Irish Meteorological Society

Newsletter

Number 15 **February 1989**

This newsletter contains (a) the text of the Millennium lecture delivered by Dr. M. Kelly (in TCD) and (b) a sample copy of the Monthly Weather Bulletin issued by the Meteorological Service.

Announcements of interest to members are also included.

Aodhagan Roddy

Aodhagan Roddy
President

Evelyn Cusack

Evelyn Cusack
Acting Secretary

Annual Subscriptions

Subscriptions for 1989 became due on 1st January 1989. The subscription is £8 for Dublin members and £4 for country members. Cheques should be made payable to the **Irish Meteorological Society.**

Members have the option of paying by standing order (if they so wish). If you wish to use this method please use the standing order form which is enclosed with this newsletter. It is important to enter your name as a reference - otherwise the society will have no way of telling who has paid in the standing order.

Subscriptions to *Weather*

Members who wish to subscribe to *Weather Magazine* may do so by sending Stg£14.50 (or the equivalent in Ir£) to the Treasurer, J.Hamilton. This is a special price for twelve issues for Society members. Cheques should be made out to the **Irish Meteorological Society.**

Meteorological Calendar

As in previous years, the Royal Meteorological Society has produced a very attractive calendar for 1989. It may be ordered directly from :

Royal Meteorological Society,
James Glaisher House,
Grenville Place,
Bracknell,
Berkshire RG12 1BX,
England.

The price is Stg£1.90 for single copies (or Stg£1.60 per copy for orders of 5 or more). Postage is extra at 60p per copy. Cheques shoule be made payable to the **Royal Meteorological Society.**

Subscriptions to *Monthly Weather Bulletin*

The Meteorological Service publishes a Monthly Weather Bulletin with details of the weather for the past month and articles of general interest. A sample copy is enclosed with this newsletter. The normal price is £20 but it is available to members of the society at the special price of £12. To order it write directly to the Meteorological Service at :

Climatology Division
Meteorological Service
Glasnevin Hill
Dublin 9

Cheques should be made out to the **Accountant, Department of Tourism and Transport.**

THE CLIMATE OF DUBLIN: 988 TO 1988

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Humanity is at a threshold. Through pollution of the atmosphere, we may be bringing about a change in climate unparalleled since the recovery from the last ice age. Understanding the past history of climate is more important now that it has ever been. It provides a context which we can use to gauge the significance of future trends and it provides insight into the manner in which society may be affected by future change.

The study of climatic change is an interdisciplinary process, drawing on expertise in the atmospheric sciences, the biological sciences and the social sciences. Much of the information that I am going to present is based on the work of colleagues, both in the Climatic Research Unit and in other institutions throughout the world. I would like to acknowledge the particular contribution of the founder of the Climatic Research Unit, Professor Hubert Lamb - one of the pioneers of modern climatology. The review of the events of the earlier centuries of the past millennium is, for the most part, based on his work.

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The founding of Dublin in the 10th century occurred at a time when the climate of the region was undergoing gradual amelioration following the harsher conditions of previous centuries. This climatic improvement reached its culmination in the 12th and 13th centuries and the period of relatively favourable climate, from around 900 to 1300 AD is known as the Mediaeval Warm Period. It provided favourable conditions for the development of a new trading and agricultural centre.

These conditions did not, however, last. Following the warmth of the 13th century, temperatures began to decline marking the start of the so-called Little Ice Age. This, possibly the period of harshest climate during the present interglacial, reached its climax during the 16th and 17th centuries. The most recent centuries have been a period of gradual recovery. By the mid-20th century, temperatures approached the warmth of the Mediaeval Warm Period.

How can we derive information such as this concerning past climate when our instrumental observations of weather and climate - taken with thermometers and raingauges - are restricted, in the main, to the most recent 100 years or so?

First of all, use can be made of historical, or anecdotal, accounts of periods of unusual weather and climate. These accounts are drawn from a variety of sources: from the diaries of monks in mediaeval monasteries,

from the accounts of manorial farms, from the writings of early travellers and historians, and so on.

Of course, such information has to be used with care. It is subjective. A severe winter for a monk in an unheated monastery might not appear as harsh to the lord in the manor. A Mediaeval farm manager, seeking an excuse for a poor harvest caused by his own inefficiency, would be quick to blame the weather. Care has to be taken to cross-reference accounts and, wherever possible, to track the information back to the original source.

