# Holocene wiggles

*from R. W. Fairbridge*

THE trouble with time series relating to geophysical and climatic phenomena is that the instrumental data base is often less than 100 years long, whereas many of the suspected planetary steering mechanisms operate on quasi-periodic wavelengths in excess of $10^3$ years. More precise chronostratigraphical methods are needed when looking for correlations in the area of celestial mechanics where hindcasting may often be estimated with a year-to-year accuracy, for at least $10^4$ years. The customary geological dating technique in this age range, radiocarbon, commonly suffers from an accuracy of only ± 250 years or so.

Some new developments discussed at a recent meeting* promise to provide a year-to-year chronology dating back to beyond 13,000 BP, with a precision of ± 1 year. First, there is the old varve chronology of De Geer. To begin with it suffered from a 'bad press'; people did not feel much confidence in a simple thickness counting. But over the past two decades the Swedish scientists and government have considered it important enough to spend several millions of kronor proving the accuracy of the method (within the error limits of radiocarbon), and re-counting the old series. I. Cato (University of Uppsala) recently completed the count up to AD 1980 and incidentally has shown that it is the annual peak flood (1–2 days) that corresponds to the maximum thickness of the summer varve. Soon it will be possible to state the peak flood years in south and central Sweden for the past 13 millennia.

Second, the $^{18}O/^{16}O$ analyses of ice cores taken in Greenland and Antarctica are being extended and 'massaged' to generate far more precise time series than at first seemed possible. At the meeting, C. Langway (SUNY, Buffalo) described some of the techniques and W.D. Hibler (Cold Regions Research Laboratory, New Hampshire) demonstrated an approximately 20 year cycle recognized in both ice cores and tree rings since AD 530. W. Dansgaard (University of Copenhagen) recently reported[1] some of the ice-core problems and solutions. Absolute (year-to-year) counting now goes back nearly 2 millennia and is rapidly being extended. Hammer, Clausen and Dansgaard[2] have described an ingenious *p*H-measuring device that records the acid layers in the ice cores that develop as a result of volcanic gas 'rain-out'. As Clausen (University of Copenhagen) demonstrated at the meeting, it is now possible to identify many historically known volcanic eruptions and thus independently confirm the layer counts. When combined with the oxygen isotopes, this gives a climatic reading.

The third category of Holocene wiggly-line time series concerns dendrochronology. In contrast to varves and ice cores that reflect regional climatic trends, tree rings initially reflect only individual trees, but with regional studies and sophisticated analysis this material also furnishes valuable climatic series. In addition, and most importantly, the tree rings provide a fourth wiggly line — the variations in the radiocarbon flux — from which come the cosmic ray and solar wind fluctuations. We now have a picture of solar activity that takes us back nearly 8,000 years[3], and this limit can be extended to beyond 13,000 BP as soon as some floating chronologies can be tied in.

The problem of floating time series is a speciality of D. Schove (St David's College, UK). There are numerous varve and dendrochronological series from Europe, North America, South America and Asia that have not been tied in to a known datum. If these long runs can be spliced together we shall get a year-by-year record of climatic events (local, regional and, we hope, global) going back nearly 14,000 years. Schove works on the principle that most of the wiggles represent local climatic 'noise' and may have little global significance, but certain key years disclose very remarkable 'spikes' which recur in distinctive patterns. The methodology works very well with tree rings, varves and, on a longer time scale, geomagnetic reversals.

Simplistic correlation attempts with the 11 year sunspot 'cycle' have often run aground, but analyses of phase changes and interactions with other cyclic effects can be rewarding, as reported by J. Harlin[4]. Schove[5] has considered the fact that the quasibiennial cycle (26 months), when superimposed on a powerful annual signal, may eventually lead to a 3 year jump. Inasmuch as the sunspot maxima fluctuate markedly, the combined effects result in distinctive patterns for any given century. Although the astrophysical and meteorological mechanisms are still shrouded in mystery, the pattern system seems to work, providing the approximate time span is known — and this link is provided by radiocarbon and other geological techniques. Particularly important time series that may soon be tied in by these 'teleconnections' are the Finnish varves, described by M. Saarnisto (Oulu University, Finland), and those of southern Germany by J. Merkt (University of Hannover). Schove has proposed teleconnections in the mid-Holocene between America (Bristlecone), Ireland, the Crimea and Anatolia[6].

Hints about the long-term variables were to be found in the palaeomagnetic records displayed at the conference by K. Creer (University of Edinburgh). Systematic coring of undisturbed lake beds from different parts of the world is now beginning to bear fruit. Both inclination and declination show systematic fluctuations with a quasi-periodicity of the order of 1,000–3,000 years. A variable rate of westerly secular drift introduces a longitudinal lag in dates, and at the same time warns of the variability in the outer core dynamics.

Inasmuch as both the geomagnetic field and the solar wind (a magnetized plasma

*A conference on 'Holocene Correlation' was held on May 1, 1981 at the Warburg Institute, University College London, under the auspices of the UNESCO-supported International Geological Correlation Programme no.158. The meeting was jointly chaired by Dr Derek Schove and Professor Rhodes W. Fairbridge.

*R. W. Fairbridge is Professor in the Department of Geological Sciences, University of Columbia.*

## 100 years ago

*NOTES FROM THE MALAY ARCHIPELAGO*

A correspondent in Java sends us the following:-

The cattle plague has been raging in the west end of Java, Bantam, the Preanger, and Batavia residences — during the west monsoon (now finishing) with redoubled vigour. It has now abated a little (after four years it may well do so, from want of victims) in these parts, but is extending eastward, its appearance in Krawang being the most alarming. The authorities have decided upon making a double-fence right across Java at its narrowest part. This means a line from somewhere about Cheribon due south. In the interval — a considerable one — between the two fences, no cattle will be allowed to pass or exist.

There is a bird (native name Jallak) which follows the buffaloes about and perches on their backs. Query, can this bird have anything to do with the spreading of the plague? If so I don't see what Government can do. They can't fence him out.

In all the parts where the cattle-plague has raged the most awful fevers have been the result amongst the native population. In Bantam alone 50,000 died in 1880. In the Preanger and Batavia the death-rate was also very high. There is no doubt whatever that this is due to the imperfect interment of the carcases. The Government says it is due to the wet season; but this is a lame excuse, for why is there no fever elsewhere? In the wet season it is, of course, worse, for the heavy rains cause more miasma.

From *Nature* **24**, 25 August, 399, 1881.

0028-0836/81/340670-02$01.00