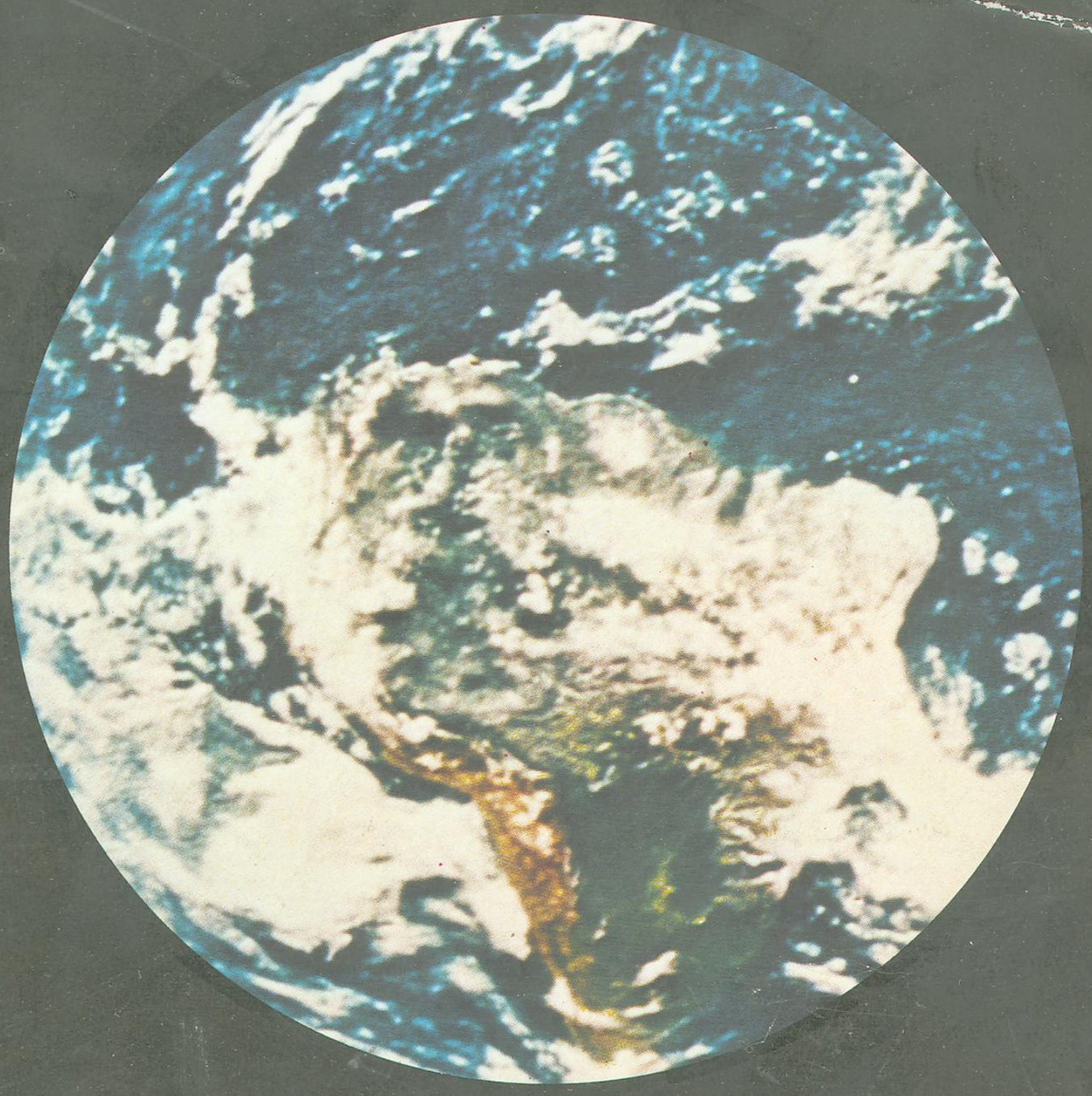
H. E. LANDSBERG
EDITOR IN CHIEF

World Survey of Climatology



VOLUME 13

Climates of Australia and New Zealand

J. GENTILLI
EDITOR

World Survey of Climatology Volume 13

Climates of Australia and New Zealand

edited by J. GENTILLI

University of Western Australia
Nedlands, W.A. (Australia)

ELSEVIER PUBLISHING COMPANY Amsterdam-London-New York 1971

ELSEVIER PUBLISHING COMPANY
335 Jan van Galenstraat
P.O. Box 211, Amsterdam, The Netherlands