There are also a variety of biological and geological indicators that can also be used to derive past climate information. For example, tree growth responds to climatic change and provides the most accurately dated of the biological measures of climate.

In order to illustrate the potential of this method of climatic reconstruction, I am going to describe recent work undertaken by myself in collaboration with Dr. Malcolm Hughes at the University of Arizona and Martin Munro then of the Palaeoecology Laboratory at the Queen's University, Belfast.

Previous research by Dr Mike Baillie at Queen's has demonstrated that, during particular years, oak growth throughout much of western Europe experienced a simultaneous increase or decline. From the west of Ireland over to eastern Scandinavia, from northern Denmark through to southern France, during these critical years - about one a decade - tree growth showed the same growth trend.

It has been known from many years that these common growth trends occurred on a local scale. Indeed, this is the basis of the dating of early timbers - dendrochronology - but no one had realized that it was possible to identify common trends over the many hundreds of kilometres represented by the network of chronologies. Why should this behaviour occur? We examined the climate data for these years in order to determine whether or not this was the linking factor. And, indeed, it is.

During the spring and summer of years when growth increased over the network, above normal rainfall levels occur over much of western Europe. Rainfall is a critical factor in this part of the world, limiting tree growth if it is in short supply. With abundant rainfall throughout the region, tree growth is not limited and increases throughout the network. The cause of the increase in rainfall supply is clear in the pressure charts for these years - low pressure, more frequent, and perhaps more intense, depressions passing through the area - a pretty miserable summer for human beings but favouring the growth of trees!

In the case of years with decreased growth, temperature is the critical factor - low temperature in the north of the network, where the trees are near the northern tolerance limit, and high temperatures in the south, where oak is near the southernmost limit of its range.

Information such as this can be used to construct records of the changing frequency of wet springs and summers, low temperatures over Scandinavia, high temperatures in southern France, back well into the most recent millennium using the information from the tree-ring chronologies.

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And so to the most recent 100 years.

The Climatic Research Unit has, over the past ten years or so, compiled one of the most comprehensive and reliable sets of instrumental climate data available today, totally 1000s of records worldwide. I have used this data bank to compile two new records of Irish climate for the past 10 years or so - one for temperature and the other for precipitation, rain and snowfall.

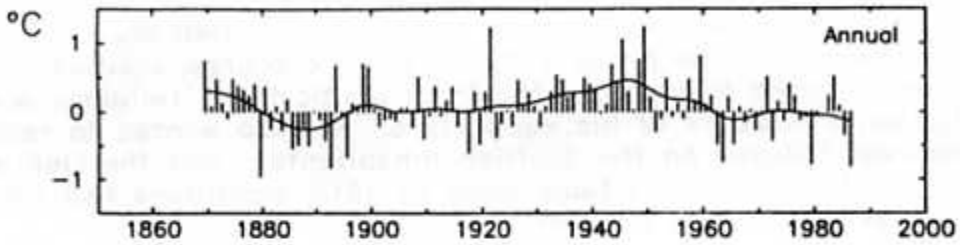

Figure 1

Annual temperature, as departures from the 1951-79 reference mean in degrees Celsius, for the area of Ireland.

Figure 1 shows the area-average record of temperature based on all Irish meteorological stations for the period 1869 to 1986. The data are in degrees Celsius as departures from the 1950-79 reference level. These are annual averages. I would like to draw your attention to three main points: the warmth of the very early years of the record, the gradual warming of the early 20th century that reached its culmination in the 1940s, and the cooling that ensued. The three coldest years this century have occurred in recent decades - 1963, 1979 and 1986.

This pattern of warming and cooling has affected all four seasons although it has been most marked in winter and spring. In winter, though, the warming peaked earlier, during the 1920s. Interestingly, summer and autumn temperatures have been rising in recent years.

These variations in temperature have had a marked affect on the growing season. From eight months a year with temperatures above 6°C in 1900, the growing season increased to almost nine months by the 1940s, with a 20% reduction in the period of winter cattle feeding. It has since decreased in length by about two weeks.

In the case of precipitation (Figure 2), there has been an overall increase in levels over the period of record. Winter rain and snowfall has increased steadily through the 20th century, with the highest levels reached during the 1960s. Spring rainfall has been very variable, and shows a decline over recent decades. There has been a gradual increase in summer rainfall, with particularly high levels during the 1960s and 1980s and the same pattern, albeit with a more marked increase, can be seen in autumn.

