject after the next three or four paragraphs. There are two quite different ways in which inferences, and in particular predictions, are made in physics, and the contrast between them must be made clear.

The older method is the ordinary process of cause and effect. As an example, Newton enunciated the law of universal gravitation, in obedience to which not only the apple falls to earth, but also the moon goes round the earth, and the earth round the sun. This principle enables the astronomer to predict exactly where any planet will appear in the sky at any given future date. Or again take the design of a complicated instrument, such as a television set. The designer arranges his electric circuits and his electronic valves in such a way that, if a specified electro-magnetic signal reaches the antenna, then calculable currents will flow in all the circuits, and these will give rise to calculable streams of electrons in the television tube, which in turn will give a calculable visual image. In this general type of case a definite cause produces a definite effect, and if the effect is not always exactly predictable, that is only because the calculations may be so intricate that the evaluation of the results is not practicable. By those who have not followed recent developments in science, this relation of cause and effect is regarded as the only way by which things can be predicted. For them scientific progress means the discovery of yet more exact effects produced by exact causes, and they conceive that the cause-and-effect relation is the sole idea in what is popularly, if vaguely, called the scientific method.

This would indeed have been broadly true of all the earlier stages of scientific progress and of all the earlier scientific laws that were discovered, but a very different new type of procedure began to emerge some eighty years ago, which has assumed almost dominating importance in recent times. This newer type of reasoning is connected with the principle of probability, and it is unfortunately true that there are a great many people to whom it has not yet become familiar. They find it surprising that the result of a great number of chances may be far more certain than the result of a few. Of course absolute certainty, of the kind given by the cause-and-effect relation, is never attained in this manner, but something effectively just as good does come out of it. As the number of chances becomes larger and larger, the effects of each single event become less and less important, and they tend to cancel out; the probability that they will all go one way becomes quite negligible, so that something approximating with great accuracy towards the average is the final, practically inevitable, consequence.

The classical instance is given by the molecules of a gas. We know a certain amount about the nature of these molecules, and indeed it might be possible at any rate in some of the simpler cases, to work out in detail what happens when two of them collide together, though I cannot call to mind any case where this has actually been done. To do it would be in accordance with the old cause-and-effect physics, but in fact it would not be very useful. This is because the number of molecules is so vast, and their collisions so frequent, that the effect of a single collision is of no interest, but only the average effect of all the collisions. It proves possible to know this average by a very general method, and the average can be found with out even invoking many of the properties of the individual molecules, even when these properties are well known. The most general deductions are the gas laws, which describe how the pressure of the gas depends on the volume of the containing vessel and the temperature; the most famous is Boyle's Law, which relates pressure to volume. Boyle's Law is verified with the greatest precision and the most absolute regularity whenever it is tested, and yet it is the consequence of the wildly varying and extremely violent collisions between the molecules of the gas. As I have said, in deducing the law it is not even necessary to use all the known properties of the molecules; for example we know with some accuracy the distance between the two atoms of an oxygen molecule, but in fact this distance plays no part whatever in the result. In order to derive Boyle's Law all that is required is the knowledge that the molecules constitute what are technically known as conservative dynamical systems.

For the rest of the gas laws it is true that a little more detail is needed; for example there are differences according to how many atoms there are in each molecule, but a very great deal can be known about the behaviour of the gas with only the sketchiest consideration of the details of the individual molecules. Indeed when a student first encounters the theory leading to the gas laws —it is usually called the theory of statistical mechanics— he is always surprised at the very little foundation that is required in order to establish, quite fully and logically, such an enormous superstructure. Of course it can never be possible to get something out of nothing; there must be a basic principle, and this, as I have said, is the condition that the molecules are conservative dynamical systems. This name is derived from the fact that the total energy of two colliding molecules is conserved, so that it stays constant during the collision, but the term itself has a far deeper significance than this, though it is one which can only be described in technical language. It would involve going rather deeply into the subject to explain it here; and I shall not attempt to do so, since I am only citing it as an analogy, but I must make the point that in this technical language the whole property of conservative dynamical systems can be described in a single sentence. The outcome is that in statistical mechanics, unlike the older cause-and-effect mechanics, the most enormous superstructure can be built, with confidence and certainty, out of a foundation which might appear to be narrow, in the sense that it can be expressed in very few words.

The analogy I have cited of the gas laws is the simplest example that is furnished by statistical mechanics, and it is only fair to mention that, when the subject is pursued further, it does get a good deal more complicated. Thus much greater difficulties arise in considering how the gas can condense into a liquid or solid, but it would not be profitable to follow the analogy into these intricacies. Even in such cases however, though the structure of the molecules must be specified a good deal more fully, the specification still remains fairly simple, and yet it can lead to the most elaborate consequences. The general principle stands, that in statistical theories quite complicated results can be deduced from simple principles.

The internal condition of the gas depends, as I have said, on the molecules being conservative dynamical systems, but there are also external conditions. Boyle's Law relates together the pressure and volume of the gas, so that the measurement of both these quantities must come into the picture somewhere. This they do through consideration of the containing vessel, for its size determines the volume of the gas, and the pressure is measured through the force exerted on the vessel's walls. If, then, predictions are to be made, of the kind yielded by the methods of statistical mechanics, it is necessary to consider both the internal and the external conditions.

