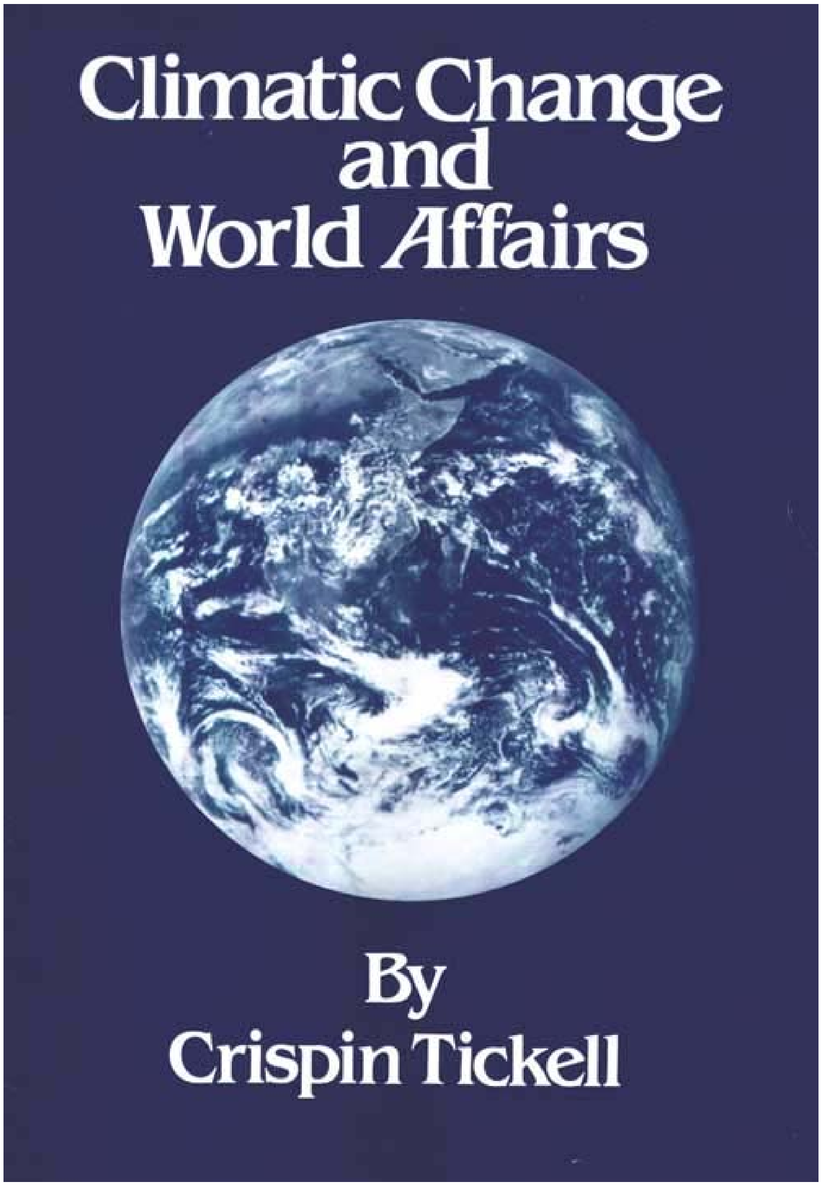

Introduction

For the complete text, please visit www.crispintickell.com/key14.html.

This is the introduction to Climatic Change and World Affairs (second edition), by Crispin Tickell.

This seminal book was first published in 1977, having been written the previous year while the author was on sabbatical from the Foreign Office as a Fellow at the Centre for International Affairs at Harvard University. It was published by the Centre and the University Press of America. The second edition, which represented a substantial revision and update, was published in 1986.

Climate is a condition of life. We are all a product of its vagaries. When it changes, so must we. Yet until recently most people refused to allow a climatic variable into their calculations of past, present, and future. Fluctuations had seemed so constant that real change, stretching over the span of a generation, had passed almost unnoticed. Even those required to think forwards - farmers, economists, planners, and politicians - preferred to work on a simple extrapolation of here and now.