Let's now place these trends in a wider context.

In the case of global temperature, based on records from land and sea, there has been a consistent rise in temperature - by about 0.5°C - since the mid-19th century. The record for the warmest year in the temperature record has been broken four times during the present decade.

I would now like to return to the Little Ice Age and look at the climatic backdrop to two events which have shaped Ireland's history: the so-called plantation of the early 17th century and the potato famine of the 1840s.

The late 16th century was a time of poor climatic conditions in many areas of Scotland. Starvation occurred because of the combined impact of poor summers - harvest failure - and severe winters - resulting in stock losses.

The plantation of Scots farmers to the more fertile and climatically benign lands of Ulster in 1612 and the eviction of the native Irish occurred for a multiplicity of reasons. The primary factor was, of course, political in that King James wanted to stabilize the Irish political and religious scene by importing large numbers of his supporters. He also wanted to reduce the impact of harvest failures on the Scottish inhabitants - and the risk of unrest there - although it is notable that, by 1612, conditions had improved following the severity of the late 16th century.

As conditions again worsened during the late 1600s, a second wave of emigration from Scotland began. This time in direct response to climate. The 1690s marked the most severe phase of the Little Ice Age and starvation and famine occurred in many parts of Europe.

Ireland was spared to a great extent the misery that affected other parts of western Europe. The adoption of the potato, more suited than wheat to Ireland cooler, wetter summers, provided what has been referred to as a "bulwark against famine". Not only was it more suited to the Irish environment but it produced several times as much food per area cultivated as grain crops - an important factor in a land of small farms and relatively large population.

So effective was the potato as a food crop that Ireland's population grew at a rate greater than that of her neighbours during this period. However, the 1840s provided a salutary reminder that it is not wise to depend on a single crop - a lesson that we may well bear in mind when considering the future impact of climatic change.

By the mid-1840s, the population of Ireland had reached 8.5 million with the potato the only crop capable of supporting the growing population.
The potato blight was first reported in Belgium in June 1845 and reached Ireland in September of that year. Easterly winds were typical of that summer and the disease spread westwards in response. As Dr. Austin Bourke has shown, the weather conditions were ideal for the development of the blight during that period - high humidity, a lack of low temperatures, plentiful moisture in the form of fog or rain. The record warmth of the winter kept the infection alive in many areas and frequent rains in Ireland during the summer of the following year favoured the further spread of the infection.

Over one million people, over a tenth of the population, died of starvation or malnutrition-related diseases, during the ensuing few years. By 1851, death and emigration had reduced the population by a quarter, soon by a half. I might add that my ancestors arrived in Liverpool from southwest Ireland about this time.

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Why hasn't Ireland experienced this change in climate? In fact, while much of the northern hemisphere has been warming rapidly over the past 10-20 years, temperatures around the North Atlantic sector, including Ireland, have remained constant or have dropped slightly. The warming has been strongest over the northern continental interiors, Alaska and Siberia, and over lower northern latitudes.

In the case of rainfall, Ireland's experience is consistent with the broader picture. The increase in Irish rainfall reflects the trend that has affected much of middle-to-high latitudes in recent decades - a steady and consistent rise in rainfall levels. The mirror image, in fact, of what has been happening at lower latitudes - a steady decrease in rainfall levels. This decline in rainfall has been most marked in Africa, underlying the tragic drought of recent years, but it has affected much of the subtropical belt.

