

BOOK REVIEW

Tree Rings and Climate by H.C. Fritts (Academic Press, 1976). Pounds stg 16.00, xii + 567 pages.

To readers in the southern hemisphere, dendroclimatology is a fairly new and rapidly expanding branch of science with great potential for getting at the climates of the past, beyond our very short historical and instrumental record. Even today there are only a handful of Australians working in this field, despite the knowledge that accurately dated sequences of climatically sensitive tree rings exist, or can be constructed, for a thousand years or more in Tasmania. The potential of trees in mainland Australia, ranging at least from the Atherton Tablelands to the Snowy Mountains, and across to southwestern Western Australia, is only beginning to be assessed.

It is therefore very valuable to have this detailed and comprehensive text on the classical basis of the subject as it has been developed since A.E. Douglass first attempted to relate sunspots and climate via the evidence contained in tree rings, back in 1901. Fritts has been one of the key workers in the group centred on the University of Arizona where Douglass established the Laboratory of Tree-Ring Research in 1937.

The book has been a long time in the making, having been largely written during a sabbatical in 1968-69, but not published until 1976. This is both a strength and a weakness. It ensures a well-considered text, which focuses on the classical proven methods, techniques and findings, but on the other hand it pays scant attention to some important recent developments. The most notable of the latter is isotopic analysis of tree-ring material, which receives only one passing mention. X-ray densitometry is mentioned as a hopeful technique, but it too is given little solid discussion. Both these omissions are understandable in a book drafted nearly a decade ago, and are excusable in this book because it provides such a comprehensive account of the more classical aspects of the subject.

The first chapter introduces and defines terms and concepts, and whets the appetite with glimpses of the potential of dendroclimatology. Nevertheless, this reviewer found some of the discussion of definitions and concepts a little ponderous and pedantic, and once or twice downright peculiar. For example, on p. 46, it is said that 'the climate may be regarded as a system with certain properties and processes that produce the climate including its variations . . .' and on p. 47 this is followed by: 'Sometimes climatic states in the past have persisted long enough to be considered climatic change . ..'. These appear to be unfortunate aberrations in an otherwise smooth-flowing text.

Three chapters follow that discuss in great detail the basic biology of tree growth, which governs the response of ring width to climatic variations. To a non-biologist struggling to interpret the text, using unfamiliar terms defined a chapter or so earlier, these chapters are heavy going. However, they do establish a sound basis for later climatic interpretations and acquaint the non-biologist with the complexities of biological systems and suggest the dangers of too facile an interpretation of tree-ring data. They also highlight for me the as yet unrealised potential for detailed intra-annual climatic reconstructions to be found in a close study of the cell structure within the annual rings.

Chapter 5 considers how the biological system is linked to climate via the variables of site location and the network of interacting biological processes. The same climatic deviation, e.g., above average temperature, can affect different processes in different ways so that some inhibit and others enhance tree growth. Different tree species, locations, or times of year may thus lead to different growth responses to similar climatic deviations.

The next chapter treats basic statistics and methods of analysis in the context of tree-ring measurements and climatic variation. Familiarity with the many considerations raised here should prevent workers falling into several common pitfalls such as inadequate replication of data and the use of inhomogeneous climatic data. Methods of standardisation, which remove variations due to the life cycle of the individual trees, are discussed, as are autocorrelations and spectral analyses.

In chapter 7 the foregoing is applied to the problem of 'calibration', i.e., identifying the standardised ring-width variations that result from variations in climate and of transforming such indicators into estimates of climate. This leads us into quite sophisticated statistical techniques of multivariate analysis, including principal components and stepwise multiple regression. For those not conversant with statistics this may prove heavy going, but it leads directly to an understanding of the most soundly based climatic reconstructions, which use tree-ring data from a multiplicity of trees and sites for local and broad regional studies.

Chapter 8 discusses the interpretation of climatic calibrations and reconstruction at single stations, and their verification from independent data. Chapter 9 goes on to look at spatial variations in climate and their reconstruction from tree-ring data, including, for instance, seasonal anomaly maps of temperature, precipitation, and pressure for particular individual years over North America and the North Pacific Ocean.

In a brief concluding section on present and future prospects of dendrochronology, Fritts holds out some hope that usable data will eventually be obtained from some tropical trees (a hope being actively pursued by a group from the Australian National University working in the Atherton Tablelands of north Queensland). However, he fails to mention isotopic studies or X-ray densitometry in this context. Isotopic studies are certainly at a very early stage and suffer severely from an understandable lack of replication due to the expense and time necessary to make each isotopic analysis. Nevertheless, a moderate investment of time and money in well-chosen areas might yield large dividends from isotopic studies. X-ray densitometry, by virtue of the technique, cannot yield as detailed a cross-section along any single tree radius as a skilled observer with a microscope, but it has the great virtue of speed and economy of scale. Where replication of data to separate climatic signal from other 'noise' is demanded, this technique may well enable more progress to be made.

Fritts' book concentrates very much on data and examples from the prolific workers at the University of Arizona. This is natural enough, but it introduces an unfortunate regional bias, with little mention of the results of European workers and even less of the small amount of work done in the southern hemisphere. Unfortunately, the book does not contain a geographical index, nor geographical entries in the subject index, so this bias is too laborious to document. Readers interested in particular sites or areas will also find this omission somewhat annoying.

The book reads well, although ponderously at times. It is well laid out, with contents lists at the beginning of each chapter and generally clear diagrams with detailed captions. I found very few typographical errors.

Overall, I would certainly think that anyone seriously interested in entering dendroclimatology, or in using dendroclimatological data, ought to read this book carefully. Those meteorologists and climatologists who are inclined to dismiss tree-ring data as inspired guesswork would also do well to examine the book. It leaves little doubt that rigorous and careful dendroclimatology is highly scientific in its approach and capable of a large contribution to our knowledge of climate variations. Despite its omissions, this book is undoubtedly destined to be the classical text in its field for a long time to come.

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