That has begun to change. With the spread of communications we know more about what is happening to others as well as to ourselves. Such events as droughts, floods, heat, or chill seem to fall into new patterns. Worry about those patterns has been added to other forebodings about the future. Climate can be seen as one of the strands in a knot of uncertainties involving multiplication of the human species, pollution of the environment, and the shifting balance of power between states.

The vulnerability of certain regions to climatic change is a crucial element in their economic management and relationships with others. It is no accident that in the United States the Central Intelligence Agency was one of the first to try and assess the political and economic implications. Our ability, deliberate or inadvertent, to cause climatic change, possibly to the detriment of others, is also a new and alarming development.

Yet of all the aspects of the earth's environment, the climate and its variations, natural or otherwise, remains one of the least understood. It is an area where vital information is still lacking, where scientists can both passionately and plausibly disagree with each other, and where the man with a bee in his bonnet could still turn out to be right.

It seems nevertheless more than time to look with a somewhat political eye into the nature of the climate, why it works as it does, the causes of change, the extremes to which change can go, and the possible effects on our species. On this basis we can consider the implications for present and future generations, and what if anything could - or should - be done. Such a study requires an excursion into science as well as international affairs, and a certain lengthening of the perspectives to which we are accustomed.

To stretch the understanding in this way needs a different focus of space and time. Those who fly high in aircraft can sometimes see the curve of the world, and the smallness of the atmospheric envelope around it. It amounts to no more than a film of moisture on a sphere, and its mass is less than a minute proportion of the earth as a whole.

The passenger cannot of course look down beyond the shining surface into the sphere which is the ground of life. Nor can he see the successive layers of gas above which make life possible by giving protection from harmful radiation in space. Nor can he get any idea of the size of space from the blue sky.

To say that the sun is no more than one suburban star in a galaxy of one hundred thousand million stars and that this galaxy is no more than one among a hundred thousand million galaxies is to speak in abstractions. But we can have a sense of distance in our own backyard. If the sun is reduced to the size of an orange, the earth is a grain of sand at thirty feet, and the nearest star - another orange - is a thousand miles away.

The scale of time is even harder to grasp. When in the last century a poet described the desert ruins of Petra as "rose-red city half as old as time", he meant it literally. For him, absolute time began 4,000 years before Christ. For us, relative time began with the universe we can see, around 15,000 million years ago; and according to our calculations the earth was formed about 4,600 million years ago.

Suppose we knock off the zeros and reduce 4,600 million years to 46 years (a good life span in most human history), then the dinosaurs died just over 6 months ago, the present human breed emerged about a week ago, our counting system before and after Christ began less than a quarter of an hour ago, and the Industrial Revolution has lasted just over a minute.

More relevant to our present purposes, on the same time scale there were major ice ages on the earth nine and one-half years, seven and three-quarter years, six and one-quarter years, four and one-half years, and around three years ago. The most recent series of glaciations began less than a week ago, and the last glaciers retreated about an hour ago (See Figure 2).