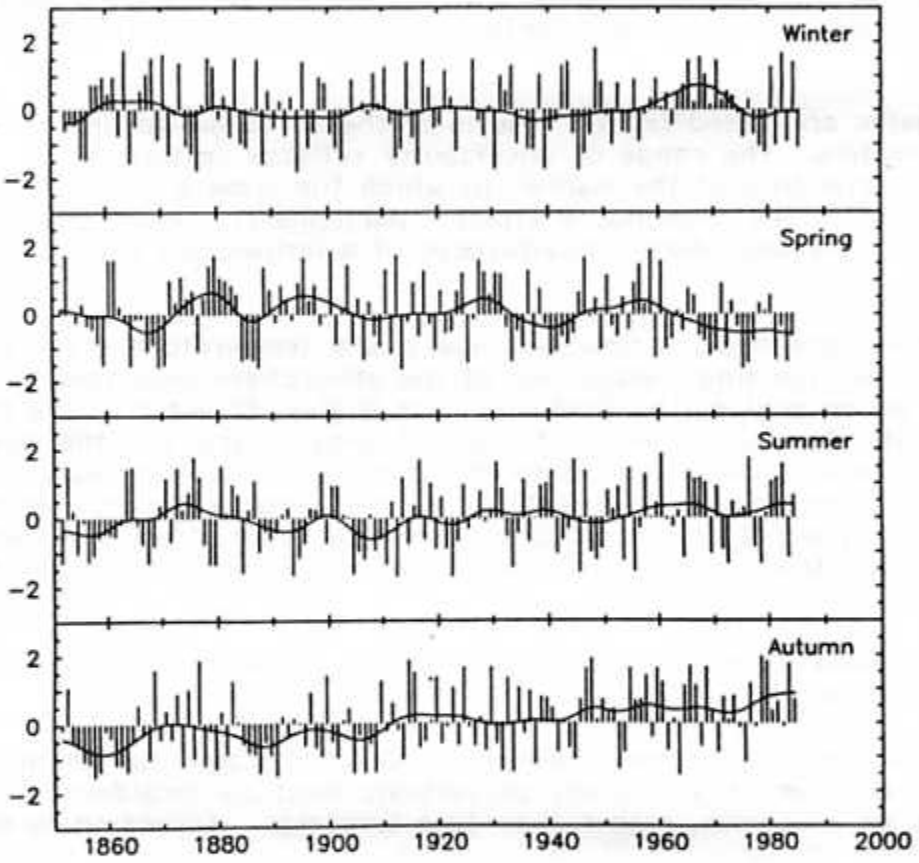

Figure 2

An index of seasonal precipitation amount, arbitrary units, for the area of Ireland.

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And so to the future. Will these trends continue? Will Irish temperatures eventually share in the rise that has affected many other parts of the world? I referred in my introduction to the fact that humanity has reached the point where it could itself shape the course of future climate.

Global levels of carbon dioxide, the chlorofluorocarbons (CFCs), methane, nitrous oxide and, in the lower atmosphere, ozone are increasing rapidly as a result of rising energy demand and industrial and agricultural expansion - processes which are fundamental to the development of modern civilization.

These gases are "greenhouse" gases. They allow incoming solar radiation to pass through the atmosphere relatively unhindered but trap heat radiated from the Earth's surface and lower atmosphere before it can escape to space. Enhancement of this heat trap - of the greenhouse effect - as levels of these gases increase could bring about a substantial change in global climate.

There is, in fact, now general agreement within the scientific community that a doubling of the concentration of carbon dioxide in the atmosphere - which might occur by the early decades of the 21st century - could produce global warming of between 1.5 and 5.5°C (Celsius). To place this projected change in climate in context, the temperature rise that marked the end of the last ice age was of the order of 3 to 4°C. Even at the lower end of the range, greenhouse warming represents a substantial change in the planetary environment.

These estimates are based on the results of the so-called general circulation models. The range of uncertainty reflects limitations in current understanding of the manner in which the climate system will respond to enhancement of the greenhouse effect - particularly concerning the role of "feedback", the secondary consequences of a large-scale rise in temperature.

Figure 3 shows one model estimate of how global temperature might rise in response to the changing composition of the atmosphere over coming decades. It is based on an analysis by Professor Tom Wigley, Director of the Climatic Research Unit. The estimates are for global temperature, but the rise in Irish temperature, given Ireland's middle latitude location, is likely to be by about the same amount. The rate of warming accelerates during the 1990s and it is in this decade that significant warming could affect this part of the world. Past trends pale into insignificance in comparison to the future warming.

How might Ireland's climate change over coming years in response to the greenhouse effect?

It is impossible to predict the regional details of the potential change in climate with any certainty and any projections must be considered possibilities, or scenarios, rather than firm forecasts. According to one scenario, based on warm periods in the past as an analogue for the effects of global warming, Irish rainfall is likely to decline over the next two decades in the spring season but increases can be expected in the other three seasons. This is the same seasonal pattern that has been observed in recent decades. Temperatures may rise by up to 1°C by the early 21st century, increasing the length of the growing season by as much as two months. Sea level will rise as glaciers on land melt and the warming ocean water expands.