ELSEVIER PUBLISHING COMPANY LTD.
Barking, Essex, England

AMERICAN ELSEVIER PUBLISHING COMPANY, INC.
52 Vanderbilt Avenue
New York, New York 10017

Library of Congress Card Number: 71-103354

ISBN 0-444-40827-4

With 141 illustrations and 113 tables

Printed in The Netherlands

World Survey of Climatology Volume 13

CLIMATES OF AUSTRALIA AND NEW ZEALAND

World Survey of Climatology

World Survey of Climatology

Editor in Chief: H. E. LANDSBERG

Volume 1 General Climatology, 1
Editor: H. FLOHN

Volume 2 General Climatology, 2
Editor: H. FLOHN

Volume 3 General Climatology, 3
Editor: H. FLOHN

Volume 4 Climate of the Free Atmosphere
Editor: D. F. REX

Volume 5 Climates of Northern and Western Europe
Editor: C. C. WALLÉN

Volume 6 Climates of Central and Southern Europe
Editor: C. C. WALLÉN

Volume 7 Climates of the Soviet Union
Editor: P. E. LYDOLPH

Volume 8 Climates of Northern and Eastern Asia
Editor: H. ARAKAWA

Volume 9 Climates of Southern and Western Asia
Editor: H. ARAKAWA

Volume 10 Climates of Africa
Editor: J. F. GRIFFITHS

Volume 11 Climates of North America
Editor: R. A. BRYSON

Volume 12 Climates of Central and South America
Editor: W. SCHWERDTFEGER

Volume 13 Climates of Australia and New Zealand
Editor: J. GENTILLI

Volume 14 Climates of the Polar Regions
Editor: S. ORVIG

Volume 15 Climates of the Oceans
Editor: H. THOMSEN

List of Contributors to this Volume:

J. GENTILLI
Department of Geography
University of Western Australia
Nedlands, W.A. (Australia)

W. J. MAUNDER
Department of Geography
University of Otago
Dunedin (New Zealand)

U. RADOK
Department of Meteorology
University of Melbourne
Melbourne, Vic. (Australia)

Contents

Chapter 1

Introduction

J. GENTILLI

When Professor Landsberg offered me the opportunity to edit this volume and to write any part of it I chose, I was well aware of the difficulties of the task. Now, having completed the manuscript, I am more than ever aware of the gaps in our knowledge of Australian climates. I have endeavoured to do justice to the painstaking, assiduous and penetrating records left by the early observers who are too readily forgotten, and to the immense amount of data published by the Australian Bureau of Meteorology. On the other hand, most of these data have been published only recently and, therefore, are still readily obtainable in official publications; it would have been out of place to burden this volume with numerous tables reproducing such data, which should be sought at the source. The same policy was followed in the editing of the New Zealand section.

The problem which posed itself from the very beginning was whether it was preferable to write a detailed static description of the various climates, full of factual information, or whether a dynamic account of the spatial relationships of climate was more desirable. The latter way was chosen, but the provision of numerous maps still makes it possible to obtain a large amount of detailed, factual knowledge by interpolation.

The first unexpected difficulty was the lack of historical studies in this field, with the notable exception of the work by RUSSELL (1889) on the early astronomers and meteorologists of New South Wales. This work, however, was mainly biographical. I am convinced that further research will disclose details and data long forgotten, but I had to call an early end to my work in this particular aspect in order to avoid further delays in the preparation of the main part of the book. The chronology which opens the volume gives the essential facts.

Use has been made of daily weather maps in order to illustrate the genesis of some climatic features or manifestations. This is not general practice in works of this kind, but I decided to do it where the frequency, repetition or magnitude of certain weather situations resulted in a definite and characteristic aspect of the climate in this or that area or at this or that time of the year. It was only possible to make a first approach and it is hoped that more research will lead to further extensions and interpretations.

The tables of the Appendix at the end of the volume provide a fuller climatography of Australia than had ever been assembled before. The many aspects of climate had been recorded over different periods; a near completeness of the climatic record has been preferred to a narrow homogeneity. Each one of the tables (or each climatic element taken through many tables) warrants statistical and graphic analysis to discover correlations, seasonal variations, geographic patterns which could not be shown in this volume without increasing its size beyond any reasonable limits.