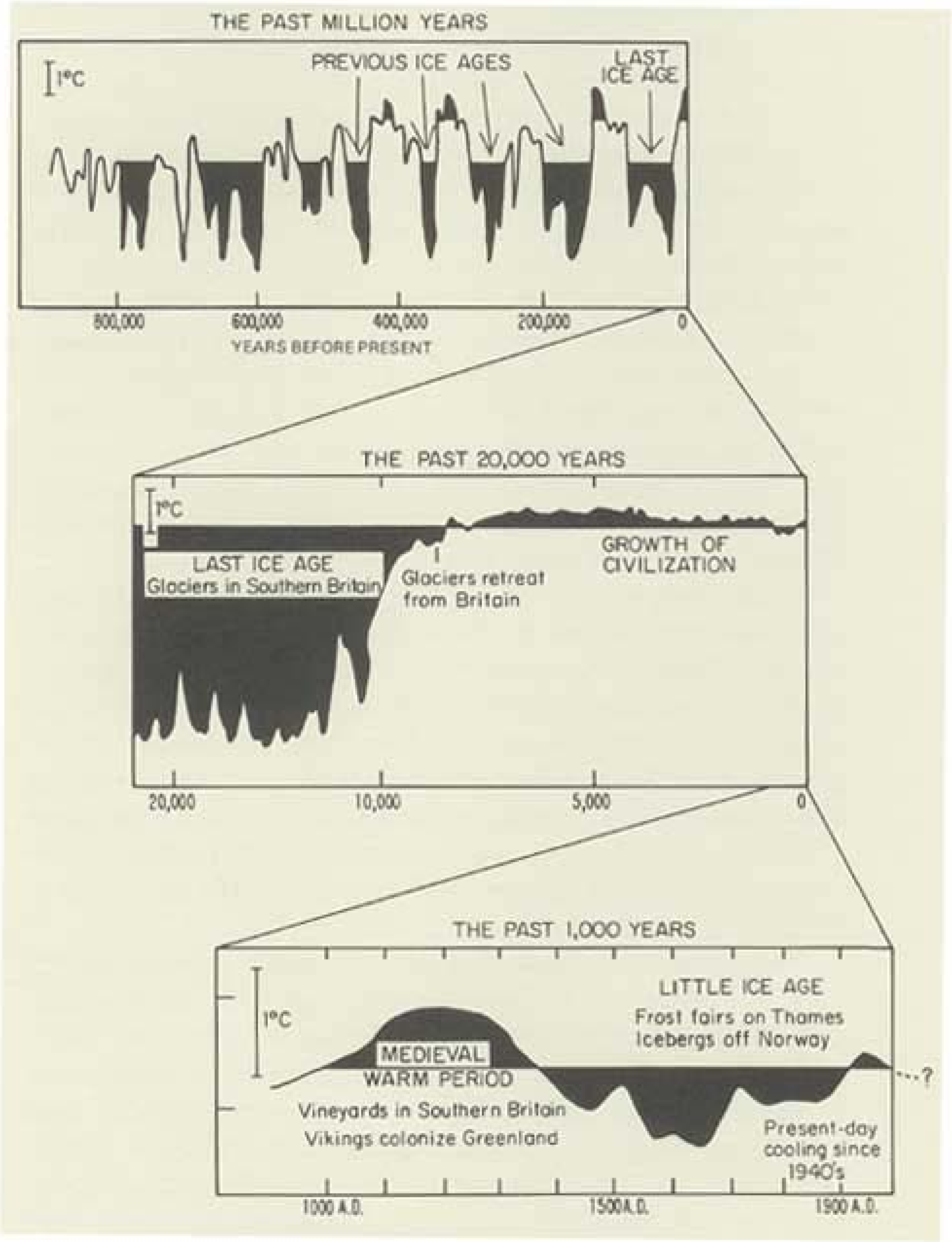

Figure 2: Temperature variations over the last million years.
Courtesy of the British Antarctic Survey.

In this perspective, we live in a tiny, damp, curved space at a pleasantly warm moment. It is hard for those in temperate latitudes to imagine the climate they know as anything but pleasantly warm. If climate is defined as average weather over forty years, then the warm conditions which prevailed in the northern hemisphere in the first half of this century were normal in their time. But in a time span of 500 years or longer, this warmth was distinctly abnormal. It was cooler before, and between 1945 and 1970 it became cooler again.

These variations, assessed on averages, are pretty small: the differences can be measured in tenths of a degree Celsius (an increase of about 0.5ºC between 1700 and 1940, and a fall of about 0.2ºC since then). But they should not be dismissed as negligible. Air temperature is only one way of measuring a climate. Rise and fall by a few tenths of a degree may point to a vital shift in weather conditions, more or less sunshine or cloud, glaciation or warm wet winds. Each of the local temperatures which contribute to a statistical average may - and do - fluctuate drastically.