The combined effect of changes in the length of the growing season, in moisture availability at different times of the growing season, in energy demand as winter temperatures rise, on coastal regions as sea level rises, and on the range of climate-related activities could be profound. As we have seen in the historical record, in some cases, the effect will be beneficial - in others it will be adverse. But without foresight and preparation, disruption will be inevitable.

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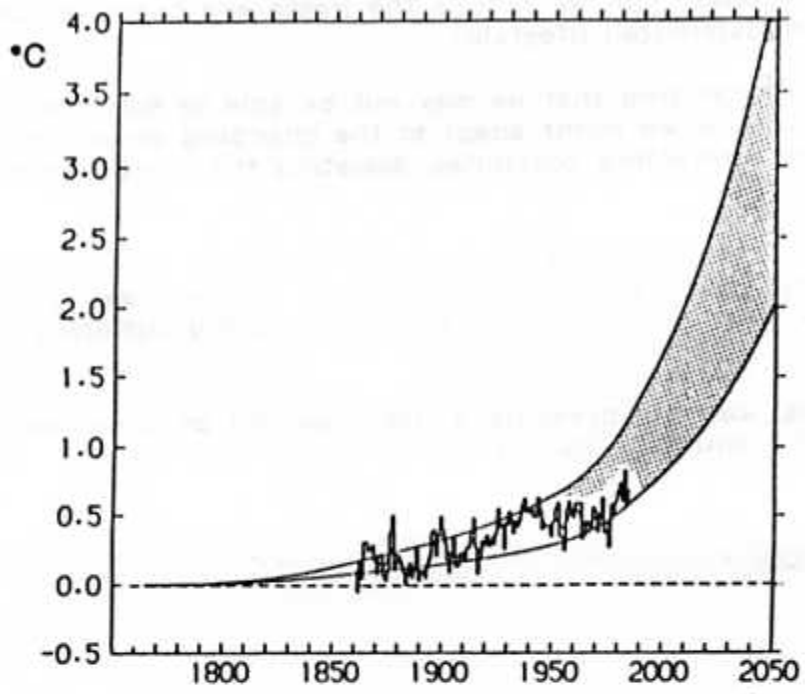

Figure 3

One estimate of the future course of global temperature (°C), expressed as departures from the pre-industrial norm. The solid line indicates the temperature history of the planet over the past 100 years or so. The shaded area suggests the range within which temperatures might fall over coming years.

Source: Wigley, T.M.L. Testimony to the US Senate on the greenhouse effect. **Climate Monitor**, 15(3), 69-77, 1986.

Whatever the nature of the impact on Ireland, it is unlikely to be as devastating as the impact of global warming on the Third World. While the impact will be measured in terms of pounds and pence in the industrialized nations, in the Third World it will be measured in terms of loss of life.

Those who have the resources will adapt to the changing environment. Those who are poor and vulnerable, already living on the margins of survival due to economic deprivation, social injustice or environmental degradation, will undoubtedly find their prospects for survival becoming slimmer and slimmer.

Can we avert this threat?

If we so choose, we can limit releases of greenhouse gases
- o by reducing energy consumption - the burning of fossil fuels is the main source of energy and of carbon dioxide pollution
- o by burning fossils fuels which release less pollution - natural gas rather than coal or oil
- o by switching to safe, renewable forms of energy such as solar and wind power
- o by banning the use of chlorofluorocarbons, the propellants in aerosol cans
- o by stopping deforestation - a major source of carbon dioxide - and
- o by promoting reforestation.

But we also need to consider the fundamental cause of the greenhouse problem which, in my view, is the headlong rush for short-term profit without thought to long-term consequences - growth at any cost. Should we be more modest in our ambitions? Can we reduce the waste and over-consumption that is typical of the industrialized lifestyle?

At the same time, recognizing that we may not be able to halt the warming trend, we must plan how we might adapt to the changing environment, by altering agriculture, protecting coastlines, assisting the Third World more effectively, and so on.

Many of these measures would have a range of beneficial side effects - reducing other atmospheric problems such as acid rain and smog, protecting valuable resources such as the tropical forests, reducing suffering in the Third World.

The threat of global warming presents a challenge and an opportunity - to create a fairer, more equitable society.

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Lamb, H.H. **Climate, History and the Modern World.** Methuen, London, 1982.