When I claim that we ought to be able to foresee the general character of the future history of mankind, I am thinking of this analogy. The operation of the laws of probability should tend to produce something like certainty. We may, so to speak, reasonably hope to find the Boyle's Law which controls the behaviour of those very complicated molecules, the members of the human race, and from this we should be able to predict something of man's future. It is not possible to get something out of nothing here any more than it is in the case of the gas; so the possibility depends on finding out whether there are for humanity any similar internal conditions, which would be analogous to the condition of being a conservative dynamical system, and external conditions analogous to the containing vessel. If both these demands can be satisfied, then there is the prospect that a great deal can be foretold of the future of the human race, and this without any very close detail in the basic principles from which it is derived.

Most of the present essay is devoted to discussing the various principles needed in order to make these predictions, but I will here very briefly anticipate the fuller discussions that are to follow. In the gas, the external conditions were given by the containing vessel, and the analogy here is obviously the earth itself. From geology, we know a great deal about this; for example we know that it has had roughly the same climate for hundreds of millions of years, so that it is nearly certain that the climate will stay the same for one more million years.

The internal principle, which is to be analogous to the property of being conservative dynamical systems, of course lies deeper. It must depend on the laws governing the nature and behaviour of the human molecules. When I compare human beings to molecules, the reader may feel that this is a bad analogy, because unlike a molecule, a man has free will, which makes his actions unpredictable. This is far less important than might appear at first sight, as is witnessed by the very high degree of regularity that is shown by such things as the census returns. When averaged over a whole population these reveal a remarkable degree of regularity in most of the happenings of life; this applies not only to basic things like births and deaths, and uncontrollable things like the incidence of sickness, but also to things in which man docs regard himself as an entirely free agent. To take a quite trivial example, there is considerable uniformity in the names given to new-born infants, in the sense that it can be foretold with some accuracy what fraction of them next year will receive each of the more fashionable names. Thus though the individual collisions of the human molecules may be a little less predictable than those of gas molecules—which, as I have said, do not have to be considered in detail either—the census returns show that for a large population the results average out with great accuracy. The internal principle then of the human molecules is human nature itself.

Here once again geology provides help. A study of fossils has shown that it takes roughly a million years of evolution to make a new species of animal; during that time the animal is, it is true, slowly changing, but the cumulative changes are so slow that it is only at the end of that period that the animal can be regarded as sufficiendy altered to be dignified by a new name. This principle may be applied to man. For the next million years we shall be concerned with a history governed by the same human nature as we know now, with all its virtues and all its faults. There will, it is true, be small slow changes in human nature as time goes on, but it is only at the end of a million years that it may be expected to have so changed that further prediction about it would become impossible. That is the reason why I have referred to a million years in the title of my essay.

It is worth noting that it is only in very recent times indeed that the present line of argument could possibly have been developed. This is true of every part of the argument. In the first place it is less than a century since anyone realized the compulsive force of the laws of probability, so that before that no one could have conceived that so much could be derived from such a simple foundation. Then again the actual surface of the earth was very incompletely explored until even more recent times, so that something quite unforeseeable might have come out of its unknown regions; the position of the walls of the vessel could not be regarded as fully known. As to the internal condition, human nature, the same is even more true. It is only in the last fifty years that much has been known about the physiology and psychology of the human animal. In particular it is only since then that the principles controlling heredity in animals have begun to be understood, and it is obvious that those principles must govern the characteristics of the human race beyond all else. So until recently there was knowledge neither of the principles, nor of the data, which I am going to attempt to use in the ensuing chapters. If there were no prospect of deriving anything beyond a sort of flat average of the future of human history, it would be a dull business, but my analogy suggests that it should be possible to carry the matter a good deal further. The physicist can not only give the average state of his gas,,but he can also say something about its fluctuations, that is to say the manner and the frequency with which it is likely to depart from the average. To explain this, suppose that a sample of the molecules is periodically taken out of one corner of the vessel, say by trapping some of them in a little box. The number of molecules in the box should be in a fixed proportion of the total number in the vessel, and it will never be far from it, but sometimes the sample will have rather too many, and at other times rather too few. Furthermore the sample may vary in other ways; for example it may sometimes be hotter or colder than the gas in the main vessel. These variabilities are what constitute the fluctuations of the gas, and they can actually be observed by suitably designed experiments. They can also be calculated, again without knowing much about the individual molecules, so that it is possible to say what variations will occur, and how often they are likely to recur, though it is not at all possible to predict when they will occur. In the same way it should be possible to get some idea of the fluctuations of human history, which will lend a variety to the dead level of the average. Indeed these fluctuations will be far more prominent in human history than are those which are observed in a gas, for the reason that, proportionately speaking, fluctuations decrease as the total number of molecules increases. Now in the course of a million years there will have been a very great number of human beings, but even so it is incomparably fewer than the number of molecules in even quite a small vessel. So the fluctuations in human history will be far more prominent than the fluctuations in a gas.