In equatorial regions temperature is in any case less significant than incidence of rainfall. Most important, the range of variation between what we regard as extreme conditions is remarkably small. The average temperature in the northern hemisphere at the time of the Little Ice Age in the second half of the 17th century (when fairs took place on the frozen Thames) was probably only 1ºC to 2ºC less than at present, and even at the height of the last glaciation some 18,000 years ago (when most of the British Isles were under ice), the mean global difference was not more than 6ºC with greater or smaller changes in specific areas.

Climate is constant only in its variability. But before we can consider why it should vary, we have to know how the weather works in that tiny, damp, curved space which is our living room.

It is not too difficult to describe the principles of the weather machine, but its precise mechanisms are of a complexity which have so far defied integrated analysis. No one has yet made a mathematical model capable of simulating the operation of more than a small part of it. In some ways the more it is studied the less we realise we know. For example, only in the last few years we have come to appreciate better, the immense importance of the sea, which occupies more than two-thirds of the earth's surface, in conserving heat, conveying it from one area to another, and transferring it to the atmosphere in a way and according to rhythms not yet established.

Stated in the most simple terms, the power which drives the weather is the radiation of the sun and the spin of the earth on its own axis (for present purposes the energy which comes from the earth itself can be ignored). Of the sun's radiation, only part reaches and is absorbed by the surface of the earth.

- Some, including much of the dangerous short-wave ultraviolet radiation, is stopped or reflected back in the outer reaches of the atmosphere.
- Some is reflected back by cloud, dust, and other particles in the air.
- Some is reflected back by the surface of the earth: ice and desert are good reflectors, water and forest are good absorbers.
- The remaining radiation retained by the earth warms the atmosphere, but is eventually reradiated into space at relatively long wavelengths in the infrared.

Without an equilibrium of radiation, or if the balance were to be interfered with, the earth would obviously become warmer or colder.

The sun's radiation falls differently according to the tilt of the earth. The equator and tropical regions receive most because there the sun's rays are most nearly vertical, and there is least atmosphere to dilute them. At the poles by contrast, the rays are almost parallel to the surface, they have a long way to go through the atmosphere, and most of them are anyway bounced off the ice back into space.

At the equator the earth receives more radiation than it returns; and at the poles (and over deserts) it returns more radiation than it receives. What turns the weather machine is the earth's adjustment to this imbalance through the transport of heat by wind and water from the equator towards the poles, and a corresponding movement of cold wind and water from the poles towards the equator. The precise way in which it does so is determined by the spin of the earth, coupled with the particular configuration of land, sea, and ice cap.

The familiar pattern of winds and currents is the result (see Figure 3). In broad terms it produces a warm, wet, and stormy area on each side of the equator; an area of sunshine and sinking air where all the world's great deserts lie; the temperate areas in mid-latitudes governed by strong westerly winds; and the concentrations of ice and snow around the poles.