While there was a clear editorial directive as to the number of pages in each volume, the arrangement of the subject matter was left to the editors and authors of each volume. This is likely to bring forth a refreshing variety, but may also produce some striking contrasts. In this volume, for instance, there is no chapter on comparative regional methodology, in which the subdivision of the area into climatic regions could be carried out according to each one of the principal methods of climatic classification. On the one hand, such a chapter might have lacked appeal for the non-specialist. On the other hand it might perhaps have arrived at some evaluation of the many methods available. A great deal of space has been devoted to the Waite Index and to its use for the purpose of classification. This was done because the index itself is little known outside Australia, notwithstanding its very great merits, and because its originators did not use it for classificatory purposes, having always considered that such classifications may too easily become codified and be used uncritically or, in any case, too rigidly. The fact remains that other classifications, which are based on much less sound methods of estimating the hydric effectiveness of the various climates, are very widely used.

Some effort has been made throughout the work to establish priorities. It is quite understandable that in the pioneering conditions of early Australian settlement, avenues of publication may have been few and far between, so that early works may have been published late, or only in part, or not at all, and very often not in Australia, but in Great Britain. Hence the frequent ignorance of prior work in one's own field, resulting in duplication and waste of effort, ill afforded in a pioneering community. In fact, the very existence of separate colonial (later state) communities caused this fragmentation, so that the man in Melbourne totally ignored what his colleague in Brisbane or in Hobart may have been doing in that very same field of research.

Some of the early pioneers had some happy intuitions, many of them were keen and perceptive observers, a few had a precision and conciseness of style which modern writers might well envy and try to emulate, but unfortunately, far too few had adequate training. But the happy intuitions and the precise descriptions deserve a place in the ever widening sequence of Australia's progress towards a fuller understanding of the realities of climatic environment.

Dr. Radok, who kindly accepted the difficult task of writing the chapter on the general atmospheric circulation in the Australian region, confided to me that, since we are now acquiring knowledge by new and more powerful means, and at a much faster rate than a few years ago, we could have found many more answers if this volume could have delayed by three or four years. I am in full sympathy with these feelings, because I have been painfully aware of the reality of such a situation throughout my own writing. But I am also firmly convinced that the ever widening frontier of knowledge is, like a tempting rainbow, ever shifting further away with our every move forwards.

My thanks are due to Dr. Radok and Mr. Maunder for writing their respective chapters, and my sincere editorial apologies go to Mr. Maunder for the ruthless cuts applied to the statistical details of his contribution.

It is a pleasure to express my appreciation to the University of Western Australia, which granted me sabbatical leave during 1966 and to Professor H. Flohn, who welcomed me at the Meteorologisches Institut of the University of Bonn, and placed at my disposal a most attractive and well equipped study where I could give the manuscript its first shape. Professor Flohn also kindly read through the whole manuscript and suggested several

improvements. Professor H. Riehl read the first chapters and his remarks were also gratefully accepted although, of course, the responsibility for the final form of the manuscript is entirely my own.

My greatest debt is to the director and staff of the Australian Bureau of Meteorology, Melbourne, and to the regional director for Western Australia, always most generous with publications and data, and to the many professional and voluntary observers, past and present. Without their indefatigable work, my task would not have been feasible.

The weather maps used were originally drawn at the Regional Weather Bureau, Perth, and published in the *West Australian*.

I wish to thank Miss Margaret Kennedy and Miss Sandra Jenkins, who typed most of the manuscript, and Mr. R. Reid, who drew the base map of Australia used for many of the illustrations. Mr. P. Barrett kindly read the galley proofs, and Mr. D. I. Milton some of the page proofs.

Reference

RUSSELL, H. C., 1889. Astronomical and meteorological workers in New South Wales, 1778–1860. In: A. LIVERSIDGE and R. ETHERIDGE (Editors), *Report of the First Meeting of the Australasian Association for the Advancement of Science*. Government Printer, Sydney, pp.45–76.

Chapter 2

A Chronology of Climatic Work in Australia

J. GENTILLI

Early climatological observations have more than a merely historical interest; early observers were keen to learn about their new world, they had few distractions, and were usually punctilious in their use of words. However, they were often misled by insufficient knowledge or by prejudice. Early data may seldom be used for further research because the quality of the instruments, their exposure, and the mode of reading are unknown. And yet, if one is aware of the pitfalls and limitations, some very good use can be made of this early work, the study of which often gives the background for a better understanding of present-day developments. While further details more properly belong to the field of historical research, a succinct chronology of climatic work in Australia provides the best introduction to the present work.

1788: Pressure and temperature observations on board ship anchored in Botany Bay (WHITE, 1790).