Much of what will happen in the future can be read from consideration of the past, but there has on the whole been a tendency for historians, apart from their primary function of recording the past, to be interested not so much in resemblances as in differences. They have tended to emphasize the difference of structure of the civilizations of Egypt and Babylon, rather than to point out how much more alike they were, than was eidier to the contemporary barbarism of Europe. A distinguished exception to this has been the great work of Arnold Toynbee, who has studied what might be called the Natural History of Civilizations. This is an incomparably finer project than any I am competent to attempt, but it does adopt a similar line of thought, that of determining whether laws can be laid down from which the march of humanity can be foreseen.

The plan of the present work follows in a general way the course suggested by the analogy I have been drawing from physics, though there will be no further reference to this source. In the next chapter the subject is population. This is the most fundamental question of all, for if there were no human beings there could be no human history. Then there are two chapters dealing with what I have called the external conditions. One of these briefly reviews past history; its aim is to mention only the fundamentally important things, those that one might imagine would be noticed by an historian of a million years hence. The other deals with the physical conditions that may be expected to prevail in the world. Then there are three chapters dealing with what in my analogy I have called the internal conditions. These contain a discussion of what appear to be the chief qualities of the human animal, in so far as those qualities are likely to help his survival in the struggle for life. In the first of them he is regarded as a wild animal just like any other animal, and I consider the qualities which will help him from that point of view. The next chapter is concerned with the influence of his social qualities, in which he is so different from other animals. The third is devoted to settling the balance between the influences discussed in the previous two chapters, and in particular to the consideration of whether man is a wild or a tame animal. After this there are two chapters dealing with matters of a slightly less fundamental character, though they are much too important to be omitted. The first examines the effect of the limitation of populations, such as that which is being experienced at the present time in many of the countries of western Europe. The second considers the interesting, if less important, question whether man, in his perpetual striving after happiness, is at all likely to achieve it. In the final chapter I attempt a synthesis of all these things in the form of a forecast of the history of the future. It is divided into several sub-sections, each of which deals with one of the main aspects of human life.

I have attempted to arrange the whole essay on the plan that all the earlier chapters should lay down principles, and that the final chapter should contain their applications to the actual history. In laying the principles down however, it has been necessary to present a good deal of detail in order to explain and to illustrate them, so that in fact a good many of the applications will be found in the earlier chapters. I fear that this may be inconvenient in some cases, because such illustrations often have implications over a wider field than the principle immediately concerned, and thus the reader may be left with the feeling that the discussion is sometimes incomplete. In the final chapter therefore I have attempted to gather these threads together, as well as to fulfil my main aim of making the forecast of the general history of the future.

Before developing my arguments, it may be well to warn the reader that the consequences I am forced to deduce will be found exceedingly depressing by all the political and social standards that are now current. It will not perhaps be quite true that history will be "nothing but a record of the crimes and follies of humanity", but it will be much more like that than like the Utopias—for the most part, be it confessed, the lather depressing Utopias—which have been expounded by all the idealists. If the world is inevitably to be so much more dreadful a place than current thought expects, would it not perhaps be better to forget the fact and simply go on hoping? I do not think so; if we are living in a fool's paradise, it is surely better to know the fact. But the matter goes further than this; tor we certainly can do something to control the world around us, and if we can appreciate the limits of what is possible, we may have some hope of achieving our aims, whereas if our aims are outside possibility, then we are doomed to failure. Therefore it is a practically important thing to see clearly any laws which must set absolute limits to what it is possible to do.

A parallel will make this clearer. In the eighteenth century the state of knowledge of mechanics was very imperfect and many inventors devoted their time to trying to invent ways of making engines, so as to provide power for machinery. There was no known limit to what could be attained. Even though it had already been adumbrated that the perpetuum mobile was not possible, the principle was not understood at all exactly, and an inventor might not unreasonably at that time have felt that there was no limit at all to what he might hope to achieve in the way of inventing an engine. Almost exactly a hundred years ago the situation changed completely when the laws of thermodynamics Were formulated; these laws set very precise and absolute limits on what is attainable in an engine. At that stage the optimistic inventor, untrained in scientific principles, may have felt that the world had collapsed; what was the use of his going on in a world lost to all ideals, a world which insisted on a dreary uniformity with no hope that mankind would rise superior to the deadening requirements of the laws of mechanics? For him it must have been a bad world. Not so for the true engineer. He now could know just what was physically possible, and could set himself a target that was actually attainable with the sure knowledge that he might achieve something towards it. Through the recognition of these absolute limitations on what he can do the engineer now has a better, not a worse, prospect of doing good.

Can we not draw from this parallel the conclusion that if we know the limit of what is possible for humanity, through determining some kind of laws of human thermodynamics, we shall be more successful in doing good in the world, than if we recognize no limitations, and so are perpetually struggling to achieve what is in fact quite impossible? I am going to try to see what some of these laws of human thermodynamics are; of course they cannot be expected to have the hard outline of the laws of physical science, but still I think some of them can be given a fairly definite form. It will be for others more skilled in biology than I can claim to be, to perfect, or perhaps to correct, these attempts that I shall be making.