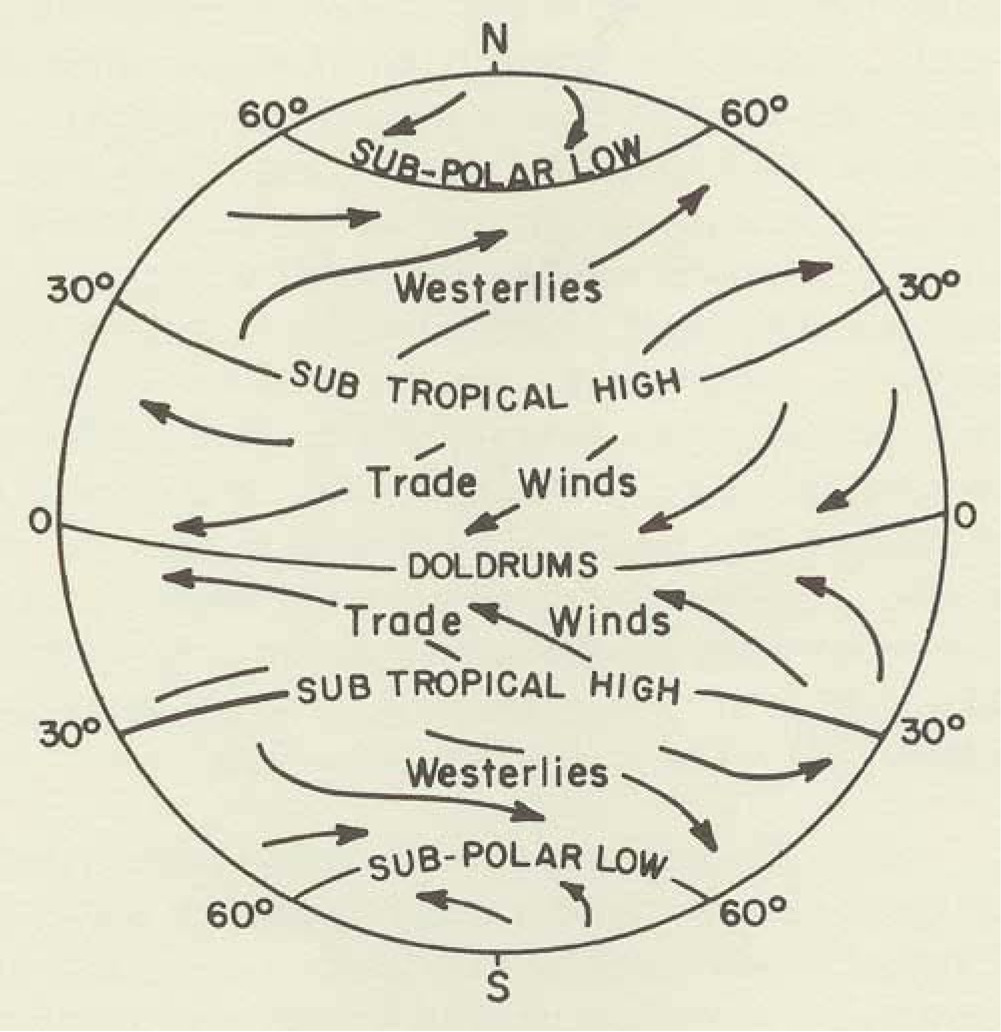

Figure 3: Prevailing surface winds in different latitudes (idealised scheme).
Courtesy of H. H. Lamb and Methuen Ltd.

No part of the weather system can be dissociated from any other: although the working parts have a certain tolerance, whatever happens in one area is likely sooner than later to have its effects around the world. The seasonal shifting of boundaries between the main areas is a function of the changing tilt of the earth towards the sun.

It is these boundary areas which are most sensitive to climatic change. The behaviour of the Asiatic monsoon is an easy example: the shift of a few degrees northwards of stormy equatorial weather in the northern summer brings rain to India and southern Asia; it shifts southwards again in the southern summer, and this time covers northern Australia. On the extent of this seasonal movement north and south, and on the tropical disturbances within it, depend the lives of hundreds of millions of people.

Seen from outer space the system would look fairly stable. Seasonal changes might not be the same every year. Annual temperatures might vary within a degree Celsius. Weather patterns might wobble over a few degrees latitude or longitude. But by and large the machine would seem to tick over with reassuring regularity.

The trouble about this spaceman's view is twofold: first, as we have seen, small changes can matter a lot to those who experience them; and secondly, the machine, from what we know of its past, is far from regular, and - depending on the time we take to look at it - can radically change its manner of operation. The point was well put in 1969:

> One can imagine a gambler's die lying on the floor of a truck running over a rough road; the die is stable on any of its six faces so that in spite of bouncing and vibration the same face usually remains up-until a particularly big bump jars it so that it lands with a different face up, whereupon it is stable in its new position...
>
> Perhaps in recent years we have been bouncing along with, say, a four showing. Perhaps 200 years ago the die flipped over to three for a moment, then flipped back to four. It could one day bounce over to a snake eye and bring in a new ice age! [1]

Or indeed to a six and to what has been called hothouse earth.

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