1815: Publication of BAUDIN's *Observations physiques et météorologiques faites pendant le voyage aux Terres Australes, 1801–1803.*

1821: Beginning of pressure and temperature (BRISBANE, 1824) and rainfall (DOVE, 1837) observations at Governor Brisbane's residence at Paramatta (now Parramatta, New South Wales).

1822: Temperature observations five times a day at Hobart's Town (now Hobart) and Macquarie Harbour in Van Diemen's Land (now Tasmania). With Capetown, perhaps the only sites of standard climatic observations in the Southern Hemisphere at that time (BRISBANE, 1825).

1824: Temperature observations inside a well at Sydney and at sea-level and on a hill at Port Macquarie (now Macquarie Harbour, Tasmania) to measure thermal lapse rate (BRISBANE, 1824a, 1827).

1825: Publication of FIELD's *Geographical Memoirs on New South Wales*, containing F. Goulburn's and T. M. Brisbane's meteorological observations.

1829: Governor J. Stirling's order to the colonial surgeon of the future Swan River Colony (now Western Australia) to keep a weather journal.

1830: First records begun at Perth (manuscript at Australian Weather Bureau; CROSS, 1833; LANDOR, 1847).

1831: Detailed and accurate meteorological journal kept at Albany, Western Australia (CROSS, 1833).

1832: Sydney observations by Dunlop and King (RUSSELL, 1877).

1833: Publication of Breton's excursions in New South Wales, Western Australia and Van Diemen's Land, with notes on climate—pressure, temperature, wind and rainfall—recorded at York, Western Australia (OMMANEY, 1839).

1835: First Tasmanian rainfall records at Hampshire Hills, 34 km south-southwest of Burnie.

1836: Kingston's private rainfall readings in Grote Street, Adelaide (KINGSTON, 1861, 1874, 1879).

1837: MEINICKE's *Das Festland Australien*, containing 20 pages on the climates of Australia, is published in Germany.

1838: Records begun at Woolnorth, Circular Head, Port Arthur and Launceston, Tasmania (DE STRZELECKI, 1845).

1839: P. P. King begins observations at Tahlee near Port Stephens, New South Wales.

1840: Records of pressure, temperature, humidity and rainfall begun at the South Head (8 km from Sydney) and Port Macquarie, New South Wales, and at Port Phillip (now Melbourne, Victoria) (RUSSELL, 1877); J. C. Wickham's weather journal begun at Brisbane; Ross Bank Observatory established at Hobart, with J. H. Kay as director.

1843: Essay by POWER on "The Climate of South Australia" in the *Royal South Australia Almanack*.

1845: Publication of DE STRZELECKI's *Physical Description of New South Wales and Van Diemen's Land*, with original climatic observations.

1846–1852:
End of observations at Parramatta (1846), Brisbane (1850), Melbourne (1851) and Port Macquarie (1852).

1852: Rainfall records begun at Fremantle Signal Station, Western Australia.

1853: Temperature and hours of rain observed at Sydney University (JEVONS, 1859).

1854: End of official observations at Hobart.

1855: Beginning of F. Abbott's private records at 82 Murray Street, Hobart (ABBOTT, 1861, 1866, 1872); new observatory at Williamstown, 7 km southwest of Melbourne, and rainfall gauge at Yan Yean Reservoir, Victoria (BARACCHI, 1919); L. L. Becker's observations at Bendigo, Victoria (BECKER, 1855); end of observations at the South Head, New South Wales.

1856: W. B. Scott appointed Government Astronomer, New South Wales; records begun at Rockhampton, Brisbane, Casino, Armidale, Maitland, Bathurst, Parramatta, Sydney, Goulburn, Deniliquin, Albury and Cooma, New South Wales; private records at Bukalong, New South Wales (RUSSELL, 1877); C. Todd appointed Superintendant of Telegraphs and Government Astronomer in South Australia, begins private observations to be continued officially at Adelaide (TODD, 1861).

1856: Observations begun at Ballarat, Geelong, Mount Buninyong, Port Albert and (1857) Bendigo and Portland, Victoria; W. S. Jevons begins private observations at Petersham near Sydney with weekly reports to the newspaper *Empire*.

1858: Flagstaff Hill Observatory built at Melbourne, with G. Neumayer as director; records begin at Beechworth, Camperdown, Castlemaine, Heathcote in Victoria (NEUMAYER, 1861, 1864, 1867). Flagstaff Hill Observatory built at Sydney (RUSSELL, 1877). A. C. Gregory advocates the use of the telegraph to transmit weather data (GREGORY, 1859).